TERRA NOSTRA

Schriften der GeoUnion Alfred-Wegener-Stiftung – 2014/1

Our Climate – Our Future

Regional perspectives on a global challenge

International REKLIM Conference

6 - 9 October, 2014
Umweltforum Auferstehungskirche
Berlin, Germany

Programme and Abstracts

REKLIM
Helmholtz-Verbund
Regionale Klimaänderungen

HELMHOLTZ
ASSOCIATION

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Our Climate - Our Future

Regional perspectives on a global challenge

International REKLIM Conference

6 - 9 October, 2014
Umweltforum Auferstehungskirche
Berlin, Germany

Programme and Abstracts

REKLIM Helmholtz-Verbund Regionale Klimaänderungen
AWI Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung
DLR
JÜLICH Forschungszentrum
GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel
GFZ Helmholtz-Zentrum Potsdam
Helmholtz Association
HelmholtzZentrum münchen Deutsches Forschungszentrum für Gesundheit und Umwelt
Helmholtz-Zentrum Geesthacht Zentrum für Material- und Küstenforschung
KIT Karlsruhe Institute of Technology
Helmholtz Zentrum für Umweltforschung UFZ

Table of content

Introduction

One of the biggest challenges of current climate research is to analyse and understand the regional effects of global climate change, especially to describe consequences and impacts of climate change on a socially relevant scale. This is where the Helmholtz Climate Initiative REKLIM focuses on.
Since October 2009 experts of the nine German Centres of the Helmholtz Association‘s research field Earth and Environment are working together on different interdisciplinary research topics. In cooperation with nine universities, the Helmholtz research centres combine their expertise in regional climate change research. Regional observations and process studies coupled with model simulations will help to improve regional and global climate models, which provide a more solid basis for climate-related decision support.
REKLIM contributes to the strengthening of interdisciplinary regional climate research in Germany.

The Helmholtz Climate Initiative REKLIM addresses the following research topics:

- Coupled modelling of the regional Earth systems
- Sea level changes and coastal protection
- Regional climate changes in the Arctic: Forcing and long-term effects at the land-ocean interface
- The Land surface in the climate system
- Chemistry-climate interactions on global to regional scales
- Extreme weather events - storms, heavy precipitation, floods and droughts
- Risk analysis and risk management for integrated strategies
- Abrupt climate change derived from proxy data

The REKLIM research network offers new possibilities for improving the knowledge of regional effects of climate change. Via the **Helmholtz Regional Climate Offices** (www.klimabuero.de) and the Climate Service Centre 2.0 (www.climate-service-centre.de) policymakers and other decision makers are supported in assessing risks and opportunities and designing mitigation and adaptation strategies based on results obtained from the REKLIM research network.
For more information on the Helmholtz Climate Initiative REKLIM, please visit our website: www.reklim.de

In conclusion of the first funding period, the Helmholtz Climate Initiative REKLIM has organised the international conference **‚Our climate – Our Future, regional perspectives on a global challenge‘**
taking place in Berlin, Germany from 6–9 October, 2014.

The conference aims at providing a forum were scientists from all over the world can present and discuss new results from regional climate research in the context of the REKLIM research topics.

The conference is divided into two parts:
The first part is a three-day international scientific conference from 6–8 October, 2014. The scientific programme offers a broad and interdisciplinary spectrum of current international and national research activities in regional climate change.
The second part consists of a public outreach event on ‚Regional climate change – causes and effects‘ on the 9th of October, 2014, which focuses on the dialogue between scientists and decision makers from the fields of politics, administration and associations. This event will be held in German.

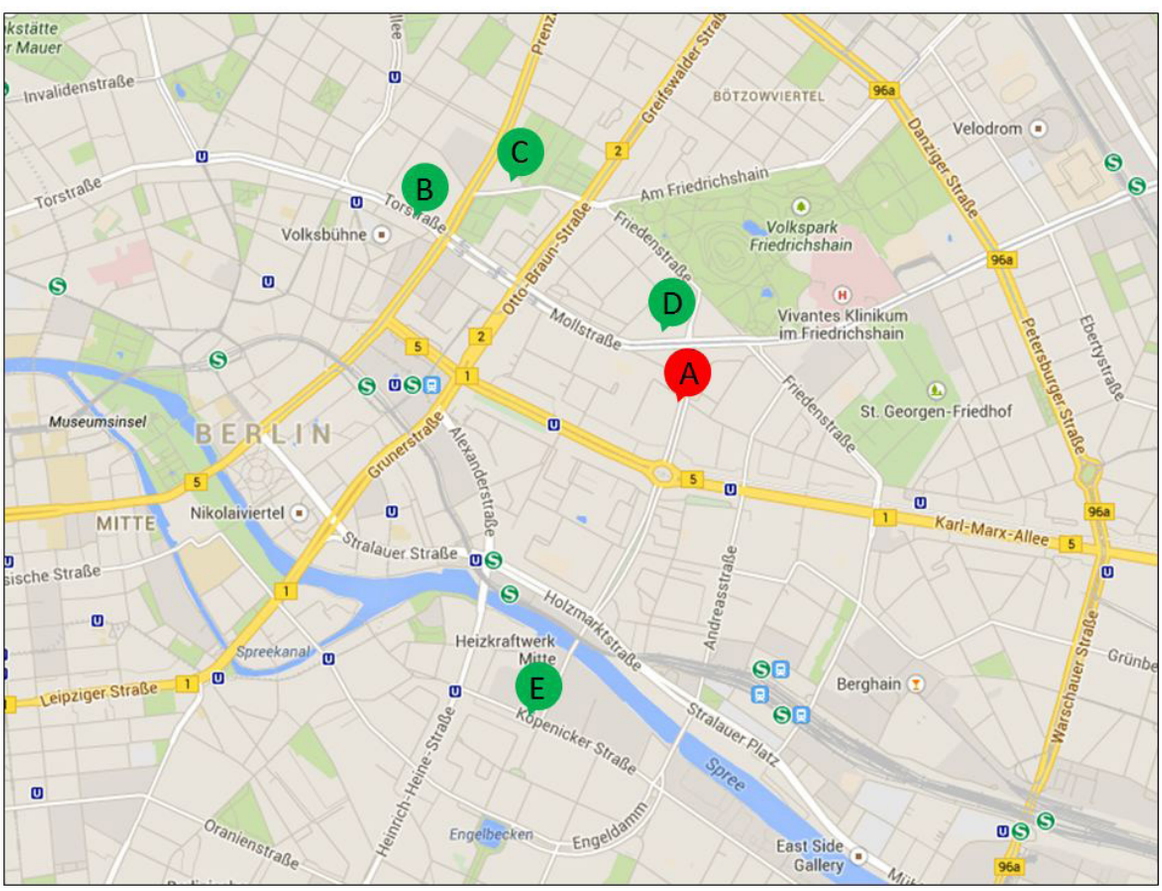
Conference venue, location map and conference office information

Venue

The ‘Umweltforum’ is located in the center of Berlin near the famous Alexanderplatz. The church, which is the main part of the building, is over one hundred years old. Beautiful ceilings, galleries and the organ loft make this venue an extraordinary event location. Being equipped with eco technology and the possibility of making events carbon neutral make the ‘Umweltforum’ is highly suitable for Green Meetings.

Address of the venue
Umweltforum Berlin
Pufendorfstraße 11
10249 Berlin, Germany

Location map



Location of conference venue (A) ‘Umweltforum’ and four nearby hotels (B) Leonardo Royal Hotel Berlin, (C) Victor’s Residenz-Hotel Berlin, (D) NH Hotel Berlin Alexanderplatz and (E) Ibis Hotel Ostbahnhof in the city of Berlin (map source: http://maps.google.de)

Contact conference office:
familie redlich AG
Agentur für Marken und Kommunikation
Saarbrücker Straße 37
10405 Berlin
Tel.: +49 (0)30 818 777 160
E-Mail: kontakt@reklim-conference-2014.de

Research partner institutions of the Helmholtz Climate Initiative REKLIM

Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung (www.awi.de)
Deutsches Zentrum für Luft- und Raumfahrt in der Helmholtz-Gemeinschaft (www.dlr.de)
Forschungszentrum Jülich GmbH (www.fz-juelich.de)
GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel (www.geomar.de)
Helmholtz-Zentrum Geesthacht - Zentrum für Material- und Küstenforschung (www.hzg.de)
Helmholtz-Zentrum Potsdam - Deutsches GeoForschungsZentrum (www.gfz-potsdam.de)
Helmholtz Zentrum München - Deutsches Forschungszentrum für Gesundheit und Umwelt (www.helmholtz-muenchen.de)
Karlsruher Institut für Technologie (www.kit.edu)
Helmholtz-Zentrum für Umweltforschung GmbH (www.ufz.de)

Partner Universities

Europa-Universität Viadrina, Universität Bremen, Universität Hamburg, Universität Heidelberg, KIT – University Sector, Universität zu Köln, Universität Leipzig, Technische Universität München, Universität Potsdam

Acknowledgements

The Helmholtz climate initiative REKLIM would not have been possible without the support and funding of the Helmholtz Association and its participating Research Centres. Promotion of the climate conference ‘Our future – Our climate’ through AWI, the GeoUnion and iLEAPS is gratefully acknowledged.

GeoUnion
Alfred-Wegener-Stiftung

ileaps

Climate-neutral conference

Calculation of the carbon footprint is an important component in climate protection. The carbon footprinting of this conference involves calculating and reporting all relevant greenhouse gas emissions. This includes the emissions of the infrastructure (power consumption, heat energy, refrigeration), the journeys of the participants to the event, catering and lodging for the participants, and event-specific materials and waste. This data was compiled and then checked by *myclimate* to ensure that it is plausible. Following this procedure we received the climate-neutral label and an overview of the carbon footprint of this event.

The emissions are offset in high-quality *myclimate* carbon offset projects throughout the world that fulfil the highest standards (CDM, Gold Standard, Plan Vivo). The projects reduce the emission of greenhouse gases, thus directly protecting the climate. However, carbon offset projects not only reduce climate-impacting emissions; they also contribute to sustainable development in the project region.

With the CO_2 compensation of the REKLIM conference the project ‘Reforestation and Improved management of forest in Uganda’ will be supported. The Western Uganda forests in Masindi are of particular importance as they maintain the only sources of water and provide the connectivity between the different protected areas. This allows wildlife populations to migrate through this natural biological corridor. Currently, the community forests have very limited protection and decrease continuously due to the expansion of small-scale and large-scale agriculture. The project mobilises the communities to protect their forest by controlling fires and illegal activities. Forest rehabilitation includes planting of heavily degraded areas and the planting of fuel wood to reduce pressure on existing forests. Further, the project promotes the development of agroforestry systems of mixed native and naturalised tree species on smallholder lands. At the same time, deforestation pressure on the surrounding forests is decreased as sustainably grown wood can serve as marketable fuel wood source. In addition, the project is building the resilience of the communities to the effects of climate change through improved land management and diversification of sources of income to reduce dependency on crops vulnerable to droughts. Thereby they contribute to the Millennium Development Goal of improved livelihood. Micro-loan systems are established in addition to allow capacity building for ecotourism, apiary and crafts-business. The project is strengthening the organisational structures through which the communities can be mobilised to undertake improved forest management laying the foundation for long-term sustainable land-use, which continues to sequester and store carbon in its biomass.

myclimate
neutral
Event

Conference Programme

Monday 6, October					
09:00-11:00	**Registration** (Foyer UFO)				
11:00-11:40	**Opening Plenary (PH)**				
11:40-12:50	**Plenary Session Keynotes (Room PH)**				
	'Limited-area domain atmospheric energetic' R. Laprise				
	'*Darkening Greenland ice: integrating a spectrum of climate change processes*' J. Box				
12:50-14:20	Lunch break (S8 and MP)				
14:20-15:35	**Parallel Sessions**				
	Room PH	Room S9	Room MKS	Room MKN	
	Topic 1 Regional climate system modelling **TP1-O-01 – TP1-O-05**	**Topic 3** Arctic change **TP3-O-01 – TP3-O-05**	**Topic 5** Atmospheric composition and climate: interaction from global to regional scales **TP5-O-01 – TP5-O-05**	**Topic 2** Sea level changes from global to regional and local scales **TP2-O-01 – TP2-O-05**	
15:35-15:45	Room change				
15:45-18:00	**Poster Session**				
	Room G		Room WK		
	Topic 1 Regional climate system modelling **TP1-P-01 – TP1-P-16** **Topic 2** Sea level changes from global to regional and local scales **TP2-P-01 – TP2-P-16**		**Topic 3** Arctic Change **TP3-P-01 – TP3-P-11** **Topic 4** The land surface in the climate system **TP4-P-01 – TP4-P-08**		

Scientific topics and session titles

Topic 1: Regional climate system modelling

Topic 2: Sea level changes from global to regional and local scales

Topic 3: Arctic Change

Topic 4: The land surface in the climate system

Topic 5: Atmospheric composition and climate: Interactions from global to regional scales

Topic 6: Extreme meteorological events and their impacts in a changing climate

Topic 7: Integrated strategies for climate change mitigation and adaptation

Topic 8: Rapid climate change in the past – mechanisms, processes and regional patterns

Rooms

Umweltforum (UFO)

PH: Plenary Hall ('Großer Saal')

S8: Seminar room 8, 1st floor

S9: Seminar room 9, 1st floor

G: Gallery, 1st floor

WK: Winterkirche

Neue Mälzerei (M)

MP: Plenary Hall, 5th floor

MKS: Kuppelsaal Süd, 5th floor

MKN: Kuppelsaal Nord, 5th floor

MS: Seminar I+II, 5th floor

Tuesday, 7 October					
08:30-09:30	**Plenary Session Keynotes** (Room PH)				
	'NGEE: The Study of the Interaction of Atmospheric, Hydrologic, Geomorphic and Ecosystem Processes on the Alaskan Arctic Coastal Plain' L. Hinzman				
	'Composition-Climate Interactions from Global to Local Scales' M. Chipperfield				
09:30-10:00	Coffee break (S8 and MP)				
10:00-11:15	**Parallel Sessions**				
	Room PH	Room S9	Room MKS	Room MKN	
	Topic 1 Regional climate system modelling **TP1-O-06 – TP1-O-10**	**Topic 3** Arctic change **TP3-O-06 – TP3-O-09**	**Topic 5** Atmospheric composition and climate: interaction from global to regional scales **TP5-O-06 – TP5-O-10**	**Topic 2** Sea level changes from global to regional and local scales **TP2-O-06 – TP2-O-10**	
11:15-11:45	Coffee break (S8)		Coffee break (MP)		
11:45-13:00	**Parallel Sessions**				
	Room PH	Room S9	Room MKS	Room MKN	
	Topic 1 Regional climate system modelling **TP1-O-11 – TP1-O-15**	**Topic 3** Arctic change **TP3-O-10 – TP3-O-13**	**Topic 5** Atmospheric composition and climate: interaction from global to regional scales **TP5-O-11 – TP5-O-14**	**Topic 7** Integrated strategies for climate change mitigation and adaptation **TP7-O-01 – TP7-O-05**	
13:00-14:15	Lunch break (S8)		Lunch break (MP)		
14:15-14:45	**Plenary Session Keynotes (Room PH)**				
	'Transformative adaptation' M. Pelling				
14:45-14:55	Room change				
14:55-16:10	**Parallel Sessions**				
	Room PH	Room S9	Room MKS	Room MKN	MS
	Topic 1 Regional climate system modelling **TP1-O-16 – TP1-O-20**	**Topic 3** Arctic change **TP3-O-14 – TP3-O-18**	**Topic 5** Atmospheric composition and climate: interaction from global to regional scales **TP5-O-15 – TP5-O-19**	**Topic 7** Integrated strategies for climate change mitigation and adaptation **TP7-O-06 – TP7-O-10**	**Topic 6** Extreme meteorological events and their impact in a changing climate **TP6-O-01 – TP6-O-04**
16:10-18:10	**Poster Session**				
	Room G		Room WK		
	Topic 5 Atmospheric composition and climate: interaction from global to regional scales **TP5-P-01 – TP5-P-19** **Topic 6** Extreme meteorological events and their impact in a changing climate **TP6-P-01 – TP6-P-10**		**Topic 7** Integrated strategies for climate change mitigation and adaptation **TP7-P-01 – TP7-P-07** **Topic 8** Rapid climate change in the past – mechanisms, processes and regional patterns **TP8-P-01 – TP8-P-12**		
from 19:00	Social Evening (on registration) Room PH				

Wednesday, 8 October					
08:30-09:30	**Plenary Session Keynotes (Room PH)**				
	'Extreme Events: Re-enacting past winter storms' S. Brönnimann				
	'Role of land surface processes and land use change at the regional scale' E. L. Davin				
09:30-10:00	Coffee break (S8 and MP)				
10:00-11:15	**Parallel Sessions**				
	Room PH	Room S9	Room MKS	Room MKN	
	Topic 4 The land surface in the climate system **TP4-O-01 – TP4-O-05**	**Topic 8** Rapid climate change in the past – mechanisms, processes and regional patterns **TP8-O-01 – TP8-O-05**	**Topic 6** Extreme meteorological events and their impact in a changing climate **TP6-O-05 – TP6-O-09**	**Topic 7** Integrated strategies for climate change mitigation and adaptation **TP7-O-11 – TP7-O-15**	
11:15-11:45	Coffee break (S8)		Coffee break (MP)		
11:45-13:00	**Parallel Sessions**				
	Room PH	Room S9	Room MKS	Room MKN	
	Topic 4 The land surface in the climate system **TP4-O-06 – TP4-O-10**	**Topic 8** Rapid climate change in the past – mechanisms, processes and regional patterns **TP8-O-06 – TP8-O-09**	**Topic 6** Extreme meteorological events and their impact in a changing climate **TP6-O-10 – TP6-O-14**	**Topic 7** Integrated strategies for climate change mitigation and adaptation **TP7-O-16 – TP7-O-20**	
13:00-14:15	Lunch break (S8)		Lunch break (MP)		
14:15-14:45	**Plenary Session Keynotes (Room PH)**				
	'Environmental changes in the Black Sea region during the last ~140 kyrs' H. W. Arz				
14:45-14:55	Room change				
14:55-16:10	**Parallel Sessions**				
	Room PH	Room S9	Room MKS		
	Topic 4 The land surface in the climate system **TP4-O-11 – TP4-O-15**	**Topic 8** Rapid climate change in the past – mechanisms, processes and regional patterns **TP8-O-10 – TP8-O-14**	**Topic 6** Extreme meteorological events and their impact in a changing climate **TP6-O-15 – TP6-O-19**		
16:20-17:00	**Closing Plenary (Room PH)**				
	Closing remarks				

Public day (in German language only)

Thursday, 9 October	
09:00-10:00	Einlass und Registrierung (Foyer UFO)
10:00-10:20	**Begrüßung (Umweltforum, Raum PH)**
	Prof. Dr. Johanna Wanka (Bundesministerin für Bildung und Forschung)
	Prof. Dr. Jürgen Mlynek (Präsident der Helmholtz-Gemeinschaft)
10:20-11:45	**Herausforderung Klimawandel – Klimaforschung im Verbund**
	Die Helmholtz-Klimainitiative REKLIM – was haben wir gelernt? Prof. Dr. Peter Lemke (Wissenschaftlicher Koordinator REKLIM, Alfred-Wegener-Institut)
	Klimawandel - wo stehen wir? Prof. Dr. Mojib Latif (GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel)
	Hagel in Deutschland - ein unterschätztes Risiko? Priv. Doz. Dr. Michael Kunz (Karlsruher Institut für Technologie KIT)
	Feld, Wald und Wiese – wie beeinflussen Landoberflächen das Klima? Prof. Dr. Hans Peter Schmid (Institut für Meteorologie und Klimaforschung; KIT-Campus Alpin)
11:45-12:45	**Herausforderung Klimawandel – Folgen und Anpassung in der Praxis**
	Klimaanpassung in Berlin - der Stadtentwicklungsplan Klima Dr. Gregor Langenbrinck (Urbanizers – Büro für städtische Konzepte, Berlin)
	Klimawandel in der Siedlungswasserwirtschaft - Herausforderungen am Standort Berlin Erika Pawlowsky-Reusing (Berliner Wasserbetriebe)
	Klimawandel und übertragbare Krankheiten - welche Auswirkungen sehen wir, welche erwarten wir? Priv.-Doz. Dr. Lars Schaade (Robert Koch-Institut)
12:45-13:45	Podiumsdiskussion Moderation: Hellmuth Henneberg (rbb Rundfunk Berlin-Brandenburg)
ab 13:45	**Mittags-Imbiss und Gelegenheit...**... zu Gesprächen im Foyer

Programme Committee

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Dr. Frauke Feser (Helmholtz-Zentrum Geesthacht - Centre for Materials and Coastal Research)

Prof. Dr. Achim Brauer (German Research Centre for Geosciences, Potsdam, Germany)

Plenary Lectures

Monday, 6 October 2014

Umweltforum, Room PH, Plenary Hall ('Großer Saal')

9:00 **Registration (Foyer)**

11:00 **Opening Plenary**
Guido Beermann (Permanent Secretary in Berlin's Senate Department for Economics, Technology and Research, Berlin)
Prof. Dr. Karin Lochte (Director of the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven)
Prof. Dr. Peter Lemke (Scientific Coordinator REKLIM)

11:40 **Keynote Lecture 1**
'Limited-area domain atmospheric energetic'
Prof. Dr. René Laprise (Université du Québec à Montréal, Canada)

12:20 **Keynote Lecture 2**
'Darkening Greenland ice: integrating a spectrum of climate change processes'
Prof. Dr. Jason Box (Geological Survey of Denmark and Greenland, Denmark)

12:50 Lunch break (Umweltforum, Room S8, Seminar 8, 1st floor & Neue Mälzerei, Room MP, Plenary Hall, 5th floor)

Tuesday, 7 October 2014

Umweltforum, Room PH, Plenary Hall("Großer Saal")

08:30 **Keynote Lecture 3**
'NGEE: The Study of the Interaction of Atmospheric, Hydrologic, Geomorphic and Ecosystem Processes on the Alaskan Arctic Coastal Plain'
Prof. Dr. Larry Hinzman (International Arctic Research Center, University of Alaska Fairbanks, USA)

09:00 **Keynote Lecture 4**
'Composition-Climate Interactions from Global to Local Scales'
Prof. Dr. Martyn Chipperfield (University of Leeds, School of Earth and Environment, UK)

09:30 Coffee break (Umweltforum, Room S8, Seminar 8, 1st floor & Neue Mälzerei, Room MP, Plenary Hall, 5th floor)
...

13:00 Lunch break (Umweltforum, Room S8, Seminar 8, 1st floor & Neue Mälzerei, Room MP, Plenary Hall, 5th floor)

14:15 **Keynote Lecture 5**
'Transformative adaptation'
Prof. Dr. Mark Pelling (Department of Geography, King's College London, UK)
...

19:00 **Social Evening** (on registration)

Wednesday, 8 October 2014

Umweltforum, Room PH, Plenary Hall ("Großer Saal")

08:30 **Keynote Lecture 6**
'Extreme Events: Re-enacting past winter storms'
Prof. Dr. Stefan Brönnimann (Oeschger Center, University Bern, Switzerland)

09:00 **Keynote Lecture 7**
'Role of land surface processes and land use change at the regional scale'
Dr. Edouard Davin (Institute for Atmospheric and Climate Science, ETH Zürich, Switzerland)

09:30 Coffee break (Umweltforum, Room S8, Seminar 8, 1st floor & Neue Mälzerei, Room MP, Plenary Hall, 5th floor)
...

13:00 Lunch break (Umweltforum, Room S8, Seminar 8, 1st floor & Neue Mälzerei, Room MP, Plenary Hall, 5th floor)

14:15 **Keynote Lecture 8**
'Environmental changes in the Black Sea region during the last ~140 kyrs'
Prof. Dr. Helge Arz (Leibniz Institute for Baltic Sea Research Warnemünde, Germany)
...

16:20 **Closing remarks**

Session Programme Topic 1

Regional climate system modelling

Convener: Klaus Dethloff, Hans von Storch

Regional climate system models consist of high resolution and complex model components for the atmosphere, ocean, sea ice, land surface, soil, vegetation and aerosol chemistry. Beside external forcing and anthropogenic drivers, internally generated variability within the atmosphere and by atmosphere-ocean-land feedbacks in the regionally coupled system contribute to observed changes.

The first aim of this session is to evaluate the performance of regional climate models against observations for the Arctic, Europe, Asia and other regions, to identify added model values, shortcomings with respect to climate anomalies, climate trends and extremes over the last decades.

A second aim is to analyse the sensitivity of regional climate simulations to initial conditions, large-scale boundary conditions, regional forcings by land-use and aerosol loading, sub-grid scale model parameterizations, internal variability with ensemble members and to quantify the uncertainties for present-day climate simulations and future climate projections.

Monday, 6 October 2014

Umweltforum, Room PH, Plenary Hall ('Großer Saal')

14:20 TP1-O-01: Ho-Hagemann, H., B. Rockel, B. Geyer: Different coupling methods for regional atmosphere - ocean simulations

14:35 TP1-O-02: Brauch, J., B. Früh, T. van Pham, N. Akhtar, B. Ahrens: Coupling of COSMO/CLM and NEMO in two regions

14:50 TP1-O-03: Madsen, K. S., R. Mottram, J. H. Christensen, O. B. Christensen, T. A. S. Rasmussen, M. H. Ribergaard: A coupled model system to examine ocean-atmosphere-sea ice processes in the Arctic: HIRHAM5 - HYCOM – CICE

15:05 TP1-O-04: Breil, M., H.-J. Panitz, N. Laube, G. Schädler, C. Kottmeier: Regional Climate Simulations with COSMO-CLM using different soil-vegetation-atmosphere-transfer (SVAT) module

15:20 TP1-O-05: Tinz, B., H. Heinrich, L. Gates, G. Rosenhagen, B. Klein, H. Klein, A. Ganske, K. Bülow, N. Schade, J. Möller, S. Hüttl-Kabus: Regional coupled atmosphere ocean modelling in the North Sea region

Poster Session:

Umweltforum, Room G, Gallery, 1st floor: 15:45 – 18:00

TP1-P-01: Arnault, J., D. Heinzeller, C. Klein, L. Hingerl, J. Bliefernicht, H. Kunstmann: Towards a regional climate modeling system for West Africa: sensitivity studies, input bias correction and hydrological coupling

TP1-P-02: Stéfanon, M., J. Polcher: Testing coupling techniques for a regional climate model: What are the advantages?

TP1-P-03: Zhou, X., H. Matthes, A. Rinke, K. Klehmet, B. Heim, W. Dorn, D. Klaus, K. Dethloff, B. Rockel: Evaluation of arctic land snow cover characteristics, surface albedo and temperature during the transition seasons from regional climate model simulations and satellite data

TP1-P-04: Veljovic, K., F. Mesinger: Improving on large scales within RCM domain: how much does the resolution help?

TP1-P-05: Sannino, G., A. Carillo, G. Pisacane, V. Artale: On the improvement of the simulated Mediterranean Sea interannual variability

TP1-P-06: Menberg, K., P. Bayer, P. Blum: Subsurface urban heat islands: tWhermal impact of urbanisation on groundwater

TP1-P-07: Cavazos-Guerra, C., A. Lauer: The importance of physical parameterizations in WRF to reproduce atmospheric dynamics and BC transport in the arctic region: A sensitivity study

TP1-P-08: Mathis, M., A. Elizalde, U. Mikolajewicz: Variability patterns of the general circulation and sea water temperature in the North Sea

TP1-P-09: Zhang, L., T. Zhou: Prediction of East Asian summer tropospheric temperature in ensemble multi-seasonal forecast

TP1-P-10: Hanf, F. S., A. Rinke, K. Dethloff: Simulation of the South Asian summer monsoon with the HIRHAM5 regional atmospheric model from 1979 until 2012

TP1-P-11: Ozturk, T., M. T. Turp, M. Türke, M. L. Kurnaz: Future Projections of Air Temperature and Precipitation for the CORDEX-MENA Domain by Using RegCM4.3.5

TP1-P-12: Wechsung, F.: Reassessing the STARS climate scenarios used in climate impact assessments for the Elbe river basin

TP1-P-13: Huang, B., S. Polanski, U. Cubasch: Evaluation of the Performance of Regional Climate Models from CORDEX-East Asia on simulating the Asian-Australian Monsoon system

TP1-P-14: Maraun, D., M. Widmann, R. Benestad, S. Kotlarski, E. Hertig, J. Wibig, R. Huth, J. Gutierrez, R. Chandler, R. Wilke: VALUE - a framework to validate downscaling approaches for climate change studies

TP1-P-15: Kim, S., M.-K. Kim, J. Hyeok Oh, J. Sang: PRIDE model for High Resolution Climate Change Scenario using Outputs of Multi Regional Climate Model in South Korea

TP1-P-16: Yoon, S., M.-K. Kim, J.-S. Park: Comparison of Statistical Linear Downscaling Models for Monthly Precipitation in South Korea

Tuesday, 7 October 2014

Umweltforum, Room PH, Plenary Hall ('Großer Saal')

10:00 TP1-O-06: Maslowski, W., R. Osinski, A. Roberts, J. Clement Kinney, A. Craig: Regional Arctic System Model (RASM) – Added Value, Sensitivity and Future Prospects

10:15 TP1-O-07: Niederdrenk, L., U. Mikoklajewicz: Modelling today's arctic climate with a regional coupled climate model

10:30 TP1-O-08: Anisimov, A., D. Yarovaya: Validation of the RegCM4 regional model over the Eastern European/Black Sea region

10:45 TP1-O-09: Sumata, H., R. Gerdes, F. Kauker, M. Karcher, C. Koeberle: Development of ocean-sea ice model for the Arctic by model-data synthesis

11:00 TP1-O-10: Schultze, M., B. Rockel, H. v. Storch: Impacts of different aerosol climatologies on the European climate during the last decades

11:15 COFFEE BREAK (Umweltforum, Room S8, Seminar room 8, 1st floor)

Umweltforum, Room PH, Plenary Hall ('Großer Saal')

11:45 TP1-O-11: Klaus, D., K. Dethloff, W. Dorn, A. Rinke: Adaptation of the HIRHAM5 stratiform cloud parameterization to arctic climate conditions

12:00 TP1-O-12: Kraut, I., M. Bangert, C. Kottmeier, B. Vogel, H. Vogel: Impact of Aerosols on the Evolution of a Medicane in November 2011

12:15 TP1-O-13: Nikiéma, O., R. Laprise: Energy cycle associated with Inter-member Variability in a large ensemble of simulations with the Canadian RCM (CRCM5)

12:30 TP1-O-14: Sommerfeld, A., O. Nikiéma, A. Rinke, K. Dethloff, R. Laprise: Arctic Budget Study of Inter-member Variability using HIRHAM5 Ensemble Simulations

12:45 TP1-O-15: Becker, N., U. Ulbrich, R. Klein: Anomalous circulations in an RCM caused by orography

13:00 LUNCH BREAK (Umweltforum, Room S8, Seminar room 8, 1st floor)

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Umweltforum, Room PH, Plenary Hall ('Großer Saal')

14:55 TP1-O-16: Zhang, W., C. Jansson, P. Miller, B. Smith, P. Samuelsson: Severity of climate change dictates the direction of biophysical feedbacks of vegetation change to arctic climate

15:10 TP1-O-17: Rousi, E., C. Anagnostopoulou, K. Tolika, P. Maheras: Present and future of teleconnection patterns affecting the climate of the Mediterranean region

15:25 TP1-O-18: Khon, V., I. I. Mokhov, F. A. Pogarskiy, A. V. Babanin, K. Dethloff, A. Rinke, H. Matthes: Projected changes of wind-wave activity in the Arctic Ocean in the 21st century

15:40 TP1-O-19: Klein, B., K. Bülow, H. Heinrich, C. Dieterich, S. Hüttl-Kabus, B. Mayer, H. E. M. Meier, U. Mikolajewicz, N. Narayan, T. Pohlmann, G. Rosenhagen, D. Sein, J. Su: Climate change projections for the North Sea from three coupled high-resolution models

15:55 TP1-O-20: Rechid, D., B. Eggert, D. Jacob: Range of future perspectives from regional climate change projections

Session Programme Topic 2

Sea level changes from global, regional to local scale

Convener: Peter Lemke, Klaus Grosfeld, Ingo Sasgen

In the past 3000 years, in which human civilization has been predominately settled along coasts, the sea level has changed only slightly. This has altered in recent decades where global mean sea level is rising at 3,2 mm/year. The cause is the increased melting of mountain glaciers and of the large ice sheets on Greenland and in the Antarctic due to the higher atmospheric temperatures and the thermosteric expansion of the ocean provoked by climate change.

We invite contributions investigating the role of ocean dynamics and fresh water fluxes from melting glaciers and ice sheets in determining patterns of sea level change, studies analysing sea level from tide gauge, satellites as well as modelling efforts in order to improve our understanding of past, present and future changes in sea level.

Monday, 6 October 2014

Neue Mälzerei, Room MKN, Kuppelsaal Nord, 5th floor

14:20 TP2-O-01: Rietbroek, R., B. Uebbing, S.-E. Brunnabend, J. Kusche, J. Schröter: Sea Level Change from Observations and Modelling: a Global Perspective on a Regional Challenge

14:35 TP2-O-02: Weisse, R., Consequences of sea level rise for the German coast

14:50 TP2-O-03: Dangendorf, S., A. Arns, J. Jensen: Mechanisms of inter-annual to multi-decadal sea level variability in the North Sea

15:05 TP2-O-04: Esselborn, S., T. Schöne: Regional Sea Level Changes in the North Atlantic During the Last Decade

15:20 TP2-O-05: Wahl, T., F.M. Calafat, S. Dangendorf, M.E. Luther: Changes in the seasonal sea level cycle in the Gulf of Mexico

Poster Session:

Umweltforum, Room G, Gallery, 1st floor: 15:45 – 18:00

TP2-P-01: Löcher, A., J. Schall, A. Eicker, J. Kusche, R. Weiss, A. Sudau, R. Rietbroek: Consistency of geoid models, altimetry, tide gauges and time-variable water levels in the North Sea

TP2-P-02: Albrecht, F., S. Esselborn, T. Schöne: Yearly Mean Distribution of Sea Levels in the North Sea Since 1900

TP2-P-03: Janßen, H., S. Vollbrecht: Sea level rise in a Baltic UNESCO Biosphere Reserve - Impacts and Management Implications

TP2-P-04: Karabil, S., E. Zorita, B. Huenicke: Sea level trends and variability in the Baltic Sea

TP2-P-05: Papazachariou, D., G. Zodiatis, A. Nikolaidis, S. Stylianou, D. Arabelos: Validation of Sea Level Anomalies – comparison of satellite altimetry and tide gauge data in the Eastern Mediterranean

TP2-P-06: Moghaddam, K. H.: Climate change of biogenic substance and bioproductivity of water in the northern part of the Caspian Sea

TP2-P-07: Zhao, Y., Y. Li, J. Deng, J. Harff, C. Tang, H. Zhang: Sea level and coastline change in the Bohai Sea – natural and anthropogenic impacts

TP2-P-08: Mihoubi, M. K., H. Dahmani: Approach to study sediment transport by measurement of velocity field in the swash zone

TP2-P-09: Rückamp, M., A. Humbert: Modeling the flow dynamics of the northeast Greenland ice stream

TP2-P-10: Wang, Q., D. Sidorenko, S. Danilov, T. Jung, J. Schröter: The impact of vertical discretization on ice cavity modelling

TP2-P-11: Timmermann, R., J. Determann, H. Hellmer, S. Göller, W. J. van de Berg: Reducing the uncertainty in projections of future ice shelf basal melting

TP2-P-12: Konrad, H., I. Sasgen, M. Thoma, V. Klemann, K. Grosfeld, Z. Martinec: Marine ice-sheet instability in a fully coupled ice-sheet – solid-earth model

TP2-P-13: Bordbar, M. H., T. Martin, M. Latif, W. Park: Internal variability of dynamic sea level and its impact on 21st century sea level change in the tropical Pacific

TP2-P-14: Wei, W., G. Lohmann: Projections of centennial-scale sea level change in an earth system model including dynamic ice sheets

TP2-P-15: Sutter, J., M. Thoma, G. Lohmann: Estimating past sea level contributions from Antarctica; A 3D paleo-ice-sheet-modelling approach

TP2-P-16: Madsen, K. S., T. Schmith: Regional sea level rise in the 20th and 21st century - the example of Denmark

Tuesday, 7 October 2014

Neue Mälzerei, Room MKN, Kuppelsaal Nord, 5th floor

10:00 TP2-O-06: Richter, K., B. Marzeion, R. Riva: Regional sea level changes: the role of internal variability in ocean dynamics and the worlds glaciers

10:15 TP2-O-07: Sasgen, I.: The state of the polar ice sheets: Insights from a decade of satellite gravimetry observations

10:30 TP2-O-08: Goeller, S., R. Timmermann, J. Determann, H. Hellmer, M. Thoma, K. Grosfeld: The interplay of ocean circulation and ice dynamics at the Filchner-Ronne Ice Shelf, Antarctica

10:45 TP2-O-09: Dierking, W.: How satellite remote sensing of the ice sheets can contribute to studies of sea level changes

11:00 TP2-O-10: Linow, S., W. Dierking, M. Hörhold, W. Rack: Microwave remote sensing of firn properties in Antarctica

Session Programme Topic 3

Arctic Change

Convener: Torsten Sachs, Birgit Heim

The Arctic plays a key role within the Earth system. The high albedo of sea ice and of ice and snow on land determines to a considerable extent the Earth radiation budget. The huge continental ice sheets constitute the main pool for the sea level variations, and the massive and deep reaching permafrost layers contain a large reservoir of organic carbon, which could be mobilized and turned into a significant greenhouse gas source as the Arctic continues to warm at a much faster rate than the global mean.

We invite contributions to the sub-sessions of this topic, focusing on the terrestrial and marine energy, water, and carbon fluxes and ongoing changes as observed by both, in-situ and remote sensing techniques.

Monday, 6 October 2014

Umweltforum, Room S9, Seminar room 9, 1st floor

14:20 TP3-O-01: Turner, D. D., M. D. Shupe, V. P Walden, R. Bennartz, B. Castellani, C. Cox, N. Miller, R. Neely III, E. Olson, C. Petterson: The ICECAPS experiment - An overview of the integrated characterisation of energy, clouds, atmospheric state and precipitation at summit, Greenland

14:35 TP3-O-02: Petelski, T., P. Makuch, M. Chilinski, J. Lisok, C. Ritter, R. Neuber, R. Udisti, M. Mazzola, M. Gausa, J. Struzewska, J. Kaminski, K. Markowicz, T. Zielinski, A. Rozwadowska: Aerosol optical properties studied in the Svalbard area during the iAREA campaign

14:50 TP3-O-03: Möller, M., C. Schneider: Possible loss of accumulation area at Vestfonna ice cap, Svalbard, in the 21st century as an indication of short-term severe climate change impacts on arctic ice caps

15:05 TP3-O-04: Schaffer, J., R. Timmermann, J. E. Arndt, D. Steinhage, T. Kanzow: RTopo-2: A global dataset of ice sheet topography, cavity geometry and ocean bathymetry to study ice-ocean interaction in Northeast Greenland

15:20 TP3-O-05: Bogorodsky, P., A. Makshtas, V. Kustov: Rapid melt of land fast-ice

Poster Session:

Umweltforum, Room WK, Winterkirche: 15:45 – 18:00

TP3-P-01: Markowicz, K., T. Zielinski, T. Petelski, I. Stachlewska, A. Rozwadowska, T. Stacewicz, M. Gausa, S. Blindheim, J. Struzewska, J. Kaminski, S. Malinowski, M. Chilinski, J. Lisok, P. Makuch, P. Pakszys, P. Markuszewski, A. Strzalkowska: Optical properties of Arctic aerosols studied within the framework of the iAREA research program

TP3-P-02: Maturilli, M., A. Herber, G. König-Langlo: Changes in Temperature and Radiation at the Arctic Station Ny-Ålesund (79°N, 12°E)

TP3-P-03: Ludwig, V., L. Kaleschke: Retrieving sea ice concentrations from 1.4 GHz brightness temperature measurements

TP3-P-04: Andersen, O. B., L. Stenseng, C. S. Sørensen, Y. Cheng, P. Knudsen: Arctic sea level change over the past 2 decades from GRACE gradiometry and multi-mission satellite altimetry

TP3-P-05: Safarov, J., A. Mirzaliyev, A. Shahverdiyev, E. Hassel: Thermophysical properties of seawater for climate change

TP3-P-06: Dvornikov, Y., M. Leibman, B. Heim, A. Bartsch, B. Widhalm, A. M. Trofaier, A. Morgenstern: POLYAR - Process of Organic transport to the Lakes of the Yamal Region

TP3-P-07: Boike, J., T. Grau, B. Heim, F. Günther, M. Langer, S. Muster, I. Gouttevin, C. Duguay: Ice, water, fire: Changes in the permafrost landscape of central Yakutia, 2000-2011

TP3-P-08: Kohnert, K., A. Serafimovich, S. Metzger, J. Hartmann, T. Sachs: Regional variability of methane fluxes in the permafrost landscape of the Mackenzie River Delta, Canada derived from airborne measurements

TP3-P-09: Serafimovich, A., S. Metzger, J. Hartmann, S. Wieneke, T. Sachs: Variability of surface energy fluxes over high latitude permafrost wetlands

TP3-P-10: Heim, B., A. Bartsch, A. Rinke, H. Matthes, X. Zhou, K. Klehmet, B. Rockel, C. Duguay, S. Muster, J. Boike, M. Buchhorn, A. Morgenstern, K. Elger: ESA DUE PERMAFROST: Circumpolar Remote Sensing Service for Permafrost – Evaluation and Application Case Studies

TP3-P-11: Madsen, K. S., G. Dybkjær, T. A. S. Rasmussen, M. H. Ribergaard, R. T. Tonboe: A decade of decreasing Arctic sea ice cover: Implications for Cape Farewell

Tuesday, 7 October 2014

Umweltforum, Room S9, Seminar room 9, 1st floor

10:00 TP3-O-06: Karcher, M., J.-C. Gascard, J. Wilkinson: Arctic climate change, economy and society - the two EU projects ACCESS: ‚Arctic Climate Change, Economy and Society' and ICE-ARC: 'Ice, Climate, Economics - Arctic Research on Change'

10:15 TP3-O-07: Ionita, M., P. Scholz, G. Lohmann, M. Prange: Relationship between the atmospheric blocking over Greenland and sea ice export through Fram Strait

10:30 TP3-O-08: Cherkasheva, A., A. Bracher, C. Melsheimer, C. Köberle, R. Gerdes, E.-M. Nöthig, E. Bauernfeind, A. Boetius, D. Antoine, B. Gentili: Greenland Sea primary production with respect to changes in the sea ice cover

10:45 TP3-O-09: Gonçalves-Araujo, R., A. Kraberg, A. Bracher: Dynamics of colored dissolved organic matter in a climate changing environment in northern Siberia

11:15 COFFEE BREAK (Umweltforum, Room S8, Seminar room 8, 1st floor)

11:45 TP3-O-10: Klemann, V., B. Heim, S. Wetterich, T. Opel, H. Bauch: Sea level evolution of Laptev and East Siberian Sea - evidence from geological data and glacial isostatic adjustment

12:00 TP3-O-11: Overduin, P., S. Liebner, C. Knoblauch, F. Günther, H.-W. Hubberten, M. Grigoriev: Permafrost degradation and methane release in the central Laptev Sea

12:15 TP3-O-12: Lenz, J., S. Wetterich, G. Grosse: Stories of the Past – Frozen archives tell about Alaskan landscape dynamics

12:30 TP3-O-13: Sachs, T., A. Serafimovich, S. Metzger, K. Kohnert, J. Hartmann: Airborne measurements of methane fluxes in permafrost landscapes (AIRMETH)

13:00 LUNCH BREAK (Umweltforum, Room S8, Seminar room 8, 1st floor)

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Umweltforum, Room S9, Seminar room 9, 1st floor

14:55 TP3-O-14: Muster, S., K. Roth, A. Morgenstern, M. Langer, A. Bartsch, G. Grosse, J. Boike: Zooming out: from local snapshots to a pan-arctic inventory of Arctic ponds and lakes

15:10 TP3-O-15: Bartsch, A., A. M. Trofaier, B. Widhalm, M. Leibmann: Combining remote sensing and field studies for assessment of land surface dynamics in sub-arctic environments

15:25 TP3-O-16: Golubkin, P. A., B. Chapron, V. N. Kudryavtsev: Arctic wind waves characteristics from satellite altimetry data

15:40 TP3-O-17: Klehmet, K., B. Geyer., B. Rockel: Regional characteristics of Siberian snow cover changes

15:55 TP3-O-18: Cuntz, M., V. Haverd: Physically Accurate Soil Freeze-Thaw Processes in a Global Land Surface Scheme

Session Programme Topic 4

The land surface in the climate system

Convener: Hans Peter Schmid, Andreas Marx

Climate exerts a great influence on the land surface, and vice-versa. In the global greenhouse, the land surface (soils-water-vegetation) is arguably the largest 'broker' (source or sink) for the most important greenhouse gases: water vapor, CO_2, methane, and nitrous oxide. Moreover, the land surface is the most dynamic 'hub' for the transformation and cycling of energy and water through the climate-Earth system. Land surface-atmosphere exchange processes form the backbone of any predictive model that accounts for the source-sink behavior of soils and the biosphere, and their interaction with climate. This 'broker'- and 'hub'-role of the land surface in the climate system is significantly affected by environmental stressors (e.g., drought, flooding, heat, ozone, pests), as well as by land-management practices (e.g., agriculture, forestry) and land use – land cover changes (LULCC).

This session solicits contributions on observations or modelling of hydrological and biogeochemical/-physical cycling, as well as LOLCC, up to regional scales.

Monday, 6 October 2014

Poster Session:

Umweltforum, Room WK, Winterkirche: 15:45 – 18:00

TP4-P-01: Klein, Ch., Ch. Biernath, Ch. Thieme, F. Heinlein, E. Priesack: The influence of dynamic vegetation models including harvest on the energy fluxes and the feedback effects between weather and land surface models

TP4-P-02: Fang, Z., H. Bogena, S. Kollet, H. Vereecken: High Resolved Long Term Simulation for a Complicated Forest Catchment with Litter Layer and Fractured Bedrock System

TP4-P-03: Zurba, K., J. Matschullat: Short-rotation forestry vs. rapeseed - what about GHG emissions?

TP4-P-04: Göhler, M., J. Mai, M. Cuntz: Use of eigendecomposition in a parameter sensitivity analysis of the Community Land Model

TP4-P-05: Markkanen, T., T. Aalto, A. Arslan, M. Aurela, K. Böttcher, M. Holmberg, M. Kangwa, P. Kolari, T. Laurila, T. Manninen, S. Metsämäki, A. Mäkelä, M. Peltoniemi, J. Susiluoto, T. Thum, T. Vesala, J. Pulliainen: Climate change indicators and vulnerability of boreal zone applying innovative observation and modelling techniques (MONIMET)

TP4-P-06: Franz, D., E. Larmanou, K. Kohnert, A. Serafimovich, F. Koebsch, T. Sachs: Eddy covariance CO_2 and CH_4 fluxes in a rewetted fen in NE Germany

TP4-P-07: Cho, M.-H., K.-O. Boo, G. Martin, J. Lee, G.-H. Lim: The impact of land cover generated by dynamic vegetation model on present and future climate over East Asia

TP4-P-08: Remedio, A.R.C, D. Rechid, D. Jacob: Sensitivity study on land-atmosphere coupling over the Amazon

Wednesday, 8 October 2014

Umweltforum, Room PH, Plenary Hall ('Großer Saal')

10:00 TP4-O-01: Mauder, M., F. Eder, K. Träumner, H. P. Schmid, R. L. Desjardins, T. Sachs, S. Metzger, J. Hartmann, D. Yakir, E. Rotenberg: On the relevance of mesoscale transport for in-situ energy balance measurements

10:15 TP4-O-02: Shannak, B., U. Corsmeier, C. Kottmeier, K. Träumner, A. Wieser: Influence of airflow characteristics on the locating of wind farms in forests

10:30 TP4-O-03: Schädler, M., H. Auge, F. Buscot, S. Klotz: Investigating the consequences of climate change under different land use regimes – the Global Change Experimental Facility (GCEF)

10:45 TP4-O-04: Koebsch, F., M. Koch, S. Glatzel, J. Hahn, T. Sachs, G. Jurasinski: Ecosystem response in the initial revitalization phase - A multi-year record of greenhouse gas exchange after peatland rewetting

11:00 TP4-O-05: Dannenmann, M., C. Bimüller, S. Gschwendtner, M. Leberecht, J. Tejedor, S. Bilela, R. Gasche, M. Hanewinkel, A. Baltensweiler, I. Kögel-Knabner, A. Polle, M. Schloter, J. Simon, H. Rennenberg: Climate change impairs nitrogen cycling in European beech forests

11:15 COFFEE BREAK (Umweltforum, Room S8, Seminar room 8, 1st floor)

Umweltforum, Room PH, Plenary Hall ('Großer Saal')

11:45 TP4-O-06: Krebs-Kanzow, U., V.C. Khon, Y.V. Wang, J.O. Kaplan, B. Schneider, R.R. Schneider: Climate and CO_2 effects on the vegetation of southern tropical Africa over the last 37,000 years

12:00 TP4-O-07: Heidbach, K., H.P. Schmid, M. Mauder: Experimental evaluation of flux footprint models

12:15 TP4-O-08: Kraus, D., S. Weller, S. Klatt, E. Haas, R. Kiese, K. Butterbach-Bahl: Measuring and modelling greenhouse gas pollution swapping of methane (CH_4) and nitrous oxide (N_2O) in a diversified rice cropping system

12:30 TP4-O-09: Han, X., H.-J. Hendricks Franssen, H. Bogena, H. Vereecken: MODIS land surface temperature assimilation and verification at Rur catchment

12:45 TP4-O-10: Greve, P., B. Orlowsky, B. Mueller, J. Sheffield, M. Reichstein, S.I. Seneviratne: Global assessment of trends in wetting and drying over land

13:00 LUNCH BREAK (Umweltforum, Room S8, Seminar room 8, 1st floor)

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Umweltforum, Room PH, Plenary Hall ('Großer Saal')

14:55 TP4-O-11: Hagemann, S.: Role of soil moisture for dry biases over Amazon and Congo catchments simulated by MPI-ESM

15:10 TP4-O-12: Menberg, K., P. Blum, P. Bayer: Influence of recent climate change on groundwater temperatures in shallow aquifers

15:25 TP4-O-13: Wagner, S., B. Fersch, H. Kunstmann, F. Yuan, Z. Yu: Development and application of a coupled atmospheric-hydrological model system, suitable for regional spatial and climate relevant temporal scales

15:40 TP4-O-14: Daniels, E.E., R.W.A. Hutjes, G. Lenderink, A.A.M. Holtslag: Feedbacks of the land surface and urban areas on precipitation in the Netherlands

15:55 TP4-O-15: Fersch, B., D. Gochis, S. Wagner, H. Kunstmann: The impact of groundwater-soil moisture coupling on WRF-Hydro modelled water budgets and surface exchange: a case study for the Ammer catchment in Southern Germany

Session Programme Topic 5

Atmospheric composition and climate: Interactions from global to regional scales

Convener: Peter Braesicke, Martin Schultz

The global atmospheric composition-climate system (CCS) encompasses many scales and feedbacks. The session will explore the full chain of global to regional scale challenges in modelling and observing the CCS. For example, chemical budgets, stratosphere-troposphere exchange, tropopause structure and aerosol impacts on the global scale. On smaller scales one focus will be on the interactions of clouds, precipitation and composition. Another focus will be on the urban environment and its impact on composition and climate, in particular with respect to urban heat stresses and air quality.

Monday, 6 October 2014

Neue Mälzerei, Room MKS, Kuppelsaal Süd, 5th floor

14:20 TP5-O-01: Schultz, M. G., O. Stein, F. Rohrer, H. Fuchs, A. Wahner: From local process studies to global scale impacts

14:35 TP5-O-02: Trickl, T., H.-E. Scheel, H. Vogelmann: Is there a link between the Zugspitze ozone trend and climate change?

14:50 TP5-O-03: Zhu, S., T. Butler: Source attribution of tropospheric ozone using tagging techniques

15:05 TP5-O-04: von Schneidemesser, E., J. Coates, K. Mar, H. D. van der Gon, A. Visschedijk, T. Butler: Ozone production in models and the role of NMVOC speciation

15:20 TP5-O-05: Paschalidi, Z., H. Elbern, E. Friese, K. Kasradze: 4d var data assimilation for the anthropogenic emission estimation

Tuesday, 7 October 2014

Neue Mälzerei, Room MKS, Kuppelsaal Süd, 5th floor

10:00 TP5-O-06: Braesicke, P.: Global composition-climate interactions and regional change: The two-way interaction

10:15 TP5-O-07: Paukert, M., C. Hoose: Quantification of Cloud Susceptibilities to Ice Nuclei

10:30 TP5-O-08: Sinnhuber, B.-M., G. Krysztofiak, S. Meul: The impact of biogenic bromine emissions from the oceans on atmospheric chemistry in a changing climate

10:45 TP5-O-09: Konopka, P., F. Ploeger, B. Vogel, M. Tao, R. Müller: Seasonality of the mean age in the UTLS region: Hemispheric differences and impact of the Asian monsoon

11:00 TP5-O-10: Tummon, F., B. Hassler, N. R. P. Harris, J. Staehelin, G. E. Bodeker, S. M. Davis, D. Degenstein, S. M. Frith, L. Froidevaux, E. Kyrölä, M. Laine, C. Long, A. Penckwitt, C. Sioris, K. H. Rosenlof, C. Roth, H. J. Wang, J. Wild: Comparison of merged profile ozone satellite observations (1984-2011): Assessment and implications in terms of ozone recovery

11:15 COFFEE BREAK (Neue Mälzerei, Room MP, Plenary Hall, 5th floor)

Neue Mälzerei, Room MKS, Kuppelsaal Süd, 5th floor

11:45 TP5-O-11: Matthes, K., T. Reddmann, M. Sinnhuber, R. Thieblémont, T. Fytterer, A. Vlasov: Regional Influence of Solar Variability on European Climate

12:00 TP5-O-12: Reddmann, T., S. Versick, A. Vlasov: NOy transport from the lower thermosphere and its impact on ozone in a chemical transport model

12:15 TP5-O-13: Fallmann, J., R. Grote, R. Forkel, K. Schaefer, S. Emeis: Regional air quality in European urban areas – A WRF-Chem modelling study

12:30 TP5-O-14: Martins, L. D., J. A. Martins, R. Y. Ynoue, E. D. Freitas, M. de Fátima Andrade: Evaluation of impact on air quality by changes on public transportation: a case study of a Brazilian city

13:00 LUNCH BREAK (Neue Mälzerei, Room MP, Plenary Hall, 5th floor)

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Neue Mälzerei, Room MKS, Kuppelsaal Süd, 5th floor

14:55 TP5-O-15: Peters, A., S. Breitner, A. Schneider, K. Wolf, K. Richter, J. Cyrys: Weather and ambient air pollution - Health Effects and potential interactions

15:10 TP5-O-16: Mentel, T. F., J. Wildt, E. Kleist, A. Kiendler Scharr, Y. Rudich, M. Hallquist, R. Bergström, D. Simpson: Secondary aerosol formation from stress-induced biogenic emissions and possible climate feedbacks

15:25 TP5-O-17: Junkermann, W., J. M. Hacker: Ultrafine particles and rainfall trends: evidences from airborne studies?

15:40 TP5-O-18: Kuik, F., A. Lauer, J. P. Beukes, P. G. van Zyl, M. Josipovic, V. Vakkari, L. Laakso: The anthropogenic contribution to black carbon concentrations in South Africa

15:55 TP5-O-19: Mues, A., A. Lauer: Air quality modeling in the Kathmandu Valley and surroundings

Poster Session:

Umweltforum, Room G, Gallery, 1st floor: 16:10 – 18:10

TP5-P-01: Schröter, J., R. Ruhnke, H. Vogel: Simulating the Ozone Distribution over Europe in May 2008 with a new Photolysis Module for COSMO-ART

TP5-P-02: Ploeger, F., G. Günther, P. Konopka, R. Müller, C. Hoppe, M. Riese: Horizontal water vapor transport in the lower stratosphere from subtropics to high latitudes during boreal summer

TP5-P-03: Brand, S., K. Dethloff, D. Handorf: Stratospheric chemistry and gravity wave drag within a coupled AOGCM

TP5-P-04: Grote, R., T. Butler: Modelling Feedbacks between Biogenic Emissions and Air Chemistry from Site to Globe

TP5-P-05: Coates, J., T. Butler: Understanding Ozone Pollution: A Comparison of Chemical Mechanisms

TP5-P-06: Mertens, M., E. Tsati, A. Kerkweg, V. Grewe, P. Jöckel: Contributions of road traffic emissions to tropospheric ozone on global and regional scale

TP5-P-07: Lyapina, O., M. Schultz, A. Hense, O. Stein, S. Waychal, S. Schröder: Cluster analysis of European surface ozone observations for evaluation of MACC reanalysis data

TP5-P-08: Otero, N., J. Sillmann, T. Butler: Effect of 'low-wind' circulation types on air pollution conditions in present and future climate

TP5-P-09: Forkel, R., J. Werhahn, A. Balzarini, R. Baró, G. Curci, M. Hirtl, L. Honzak, P. Jiménez-Guerrero, M. Langer, C. Lorenz, J. L. Pérez, G. Pirovano, R. San José, P. Tuccella, R. Žabkar: Analysis of the WRF-Chem simulations contributing to the AQMEII-Phase II exercise with respect to aerosol impact on precipitation

TP5-P-10: Ullrich, R., N. Hiranuma, C. Hoose , O. Möhler , M. Niemand, I. Steinke, R. Wagner: Development and model application of a new parameterization framework for the heterogeneous ice nucleation in tropospheric clouds

TP5-P-11: Biernath, C., C. Klein, J. Hauck, F. Heinlein, C. Thieme, R. Hentschel, J. C. Munch, E. Priesack: Improvement of atmospheric pollen load forecasts by using dynamic plant growth models: Suitability of temperature sum models to simulate birch flowering periods on regional scale

TP5-P-12: Churkina, G., R. Grote, T. Butler: Heat Waves, Urban Vegetation, and Air Pollution

TP5-P-13: Vlasov, A., T. Reddmann: A study of reactive nitrogen intrusions into the stratosphere with vertically extended EMAC.

TP5-P-14: Ringer, D.: Teaching a basic understanding for the material networks of Planet Earth with simple, global, dynamic material flow models

TP5-P-15: Kolvev, N., T. Evgenieva, P. Kaleyna, P. Muhtarov, D. Petkov, E. Donev, D. Ivanov, V. Danchovski, I. Kolev: Five years observations the urban atmosphere by ceilometer, sun photometer and ozonemeter over Sofia (Bulgaria) (2009-2013)

TP5-P-16: Martins, L. D., C. F. H. Wikuats, J. A. Martins, M. de Fátima Andrade: Extreme values analysis of air quality pollutants in the two largest metropolitan areas of Brazil

TP5-P-17: Venevsky, S., C. Wu: Climate change and influence of smoke from wildfires to health of population in megacities

TP5-P-18: Beck, I., S. Gilles, S. Breitner, A. Schneider, K. Wolf, C. J. Biernath, J. Cyrys, C. Klein, E. Priesack, J. C. Munch, A. Peters, C. Traidl-Hoffmann: Influence of biogenic and anthropogenic factors on pollen allergenicity and allergic sensitization

TP5-P-19: Mahieu E., M. P. Chipperfield, J. Notholt, T. Reddmann, J. Anderson, P. F. Bernath, T. Blumenstock, M. T. Coffey, S. Dhomse, W. Feng, B. Franco, L. Froidevaux, D. W. T. Griffith, J. Hannigan, F. Hase, R. Hossaini, N. B. Jones, I. Morino, I. Murata, H. Nakajima, M. Palm, C. Paton-Walsh, J. M. Russell III, M. Schneider, C. Servais, D. Smale, K. A. Walker: Increase in northern hemisphere stratospheric hydrogen chloride over recent years

Session Programme Topic 6

Extreme meteorological events and their impacts in a changing climate

Convener: Michael Kunz, Frauke Feser

Over recent years, damage caused by extreme weather events has increased substantially. In Germany, for example, the year of 2013 marked a new record in total losses due to large-scale flooding, record-breaking hailstorms, and a wide-spread heat wave. Combining results of high-resolution regional climate models with different observation records makes it possible to quantify the frequency and intensity of meteorological extremes better than before. However, there is still insufficient knowledge about long-term changes in the probability or intensity of meteorological extremes and the extent how these changes are driven by global warming. Furthermore, it is not clear how changes in the hazard will also affect the impact of extremes, which is also controlled by factors such as vulnerability, protection measures, or resilience. This session invites researchers from different disciplines that work on analyses of weather and climate extremes, their context to climate change, and the impacts on society.

Tuesday, 7 October 2014

Neue Mälzerei, Room MS, Seminar I+II, 5th floor

14:55 TP6-O-01: Russo, S., A. Dosio, A. Dosio, P. Barbosa, L. Feyen, G. Forzieri, A. Bianchi, J. Vogt: Projection of occurrence of extreme heat waves in Europe with Heat Wave Magnitude Index

15:10 TP6-O-02: Jänicke, B., F. Meier, U. Fehrenbach, J. Curio, D. Scherer: Causes for cold biases in a regional reanalysis of weather and climate in Berlin, Germany, and their implications for analysing heat-stress events

15:25 TP6-O-03: Scherer, D., U. Fehrenbach, F. Meier, B. Jänicke, J. Curio: Heat-stress events and excess mortality in Berlin, Germany, as resolved by a regional reanalysis of weather and climate

15:40 TP6-O-04: Thober, S., L. Samaniego, R. Kumar: Assessment of a Multi Model Ensemble to Forecast the European 2003 Drought

Poster Session:

Umweltforum, Room G, Gallery, 1st floor: 16:10 – 18:10

TP6-P-01: Seidel, P.: What do we know about impacts of extreme weather on plant pests - nearly nothing?

TP6-P-02: Kelem, G., S. Kahsay, E. Fkadu, A. Tegann: Climate variability, climate change and extreme events in Ethiopia

TP6-P-03: Schaaf, B., F. Feser, H. von Storch: Analysis of the variability of extra-tropical cyclones at the regional scale for the coasts of Northern Germany and investigation of their coastal impacts

TP6-P-04: Dietrich, S., A. Winterscheid: Influence of internal climate variability on estuarine sediment dynamics

TP6-P-05: Sassen Brand, V., L. Droprinchinski Martins, J. A. Martins: Study of heat waves and hot spells in Southern Brazil

TP6-P-06: Martins, J. A., C. B. Machado, M. N. Capucim, V. Sassen Brand, L. Droprinchinski Martins: Extreme rainfall events and the vulnerability of the biomass and hydro sectors in the Paraná River Basin – South America

TP6-P-07: Sang, J., M.-K. Kim, S.-H. Kang, C.-K. Park, S. Kim: Large-scale characteristics of top 20 heat waves in Korea

TP6-P-08: Seo, Y.A., Y. Shin, J. Heo, J. Jang, J.-S. Park: Changes in extreme rainfall in East Asia: comparison of historical and future projection by using general extreme value distribution

TP6-P-09: Shin, Y., Y.A. Seo, J. Heo, J. Jang, J.-S. Park: Assessing changes in observed and future projected precipitation and temperature extremes in East Asia via Bayesian model averaging

TP6-P-10 Semenov, V., M. Latif: A non-linear link between anomalous winter weather regimes over Northern Eurasia and arctic sea ice reduction

Wednesday, 8 October 2014

Neue Mälzerei, Room MKS, Kuppelsaal Süd, 5th floor

10:00 TP6-O-05: Outten, S.: Statistical Analysis of Future Projections of Extreme Winds and their Inclusion in Current Infrastructure Planning

10:15 TP6-O-06: Zahn, M., F. Feser, M. Schubert-Frisius, H. von Storch: Past and future changes of wind storms - latest achievements and current activities at HZG

10:30 TP6-O-07: Eggert, B., P. Berg, J. O. Haerter, C. Moseley, D. Jacob: Impact of temporal and spatial resolution on extreme event statistics and its implications on climate modelling

10:45 TP6-O-08: Maraun, D., W. Park: The impact of Atlantic multi-decadal variability on European precipitation extremes

11:00 TP6-O-09: Feser, F., M. Barcikowska, O. Krueger, F. Schenk, R. Weisse, L. Xia: Storminess over the North Atlantic and Northwestern Europe – A Review

11:15 Coffee BREAK (Neue Mälzerei, Room MP, Plenary Hall, 5th floor)

Neue Mälzerei, Room MKS, Kuppelsaal Süd, 5th floor

11:45 TP6-O-10: Curio, J., D. Scherer, F. Maussion: The influence of atmospheric water transport on precipitation variability on the Tibetan Plateau

12:00 TP6-O-11: Volosciuk, C., V. Semenov, D. Maraun, M. Latif, N. Tilinina: The impact of a warmer Mediterranean Sea on Central European summer flooding

12:15 TP6-O-12: Meredith, E., V. Semenov, D. Maraun, W. Park: The extreme flooding of July 2012 in Krymsk, Russia, from a climate perspective

12:30 TP6-O-13: Merz, B., S. Vorogushyn, N. Viet Dung, K. Schröter: Space-time variability of flooding across Germany

12:45 TP6-O-14: Wahl, T., S. Jain, J. Bender, S.D. Meyers, M.E. Luther: Increasing risk of compound flooding from storm surge and rainfall for major US coastal cities

13:00 Lunch BREAK (Neue Mälzerei, Room MP, Plenary Hall, 5th floor)

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Neue Mälzerei, Room MKS, Kuppelsaal Süd, 5th floor

14:55 TP6-O-15: Sørensen, C., P. Knudsen, O. B. Andersen: Coastal flooding in Denmark – future outlook

15:10 TP6-O-16: Schlauss, S., M. Grottker, T. Einfalt, B. Schaeffers, H. Deng, A. Jackisch: Flash flood emergency planning and warning for the City of Luebeck based on hydrodynamic modelling

15:25 TP6-O-17: Punge, H.J., K. M. Bedka, M. Kunz: Hail hazard in Europe: Analysis based on the overshooting cloud top (OT) proxy and reanalysis data

15:40 TP6-O-18: Kunz, M., M. Schmidberger, D. Köbele: Hail hazard in Germany related to orographic and atmospheric characteristics

15:55 TP6-O-19: Mohr, S., M. Kunz: Changes in the hail potential over past and future decades using a logistic hail model

Session Programme Topic 7

Integrated strategies for climate change mitigation and adaptation

Convener: Reimund Schwarze, Beate Ratter, Hans von Storch, Bernd Hansjürgens

In the socio-economic analysis of integrated climate change strategies there are still large research gaps and considerable uncertainties as there are many different interdependencies between mitigation and adaptation, natural and socio-economic factors that need to be considered. Climate change mitigation and adaptation can relate to each other through synergies or conflicts, and they must be coherently connected to other environmental, economic and social policies. Policies are social discourses, based on negotiation processes, which are culturally embedded. Cultural perception research and the analysis of negotiation processes, which are not least shaped by the media, are of great significance. Studies of risk perception and awareness and policy coherence are important conditions for consistent adaptation and mitigation strategies. The investigation of integrated approaches must therefore be coupled with socio-cultural analyses in global and regional contexts.

Tuesday, 7 October 2014

Neue Mälzerei, Room MKN, Kuppelsaal Nord, 5th floor

11:45 TP7-O-01: Döring, M., B. Ratter: 'Your Climate – not mine.' Towards a place-based perspective on regional climate change adaptation and mitigation

12:00 TP7-O-02: Barkmann, T., R. Siebert, A. Lange: Regional climate change perception of land use experts in the North German Plain

12:15 TP7-O-03: de Guttry, C.: Climate change through a multicultural lens: the relevance of investigating migrants´ framing of climate change

12:30 TP7-O-04: Kreibich, H., S. G. Adnan, D. T. Chinh, P. Bubeck: Insights into flood precautionary behaviour of private households in Can Tho city in the Mekong Delta

12:45 TP7-O-05: Barbey, K.: Integrative concept climate protection & adaption

13:00 LUNCH BREAK (Neue Mälzerei, Room MP, Plenary Hall, 5th floor)

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Neue Mälzerei, Room MKN, Kuppelsaal Nord, 5th floor

14:55 TP7-O-06: Vidaurre, R., H. Bressers, J. Tröltzsch, U. Stein, A. Browne, G. Ozerol, C. Furusho, M.-H. Ramos: Regional governance and management for drought adaptation in North-West Europe – insights from the DROP project

15:10 TP7-O-07: Ashardiono, F.: Adapting to climate change: terroir elements of Uji Tea and its challenges

15:25 TP7-O-08: Köchy, M.: The knowledge hub 'FACCE MACSUR' modelling European agriculture with climate change for food security

15:40 TP7-O-09: Kunz-Plapp, T., J. Hackenbruch, H. Schipper: Urban adaptation to heat: what can we learn from subjective heat stress of urban citizens in context of everyday life?

15:55 TP7-O-10: Erb, C.: Welfare and distribution effects of heat waves in Switzerland: Do we need to adapt?

Poster Session:

Umweltforum, Room WK, Winterkirche: 16:10 – 18:10

TP7-P-01: Gneuss, P., W. Schmid, R. Schwarze: Spatio-temporal statistical analysis of the CO_2 balance of the terrestrial vegetation

TP7-P-02: Süsser, D.: The interrelationship between individual and community engagement in dealing with climate change

TP7-P-03: Zölch, T., J. Maderspacher, S. Pauleit: Identifying synergies for climate change mitigation and adaptation at district level

TP7-P-04: Lorenz, S., S. Dessai, J. Paavola, P. Forster: Communicating and visualising climate projections – assessment of user preferences and abilities in Germany

TP7-P-05: Kamburow, Ch., R. Nolte: Adaptation of railway Infrastructure to climate change. Lessons from the ARISCC project

TP7-P-06: Krellenberg, K.: Urban vulnerability assessment based on socio-environmental fragmentation – supporting climate change response at local level

TP7-P-07: Kasangala jr., M., N. Louisa: The disturbance climate in eastern of Democratic Republic of Congo

Wednesday, 8 October 2014

Neue Mälzerei, Room MKN, Kuppelsaal Nord, 5th floor

10:00 TP7-O-11: Paimpillil, J.S., Vishnu: Green Technology Solutions for climate change impacts reductions in Kerala state (India)

10:15 TP7-O-12: Hossain, Md. K., S. As-Saber: Climate change adaptation, MNC strategy and environmental pragmatism: a cross-country perspective

10:30 TP7-O-13: Khare, V., Deshmukh, S.: India-Europe strategic cooperation for tackling climate change and its impact on global peace and security

10:45 TP7-O-14: Gädeke, A., I. Pohle, H. Koch, U. Grünewald: Using the analytical tool SWOT for planning climate change adaptation strategies – a case study for the Lusatian river catchments

11.00 TP7-0-15: Schmidt, H.-M., K. Fath, M. Wiens, J. Stengel, F. Schultmann: Indicator-based methodology for the climate change risk vulnerability analysis

11:15 COFFEE BREAK (Neue Mälzerei, Room MP, Plenary Hall, 5th floor)

Neue Mälzerei, Room MKN, Kuppelsaal Nord, 5th floor

11:45 TP7-O-16: Schanze, J., A. Sauer, M. Neubert, R. Vogel, G. Hutter: Policy-oriented local climate change risk assessment and evaluation

12:00 TP7-O-17: Krause, G.: The challenge of measuring 'success' in transdisciplinary evidence-based stakeholder dialogue processes: potentials and pitfalls of quantitative and qualitative metrics

12:15 TP7-O-18: Meinke, I.: Providing information - enabling knowledge – a case study in Northern Germany

12:30 TP7-O-19: Huang, J. T., M. Bergmann, C. Brinkmann., S. Rödder, S. Schuck-Zöller: Transdisciplinary communication processes supporting integration strategies

12:45 TP7-O-20: Fick, J., A. Steinführer, U. Grabski-Kieron, M. Hellmich, M. Raabe: Which land use strategies are appropriate and feasible for climate change mitigation? Stakeholder assessments and policy instruments in Germany

Session Programme Topic 8

Rapid climate change in the past – mechanisms, processes and regional patterns

Convener: Achim Brauer, Ralf Tiedemann, Gerrit Lohmann

For an improved assessment of future climate change, researchers need information on time duration, rate, frequency and regional patterns of climate variability. A review into the Earth's history forms the basis of understanding climate reaction and dynamics in comparison with changes in external forcing and internal feedback processes.

The session focusses on identifying and explaining mechanisms and processes of regional and temporal patterns of climate variability. The time span of interest encompasses the last 150,000 years, which also allows for comparisons between the last two glacial terminations, the Eemian and the Holocene. We invite contributions from paleo-modelling and different paleoclimate archives (marine and lake sediments, ice cores, speleothemes).

Tuesday, 7 October 2014

Poster Session:

Umweltforum, Room WK, Winterkirche: 16:10 – 18:10

TP8-P-01: Wagner, S., E. Zorita: Regional trends in the last two millennia in a comprehensive climate model simulation

TP8-P-02: Lohmann, G., X. Zhang, X. Gong, G. Knorr, L. Max, M. Pfeiffer, X. Shi, L. Lembke-Jene, T. Laepple, R. Tiedemann: Sea surface temperature trends in the North Atlantic and Pacific Oceans: models and observations

TP8-P-03: Luedecke, H.-J., A. Hempelmann, C. O. Weiss: Spectral analysis of Central European temperature data

TP8-P-04: Max, L., L. Belz, R. Tiedemann, K. Fahl, D. Nürnberg, J.-R. Riethdorf: Rapid shifts in subarctic Pacific climate between 138,000 – 70,000 years ago

TP8-P-05: Ludwig, J., S. Lindhorst, S. Bierstedt, C. Betzler, R. Borówka, K. Osadczuk: The sedimentary 'barcode' of past wind regimes: southern Baltic coastal dunes as climate archive

TP8-P-06: Masson, D., R. Furrer, N. Kirchner: Dynamic Bayesian models to assess palaeo-Arctic ice shelf extents

TP8-P-07: Kandiano, E. S., H. A. Bauch, K. Fahl: Last interglacial surface water structure in the NW Mediterranean (Balearic) Sea: climatic variability and Link between low and high latitudes

TP8-P-08: Wündsch, M., T. Haberzettl, J. Baade, G. Daut, P. Frenzel, K. Kirsten, R. Mäusbacher, M. Meadows, S. Meschner, L. Quick, M. Zabel: Holocene palaeoenvironmental reconstructions from Eilandvlei and Groenvlei, Wilderness Embayment, South Africa

TP8-P-09: Schwab, M. J., A. Brauer, T. Blume, M. Błaszkiewicz, T. Raab., M. Wilmking, the ICLEA Scientific Team: The Virtual Institute of Integrated Climate and Landscape Evolution Analyses – ICLEA

TP8-P-10: Lembke-Jene, L., R. Tiedemann, D. Nürnberg, L. Max, G. Lohmann: A mid-Holocene shift and millennial-scale variations in North Pacific mesopelagic oxygenation and upper mixed layer hydrography

TP8-P-11 Lane C., D. Sachse, A. Brauer, A. Moreno, S. Rasmussen, D. Roche, D. Veres, INTIMATE members: INTegrating Ice core, Marine and TErrestrial records to understand abrupt climate changes

TP8-P-12 Stepanek, C., G. Lohmann: Towards a more flexible representation of hydrological discharge transport in paleoclimate modelling

Wednesday, 8 October 2014

Umweltforum, Room S9, Seminar room 9, 1st floor

10:00 TP8-O-01: Kandiano, E. S., M. T. J. Van der Meer, S. Schouten, H. A. Bauch, J. S. Sinninghe Damste: Intra-interglacial climate variability in the North Atlantic during MIS 11

10:15 TP8-O-02: Rehfeld, K., S. L. Ho, T. Münch, T. Laepple: Glacial-interglacial variability change: a view beyond ice-cores

10:30 TP8-O-03: Knorr, G., X. Zhang, G. Lohmann, P. Köhler , S. Barker, A. Brauer, C. Martin-Puertas: The role of glacial/interglacial CO_2 and ice sheet changes for abrupt climate transitions

10:45 TP8-O-04: Martin-Puertas, C., A. Brauer, S. Wulf, F. Ott, S. Lauterbach, G., Knorr, P. Dulski: Abrupt climate changes during the demise of the last interglacial across a transect from Greenland to the Mediterranean: regional similarities and differences

11:00 TP8-O-05: Schwab, M.J., I. Neugebauer, A. Brauer, N. Waldmann, U. Frank, P. Dulski, R. Tjallingii, N. Taha, DSDDP Scientific Party: From warm to cold climate - the MIS 5-4 transition in sediments from the deep Dead Sea basin

11:15 COFFEE BREAK (Umweltforum, Room S8, Seminar room 8, 1st floor)

Umweltforum, Room S9, Seminar room 9, 1st floor

11:45 TP8-O-06: Mulitza, S., C. Chiessi, J. Lippold, E. Schefuß, A. Mackensen, A. Paul, M. Prange, A. Sawakuchi, R. Tiedemann, Y. Zhang: Atlantic Ocean forcing of northeast Brazilian precipitation during Heinrich Stadial 1

12:00 TP8-O-07: Müller, J., R. Stein: Abrupt sea ice fluctuations in the subpolar North Atlantic at the end of the last glacial and their potential impact on ocean circulation changes

12:15 TP8-O-08: Sachse, D., K. Schütrumpf, I. Neugebauer, B. Plessen, A.M. Noryskiewicz, A. Brauer: Palaeohydrological changes during the onset of the Younger Dryas from the Rehwiese Paleolake, Berlin, NE Germany and their regional context – a combined biomarker δD and carbonate δ18O record

12:30 TP8-O-09: Wulf, S., F. Ott, M. Słowinski, N. Dräger, I. Neugebauer, C. Martin-Puertas, A. Brauer: The use of tephras as tools for synchronising palaeoclimate records – an example from late-glacial central European varved lake records

12:45 TP8-P-02: Lohmann, G., X. Zhang, X. Gong, G. Knorr, L. Max, M. Pfeiffer, X. Shi, L. Lembke-Jene, T. Laepple, R. Tiedemann: Sea surface temperature trends in the North Atlantic and Pacific Oceans: models and observations

13:00 LUNCH BREAK (Umweltforum, Room S8, Seminar room 8, 1st floor)

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Umweltforum, Room S9, Seminar room 9, 1st floor

14:55 TP8-O-10: Rimbu, N., G. Lohmann, M. Ionita: Reconstruction of climate extreme indices over Europe from high resolution proxy data

15:10 TP8-O-11: Bierstedt, S., B. Hünicke, E. Zorita, S. Wagner: Simulated changes in wind extremes during the last millennium over northern Europe

15:25 TP8-O-12: Ott, F., A. Brauer, M. Słowinski, S. Wulf, V. Putyrskaya, M. Obremska, B. Plesssen, M. Blaszkiewicz: A robust chronology established by a multiple dating approach for the varved sediment record from Lake Czechowskie (Poland)

15:40 TP8-O-13: Hoffmann, H., P. Bohleber, T. Erhardt, J. Kerch, N. Spaulding, J. Freitag, D. Wagenbach: Towards retrieving Holocene climate changes in Western Europe from a high Alpine ice core

15:55 TP8-O-14: Helle, G., M. Freund, U. Cubasch, ISONET Members: A spatial reconstruction of European drought from a tree-ring stable isotope network

Keynote Lectures

Monday, 6 October 2014 (11h40)

Umweltforum, Room PH, Plenary Hall ('Großer Saal')

'Limited-area domain atmospheric energetics'

René Laprise, Marilys Clément and Oumarou Nikiéma

Centre ESCER (Étude et Simulation du Climat à l'Échelle Régionale)
Dept. of Earth and Atmospheric Sciences
Université du Québec à Montréal, Canada

The study of the atmospheric energetics provides fundamental information concerning the behaviour and maintenance of the general circulation.
Lorenz was the first to develop a detailed atmospheric energy cycle and his work is still today considered a classic in atmospheric energetics. He introduced the concept of available potential energy (APE) with respect to a reference state defined as that which would exist if the total mass of the atmosphere were redistributed adiabatically to result in a horizontal density stratification everywhere. Lorenz further decomposed the APE and kinetic energy (KE) fields into components associated with the zonal mean atmospheric state and departures thereof, termed eddies. A significant advantage of this approach is that the resulting energy expressions are quadratic, positive-definite quantities, which greatly facilitates the physical interpretation. There are however noteworthy limitations associated with this classical approach. An important one is that the concepts of reference state, APE and zonal mean are only meaningful when applied to the entire atmosphere, not for a portion of it. Furthermore several mathematical manipulations to establish APE and energy conversion terms require integrating over the entire atmosphere, in which case several terms vanish identically. Hence previous attempts at carrying energetics calculations on limited regions have faced many challenges. Understanding the physical processes and energy conversions underlying the development of individual weather systems however remains a long-standing scientific interest. The recent advent of high-resolution atmospheric analyses and regional model simulations facilitates the access to the required data and stimulates such undertaking.

Here we present an energy cycle appropriate for a limited-area domain following the work of Pearce and Marquet. The formulation is based on available enthalpy (AE), which naturally separates into contributions from temperature and pressure, facilitating the calculation of the energy cycle on pressure levels. The AE and KE fields are decomposed in components relating to their time-mean state and deviations thereof, the transient eddies. The energy budget has been computed for a simulation of the fifth-generation Canadian RCM driven by reanalyses over a specific domain and season of one year.

Monday, 6 October 2014 (12h20)

Umweltforum, Room PH, Plenary Hall ('Großer Saal')

'Darkening Greenland ice: integrating a spectrum of climate change processes'

Jason Box

Geological Survey of Denmark and Greenland Kopenhagen, Denmark

A key element to the Northern cryosphere, regional ocean circulation and global sea level, Greenland ice reacts to and indicates climate change. This presentation reviews a number of processes promote the climate response of Greenland ice, including its surface darkening. Our knowledge of the dark snow phenomenon befits from a wealth of satellite and ground observations and through the latest atmospheric data assimilation models. This talk presents several recent insights of the sensitivity of Greenland ice to climate change in context of the surface reflectivity. No matter the future climate state, Greenland ice will continue to compete among several other top climate elements that capture our attention.

Tuesday, 7 October 2014 (08h30)

Umweltforum, Room PH, Plenary Hall ('Großer Saal')

'NGEE: The Study of the Interaction of Atmospheric, Hydrologic, Geomorphic and Ecosystem Processes on the Alaskan Arctic Coastal Plain'

Larry Hinzman

International Arctic Research Center, University of Alaska Fairbanks, USA

The complex interplay of physical, chemical, and biological processes interact to such a degree that it is not possible to understand future trajectories without developing more fully holistic perspectives of the complete system. The components of the Arctic are inter-related through a complex network of linkages, feedbacks and multi-dependent interactions. Theoretically a change in one variable in a part of the system can initiate a cascade of effects throughout the system, and these connections need to be understood and quantified to achieve a level of predictability. In arctic regions, the interactions of surface mass and energy fluxes are complicated by the presence of permafrost and the important role of microtopography; these both affect and are mediated by dynamic atmospheric, geomorphological and ecosystem processes such as non uniform snow distribution, lake formation and drainage, wetland succession, thermokarst and erosion, and hydrological dynamics highly variable on different temporal and spatial scales.

Especially in northern regions, soil moisture is important not only as a hydrological storage component, also as a result of its strong influence on the hydrological cycle through controls on energy fluxes such as evaporative heat flux, phase change in thawing of permafrost, and effects on thermal conductivity. With projected increases in surface temperature and decreases in surface moisture levels that may be associated with global warming, it is likely that the active layer thickness will increase, leading to subtle but predictable ecosystem responses such as vegetation changes.

Spatially distributed model simulations are being conducted across a range of scales. Preliminary results indicate macro-topographic gradients greatly impact the importance of lateral versus vertical fluxes. Micro-topographic differences affect the small spatial scale differences in snow distribution, soil moisture and runoff rates, but have less impact upon flux direction. Permafrost in arctic regions exerts a significant influence on soil moisture through controls on snow cover, vegetation and drainage and through differential degradation due to inhomogeneous ground ice distribution. In relatively flat areas where the frozen layer is near the surface, the soil moisture contents are usually quite high. These areas have relatively high evapotranspiration and sensible heat transfer, but quite low conductive heat transfers due to the insulative properties of thick organic soils. As in more temperate regions, watershed morphology exerts strong controls on hydrological processes; however unique to arctic watersheds are complications arising from the short-term active layer dynamics and longer-term permafrost dynamics. In permafrost lowlands, degradation of near-surface regularly and irregularly distributed ground ice may substantially enhance microtopographic gradients impacting hydrologic flow. In addition, hydrologic flow patterns are seasonally highly variable due to strongly varying water supply and connectivity throughout the thaw season.

The Arctic, an area of low rainfall but even lower actual evapotranspiration, is generally an area of abundant wet and moist tundra. The limited precipitation is held near the surface, resulting in abundant ponds, wetlands, and moist tundra. This situation is, in part, made possible due to the presence of permafrost near the surface, and where there is limited lateral flow due to modest topography. Vegetation also plays its role. Mosses tend to act as rectifiers, tending to conduct heat to the atmosphere when it is cool and wet, and slowing heat uptake under warm dry conditions when their thermal conductivity is lower. Shrubby vegetation can both increase the depth of snow and decrease the albedo and the snow free period compared to graminoid vegetation. Increases in the active layer can cause a lowering of the active layer and a lowering of the soil water table. Sufficient increase in the active layer can cause thermokarst erosion tending to drain surrounding areas, often increasing the decomposition rate of soil organic matter, and speeding the loss of carbon from the landscape. The impact of increasing temperature and decreasing soil moisture on net ecosystem carbon flux is a complex interaction of non-linear processes. Optimal water content for maximal soil respiration falls in intermediate soil water contents. Decreasing soil moisture can increase or decrease soil respiration, decomposition, and mineralisation depending on the state of water content in the soil.

Tuesday, 7 October 2014 (09h00)

Umweltforum, Room PH, Plenary Hall ('Großer Saal')

'Composition-Climate Interactions from Global to Local Scales'

Martyn Chipperfield

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There are many two-way interactions between atmospheric composition (i.e. chemical and aerosol species) and climate. Changes to the distribution and abundance of gas-phase chemical species and aerosols can change atmospheric and surface climate. Many greenhouse gases (GHGs) have atmospheric lifetimes short enough that their abundance is affected by changes in atmospheric oxidants. For example, CH4 has a lifetime of around 9 years and its main atmospheric sink is through reaction with OH. Ozone plays a key role in the energy balance of the atmosphere by absorbing both incoming ultraviolet radiation and outgoing longwave infra-red radiation. In particular, ozone changes in the upper troposphere – lower stratosphere (UTLS) can exert a major impact on climate. Climate perturbations by aerosol can occur on a large scale (e.g. following a major volcanic eruption) or be more regional due to localised pollution or emissions. In the other direction, changes in climate (e.g. temperature, meteorology) will impact on atmospheric composition through changes in reaction rates, emissions and transport of species. Again, these effects can be global in extent or can be localised due to different atmospheric regimes.

In this talk I will give an overview of two-way composition-climate interactions using examples from the troposphere and stratosphere. On the global scale I will discuss the evidence from observations and models that coupled changes have already occurred, and present model simulations of future changes. I will then discuss how these global changes are linked to possible regional changes.

Tuesday, 7 October 2014 (14h15)

Umweltforum, Room PH, Plenary Hall ('Großer Saal')

'Transformative adaptation'

Mark Pelling
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Transformation describes those actions and consequences causing fundamental change in systems characteristics, goals and behaviour. The term has been invoked in adaptation literature to indicate the potential offered by adaptation to redirect development pathways. This connects well with its use in mitigation and the aspiration or necessity for a transformation in the global energy economy. As yet however these two discourses on transformation have not been connected. This paper takes as its starting point the IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX), published in 2012. It proposed transformation as one of seven components of the solution space for adaptation to climate change. This paper also reflects on the evolution of transformative adaptation through SREX and the IPCC 5th Assessment Report and in ongoing discussions around UNISDR Hyogo Framework for Action II, the international agreement guiding national investment and strategy for disaster risk reduction from 2015.

Wednesday, 8 October 2014 (08h30)

Umweltforum, Room PH, Plenary Hall ('Großer Saal')

'Extreme Events: Re-enacting past winter storms'

Stefan Brönnimann
University of Bern, Bern, Switzerland

Meteorological or climatological extremes are rare and hence studying them requires long meteorological data sets. Moreover, for addressing the underlying atmospheric processes, detailed three-dimensional data are desired. Until recently the two requirements were incompatible as long meteorological series were only available for a few locations, whereas detailed 3-dimensional data sets such as re-analyses were limited to the past few decades. With the release of the 'Twentieth Century Reanalysis' (20CR), a 6-hourly global atmospheric data set covering the past 140 years has become available. In this contribution I show that 20CR, combined with numerical techniques such as dynamical downscaling, not only provide a fresh look at past climate extremes, but also re-valuates historical documentary information. Using the example of winter storms in Switzerland, the combination of storm damage information from documentary sources with downscaled storms from 20CR provides a detailed picture of the event that eventually can contribute towards a better quantification of storm risks.

Wednesday, 8 October 2014 (09h00)

Umweltforum, Room PH, Plenary Hall ('Großer Saal')

'Role of land surface processes and land use change at the regional scale'

Edouard L. Davin
ETH Zurich, Zurich, Switzerland

The interface between the land and the atmosphere plays a central role in the climate system, as climate change affects humans and ecosystems through this interface, and vice versa. The land surface is involved in many climate feedback loops (biogeophysical and biogeochemical) which will be illustrated in this presentation focusing particularly on the role of vegetation in shaping land-atmosphere water and energy exchanges [1,2]. Moreover, the land surface is also directly modified by human activities (through changes in land cover) thus exerting a forcing on climate. This has large-scale implications [3], but some of the most substantial impacts are expected to occur at the regional scale [4]. The paradox is that most current regional climate models do not account for these influences (e.g. unlike the global models used in the CMIP5 intercomparison, most of the regional climate models participating in CORDEX do not consider land cover change as a standard forcing). This presentation will present some recent efforts to improve the representation of land processes in regional climate models [1,5] and will illustrate the importance of these processes, in particular land cover change, at this scale [4]. Finally, new opportunities to design land management strategies as a way to optimize climate benefits at regional or local scales will also be discussed [6].

References:

[1] Davin, E.L. and S.I. Seneviratne (2012), Role of land surface processes and diffuse/direct radiation partitioning in simulating the European climate, Biogeosciences, 9, 1695-1707, doi:10.5194/bg-9-1695-2012.

[2] Lorenz, R., E.L. Davin, D.M. Lawrence, R. Stöckli and S.I. Seneviratne (2013), How important is vegetation phenology for European climate and heatwaves?, J. Clim., 26, 24, 10077–10100, doi: http://dx.doi.org/10.1175/JCLI-D-13-00040.1

[3] Pitman, A.J., N. de Noblet-Ducoudré, F.T. Cruz, E. L. Davin, G.B. Bonan, V. Brovkin, M. Claussen, C. Delire, V. Gayler, B.J.J.M. van den Hurk, P.J. Lawrence, M.K. van der Molen, C. Müller, C.H. Reick, S.I. Seneviratne, B. J. Strengers and A. Voldoire (2009), Uncertainties in climate responses to past land cover change: first results from

the LUCID intercomparison study, Geophys. Res. Lett., 36, L14814, doi:10.1029/2009GL039076.

[4] Lejeune, Q., E.L. Davin, B. Guillod and S.I. Seneviratne (2014), Influence of deforestation on the future of the Amazonian climate and water cycle, Clim. Dyn., Online First, doi:10.1007/s00382-014-2203-8.

[5] Davin, E. L., R. Stoeckli, E. B. Jaeger, S. Levis and S.I. Seneviratne (2011), COSMO-CLM2: A new version of the COSMO-CLM model coupled to the Community Land Model, Clim. Dyn., 37, 9, 1889-1907, doi: 10.1007/s00382-011-1019-z.

[6] Davin, E.L., S.I. Seneviratne, P. Ciais, A. Olioso, and T. Wang (2014), Preferential cooling of hot extremes from cropland albedo management, Proc. Natl. Acad. Sci. U. S. A., Published online, doi:10.1073/pnas.1317323111.

Wednesday, 8 October 2014 (14:15h)

Umweltforum, Room PH, Plenary Hall ('Großer Saal')

'Environmental changes in the Black Sea region during the last ~140 kyrs'

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Due to its narrow/shallow Bosporus Strait connection to the Mediterranean, the Black Sea is a well stratified marginal sea since about 8000 years. The relatively fresh surface waters are sustained by a large river runoff, and Mediterranean inflow generates saltier deep water that is largely anoxic below the well-developed pycnocline. However, on longer time scales the Black Sea is characterized by transient environments, critically depending on its sea-level-dependent connection with the Mediterranean Sea on glacial/interglacial time scales with marine conditions during warm interglacials/sea-level high-stands and freshwater/brackish conditions during glacials.
In this talk, we present detailed paleoenvironmental reconstructions of changes in the aquatic and terrestrial ecosystems during the Holocene, Eemian, the last two glacial/interglacial transitions (Terminations I and II) and the last glacial lacustrine phase (MIS 3) relying on multidisciplinary studies on Black Sea sediment cores. The sediment cores were retrieved from the Archangelsky Ridge in the southeastern Black Sea, an uplifting region that is part of an actively deforming orogenic wedge [1]. Additional evidence for this tectonically unstable regime comes from sediment acoustic data and several hiatuses in our sedimentary records.
Our high-resolution paleoproxy records document an immediate response of the glacial Black Sea freshwater lake to the abrupt D-O climate oscillations of the last glacial period [2]. Furthermore they indicate gradual changes from late glacial cold/arid conditions in northern Anatolia, dominated by steppe vegetation, towards warm/humid forest dominated landscapes characteristic for interglacial periods. Disrupted by large melt water pulses from the disintegrating Fennoscandian Ice Sheet, the limnic glacial Black Sea environment becomes more productive during the postglacial warming [3]. The global sea level rise finally reconnects the hydrological increasingly active Black Sea basin with the Mediterranean Sea, leading to the development of marine, for the Eemian even fully marine, conditions with a stratified water column and sapropelic sedimentation. Significant multicentennial hydrological changes in the North Anatolian region are evident throughout the Holocene [4,5].

References

[1] Yildirim, C.; Melnick, D.; Ballato, P., Schildgen, T. F., Echtler, H., Erginal, A. E., Kiyak, N. G., Strecker, M. R. (2013). Differential uplift along the northern margin of the Central Anatolian Plateau: inferences from marine terraces. Quaternary Science Reviews 81, 12-28.

[2] Shumilovskikh, L. S., Fleitmann, D., Nowaczyk, N., Behling, H., Marret, F., Wegwerth, A., Arz, H. W. (2014). Orbital - and millennial - scale environmental changes between 64 and 20 ka BP recorded in Black Sea sediments. Climate of the Past 10 (3), 939-954.

[3] Shumilovskikh, L. S., Marret, F., Fleitmann, D., Arz, H. W., Nowaczyk, N., and Behling, H. (2013). Eemian and Holocene sea-surface conditions in the southern Black Sea: organic-walled dinoflagellate cyst record from core 22-GC3, Mar. Micropaleontol., 101, 146–160.

[4] Lamy, F., Arz, H. W., Bond, G., Bahr, A., and Pätzold, J. (2006) Multicentennial-scale hydrological changes in the Black Sea and northern Red Sea during the Holocene and the Arctic/North Atlantic Oscillation. Paleoceanography 21, PA1008, doi:10.1029/2005PA001184.

[5] Goektuerk, O. M, Fleitmann, D., Badertscher, S. Cheng, H., Edwards, R. L., Leuenberger, M., Fankhauser, A., Tuysuz, O., Kramers, J. (2011). Climate on the southern Black Sea coast during the Holocene: implications from the Sofular Cave record. Quaternary Science Reviews 30, 2433-2445.

Abstracts of Oral Presentations and Posters

(Presenters of presentations are underlined)

Session Abstracts Topic 1:

Regional climate system modelling

TP1-O-01: Different coupling methods for regional atmosphere - ocean simulations

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Coupling between atmosphere and ocean in a coupled climate model system can be done via state variables and/or fluxes. Several coupling methods of field exchange are investigated to analyse how these methods impact the simulated climate and the interactions and feedback between the atmosphere and ocean. Here, we use the atmosphere – ocean – sea ice coupled system COSTRICE that has been developed for regional climate simulations over the Baltic Sea and North Sea regions COSTRICE comprises the atmospheric model CCLM, the ocean model TRIMNP, and the sea ice model CICE, which are coupled via the coupler OASIS3-MCT2.0. In the two-way coupling setup, TRIMNP and CICE are driven by 1-hourly atmospheric state variables and fluxes of CCLM, while CCLM receives skin temperatures which are the combination of the SST from TRIMNP and the sea ice skin temperature from CICE, weighted by the sea ice concentration. Four experiments were designed for simulations covering the period 1979-2005:

(1) State variables, such as mean sea level pressure, temperature, humidity, wind, are passed from CCLM to TRIMNP, where they are used to calculate surface shortwave incoming radiation, surface longwave downward radiation, latent and sensible heat fluxes. As these fluxes are not given back to CCLM, the surface energy fluxes seen by the atmosphere in CCLM are not consistent to those seen by the ocean in TRIMNP.

(2) All surface radiation and heat fluxes are transferred from CCLM to TRIMNP, except outgoing longwave radiation that is calculated in TRIMNP using its SST.

(3) Similar to (2) but latent and sensible heat fluxes are determined in TRIMNP using state variables for the bulk formula (but not provided back to CCLM).

(4) Similar to (3) but latent and sensible heat fluxes, after calculated in TRIMNP, are passed back to CCLM. In this experiment, the surface energy fluxes seen by CCLM and TRIMNP are consistent.

Simulations of the four experiments are compared to each other and to observations for the 20 year period 1986-2005. They are also compared to a standalone run of CCLM, which is forced by ERA-interim SST, to investigate the impacts of coupling on simulated regional climate. First results show that when TRIMNP calculates latent and sensible heat fluxes by itself in (1), (3) and (4), SST tends to be better reproduced than when TRIMNP is forced by all atmospheric fluxes as in (2). Wet biases over Scandinavia and cold biases over North Europe simulated by the standalone CCLM were slightly improved in the coupled experiments. In general, simulated monthly 20-year averages of SST, 2 m temperature and rainfall are similar in all experiments. However, for some extreme rainfall events, several experiments showed rather good performance in capturing patterns and magnitudes of the heavy rainfall events. Reasons for the differences between the experiments in capturing these events will be analysed in more detail.

TP1-O-02: Coupling of COSMO/CLM and NEMO in two regions

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We have established two coupled regional atmosphere-ocean models, one for the Mediterranean Sea and the other for the North and Baltic Seas. The atmosphere model chosen is COSMO/CLM, for the ocean, it is NEMO, which includes the sea-ice model LIM. Both models are coupled via the OASIS3 coupler. This coupler interpolates heat, fresh water, momentum fluxes, sea level pressure and the fraction of sea ice at the interface in space and time.

We will present the individual setups for the two regions and show results of our hindcast experiments. Our main focus is to compare the uncoupled atmospheric model and coupled atmospheric-ocean models to study the influence of the active coupled ocean on the atmospheric circulation and especially how far this influence reaches inland. With the Mediterranean Sea setup, we participate in the HYMEX community.

TP1-O-03: A coupled model system to examine ocean-atmosphere-sea ice processes in the Arctic: HIRHAM5 - HYCOM – CICE

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We introduce a high resolution fully coupled regional model system that describes ocean, atmosphere and sea ice processes in the Arctic Ocean and North Atlantic. The system has been developed using three existing models, the high resolution regional climate model HIRHAM5, the regional ocean model HYCOM and the CICE model that describes sea ice dynamics. These models have been interactively coupled which enables us to perform experiments examining the relative importance of ocean and atmospheric forcing as well as internal dynamics, to explain the recent rapid decline of arctic sea ice. Analysis of the model results indicates the model can successfully reproduce the interannual and seasonal variability in sea ice extent. This opens up the possibility of a range of process based experiments as well as simulations to project the future of arctic sea ice that we plan to run using the EC-Earth GCM as boundary forcing.

TP1-O-04: Regional climate simulations with COSMO-CLM using different soil-vegetation-atmosphere-transfer (SVAT) module

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Climate predictions on decadal timescales constitute a new field of research, closing the gap between short-term and seasonal weather predictions and long-term climate projections. Therefore, the Federal Ministry of Education and Research in Germany (BMBF) has funded the research program MiKlip (Mittelfristige Klimaprognosen), which aims to create a model system that can provide reliable decadal climate forecasts.

One of the most import boundary conditions influencing the decadal climate variability is the interaction between the soil, the vegetation and the atmosphere. Thereby, the soil and vegetation characteristics affect the radiation balance and control the water and heat fluxes between the surface and the atmosphere. Within a Regional Climate Model this interactions are represented in SVAT. Thus, one opportunity to investigate the influence of the soil-vegetation-atmosphere interaction on the regional decadal climate variability is to use different SVATs within regional climate simulations. Therefore the standard SVAT implemented in COSMO-CLM (CCLM) TERRA_ML, is replaced by the two new SVATs, the Community Land Model (CLM) and VEG3D. As a first step, TERRA_ML is substituted by VEG3D, a SVAT developed at the IMK-TRO, Karlsruhe, Germany. Compared to TERRA_ML, VEG3D includes an explicit vegetation layer by using a big leaf approach, inducing higher correlations with observations as it has been shown in previous studies. By comparing the CCLM simulation results achieved with both SVATs with each other, sensitive model parameters for this interaction can be identified, which might help to improve decadal climate predictions. The coupling of CCLM and VEG3D was done via the OASIS3-MCT coupling software, developed by CERFACS, Toulouse, France.

The presented research will contribute to MiKlip by performing hindcast ensemble simulations for several decades with CCLM coupled to both SVATs, driven by global decadal MPI-ESM-LR simulations. Thereby CCLM simulations with VEG3D showed better agreement with observational data than simulations with TERRA_ML concerning the monthly mean 2 meter temperatures and the monthly precipitation sums. The performance of both models is evaluated by several skill scores. Additionally, important processes in the interaction between the surface and the atmosphere are shown exemplarily.

TP1-O-05: Regional coupled atmosphere-ocean modelling in the North Sea region

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The validation and evolution of climate projections in the North Sea is one of the research tasks of the research programme KLIWAS of the German Federal Ministry of Transport and Digital Infrastructure (BMVI). Simulations of three coupled regional atmosphere-ocean models were made in co-operation with the Swedish Meteorological and Hydrological Institute, the Climate Service Centre and the Max Planck-Institute for Meteorology for both the North Sea and the Baltic for the time period of 1950 to 2100. The regional coupling results for present-day climate are compared to a new North Sea climatology. The KLIWAS project adds coupled ocean simulations to the band width of possible future climate conditions in the atmosphere as given by the ENSEMBLES project. While air and water temperature will rise to the year 2100, the mean wind speed does not show a significant trend, but large decadal variability. The frequency of wind directions from the western sector increases in the majority of the simulations and results in an increase of significant wave height in the eastern parts of the North Sea.

TP1-O-06: Regional Arctic System Model (RASM) – added value, sensitivity and future prospects

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We demonstrate the capability of the Regional Arctic System Model (RASM) in simulating observed seasonal to decadal variability and trends in the sea ice cover. RASM is a high resolution fully coupled pan-arctic climate model that uses the Community Earth System Model (CESM) framework and is configured at an eddy-permitting resolution of 1/12° for the ice-ocean and 50 km for the atmosphere-land model components. All RASM components are coupled at 20-minute intervals. We also investigate sensitivity of simulated sea ice states to scale dependence of model parameters controlling ice dynamics, thermodynamics and coupling with the atmosphere and ocean. For this study we use both fully coupled and a subset of RASM, where the atmospheric and land components are replaced with prescribed realistic atmospheric reanalysis data for 1948-2009. This approach allows direct comparison of model results with observations and comparison of forced and prognostic model sensitivity to varying parameter space. Model outputs from multi-decadal ensembles are compared against each other and against basin-wide estimates of sea ice extent and volume. Our results confirm that many parameterisations of sub-grid physical processes currently used in climate models are scale-dependent and we provide further details on fine-tuning required when changing model spatial resolution. We also show that while sea ice extent in many runs compares well against observations, sea ice thickness distribution is acceptable only in a few cases. Hence, we conclude that the use of observed sea ice extent only to validate the skill of sea ice models is not a sufficient model constraint. Finally, we will discuss the ongoing work and future plans in expanding RASM modelling and predicting capability.

TP1-O-07: Modelling today's Arctic climate with a regional coupled climate model

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To investigate interaction and feedback mechanisms of different climate components in the Arctic, we use a regional atmosphere-ocean model setup, consisting of the global ocean-sea ice model MPIOM with high resolution in the Arctic coupled to the regional atmosphere model REMO. To close the hydrological cycle, the hydrological discharge (HD) model is included within the coupling domain, which covers all catchment areas of the rivers draining into the arctic Mediterranean.

With this setup we currently perform experiments using reanalysis data from the European Center of Medium Range Weather Forecast (ERA40 + ERAINTERIM) as external forcing to simulate today's climate (1958-2010). To study the changing climate due to anthropogenic warming, experiments using different scenario simulations from the IPCC AR5 as external forcing are planned (2006-2100). The historical simulation is running at the moment (1920-2005).

With these experiments, we want to analyse the interplay between arctic climate components and understand their variability. This includes the investigation of mechanisms underlying a strong sea ice retreat in summer, but also a potential large recovery within the following year. What are the atmospheric and oceanic conditions being responsible for such a large sea ice retreat? Does a large sea ice reduction imply changes over the adjacent land masses? Previous studies suggest that changes in the sea ice extend imply changes in the amount of precipitation over the adjacent coastal areas.

We are also interested in the influence of the large-scale atmospheric circulation on the variability of river runoff, which is calculated internally within the model. We have seen in an earlier version of the model that not the winter conditions but an enhanced cyclone activity over Eurasia in spring seems to be the major driver for the variability of arctic runoff. We are going to show first results of the ongoing experiments.

TP1-O-08: Validation of the RegCM4 regional model over the Eastern European/Black Sea region

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In this study, the RegCM4 model was applied to downscale the ERA-Interim reanalysis over the territory of Eastern European/Black Sea region for the period of 1979 – 2013. The region has a very complex topography which makes the regional modelling an essential tool to study the specific features of regional climate. The first step to validate the model is the evaluation of the regional patterns of basic meteorological variables compared to input large-scale ERA-Interim forcing fields. The analysis confirmed the model is able to correctly simulate the regional climate, keeping the initial domain-averaged climate characteristics. At the same time, the model successfully captures the regional climatic patterns linked to local peculiarities of orography and air-sea interaction. The model produces realistic interannual variability of temperature and precipitation, slightly underestimating it in winter. The second step was to identify the systematic model biases against the available observational datasets and assess its possible sources. The key parameter to consider is precipitation, which is especially sensitive to physical formulation and horizontal resolution of the model. We used three control datasets: ERA-Interim and MERRA reanalysis, and the E-OBS gridded

observational dataset. The model had successfully simulated the regional precipitation regime, with mean annual error not exceeding 15%. The main disadvantage was the overestimation (up to 30%) of precipitation during November – March in the Northern part of the domain. The further analysis showed this is mainly due to intensity overestimation, while the precipitation frequency is close to that in the control datasets. The model tends to produce too intense stratiform precipitation events in winter, which was also claimed in other studies (Torma et al., 2011, Giorgi et al., 2012). So, the third step, which is currently in progress, is performing the additional sensitivity experiments to find the best configuration of RegCM4 large-scale precipitation scheme.

TP1-O-09: Development of ocean-sea ice model for the Arctic by model-data synthesis

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To understand the impact of changing arctic environment on the global climate system, it is indispensable to develop an ocean-sea ice model which can simulate ongoing drastic changes in the arctic sea ice. For this purpose we develop data assimilation system for the Arctic Ocean, which synthesises model development activity and past and ongoing arctic observation activities. For the data assimilation scheme, we combine two different approaches; one is an adjoint method (4DVar) and the other is a genetic-algorithms method. The combination of the two different approaches enables us to obtain appropriate external conditions (initial and boundary conditions) and suitable set of internal model parameters. As a part of data assimilation system, we also develop a systematic approach to estimate uncertainty of observational data as a function of space and time, which is an important part of the realistic data assimilation. In our presentation we will introduce our past and ongoing data assimilation activity for the Arctic Ocean and future plans.

TP1-O-10: Impacts of different aerosol climatologies on the European climate during the last decades

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As summarised in the 5th Assessment Report of the IPCC the effects of aerosols on the earth's energy budget are one of the largest uncertainty in a changing climate. Despite a better understanding of aerosol processes since the last report, it remains unclear how complex these processes have to be represented within the climate models to consider their effects in a sufficient way.

Within the non-hydrostatic regional climate model COSMO-CLM the aerosol climatology of Tegen from 1984 is widely used to simulate the direct effect of aerosols on radiative processes using the Aerosol Optical Depth (AOD). Apart from a very low spatial resolution and a missing temporal variability this climatology is dominated by unrealistic high values of AOD over Northern Africa which is caused by an overestimation of Saharan dust.

To investigate the impacts of different aerosol distributions on the meteorological fields the Tanre aerosol climatology is replaced by the more realistic climatologies of Tegen from 1994 and AEROCOM from 2006 with monthly mean values of AOD. In addition to three simulations with the different aerosol climatologies a control simulation without any aerosol feedbacks was performed from 1975 to 2010, with a spin-up time of 5 years.

As the next step (in preparation) the fully online coupled model system COSMO-ART will be used to compile up-to-date aerosol climatology with a high spatial and temporal resolution. Gas phase chemistry and aerosol dynamics are taken into account within this model system. In addition to the direct aerosol effect on radiation interactions of aerosols and cloud microphysics (indirect effect) are considered. Besides to the general effects of aerosols on temperature, clouds and precipitation it is a main objective of this study to investigate possible effects on synoptic structures and circulation.

TP1-O-11: Adaptation of the HIRHAM5 stratiform cloud parameterization to arctic climate conditions

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Satellite-based cloud observations (MODIS and CPR/CALIOP) and single-column climate model simulations (HIRHAM5-SCM) were exploited to evaluate and improve the simulated arctic cloud cover of the atmospheric regional climate model HIRHAM5. The ERA-Interim dataset has been used for the model initialisation, the lateral boundary forcing as well as the dynamical relaxation inside the pan-arctic domain. HIRHA M5 uses a horizontal resolution of 0.25° and has 40 hybrid vertical levels. In comparison with the satellite observations, the HIRHAM5 control run ('HH5ctrl') systematically overestimates total cloud cover but to a lesser extent than ERA-Interim. The underestimation of high- and mid-level clouds is strongly outweighed by the overestimation of low clouds. Numerous sensitivity studies with HIRHAM5-SCM suggested that the combination of a parameter tuning, enabling a more efficient Bergeron-Findeisen process, and an extension of the prognostic-statistical cloud scheme, enabling the use of negatively skewed beta distributions, is most suitable for correcting the simulation of arctic clouds. This improved model setup

has been used in a corresponding HIRHAM5 sensitivity run ('HH5sens'). While the simulated high - and mid-level cloud cover is improved to a limited extent, the overestimation of low clouds can be systematically and significantly reduced, especially over sea ice. Consequently, the multi-year annual mean area average of total cloud cover with respect to sea ice is almost 14% lower than in HH5ctrl. Overall, HH5sens now underestimates the observed total cloud cover but shows a halved multi-year annual mean bias of 2.2% relative to CPR/CALIOP and with respect to all latitudes north of 60°N. The improved cloud simulation corrects the radiative transfer, the surface energy budget and the turbulent vertical fluxes of heat, moisture and momentum. This mitigates the positive temperature, relative humidity and horizontal wind speed bias in the lower model levels.

TP1-O-12: Impact of aerosols on the evolution of a medicane in November 2011

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If and how natural and anthropogenic aerosols influence high impact weather is still an open question. Consequently, it is not known whether it is necessary to take into account this impact in numerical weather prediction models. A depression which produced heavy precipitation over France and Italy at the beginning of November 2011 was converted into a system with tropical features when it reached the Mediterranean Sea. Such systems are named medicane. They occur once in a while mainly in the autumn and winter months. In our study we will focus on the development of the medicane that occurred in November 2011. Simulations of such systems were done before, but the possible impact of sea salt and dust was not investigated yet. Applying COSMO-ART we simulate the effect of sea salt on the evolution of the medicane, the track, and precipitation as a first step. We do a triple nesting where the highest horizontal resolution is 2.8 km. For the microphysics we use a two-moment-scheme where not only the mass concentration but also the number concentration of hydrometeors is treated explicitly. Locally a strong impact of aerosol particles on precipitation was found. In comparison with observation the accumulated precipitation is in better agreement if sea salt is concerned.

TP1-O-13: Energy cycle associated with inter-member variability in a large ensemble of simulations with the Canadian RCM (CRCM5)

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In an ensemble of high-resolution Regional Climate Model (RCM) simulations where different members are initialised at different times, the individual members provide different, but equally acceptable, weather sequences. In others words, RCM simulations exhibit a kind of uncertainty called Internal Variability (or Inter-member Variability – IV), defined as the inter-member spread between members of the ensemble of simulations. Our recent studies reveal that RCM's IV can be associated with energy conversions similar to those taking place in weather systems.

By analogy with the classical work on global energetics of weather systems, a formulation of an energy cycle for IV has been developed that is applicable over limited-area domains. Prognostic equations for ensemble-mean kinetic energy and available enthalpy are decomposed into contributions due to ensemble-mean (EM) variables and those due to deviations from the ensemble mean (IV). Together these equations constitute an energy cycle for IV in ensemble simulations of a RCM.

By using a 50-member ensemble of one-year simulations that differ only in their initial conditions (IC) and performed with the fifth-generation of the Canadian RCM (CRCM5) over an eastern North America domain, we evaluate the various energy reservoirs of IV and exchange terms between reservoirs. Results show a remarkably close parallel between the energy conversions associated with IV in ensemble simulations of RCM and the energy conversions in weather systems.

TP1-O-14: Arctic budget study of inter-member variability using HIRHAM5 ensemble simulations

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One of the challenges in evaluating and applying regional atmospheric models (RCM) is the non-linear behaviour of atmospheric processes, which is still limited understood. The non-linearities lead to an internal variability in the model. Therefore, an ensemble of RCM simulations with different atmospheric initial conditions has been run and a diabatic budget study for potential temperature (developed by O. Nikiéma et al. 2010) has been applied on the ensemble simulations to investigate the internally generated variability. Hence, the physical processes associated with diabatic and dynamical terms inducing the inter-member variability (IV) can be analysed and understood.

The study is applied over the Arctic on an ensemble of 20 members, differing in their initial conditions, simulated with the regional atmospheric model HIRHAM5 from July 6th 2012 to September 30th 2012. This time period is of particular importance because of the melting sea ice and its influence on atmospheric circulations and the resulting effect on the IV. The model is driven by the ERA-Interim

data set and runs with a spatial resolution of 25 km.

The amplitude of the IV of the HIRHAM5 ensemble simulations fluctuates both temporally and spatially. Considering height level, it reaches its maximum at 500 hPa. The spatial distribution reveals two centres of high IV, over the Laptev Sea and over the Beaufort Sea/North America. Generally, the IV is generated/reduced by horizontal/vertical baroclinicity, which fluctuates in time like IV. Both terms have strongest influence at the coast lines.

It is planned to analyse shorter time periods and individual events of high and low IV to get more insight of the development and decline of the IV. Besides, the budget study will be applied for different years, to find a possible dependency between the IV and arctic sea ice anomalies.

TP1-O-15: Anomalous circulations in an RCM caused by orography

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One-way nested regional climate models (RCMs) are known to show large scale deviations from the driving data in the temporally averaged fields. However, little research has been done regarding the causes of these deviations. Here we show that these deviations are the footprints of a large scale anomalous circulation that develops within an RCM domain. A 40-year simulation with the regional climate model COSMO-CLM is analysed, which was run for the European region at a resolution of 0.165° and was forced by a simulation with the global climate model (GCM) ECHAM5 at a resolution of T63. The RCM wind fields are interpreted as the sum of a primary and a secondary circulation, where the primary circulation (PC) is equal to the GCM wind fields and the secondary circulation (SC) equates to the wind vector difference between RCM and GCM. The SC climatology exhibits a circular vortex, which is related to a geopotential height anomaly. By clustering the PC we analyse the SC patterns that result from different flow situations. We find that the SC is a balancing flow, which is induced by modifications of the circulation by the finer resolved RCM topography relative to the driving data. These modifications of the flow have to be balanced within the RCM domain because of the prescribed boundary conditions. Consequently, the SC arises, which affects the whole troposphere. Our results suggest that in winter the main driving mechanism of the SC is the modification of the RCM flow by the Alpine mountain range, while in summer the Turkish highlands are the dominating cause of the SC.

TP1-O-16: Severity of climate change dictates the direction of biophysical feedbacks of vegetation change to arctic climate

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Vegetation-climate feedbacks induced by vegetation dynamics under climate change alter biophysical properties of land surface and terrestrial carbon cycling. Simulations with Earth System Models applied at global scale suggest that the current warming in the Arctic has been amplified, with large contributions from positive feedbacks. However, these models generally employ a simplified representation of vegetation dynamics and structure and a coarse grid resolution, overlooking local or regional scale details determined by diverse vegetation composition and landscape heterogeneity.

In this study, we perform simulations using an advanced regional coupled climate-vegetation model (RCA-GUESS) applied at high resolution (0.44×0.44˚) over the CORDEX-Arctic domain for three scenarios (RCP 2.6, 4.5, 8.5). Our results indicate that net effects of biogeophysical feedbacks to future climate largely result from two opposing feedback mechanisms. The amplified warming found in winter and spring is associated with positive feedbacks arising from substantial reductions of albedo. But the warming tends to be alleviated in the higher RCPs. The attenuated warming in summer is associated with evaporative cooling feedbacks that overtake positive feedbacks arising from albedo decline. The enhanced evapotranspiration is linked to a higher overall LAI (leaf surface for evaporation), which promotes a more dynamic exchange of water vapour and energy with the atmosphere. Spatially, Eastern Siberia and Far East Siberia are identified as the most susceptible locations with feedback sign shift (positive to negative, vice versa), experiencing dominant vegetation species replacement. Western Siberia and North Canada show less feedback sign shifts, experiencing increased abundance of trees at the expense of tundra land. The Scandes Mountain and Alaska are identified as regions with relatively stable feedback effects among all the RCPs scenarios.

TP1-O-17: Present and future of teleconnection patterns affecting the climate of the Mediterranean region

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The aim of this study is the recognition of important atmospheric circulation patterns dominating over Europe and the study of their links to climate parameters of the Mediter-

ranean region for a present and future period. The method of pattern recognition used is 'Self Organizing Maps' (SOM), a method based on Artificial Neural Networks. Three teleconnection patterns were chosen, the North Atlantic Oscillation (NAO), which is a basic variability mode mostly affecting the climate of Western Europe, the North Sea-Caspian Pattern (NCP) and the Eastern Mediterranean Pattern (EMP), mainly affecting the eastern Mediterranean and the Balkan Peninsula. The patterns are studied on a seasonal basis for 500 hPa geopotential height anomalies over Europe, for a reference (1971-2000) and future period (2071-2100) based on the simulations of ECHAM5/MPI General Circulation Model (GCM). The GCM data have been evaluated against reanalysis data and gave satisfactory results. Using the SOM method, the teleconnection indices were defined and their time series were calculated. Days characterised by extreme teleconnection indices were taken into consideration in order to examine their relationships with different climate parameters (temperature, precipitation, wind, low pressure systems) of the Mediterranean, based on Regional Climate Model (RCM) simulations (KNMI-RACMO2, MPI-M-REMO, ICTP-REGCM3), that are all forced by the same GCM (ECHAM5). According to the results, days of extreme positive NAO index play an important role in the variability of temperature, precipitation and wind speed in the Mediterranean, especially in its central and western part and mostly during winter. EMP and NCP indices have broader effects when in their negative phases. In contrary, the frequency of low pressure systems is mostly affected by negative NAO and positive NCP and EMP phases, mainly in eastern Mediterranean. The effects of the teleconnection indices are more pronounced in the future period.

TP1-O-18: Projected changes of wind-wave activity in the Arctic Ocean in the 21st century

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Global wave climate can serve as an indicator of changes and trends in general weather climate and has great practical significance in its own right. While wave heights have been growing globally over recent decades, observations of their regional trends vary. Simulations of future wave climate can be achieved by coupling wave and climate models. However, wave heights and their future trends in the Arctic Ocean remain unknown. Here we show that significant wave height and its extremes will increase over different inner arctic areas due to simulated reduction of sea ice cover and regional wind intensification in the 21st century. We used the third-generation wave forecast model WAVEWATCH-III forced by winds and sea ice concentration produced within the regional model HIRHAM, under the anthropogenic scenario SRES-A1B. We found that the largest wave height growth was observed over the arctic shelf in the September-October period. The opposite tendency, with a slight reduction in wave height appears for the Atlantic sector and the Barents Sea. Our results extend the knowledge of wave climate to high latitudes in the Northern Hemisphere and demonstrate the wave response to a combined influence of wind and ice forcing in a climate-change scenario. We anticipate this to be a starting point for discussion on the coupled wave-wind-ice dynamics of the Arctic Ocean important for climate studies, navigation planning and offshore engineering in this vital region of the world ocean.

TP1-O-19: Climate change projections for the North Sea from three coupled high-resolution models

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1. Introduction

Most of the common global climate models (coupled ocean/atmosphere ocean models) have too large spatial scales to be suitable in the North Sea area. Therefore either high-resolution global models have to be run or dynamical downscaling of the model-output has to be employed using regional models. Regionalized climate change simulations for the North and Baltic Sea were carried out with coupled ocean atmosphere models in the framework of the research program KLIWAS. The numerical simulations of the A1B scenario were performed by the Max-Planck Institute for Meteorology (MPI), the Swedish Meteorological and Hydrological Institute (SMHI) and the Institute of Oceanography (IfM Hamburg). Output from the models is analysed jointly with the Federal Maritime service (BSH) and the German weather service (DWD/SWA).

2. Temperature changes

The three models are showing a large scale temperature increase in the order of 2-2.5 °C at the end of the 21st century, but differ seasonally at smaller horizontal scales. The largest warming is found in the central North Sea and the inflowing waters of Atlantic origin from the North and through the English Channel are visible as slightly reduced warming. Two of the three models (HAMSOM and MPIOM) additionally indicate changes in the annual cycle in the future with larger warming rate in late spring and early winter.

3. Salinity

The enhanced hydrological cycle and moister climate of the A1B scenario leads to a freshening of the North Sea proper. The strongest decreases in the North Sea at the end of the 21st century are associated with the Baltic outflow where salinity decreases by more than 2 psu. This signal does not seem to mix substantially with surrounding waters and is confined to the narrow band of the Norwegian Coastal Current. In the southern North Sea two of the three models indicate slightly larger freshening, mostly associated with changes in the surface fresh flux. The detection of the anthropogenic climate change signal is impeded by a low signal-to-noise ratio caused by the large multi-decadal variability. All simulations show pronounced 30-40 year oscillations in salinity which have the same order of magnitude as the long-term trends.

4. Sea level changes

The three models give similar rise of the steric component of sea level in the North Sea in the order of 28-30 cm at the end of the 21st century. The sea level rise signal is spatially mostly homogeneous and indicates only small dynamic changes. Sea level time series are dominated on inter-annual time scales by large natural variability associated with the North Atlantic Oscillation with similar representation in the three models. The contributions from glacial melt (ice shields and small glaciers) and terrestrial sources have to be estimated from other sources and have to be added offline since the simulations only provide the steric part of the sea level budget. The vertical land movement due to glacial isostatic adjustment has to be considered in order to translate geocentric sea level used in the model into a reference frame based on land. The land movement rates are particularly large around the North Sea and the uncertainties in GIA (glacial isostatic adjustment) models need to be considered.

TP1-O-20: Range of future perspectives from regional climate change projections

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A major application of climate models is the projection of potential future climate changes due to human action in the climate system. The future climate evolution will depend on human influence on climate and on natural climate dynamics. Natural climate variability is caused by external forcings such as solar variability, earth orbital parameters or geothermics; and by internal climate variability. Internal climate variability arises from feedbacks inside the climate system and between its components atmosphere, hydrosphere with cryosphere, pedosphere and biosphere. General circulation models are able to simulate those internal climate dynamics. The external anthropogenic forcing is prescribed to the models as concentrations of atmospheric substances and earth surface alterations based on different plausible future socio-economic scenarios.

For each scenario, climate models project a range of possible climate evolutions due to internal climate variability, and because models differ in their sensitivity to the external forcing due to modelling uncertainties. In order to develop adaptation strategies to cope with potential climate changes, the whole range of projected climate evolutions for the specific region and times scales has to be considered. In this presentation, we explain the general procedure how to represent ranges of potential future climate evolutions with regional climate model simulations. We analyse exemplarily for two specific regions in Germany the range of temperature and precipitation changes simulated by an intra-model study and an inter-model ensemble, based on different emission scenarios, respectively. The intra-model study was performed with the regional climate model (RCM) REMO, driven by the atmosphere-ocean general circulation model (GCM) ECHAM5-MPIOM and based on emission scenarios A2, A1B and B1 for the 21st century. The multi-model ensemble simulations have been established within the European Coordinated Downscaling Experiment EURO-CORDEX. The simulations are performed with different RCM/GCM combinations based on the three representative concentrations pathways RCP2.6, RCP4.5 and RCP8.5. The results illustrate a range of future climate perspectives due to internal climate variability, modelling uncertainty and due to different emission scenarios.

Poster presentations:

TP1-P-01: Towards a regional climate modelling system for West Africa: sensitivity studies input bias correction and hydrological coupling

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The credibility of regional climate simulations over West Africa stands and falls with the ability to reproduce its key climatic feature, the West African Summer Monsoon. This seasonal shift in large-scale wind patterns plays a pivotal role in every day's life, and any shift caused by climate change will greatly impact the future of this region. Despite the increase in spatial and temporal resolution, regional climate simulations are still struggling to simulate the onset, duration and geographical displacement of the monsoon rainband. Severe biases are introduced not only by the regional model itself, but also by the driving global circulation model data. Moreover regional models generally include a one-dimensional description of land-atmosphere exchange processes, thus neglecting feedback mechanisms associated with three-dimensional hydrological processes.

Here we present results of an extensive study of 55 model configurations, specifically targeted to improve the West

African Monsoon representation in the Weather Research and Forecasting (WRF) model. We find that some configurations consistently fail to reproduce the observed monsoon transition and precipitation characteristics, while others are in good agreement. We also report on a comparison of two bias correction methods of global model data prior to ingesting it into WRF, highlighting the importance of the accuracy of the driving data for regional climate simulations. We then present the concept of a fully-coupled atmospheric-hydrological modelling system (WRF-Hydro) for West Africa. Preliminary WRF-Hydro results are finally compared with observed discharges and energy flux measurements at three eddy covariance stations which have been recently installed in the framework of the West African Science Service Centre on Climate Change and Adaptive Land Use (WASCAL).

TP1-P-02: Testing coupling techniques for a regional climate model: What are the advantages?

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Due to the development of earth system models (ESM), the integration of the various components within the climate system has been of paramount importance to provide a better understanding for the coupled processes. The comparison of coupled versus uncoupled experiments is the most straightforward way to assess processes that act in a non-linear manner. The integration of a large number of coupled modules went through the use of two different techniques:

- Components A and B are linked together through a specific software called a 'coupler'.
- Component B is used as a subroutine of module A

Each method presents its own feature that induces different assets and drawbacks. Coupler have been historically designed to communicate and regrid data between ocean and atmospheric models. However, using an additional component leads to higher computing time. By calling a subroutine instead of using a coupler, this extra time is avoided but it implies that both models have a similar and tight structure, which precludes an independent development for each module. A coupler offers more flexibility from this point of view but may decrease the informatic portability.

In this study, we investigate these two techniques by interfacing the ORCHIDEE land surface model with the WRF regional climate model. The strength and weaknesses of the modelled results are discussed in terms of computational performance and specific functionalities added to the coupled model.

TP1-P-03: Evaluation of arctic land snow cover characteristics, surface albedo and temperature during the transition seasons from regional climate model simulations and satellite data

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This paper evaluates the simulated arctic land snow cover duration, snow water equivalent, snow cover fraction, surface albedo and land surface temperature in the regional climate model HIRHAM5 during 2008-2010, compared with various satellite, reanalysis data and one further regional climate model (COSMO-CLM). HIRHAM5 shows a general agreement in the spatial patterns and annual course of these variables, although distinct biases for specific regions and months are obvious. The most prominent biases occur for east Siberian deciduous forest albedo, which is severely overestimated in the simulation, caused by the simplified albedo parameterization (e.g. non-consideration of different forest types and neglecting effect of fallen leaves and branches for deciduous tree forest). The land surface temperature biases mirror the albedo biases in their spatial and temporal structures. The snow cover fraction and albedo biases can explain the simulated land surface temperature bias of circa -3 °C over the Siberian forest area in spring.

TP1-P-04: Improving on large scales within RCM domain: how much does the resolution help?

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There have been results in operational use and various tests and experiments done with the Eta model indicating that the Eta was successful in improving on large scales within its domain compared to those of the driver global model. Perhaps the most conspicuous among those is the result of Fennessy and Altshuler (Veljovic et al., 2010) achieving a rather accurate depiction of the summer precipitation difference between the flood year of 1993 and the drought year of 1988 over the U.S. Midwest, in spite of the failure of the driver global model to do so. For a direct investigation of the issue we have run 26 ensemble members of the Eta driven by ECMWF 32-day ensemble members (loc. cit.). Verification of 250 hPa winds looking at two skill measures seemed to offer a convincing confirmation that the large scales of the Eta have indeed been most of the time somewhat more skilful that those of the driver ECMWF ensemble members.

To look into the possible resolution impact of this Eta favourable result, we subsequently rerun these same 10 members with the resolution reduced from 31 to 80 km. This is about the resolution of the ECMWF driver ensemble members after the 10-day time. Looking at the scores averaged over 5 and 5.5 day periods, the very minor impact of resolution could be noticed, and not always in the direction of the scores being improved with higher resolution. Our conclusion is that the Eta favourable result, of the Eta members showing large scale, skill generally not inferior to that of their ECMWF driver members in spite of absorbing the lateral boundary condition error, was not due to higher resolution. Thus, it must be due to another model feature, or a combination of features, maybe it's near finite-volume design with a conservation of numerous properties. Additional results were expected to be available at the time of the conference.

TP1-P-05: On the improvement of the simulated Mediterranean Sea inter-annual variability

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The current literature provides compelling evidence that a mesoscale-resolving regional ocean model can significantly improve the quality of climate system model results and reduce the uncertainty of regional scenario simulations. However, this potential improvement has not been tested to date in multi-decadal Mediterranean (Med) climate simulations. Despite the continuous improvements achieved over the last decade in the development of credible Med climate models, there remains the need for the advancement of the ocean component as to the physically based representation of the flow exchange through the Strait of Gibraltar (SoG), the Med eddy-dominated flow field, and the formation rates and transports of water masses involved in the Med Thermohaline Circulation (MTHC). The MTHC is mainly sustained by the atmospheric forcing and controlled by the narrow and shallow SoG. Within the SoG the MTHC takes the form of a two-way exchange. A fully three dimensional, non-hydrostatic, tidally forced simulation of SoG, initialised with realistic climatology has been run at a horizontal resolution of about 30m. Results from this model can be considered as a benchmark for simulating the dynamics of the Strait. The effects produced by the non-hydrostatic assumption, physical parameterisation and resolution on the simulated hydraulic regime have been investigated. The minimum requirements in terms of spatial resolution have been estimated, moreover it has been verified that the non-hydrostaticity has no effect on the hydraulic regime. Finally the potential impact on climate scales of the tidally forced SoG dynamics has been verified analysing results from Med model at 1/16° resolution with a mesh refinement in the SoG reaching the minimum resolution suggested by the benchmark SoG simulation.

TP1-P-06: Subsurface urban heat islands: thermal impact of urbanisation on groundwater

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Changes in the urban environment caused by anthropogenic activities lead to microclimatic changes and increasing atmospheric temperatures, a phenomenon which is commonly referred to as the urban heat island (UHI) effect. This UHI effect has been a focus of atmospheric research for several decades and the relevant driving processes and mechanism, such as anthropogenic heat losses, are quite well understood. Atmospheric thermal pollution is recognised as a severe problem with consequences for human health and accordingly, considerable efforts are being taken to mitigate heat stress in cities. However, anthropogenic activities also influence the thermal environment beneath the ground level. A respective UHI effect can also be observed in the subsurface, where elevated groundwater temperatures (GWT) occur in urban aquifers. Several studies reported locally measured increased GWTs from fast-growing megacities, but also in smaller cities in this study, significant heat anomalies in the urban groundwater were observed. The high-resolved spatial distribution of GWT was mapped in several German cities and found to be highly heterogeneous with local hot spots showing temperatures up to 20 °C. Thus, urban areas show a considerable groundwater warming in comparison to undisturbed temperatures of 8-11 °C. An examination of potential heat sources revealed that increased ground surface temperatures and basements act as dominant drivers for the anthropogenic heat input into the groundwater. While some studies discuss these heat anomalies as beneficial for shallow geothermal energy use, thermally affected GWT are also likely to have a rarely discussed impact on groundwater quality and thus potentially drinking water quality. GWT is a crucial parameter for water quality as it has a considerable influence on physicochemical processes as wells as on diversity of the microbial communities and groundwater invertebrates which play an important role for water filtration and purification.

TP1-P-07: The importance of physical parameterizations in WRF to reproduce atmospheric dynamics and BC transport in the arctic region: A sensitivity study

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Regional Climate Models (RCMs) are able to capture the fine-scale features of the arctic climate due to their ability to run at high horizontal and vertical resolutions. However, the realistic representation of the relevant physical processes in the Arctic (energy balance, clouds and precipita-

tion, snow/ice albedo feedback, and sea-ice processes) is still a challenge for the models. Furthermore, Short-Lived Climate-forcing Pollutants (SLCP), particularly Black Carbon (BC), play a significant role in the arctic warming mainly due to the positive albedo feedback effect of BC deposition on snow and ice. The interaction of these processes with the dynamics is potentially important and needs to be considered in arctic modelling studies. In this work we investigate the role of specific physical parameterizations and systematic errors in the Weather Research and Forecast model (WRF) Version 3.6 to simulate realistic surface/atmosphere dynamics within the Arctic in order to reduce the uncertainties in high-resolution projections of future arctic climate. Sensitivity analyses include simulations at 45 km and 9 km horizontal resolution with three land surface models, two planetary boundary layer schemes and over two summer seasons (July, August, September) coinciding with the minimum sea ice extent in the region. The WRF model simulations are validated with meteorological data from the Arctic System Reanalysis (ASR), surface observations from automated weather stations and radiosonde profiles from the IGRA network. Preliminary results show that the model is able to reproduce the diurnal cycle and vertical structure of the arctic boundary layer reasonably well. The model is, however, sensitive to the choice of the land surface scheme with significant biases in simulated moisture and temperature profiles. The best choice of physical parameterisation is then used in the WRF with coupled chemistry (WRF-Chem) to simulate emissions and long-range transport of BC to assess the impact on arctic climate.

TP1-P-08: Variability patterns of the general circulation and sea water temperature in the North Sea

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The performance of a coupled regional climate system model is evaluated for the North Sea region by its ability to reproduce major variability patterns in the oceanic general circulation and sea water temperature. Spatio-temporal variability patterns are obtained by Empirical Orthogonal Functions (EOF) analysis of depth-averaged current velocity and sea water temperature. An adequate representation of major variability patterns in the North Sea is key e.g. for the simulation of extreme events in sea level change and for the simulation of biogeochemical processes and marine ecosystems.

The model setup consists of the global ocean model MPIOM coupled over Europe to the regional atmosphere model REMO. For its specific application to the North Sea region MPIOM is run on a stretched grid configuration with non-diametrical poles located over central Europe and North America. A global ocean model is used to circumvent the problem of prescribing open boundary conditions in conventional regional models, while the stretched grid configuration provides for a horizontal resolution in the Northwest European Shelf and North Atlantic higher than conventional global models.

With this setup the CMIP5 global historical MPI-ESM run from which the IPCC RCP future scenario runs branch off is dynamically downscaled for the Northwest European shelf. Outside the coupling domain MPIOM and REMO are forced with results from the atmosphere model ECHAM6.

For the evaluation of the model results EOF analysis of the general circulation and sea water temperature are compared with results from an uncoupled hindcast simulation driven with ERA40 reanalysis data. Mechanisms driving the leading variability modes are explained. Pronounced anomalies in the general circulation can be attributed to anomalies in the wind field, while different variability modes can be identified for surface heat flux-induced and advective heat flux-induced anomalies in water temperature.

TP1-P-09: Prediction of East Asian summer tropospheric temperature in ensemble multi-seasonal forecast

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Based on the ENSEMBLES multi-model seasonal forecasts system in Stream 2 starting from 1st May, the predictability of East Asian summer tropospheric temperature (EASTT) variability during 1960-2005 is examined. Although the climatology of summer precipitation over East Asia can be captured by ENSEMBLES, the seasonal prediction skill of precipitation is nearly zero in all ENSEMBLES models. Instead, the prediction skill of EASTT is high in the multi-model ensemble mean (MME) of ENSEMBLES models. The hindcast skills over the tropics are higher than over the mid-latitudes. The first two leading interannual variability modes of East Asian upper-tropospheric temperature, which appear as a monopole warming or cooling over the East Asia in EOF1 and a meridional dipole mode across the latitude of 30°N in EOF2 are highly predictable. The SST anomalies over the eastern central Pacific (the eastern central Pacific and the Indian Ocean basin) associated with ENSO developing (decaying) summer is the source of predictability for EOF1 (EOF2). The prediction skills exhibit robust interannual variations and depend on the predictabilities of both the strength and phases of ENSO. A better prediction of EASTT relies on a better prediction of ENSO-related SST anomalies (SSTA). When the SSTA over the eastern central Pacific is stronger in the initial month and no ENSO phase transitions occurred during the forecast period, the prediction skills of EASTT would be higher. When initial SSTA is not strong or there is ENSO phase transition during the forecast period, the prediction skills of EASTT would be lower. The higher prediction skill of EASST than precipitation shed light on statistically downscaling precipitation anomalies based on the EASTT forecast.

TP1-P-10: Simulation of the South Asian summer monsoon with the HIRHAM5 regional atmospheric model from 1979 until 2012

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Model tuning is an integral part of model development (Mauritsen et al., 2012). The target of this process is to improve the known features of the climate system represented in the model by adjusting selected parameters of not explicitly resolved processes at the model grid resolution.

In this study the latest HIRHAM regional atmospheric model (HIRHAM5) is used to simulate the South Asian summer monsoon under present-day conditions. The model is forced at the lateral and lower boundaries with ERA-Interim data for the period 1979-2012. The integration domain covers the South Asian region with a horizontal resolution of 0.25° and a vertical resolution of 40 levels (from surface up to 10 hPa).

Evaluated against reanalysis and ground station-based data sets, the model shows deficiency in simulating the strength of the summer monsoon rainfall. The total precipitation is underestimated over broad regions of India, Nepal and Bangladesh. Several sensitivity studies with different tuned cloud and soil moisture processes are performed to match the model results with observed South Asian summer monsoon intensity. The result is a tuned model set up, which will be used for the next sensitivity studies.

TP1-P-11: Future projections of air temperature and precipitation for the CORDEX-MENA domain by using RegCM4.3.5

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In this study, the projected changes for the periods of 2016-2035, 2046-2065 and 2081-2100 in the seasonal averages of air temperature and precipitation variables with respect to the reference period of 1986-2005 were examined for the Mediterranean and North Africa region. In this context, Regional Climate Model (RegCM4.3.5) of ICTP (International Centre for Theoretical Physics) was run by using three different global climate models. MPI-ESM-MR global climate model of the Max Planck Institute for Meteorology, HadGEM2 of the Met Office Hadley Centre, and GFDL-ESM2M global climate model of the National Oceanic and Atmospheric Administration Geophysical Fluid Dynamics Laboratory were dynamically downscaled to 50 km for the CORDEX-MENA domain. The projections were realized according to the RCP4.5 and the RCP8.5 emission scenarios of the IPCC (Intergovernmental Panel on Climate Change).

TP1-P-12: Reassessing the STARS climate scenarios used in climate impact assessments for the Elbe river basin

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STARS climate scenarios were used during the last ten years for several climate impact assessments e.g. for the Elbe river basin and for Germany. By theoretical analysis, it can be shown that the underlying model cannot extend statistical trends from the past into the future. Instead the short term interannual correlations between temperature and covariables are used to conclude from a prescribed temperature increase scenario on the changes of other climate variables as precipitation and global radiation. As a consequence of the existing interannual linkages of warmer summers with lower precipitations, warmer winters with higher precipitations and warmer years in general with higher global radiation, the STARS model must generate wetter winters, dryer summers and a general increase of global radiation for an imposed temperature increase in the Elbe basin. The usage of short term interannual correlations for long term projections can be also described as turning weather scale variability into climate trends. The theoretical concept of STARS lags an intrinsic value. Thus, the available climate impact studies have to be reassessed using the available simulations from RCM and GCM simulations. The consequences for the Elbe basin will be shown driving the modelling system developed in the GLOWA-Elbe project with recent ensemble runs from the CMIP5 climate simulations.

TP1-P-13: Evaluation of the performance of regional climate models from CORDEX-East Asia on simulating the Asian-Australian monsoon system

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This study investigates the performance of 5 Regional Climate Models, that participated in the Coordinated Regional Climate Downscaling Experiment East Asia (CORDEX-East Asia), driven by ERA-Interim reanalysis (1989-2008). Following the previous work (Huang et al., 2013), we analyse the ability of RCMs and their multi-model ensemble mean (MME) to reproduce the spatio-temporal characteristics

of the present-day Asian-Australian monsoon system. We focus on four monsoon metrics such as annual mean precipitation rate, the first annual cycle (JJAS minus DJFM), the second annual cycle (AM minus ON), the monsoon precipitation intensity and monsoon domain (Wang and Ding, 2008). We find that the individual RCMs tend to underestimate summer precipitation in southern India, north-western China, East China Sea and southern Japan. The RCMs simulate an eastern extension of the western north Pacific tropical monsoon domain towards the middle Pacific and a northern extension of the East Asian summer monsoon domain towards eastern Siberia.

TP1-P-14: VALUE - a framework to validate downscaling approaches for climate change studies

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Our understanding of global climate change is mainly based on General Circulation Models (GCMs) with a relatively coarse resolution, but potential impacts of climate change impacts will often be experienced on regional scales. Impact modellers and other users of climate information therefore often demand high-resolution climate change scenarios derived from GCM simulations. It is well known that downscaling adds value to global climate model simulations, but the uncertainties in regional climate scenarios due to global climate model errors, downscaling errors and internal climate variability are far from being understood. To address these uncertainties, the EU COST Action VALUE has been established.

VALUE aims to foster collaboration and knowledge exchange between climatologists, impact modellers, statisticians and stakeholders to establish an interdisciplinary downscaling community. A key deliverable of VALUE is the development of a systematic validation framework to enable the assessment and comparison of both dynamical and statistical downscaling methods. Here, we present the key ingredients of this framework. VALUE's main approach to validation is end-user focussed: starting from a specific end-user problem, a validation tree guides the selection of relevant validation indices and performance measures. Several experiments have been designed to isolate specific points in the downscaling procedure where problems may be occurring. The framework is the basis for a comprehensive community-open downscaling intercomparison study but is intended also to provide general guidance for other validation studies.

TP1-P-15: PRIDE model for high resolution climate change scenarios using outputs of multi-regional climate models in South Korea

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In this study, we have developed a PRISM-based Downscaling Estimation (PRIDE) model which is suitable for applications in complex topography environments to produce a high resolution climate scenario in South Korea. With this model, approximately 100 years of a future climate scenario was produced with horizontal resolution of 1 km in South Korea based on 12.5 km resolution scenario by Regional Climate Model (RCM). We used 5 different RCMs (HadGEM3-RA, RegCM4, WRFv3.4, RSMv3.1 and SNU-MM5_v3) which are participating in the CORDEX East Asia under RCP 4.5 and 8.5, driven by HadGEM2-AO output equally. The PRIDE model consists of three parts, i.e. a Parameter-elevation Regression on Independent Slopes Model (PRISM) part, a RCM part, and an adjustment consisting of two parts. In PRISM part, we extracted observational daily seasonal cycle of 1 km resolution based on observed station data considering elevation, distance, topographic facets, and coastal proximity. In the RCM part, daily anomaly of RCM induced by some forcing was extracted after removing the model seasonal cycle. In the last, we combined PRISM daily seasonal cycle with RCM anomaly in a daily time scale. Results show that the PRIDE model can effectively reduce the systematic bias of RCM which is mainly due to observational information with 1 km resolution by PRISM. Additionally, we have produced a multi-model ensemble output by combining outputs from the PRIDE model using multi-RCM outputs to reduce uncertainty. Finally, Cumulative Density Fitting (CDF) using PRIDE outputs is discussed for further study. This research was supported by a project CATER 2012-3082.

TP1-P-16: Comparison of statistical linear downscaling models for monthly precipitation in South Korea

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It is well recognised that statistical linear interpolation models are computationally inexpensive and applicable to any climate data compared to the dynamic simulation method at regional scales. This study demonstrated the prediction performance of four different statistical linear interpolation models; General Linear Model, Generalised Additive Model, Spatial Linear Model, and Bayesian Spatial regression Model (BSM). We used the root mean squared error (RMSE) and the mean absolute error (MAE) as the performance criterion. The Bayesian spatial regression model reflected the spatial pattern of monthly precipitation well in comparison with other models. The monthly precipitation and its 95% prediction interval on a 1 X 1 km grid spacing were generated by a spatial interpolation of 441 point observations based on BSM. As expected, the lengths of the 95% prediction intervals of BSM are larger in the non-observed sites compared with the observed sites.

Session Abstracts Topic 2:

Sea level changes from global, regional to local scale

TP2-O-01: Sea level change from observations and modelling: a global perspective on a regional challenge

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Sea level change is an integrated measure of various geophysical contributions. The ongoing melting and ablation of ice sheets and glaciers cause a widespread rise of sea level. In addition, the hydrological exchange of water between land and ocean results in time-variable fluctuation of the ocean surface. These effects are overlaid by volumetric (steric) ocean changes from temperature and salinity variations in the ocean. It must be noted however that although the above effects are of global scale, none of them result in a uniform sea level response. Consequently, regional sea level is influenced by phenomena whose study demands a global approach.

Here, we present regional sea level change estimated from a global inversion scheme using time-variable gravity from the GRACE mission, and simultaneously sea surface height changes from altimetry. The individual contributions to sea level are parameterised by a set of physically determined a priori 'fingerprints' whose time variations are then estimated from the inversion. The applied inversion scheme allows a consistent partitioning of the sea level into its most important components.

We discuss the magnitude of the estimated sea level contributions, and highlight their variations in time and space. In addition, steric variations are also put into perspective using simulations from the FESOM ocean model.

TP2-O-02: Consequences of sea level rise for the German coast

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Extreme sea levels provide a substantial hazard for low-lying coastal areas in the southern North Sea. They are caused by a combination of different factors such as high astronomical tides, a large-scale rise of the sea surface caused by high wind speeds and low atmospheric pressure (storm surges) or extreme wind-generated waves (sea states) caused by high wind speeds in extra-tropical storms. Long-term changes in any of these factors may substantially alter the hazard associated with extreme sea levels. Moreover, any long-term change in mean sea level such as observed over the past 100 years or as associated with future anthropogenic climate change will have an impact as it shifts the entire distribution of sea levels towards higher values; that is, it changes the baseline upon which storm-induced sea levels have to be added. Here, the present knowledge about long-term changes in any of these factors is reviewed. It is shown that storm activity in the area underwent considerable variations on time scales of decades and longer, but does not show clear long-term trends. Similar conclusions are obtained for long-term changes in storm surge and wave climate. Mean sea level has increased in the southern North Sea over the past centuries. Correspondingly, an increase in the extremes is found. For the future, most projections point towards a moderate increase in storm activity in the area with corresponding changes in storm surge and wave climate. These changes will add to the expected future increase in mean sea level, leading to increasing hazards from extreme sea levels. The latter may have consequences for safety, especially in the low-lying coastal areas in the Southern North Sea. Consequences for coastal protection and alternative strategies are discussed.

TP2-O-03: Mechanisms of inter-annual to multi-decadal sea level variability in the North Sea

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In this presentation we examine mean sea level (MSL) variations in the North Sea on different timescales and under the consideration of different forcing factors since the late 19th century. We use multiple linear regression models, which are validated for the second half of the 20th century against the output of a state-of-the-art tide+surge model (HAMSOM), to determine the barotropic response of the ocean to fluctuations in atmospheric forcing. We demonstrate that local atmospheric forcing mainly triggers MSL variability on timescales up to a few years, with the inverted barometric effect dominating the variability along the UK and Norwegian coastlines and wind (piling up the water along the coast) controlling the MSL variability in the South from Belgium up to Denmark. However, despite the large inter-annual sea level variability there is also a considerable fraction of decadal scale variability. We show that on decadal timescales MSL variability in the North Sea mainly reflects steric changes, which are largely remotely forced. A spatial correlation analysis of altimetry observations and gridded steric heights suggests evidence for a coherent signal extending from the Norwegian shelf down to the Canary Islands. This fits with the theory of long-

shore wind forcing along the eastern boundary of the North Atlantic, causing coastally trapped waves to propagate over thousands of kilometres along the continental slope. With a combination of oceanographic and meteorological measurements we demonstrate that ca. 80% of the decadal sea level variability in the North Sea can be explained by boundary wave propagation in the northeast Atlantic. These findings have important implications for (i) detecting significant accelerations in North Sea MSL, (ii) the conceptual set up of regional ocean models in terms of resolution and boundary conditions and (iii) the development of adequate and realistic regional climate change projections.

TP2-O-04: Regional sea level changes in the North Atlantic during the last decade

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Regional sea level changes in the North Atlantic are studied for the period 2003 to 2013 on spatial scales greater than 500 km. The focus is on the relation between the total sea level and its steric and mass equivalent components. The data bases are: monthly gridded sea levels from the Jason-1/Jason-2 satellite altimeters processed by the GFZ's Altimeter Data System as well as gridded steric sea levels from Argo floats and mass equivalent sea level from the GRACE mission. In the analysed period the sea level has decreased in the Northern Subtropical Gyre and increased in the Tropics. While the steric component is dominant in the Northern Subtropical Gyre the mass component seems to be crucial in the Tropics. Typical spatio-temporal patterns are studied using Empirical Orthogonal Functions. For the anomaly series (annual signal subtracted) of the total and the steric sea level the dominant mode is connected to the North Atlantic Tripole. This pattern indicates changes in the strength of the upper layer Gulf Stream and North Atlantic Current and has typical temporal scales of several years. The analysis indicates that these currents were weaker than normal during 2010 and 2011 which might be related to concurrent changes of the meridional mass transports in the Subtropical Gyre.

TP2-O-05: Changes in the seasonal sea level cycle in the Gulf of Mexico

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Temporal variations of the seasonal sea level harmonics throughout the 20th and early 21st century along the United States Gulf coast are investigated using long records from 13 tide gauges. A significant amplification of the annual sea level cycle from the 1990s onwards is found, with both lower winter and higher summer sea levels in the eastern Gulf. Ancillary data are used to build a set of multiple regression models to explore the mechanisms driving the decadal variability and recent increase in the annual cycle. The results suggest that changes in the air surface temperature towards warmer summers and colder winters and changes in mean sea level pressure explain most of the amplitude increase. The changes in the seasonal sea level cycle are shown to have almost doubled the risk of hurricane induced flooding since the 1990s for the eastern and north-eastern Gulf of Mexico coastlines relative to the long-term global sea level rise alone. The results from analysing the tide gauge records are complemented by satellite altimetry data covering the last 20 years (i.e. the period where we detect the amplification) to provide a much better spatial picture of the observed changes in the entire Gulf basin.

TP2-O-06: Regional sea level changes: the role of internal variability in ocean dynamics and the worlds glaciers

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Global sea level has been rising by about 20 cm during the last century and is expected to continue to rise in the 21st century in response to anthropogenic forcing. In addition, internal climate variability may induce significant temporary trends in regional sea level even in the absence of external forcing and has therefore the potential to mask a forced signal for a certain amount of time. It is important to consider the magnitude of internal variability, particularly when interpreting sea level trends obtained from rather short observations such as the 20 year-long altimeter record.

Here, we estimate the magnitude of internally generated sea level trends due to changes in the ocean dynamics and changes in global glacier volume on various time scales. Firstly, we analyse the output of the constant-forcing control simulations of 18 climate models used in the IPCC Fifth Assessment Report to quantify sea surface height variability due to variability in ocean dynamics. Secondly, the output from the same control simulations is used to force a global mass balance glacier model to quantify the variability in regional glacier volume due to internal climate variability, and the corresponding sea surface height fingerprints are computed. The rather long control simulations (250-1000 years) allow for detection of internal variability on multi-decadal to centennial time scales. Both contributions, oceanic and glacier volume internal variability are compared to

modelled sea level trends in historical and future scenarios. Regions with enhanced internal variability are identified and it is assessed when local long term trends become distinguishable from internal variability.

TP2-O-07: The state of the polar ice sheets: Insights from a decade of satellite gravimetry observations

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The polar ice sheets are a key element in the climate system and a sensitive indicator of climate change. Satellite observations have generally indicated increasing ice loss in the polar regions in the past decades but accurately quantifying the ongoing changes and attributing them to the causative processes for predicting the near-future behaviour remains a major challenge. Ground-breaking advances in monitoring the ice sheets from space have been achieved with the Gravity Recovery and Climate Experiment (GRACE); launched in the year 2002, the twin satellites have continuously collected data on the temporally varying gravity field of the Earth, allowing us to uniquely constrain the mass redistribution in the earth system. In particular, GRACE has revolutionized our view on the fluctuating mass balance of the Antarctic and Greenland ice sheets. Together with regional climate models and additional data such as changes in the elevation of the ice sheet or the velocity of the surface ice as well as the bedrock deformation recorded with GPS, GRACE data allowed to identify the processes most relevant for the mass imbalances observed today and to place the estimates into a longer-term perspective. This presentation reviews our consolidated view of the mass balance state of the polar ice sheets, focusing on a decade of satellite gravimetry observations. It addresses the causes of the ongoing change as well as its significance at climatological time scales.

TP2-O-08: The interplay of ocean circulation and ice dynamics at the Filchner-Ronne Ice Shelf, Antarctica

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The ice flow at the margins of the Antarctic Ice Sheet (AIS) is moderated by large ice shelves. Their buttressing effect substantially controls the mass balance of the AIS and thus its contribution to sea level rise. Recent results of ocean circulation models indicate that warm circumpolar water of the Southern Ocean may override the continental slope front and boost basal ice shelf melting. In particular, simulations demonstrate the redirection of a warm coastal current into the Filchner Trough and underneath the Filchner-Ronne Ice Shelf (FRIS) within the next decades. The increase of water temperature in the sub-shelf cavity is estimated to dramatically raise the basal shelf melting. Coupled simulations with an ocean circulation model and a three-dimensional thermo-mechanical ice flow model reveal that the consequent thinning of the FRIS would lead to an extensive grounding line retreat associated with a vast mass loss of the AIS. In this subsequent study, we aim for an enhanced understanding of the complex feedbacks between ocean circulation and ice dynamics of the grounded AIS. Therefore, we focus on the ice streams which are draining into the FRIS and dominating the mass transport from grounded to floating ice. For a better representation of these fast-flowing ice streams we expand the above ice flow model by the incorporation of local processes at the ice base. There, sediment deformation and lubrication by subglacial hydrology locally allow high basal sliding rates and thus create the precondition for the development of ice streams. Based on satellite-observed ice surface velocity patterns we identify such areas with low basal drag and parameterise the ice flow model accordingly. As a result, the modelled ice flow patterns will depict velocity and locations of observed ice streams in the catchment of the FRIS more realistically. We present first results of this advanced ice-flow modelling approach, anticipating an even larger response of the AIS on increased sub-shelf melting rates in future coupled simulations.

TP2-O-09: How satellite remote sensing of the ice sheets can contribute to studies of sea level changes

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During the last decades, the contribution of the ice sheets to sea level rise has increased relative to the thermal expansion of the oceans and to the melting of mountain glaciers and icecaps. Crucial for estimating and forecasting the contribution of the ice sheets is the determination of their mass balance, i.e. of mass gain caused by accumulation of snow and mass loss due to melting and iceberg calving. As a complement to field measurements and model simulations of ice sheet dynamics (the latter dependent on the environmental conditions), satellite data are needed for interpolating between sparse field sites and for the validation of model results. In addition, they are mandatory for observations of sudden events such as the collapse of ice shelves and the break-off of huge icebergs. Parameters derived from satellite data cover different spatial scales, ranging from ice sheet mass changes at horizontal resolutions between 300 and 500 km (obtained from measurements of the hemispherical gravity field) to local velocity fields of moving glaciers with 100 m to 1 km resolution. Satellites are also useful to record changes of extent and elevation of the ice sheets, for the determination of snow accumulation, and for the detection of melting processes and iceberg calving. Satellite data products do not yet exactly meet the requirements of climate studies in all cases.

However, satellite mission concepts and parameter retrieval methods are being continuously improved, increasing their usefulness in climate research. In this presentation, an overview will be given concerning the different methods to observe processes characterising ice sheet dynamics and to evaluate their impact on sea level change.

TP2-O-10: Microwave remote sensing of firn properties in Antarctica

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Sea level change is strongly linked to the state of the polar ice sheets. Hence, an evaluation of sea level change is only possible if the processes that influence ice sheet mass balance are sufficiently well-known. On global to regional scales, climate models are valuable tools to investigate ice sheet evolution. Locally, field measurements provide data for the validation of model results. However, ground truthing measurements are sparse due to the harsh environmental conditions and high logistical effort associated with field campaigns in polar regions. Spaceborne sensors operating in the microwave frequency are independent of solar radiation and cloud cover and are hence well-suited to observe the polar regions on intermediate spatial scales. The interaction between polar firn and microwave radiation is influenced by a large variety of physical properties of the firn and is a complex process. As a consequence, great care needs to be taken when interpreting satellite data. In our present work, we use firn microstructure measurements and microwave data to examine the interaction between microstructure and microwave radiation. We will investigate the impact of microstructure variability on the microwave signal. In this way, we will improve the accuracy of snow accumulation rate estimates, which constitute the gain term in the mass balance of the polar ice sheets.

Poster presentations:

TP2-P-01: Consistency of geoid models, altimetry, tide gauges and time-variable water levels in the North Sea

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Various high-resolution geoid models have been derived from the Gravity Recovery and Climate Experiment (GRACE) and Gravity field and steady-state Ocean Circulation Explorer (GOCE) satellite missions. We investigate the consistency of these models at different spatial resolution with ERS-2 and ENVISAT altimeter time series and with tide gauge data in the North Sea, when correcting for tides and time-variable water levels derived from the German Agency for Maritime Traffic and Hydrography (Bundesamt für Seeschifffahrt und Hydrographie, BSH) model, and from other models. Special attention will be paid to the problem of homogenizing the spatial resolution of the various data sets.

TP2-P-02: Yearly mean distribution of sea levels in the North Sea since 1900

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The yearly mean distribution of sea level in the North Sea is reconstructed from tide gauge and satellite altimeter data starting in 1900. Empirical orthogonal functions (EOF) estimated from Topex, Jason-1 and Jason-2 data were combined with historical tide gauge data from around the North Sea obtained from the Permanent Service for Mean Sea Level (PSMSL). The tide gauge data from PSMSL are corrected for vertical land movement based on GPS solutions. The first four EOFs of the altimetry data already account for almost 96% of the variance and there is a good agreement between tide gauge and collocated altimeter data for the last 20 years. The spatial distribution of the reconstructed sea level trend and decadal sea level variability during the last hundred years is further investigated.

TP2-P-03: Sea level rise in a Baltic UNESCO Biosphere Reserve - Impacts and management implications

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UNESCO biosphere reserves represent important ecosystems and specific cultural landscapes formed by humans over centuries. These regions are used as model regions where nature conservation is combined with sustainable development fostered by local dwellers and enterprises with often highly innovative and participative governance systems. In these regions innovative methods are tested to harmonise human activities and nature conservation. The coastal biosphere reserve ‘Südost Rügen’ is one of today 621 UNESCO biosphere reserves worldwide. This presentation highlights the impact of sea level rise on this biosphere reserve, where mainly low-lying extensively used meadows and pastures but also housing areas are threatened by sea level changes. This affects the management goals of the

biosphere reserve where some nature conservation aims might need to be given up. But sea level rise could also have a potential benefit as it might support the restoration of protected areas.

TP2-P-04: Sea level trends and variability in the Baltic Sea

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Regional sea level change is an important factor in assessing the impacts of climate change. Future Baltic Sea level will be affected not only by the thermal expansion of the water column, but also by changes in the wind regime, precipitation and stratification. The complex topography of the Baltic Sea and the coupling with the regional atmosphere renders projections based on climate models difficult. Thus, the analysis and understanding of past sea level variability and decadal timescales is necessary to estimate future sea level trends better. In addition, the relative Baltic Sea level is affected by a very strong crustal rebound due to glacial isostatic adjustment, with centennial-scale land rising in the north and land-sinking in the south. To bypass this problem, the analysis is based on the estimation of gliding linear trends through the tide-gauge records and its comparison with simultaneous trends derived from reconstructions of regional sea level for the 19th and 20th century and satellite data for the last few decades.

The variability of the decadal sea level rate appears spatially more homogenous in the northern Baltic than in the southern Baltic Sea. The rates of sea level rise display a general tendency to increase throughout the whole 20th century, an indication of a general acceleration of sea level rise. However, this underlying tendency is strongly modulated by large decadal variations, and in some tide-gauges the maximum rates of sea-level rise have been attained in the 1970s, whereas in others the maximum rate has been reached recently. An open question that is being investigated is whether the variability of the sea level rates can also be identified in the satellite altimetry data and in the global gridded reconstructions of sea level in the Baltic Sea region.

TP2-P-05: Validation of sea level anomalies – comparison of satellite altimetry and tide gauge data in the Eastern Mediterranean

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Sea level changes in the Eastern Mediterranean Sea are examined through the use of altimetric data (SSALTO/DUACS gridded DT MSLA (Mediterranean Sea)), as well as data from tide gauge stations in our research area. Annual sea level anomalies for the period between 1992 and 2013 were obtained by averaging weekly values of SSALTO/DUACS gridded delayed time map of sea level anomalies for the Mediterranean Sea. The results showed a small increase of Sea Level Anomaly (SLA) over the period under study. SLA in the Eastern Mediterranean was minimum in 1993, while in 2010 was maximum.

Annual sea level anomalies were also computed at locations near tide gauge stations in the Eastern Mediterranean Sea. Annual mean sea level data from the Permanent Service for Mean Sea Level (PSMSL) were used to validate these altimetric data. In most cases, altimetric data are in agreement with the tide gauge data.

TP2-P-06: Climate change of biogenic substance and bioproductivity of water in the northern part of the Caspian Sea

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The Caspian Sea is a unique water body: it provides 80% of the total fish catch in internal water bodies of the country and it has 90% of the world's sturgeon stock. So the study of processes of water quality formation in the Caspian Sea has scientific and practical significance. Features in the formation of hydrological /hydro-chemical regime of the Caspian Sea are defined by the closure, the inland position, the river runoff impact and by other factors. In connection with possible consequences of variations of the Caspian Sea level and anthropogenic pollution of marine environment, it is necessary to establish the mechanisms in dynamics of water ecosystem state, to reveal the most important internal water processes determining the water quality and water self- purification, to establish main processes of the transformation of polluting substances. To study the behaviour of the Caspian Sea ecosystem, the model of organogenic substance transformations was used. This model considers interconnected biogeochemical cycles on N and P as well as major fluxes in transformations of Si, dissolved organic C and O2 in two layer water ecosystem. Using the modelling data, the total inputs of biogenic substances with river waters are estimated and the primary forms of biogenic substances entering the northern part of the sea are identified. Volga waters carry to Caspian Sea 50.2-58.6% of n compounds and 56.5% of DISi. These assessments agree reasonably with the data available in the literature on the intra-annual distribution of a biogenic load from the Volga runoff. The values of hydrobional production were evaluated for all considered groups on the basis of calculated internal fluxes of substances (in units of biogenic elements C, Si, N, P). Production was calculated by summation of positive fluxes of substances spent on the construction of biomass (consumption of nutrients) and

its unavoidable losses (excretion of metabolic products, biomass dying off, grazing by organisms of higher trophic levels, output into the adjacent areas by a water flow). So with the help of mathematical modelling, the mean multi-annual biohydrochemical portrail of the northern shallow water and the most productive part of the Caspian Sea ecosystem is received. The modelling results on the annual dynamics of organogenesis substance concentration inputs of biogenic substances due to the river runoff internal fluxes of compounds bioproduction and balance between production and destruction processes in the area of the North Caspian comprehensively characterize an ecological state of a marine environment as well as expose features of development of biotransformation processes and circulation of biogenic substances.

TP2-P-07: Sea level and coastline change in the Bohai Sea – natural and anthropogenic impacts

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The Bohai Sea serves as a key area to study the interrelation of different factors influencing the relative sea level and coastline change. Eustatic effects ruled by climate variations superpose vertical displacements of the surface of the rigid earth caused by crustal movement and sediment compaction, supply of sediments discharged by rivers, and anthropogenic effect such as coastal constructions. The general development of the Bohai Sea is controlled by the postglacial sea level rise until the maximum of the Holocene transgression 6-7 ka BP and the subsequent sea level drop causing a regression of the sea during the late Holocene. Regionally, the general trend of coastline advance (regression) and retreat (transgression) varies due to tectonically induced differentiated basin subsidence and the formation of river deltas such as the Yellow River, Haihe River, and Liaohe River delta. Additionally, anthropogenic activities as an effect of the economic development cause a continuous advance of (engineered) coastlines during the last decades. In the Laizhou Bay, southern Bohai Sea, these processes can be studied exemplarily. The bay is subdivided into three parts: Yellow River Delta (prograding sediment wedge), Western and Southern Laizhou Bay (muddy coastal embayment) and eastern Laizhou Bay (sandy to rocky coast). We have used satellite images to analyse coastal processes from 1979 to 2009 in the muddy embayment of the Southwest and the South, and the sandy coast in the East of the Laizhou Bay. Along the muddy coast we have investigated the change of the waterline along the tidal flat. The waterline interpreted from satellite images shows during the time investigated a landward shift having caused the submergence of 211.16 km^2 tidal flat area. This shift coincides with a eustatic rise recorded from satellite altimetry for the years 1979 to 2009. This shift is most likely caused by climate effects and supports the hypothesis of a new (climatically controlled) sea level cycle in the Bohai Sea. Conversely, anthropogenic activities in the eastern Laizhou Bay have caused a continuous seaward shift of the coastline (marine regression). Here, anthropogenic effects such as aquaculture, construction of ports and piers, spur dikes and jetties and land reclamation play a dominant role in coastal development and have caused an emergence of 25.41 km^2 terrestrial area from 1979 to 2009.

TP2-P-08: Approach to study sediment transport by measurement of velocity field in the swash zone

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The sedimentary transport phenomenon is very complex and bad known. In lack of an appropriate instrumentation, the modelling of this phenomenon is always based on two independent studies which are exploited as being complementary. They are:

- Analysis of the free flow velocity field
- Interstitial velocity measurement within a solid porous mass in uniform flow with constant-hydraulic gradient

The objective of this study was to exploit the technique of Ultrasonic Doppler Velocimetry (UDV) to examine the evolution of the velocity field at the water-sediment interface in a zone of swash in various conditions of incidental regular waves in a wave flume. The velocities were measured in different conditions of the swash within the sediment bed, and in the fluid vein at the swash edge. The measurements obtained in the wave flume made it possible to observe an evolution of the velocity profiles according to the phases of the swash, which are characterised by a phase shift between the free flow at the swash edge and the interstitial flow during the two phases of the swash: uprush and backwash. In practice, the results obtained allow tracking of the coastline and quantification of the sediments exchanged during the swash phases which helps to understand the physical processes and to implement them in coastal protection and reduction of transit coast.

TP2-P-09: Modelling the flow dynamics of the northeast Greenland ice stream

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Recent observations show an accelerated ice loss of the Greenland ice sheet (GrIS) during the past few decades. The mass loss is associated with the speed-up of several outlet glaciers in southeast and northwest Greenland

triggered by various factors. In our study, we will focus on the northeast Greenland ice stream (NEGIS). This area is of particular interest as it shows sustained thinning (Khan et al., 2014) and its drainage basin covers 16% of the GrIS.

Here, we aim to accurately reproduce the present-day flow field of the GrIS, in particular of NEGIS. For our simulations we are using the Ice Sheet System Model (ISSM, Larour et al., 2012). It provides several approximations of the Stokes flow that makes a nesting preferable to consume computational cost. Therefore, we are using a multi-physics hybrid-scale approach to model entire ice sheet with regional refinement in full-Stokes in order to capture the flow dynamics of the outlet glaciers. Our results contribute to the understanding of NEGIS flow behaviour, which is a mandatory requirement to set up prognostic scenarios.

TP2-P-10: The impact of vertical discretisation on ice cavity modelling

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In this work we revisited the impact of vertical coordinates on the simulated basal melting rate under ice cavities. The traditional sigma grid and an augmented sigma grid are compared by using an ocean-sea ice model. The circulation across the cavity edge is changed by using different vertical grids and the basal melting rate is sensitive to their choice. Properly interpreting simulated basal melting rates under ice cavities warrants the understanding of model behaviour with different vertical discretization.

TP2-P-11: Reducing the uncertainty in projections of future ice shelf basal melting

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Simulations of ice shelf basal melting in future climate scenarios from the IPCC's Fourth Assessment Report (AR4) have revealed a large uncertainty and the potential of a rapidly increasing basal mass loss particularly for the large cold water ice shelves in the Ross and Weddell Seas. The large spread in model results was traced back to uncertainties in the freshwater budget on the continental shelf, which is governed by sea ice formation. Differences in sea ice formation in turn were shown to follow the regional differences between the atmospheric heat fluxes imprinted by the climate models. A more recent suite of FESOM model experiments was performed with output from two members of the newer generation of climate models engaged in the IPCC's Fifth Assessment Report (AR5). Comparing simulations forced with output from the AR5/CMIP5 models HadGem2 and MPI-ESM, we find that projected heat fluxes and thus sea ice formation over the Southern Ocean continental shelves have converged to an ensemble with a much smaller spread than between the AR4 experiments. For most of the modelled ice shelves, a gradual but accelerating increase of basal melt rates during the 21st century is a robust feature. Both with HadGem2 and with MPI-ESM forcing, basal melt rates for the Filchner–Ronne Ice Shelf in FESOM increase by a factor of two by the end of the 21st century in the RCP85 scenario. For the smaller, warm water ice shelves, inter-model differences in ice shelf basal mass loss projections are still slightly larger than differences between the scenarios RCP45 and RCP85; compared with AR4 projections however, the model-dependent spread has been strongly reduced. Current work aims at further reducing the uncertainties arising from atmospheric forcing by using output from the regional climate model RACMO. The effect of varying cavity geometry and the response of the grounded ice are being addressed by coupling to a dynamic ice shelf/ice sheet model.

TP2-P-12: Marine ice-sheet instability in a fully coupled ice-sheet – solid-earth model

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The interactions of ice sheets with the sea level and the solid earth are important factors when assessing the stability of the ice shelves and the tributary inland ice (e.g. Thomas and Bentley, 1978; Gomez et al, 2012). First, changes in ice extent and ice thickness induce viscoelastic deformation of the Earth surface and Earth's gravity field. In turn, global and local changes in sea level and vertical surface displacement affect the grounding line and the ice-sheet topography and, subsequently, alter the ice dynamics. In this study, we investigate these feedback mechanisms for a synthetic ice sheet configuration as well as for the configuration of the Antarctic ice sheet applying a three-dimensional thermo-mechanical ice-sheet and ice-shelf model, which is coupled to a viscoelastic solid-Earth and gravitationally self-consistent sea-level model. The coupling is realised by exchanging ice thickness, earth-surface deformation and sea level periodically during time evolution. The considered forcings are rising sea level, warming ocean, and changing surface mass balance. We investigate the coupled system's dynamics for several sets of viscoelastic Earth parameters, e.g. representing a low-viscous asthenosphere to be likely present in the West Antarctic rift. Special focus lies on the

evolution of Earth-surface deformation and local sea-level changes, as well as on the accompanying grounding-line evolution.

TP2-P-13: Internal variability of dynamic sea level and its impact on 21st century sea level change in the tropical Pacific

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There is still some controversy about the mechanisms of internal climate variability in the tropical Pacific and its impact on Dynamic Sea Level (DSL), the local deviation from globally averaged sea level. Here we investigate the contributions of El Niño Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO) and North Equatorial Current (NEC) variability on DSL internal variability and future DSL trends. We analyze a multi-millennial control experiment and an ensemble of century-long global warming integrations with the Kiel Climate Model (KCM) in which each realisation employs identical CO_2-forcing (1%/year increase) but started from different initializations. The model results indicate that a large part of the DSL variability over the eastern tropical Pacific is dominated by ENSO, while the western part is more affected by PDO. In the western tropical Pacific, a significant part of the internal variability is also controlled by long-term NEC variations. Finally, projected centennial DSL trends for the 21st century are subject to large uncertainties due to internal variability, with larger uncertainties in western tropical Pacific than in the east.

TP2-P-14: Projections of centennial-scale sea level change in an earth system model including dynamic ice sheets

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The major contribution to global mean sea level (GMSL) change under contemporary climate conditions involves thermal expansion of the ocean and outflow from the land ice, with the latter increasing more rapidly in percentage as a form of ice sheets. Current earth system models (ESM) can constrain thermal expansion with high confidence in projections; however, few of them have been successfully coupled to an ice sheet model (ISM) to incorporate future evolution of ice sheets. In this study, a coupled EMS-ISM is applied to estimate potential range of their contribution to GMSL change over the next several centuries, by simulating the new emission scenarios from the Coupled Model Intercomparison Project Phase 5 (CMIP5). Our results indicate that the thermal contribution to GMSL rise still dominates within this century, with up to 0.4 m in the highest CO_2 case, and continue to increase for many centuries even after stabilization of CO_2. This increase can reach to almost 3.5 m GMSL rise by the end of 25th century in RCP8.5, when equivalent CO_2 concentration exceeds 2500 ppm. Nevertheless, over longer time scales, GMSL contribution from ice sheets enhances more dramatically than linearly with increase in temperature and can eventually overweigh thermal contribution after 24th century. This contribution mainly results from a negative surface mass balance (SMB) of Greenland ice sheet and can exceed 4 m GMSL rise in RCP8.5. Projection of Antarctic SMB demonstrates a negative contribution to GMSL rise in all scenarios except RCP8.5, in which it can lead to more than 2 m GMSL rise. Moreover, we emphasize that sea level change contribution from these two effects exhibits substantial regional pattern, which requires more comprehensive attention from the policy makers to make their plan against this issue in the future.

TP2-P-15: Estimating past sea level contributions from Antarctica; A 3D paleo-ice-sheet-modelling approach

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Global sea level is mainly driven by the waxing and waning of the polar ice masses and thermal expansion of the ocean waters. Melting of the freshwater resources of Greenland and Antarctica would raise global sea level by approximately 65 m. Paleoclimate modelling of the polar ice sheets helps to shed light on past ice sheet evolution and hence contribution to global sea level. We employ a state of the art 3D ice sheet model forced through the last glacial cycle (about 125 kyr) from the previous interglacial (Eemian) up to present day. The range of potential ice sheet responses to changes in surface climatology, ocean temperatures and proxy-derived sea level changes is investigated by extended parameter studies and variable forcing scenarios constrained by proxy and climate model data. By this approach we strive to estimate the potential range of the Antarctic ice sheet's contribution to sea level change.

TP2-P-16: Regional sea level rise in the 20th and 21st century - the example of Denmark

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Sea level rise will be one of the dominating effects of global warming. Though future sea level rise estimates contain large uncertainties, primarily due to uncertainties in the ice sheet contributions, and also depend on global political pathways, it is clear that the global sea level is rising.

The sea level rise will not be uniform over the globe, but will vary depending on the geographical distribution of

ice melt and ocean warming and freshening and on the dynamic ocean response. Also, the sea level rise will be partly or fully compensated by land rise in some parts of the world, including Scandinavia. Here, we quantify the Danish sea level rise as observed throughout the 20th century at 9 coastal tide gauges and combine this with our present knowledge of future sea level rise of the region. The observed sea level rise in Denmark, when corrected for land rise and smoothed with a 19-year running mean, lies very close to the global mean value of the last century. For the future, the IPCC AR5 projections of mean sea level rise of the North Sea - Baltic Sea area from 1986-2005 to 2081-2100 are 0.34 m, 0.43 m, 0.45 m, and 0.61 m for the four RCPs, respectively, with and standard deviation of approximately 0.3 m. The IPCC report does not give an upper range for risk assessments, but DMI has, in corporation with University of Copenhagen, estimated and upper limit for a medium-high climate scenario for Denmark to be 1.5 m by year 2100.

The main impact of future sea level rise in our region will most likely be on storm surges. Today, a storm surge of 1.5 m is a 100-year event in Copenhagen. With a sea level rise of 0.5 cm (after correction for land rise), this level will be reached every second year.

Session Abstracts Topic 3:

Arctic Change

TP3-O-01: The ICECAPS experiment - An overview of the Integrated Characterisation of Energy, Clouds, Atmospheric state and Precipitation at Summit, Greenland

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Since spring of 2010, atmospheric and cloud properties have been continuously measured at Summit Station, Greenland, as part of the ICECAPS experiment. The observing capabilities include both active (radar, lidar, and sodar) and passive (microwave radiometer and infrared spectrometer) instruments. Twice-daily radiosondes are also being launched. Using these data, the ICECAPS team is advancing understanding of atmospheric processes over Greenland. The atmosphere is dry and cold relative to other arctic locations with strong near-surface temperature and humidity inversions throughout the year. Because of this, horizontal advection of moisture is important for forming and maintaining local clouds. Liquid water clouds are observed throughout the year even in winter. Low-level stratiform clouds are common at Summit and are similar to clouds in other Arctic locations. Several research collaborations with other scientists are on-going as part of the ICECAPS project and the data are available for others who are interested in Greenland weather and climate and model and satellite validation.

TP3-O-02: Aerosol optical properties studied in the Svalbard area during the iAREA campaign

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On the global scale a major unknown of the spatial aerosol distribution is the vertical distribution. Transport in the planetary boundary layer and the free troposphere can be decoupled, resulting in different chemical composition and thus aerosol properties in different layers. The arctic region represents a sensitive ecosystem, which is susceptible to even small changes in the local climate.

The arctic atmospheric boundary layer (ABL) poses a challenge for all models due to its persistent stable stratification and the important role of ice phase microphysical processes in the formation of boundary layer clouds. Moreover, forcing factors as radiation, conduction, turbulence, subsidence and advection processes increase the complexity of the system.

The aerosol studies presented in this abstract were carried out in two locations of Spitsbergen, i.e. Ny-Ålesund and Longyearbyen. The campaign took place in spring 2014 (March 20th to April 15th). We employed an ensemble of instruments including lidars, ceilometers, nephelometers, aethelometer and sun photometers. Full meteorological coverage (wind speed, direction, air mass backtrajectories, relative humidity, air temperature etc.) was registered during the campaign. We examined the spatial and temporal variation of aerosol optical depth both vertically and horizontally, in Ny-Ålesund and between Ny-Ålesund and Longyearbyen.

TP3-O-03: Possible loss of accumulation area at Vestfonna ice cap, Svalbard, in the 21st century as an indication of short-term severe climate change impacts on arctic ice caps

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Arctic glaciers and ice caps are major contributors to past, present and future sea level fluctuations. Continued global warming may eventually lead to the case that the equilibrium line altitude of these ice masses rises above their highest point triggering unstoppable downwasting. This may considerably trigger additional future sea level rise and will induce major changes in arctic landscapes. Vestfonna, a dome-shaped ice cap of 36,600 square kilometres and a maximum altitude of just above 600 m above sea level in the northeast of Svalbard has been studied in detail by an international team of glaciologists during recent years. Both remote sensing based studies and glacier energy and mass balance modelling result in a glacier mass balance close to zero for the last decades. However, in the course of the last three decades the equilibrium line altitude already rose to some extent. Here, we here present projections for the timing of equilibrium-line loss at the major Arctic ice cap

Vestfonna on Nordaustlandet, Svalbard. The projections are based on spatially distributed climatic mass balance modelling driven by Climate Model Intercomparison Project (CIMP) 5 multi-model Global Circulation Model (GCM) data representing the Representative Concentration Pathway (RCP) scenarios 2.6, 4.5, 6.0 and 8.5. Results indicate strongly decreasing climatic mass balances over the 21st century for all scenarios considered. Annual glacier-wide mass balance rates will drop down to -4 m water equivalent at a minimum. The timing of equilibrium line altitude equalling the summit area of Vestfonna is calculated to occur sometime between 2040–2150, depending on scenario. After that point in time a rapid meltdown of the ice cap is most probable.

TP3-O-04: RTopo-2: A global dataset of ice sheet topography, cavity geometry and ocean bathymetry to study ice-ocean interaction in Northeast Greenland

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Mass loss from the Greenland Ice Sheet presently accounts for about 12% of the global mean sea-level rise. The ocean plays an important role in modulating the mass balance of the ice sheets in both polar regions by interacting with the ice shelves in Antarctica and with the marine-terminating outlet glaciers in Greenland. A key region for the latter is the floating ice tongue of Nioghalvfjerdsfjorden ('79.5°N Glacier'). To study the relevant processes here and to provide guidance for a large field campaign on and off the floating ice tongue in summer 2016, we plan to set up a global finite-element sea ice - ice shelf - ocean model with a mesh focussed on the Northeast Greenland shelf region and the sub-ice cavities. Given that the flux of warm water onto the shelf and into the sub-ice cavity is steered by complex bathymetry, a detailed topography dataset including the most recent surveys in the area is an essential ingredient. We follow the spirit of the global RTOPO-1 data set and compile consistent maps of global ocean bathymetry, upper and lower ice surface topographies and global surface height on a spherical grid with now 0.5 minute resolution. The maps include multibeam survey data for the bathymetry on the shelf off Northeast Greenland as well as high-resolution gridded data for upper and lower ice surface topography and cavity geometry of Nioghalvfjerdsfjorden going back to seismic surveys and to data from the IceBridge campaign. We show the improvements achieved in RTopo-2 for the region off Northeast Greenland in comparison with bathymetric products commonly used for numerical simulations. Based on the new data set we also discuss possible subsurface supply pathways of warm modified Atlantic waters onto the continental shelf off Northeast Greenland, possibly triggering basal melting in the subglacial cavities.

TP3-O-05: Rapid melt of land fast-ice

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The data of Buor-Khaya Bay shallow zone (shelf of the Laptev Sea) land fast ice (LFI) radiation and thermodynamic properties in the beginning of melting (end of May – beginning of June) are presented and analysed. The event of ice rapid thawing, when during 72 hours all LFI within sight had been covered by about 0.2 meters of melt water, is described. Analysis of field data showed that short-term growth of air temperature from +5 to +12°C during May 28th was a trigger for beginning of intensive LFI melting. The growth of air temperature accompanying by increasing of cloudiness and correspondingly decreasing of longwave radiation cooling determined total thawing of snow and decreasing of LFI albedo from 0.8 to 0.25. Simultaneously melt water layer began to form on the upper ice surface. The spatial uniformity of LFI surface stimulated rapid expansion of melt ponds and its merge. As a result during May 30 all visible area of LFI, which thickness exceeded 2 meters, had been transformed to giant melt basin with 20-25 cm depth.

The observational data are compared with the results of calculations performed with conceptual thermodynamic model, describing of different stages of LFI melting. In spite of some simplifications the model allowed to obtain quantitative estimates of melt water depth evolution and also to verify an adequacy of melt pond propagation process.

TP3-O-06: Arctic climate change, economy and society - the two EU projects ACCESS: 'Arctic Climate Change, Economy and Society' and ICE-ARC: 'Ice, Climate, Economics - Arctic Research on Change'

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The presentation will provide an overview over the present state and key results from the EU 7th framework project ACCESS ‚Arctic Climate Change, Economy and Society'. The main objective of the project is to assess the potential development of the arctic climate and environment in the coming 3 decades, and evaluate potential consequences for and impacts of marine transportation (including tourism), fisheries, marine mammals and the extraction of oil and gas in the Arctic Ocean. ACCESS also focusses on Arctic governance and strategic policy options. In addition the new EU project ICE-ARC 'Ice, Climate, Economics - Arctic Research on Change' which assesses the social and economic impact of the Arctic sea ice loss will be introduced.

Benefits and difficulties of such interdisciplinary and cross-sectorial projects which serve to provide a scientific baseline for guiding EU and international policies on the protection of the Arctic marine environment will be highlighted.

TP3-O-07: Relationship between the atmospheric blocking over Greenland and sea ice export through Fram Strait

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Sea ice is an important component of the arctic climate system and is influenced by various factors such as wind forcing, ocean currents, atmospheric circulation and sea surface height. The sea ice export through Fram Strait represents a very important part of the freshwater flux into the North Atlantic Ocean and has been associated with the Great Salinity Anomaly (GSA) observed in the early 1970s in the Labrador Sea.

In this study we show that enhanced atmospheric blocking activity over a region which extends from Greenland up to the western part of Europe has a strong impact on the variability of the sea ice export out of the arctic region through Fram Strait. To evaluate the relationship between enhanced sea ice export through Fram Strait and an enhanced blocking situation over Greenland, a global setup of the Finite-Element Sea-Ice Ocean Model (FESOM) is used, with a regional enhanced resolution in the northern hemispheric deep water formation areas. Based on a Composite Map Analysis (CMA) of atmospheric blocking frequency, modelled sea ice volume and advective sea ice streamfunction, the relationship between sea ice export and atmospheric blocking is investigated. The CMAs revealed that an enhanced blocking situation over Greenland and Western Europe favours the successive reduction ('blocking') of sea-ice export through Fram Strait for up to 5 years and the accumulation of sea ice over the Arctic Ocean. In contrast, years with reduced blocking activity over Greenland support a 'flush out event' of the accumulated Arctic sea-ice, which results in an enhanced sea ice export through the Fram Strait.

TP3-O-08: Greenland Sea primary production with respect to changes in the sea ice cover

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Currently the world marine primary production estimates range by a factor of two between different models. When the Arctic Ocean alone is considered, the factor rises to as much as fifty because sea ice complicates remote sensing and bio-optical properties of water as well as vertical distribution of phytoplankton differ from those of global waters. Arctic phytoplankton today deserve special attention as they are already living in waters with most prominent climate change effect, which are shifting towards fresher surface layer, thinner sea ice, more open water area and are very likely to experience ice-free summers in the near future. These shifts in turn alter solar irradiation, nutrient transport and plankton seasonality and whether such an impact will result in an increase or a decrease of phytoplankton remains questionable. Since polar regions are difficult to access with research vessels, field data are scarce and remote sensing data provide an alternative. However it is not recommended to use remote sensing data alone as the satellite ocean colour algorithms are known to perform poorly at polar latitudes even if developed explicitly for arctic waters. Gaps in satellite data, which occur at these latitudes because of the presence of sea ice, clouds and low sun elevation angles, are also a source of error. The current study combined remote sensing, simulated and field data for the years 1998-2012 to investigate seasonal cycle, variability and productivity of phytoplankton in the Greenland Sea, which is one of the most productive and field data-abundant regions of the Arctic. Specific objectives of our Greenland Sea case study were: 1) to study the interaction between phytoplankton and the physical factors such as sea ice concentration and thickness, water temperature and salinity; 2) to investigate temporal trends, seasonal cycle and spatial variability of phytoplankton; 3) to obtain more accurate estimates of primary production.

TP3-O-09: Dynamics of coloured dissolved organic matter in a climate changing environment in northern Siberia

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The Lena is one of the largest rivers in the world and is responsible, through its outflow to the Laptev Sea, for a significant fraction of the total fresh water and organic matter discharge into the Arctic Ocean. With the known effects of climate change in the Arctic and associated increase of permafrost thaw rates, the Lena River discharge and consequent export of terrigenous dissolved organic matter (DOM) into the Arctic Ocean tends to increase. Such variations may affect the nutrients and carbon dynamics in the region with consequences for the primary production and the CO2 exchanges in the ocean-atmosphere boundary layer. Understanding the dynamics and optical properties of coloured DOM (CDOM) is of great value for carbon cycle modelling since CDOM is the fraction of the DOM which interacts with light and can be detected by satellite ocean colour remote sensing. In this context, this study

aims to investigate the dynamics of CDOM regarding the hydrographical forcing in the Lena Delta region based on in situ data collected during the late summer 2013. Water column structure was assessed through temperature and salinity profiles acquired with CTD casts and the CDOM characterisation and quantification were determined based on both absorption and fluorescence spectra obtained with a HORIBA© Aqualog spectrofluorometer. The CDOM absorption at 443 nm (a443; used as a CDOM amount index) and the terrestrial and marine absorption slopes of CDOM [STER (275-295 nm) and SMAR (350-400 nm), respectively] were obtained based on the absorption spectra. The CDOM components were identified by analysis of the excitation-emission-matrices and based on the literature. a443 was directly (inversely) related with temperature (salinity), denoting the strong modulation of CDOM by the hydrographical forcing: the highest CDOM amounts with riverine compounds were related to the Lena River Plume, while the salty waters from Laptev Sea presented lower a443 and are associated with marine compounds.

TP3-O-10: Sea level evolution of Laptev and East Siberian Sea - evidence from geological data and glacial isostatic adjustment

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Laptev Sea and East Siberian Sea are extended shallow shelf seas which were partly land-fallen during glaciated times where the global mean sea level (GMSL) was about -120 m below its present value. At the same time tectonic activity is present, which is evident in uplifted marine terraces of the New Siberian Islands. The marine terraces may be identified and mapped in historical airborne photographs and recent radar imagery.

To improve the environmental history of this region a reconstruction of the sea level and shore line migration is necessary which is based on modelling the glacial isostatic adjustment (GIA) including levering. GIA describes the deformational response of the solid earth to the glacially related water-mass redistribution, whereas levering only describes the deformational response of the solid earth to the varying ocean load.

For these shallow seas, we expect a deviation from the GMSL between +10 and +30 m by levering alone and due to the vicinity to the Pleistocene ice sheets a further correction at the order of +10 m. These mechanisms reduce therefore the GMSL drop of sea level between 10 and 30 % at last glacial maximum and markedly influence the following evolution of sea level. The variability is dominated by the rheological earth structure considered in the modelling. As the limited knowledge of the rheological earth structure hinders realistic predictions of GIA for this region we will first discuss the variability of sea level history due to GIA for the last 20,000 yr. Then, we will constrain the model dependent variability by consideration of geological proxies of sea level change for this region. Analyses on Laptev Sea sediment cores will reveal a detailed chronology of changing water masses linked to sea level rise.

TP3-O-11: Permafrost degradation and methane release in the central Laptev Sea

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The transition from onshore to offshore permafrost during periods of low relative sea level rise is often the result of coastal retreat. Along the Laptev Sea coastline, ice-rich syngenetic permafrost is particularly susceptible to erosion due to changing climate. Changes to permafrost immediately after flooding provide an opportunity to study the mechanism of submarine permafrost degradation in general. We combine direct observations of permafrost and methane to investigate the possibility of methane release from permafrost as a source. Our studies focus on a site in Buor Khaya Bay in the central Laptev Sea, for which coastal retreat rates have been studied. Following geophysical reconnaissance, we drilled a 52 m deep core in the near-shore zone of the eastern shore of Buor Khaya Bay and measured the permafrost temperature in the resulting borehole. Comparison of the submarine permafrost temperature to temperatures on land reveal warming of permafrost by 8 to 10 °C over a period of less than a millennium. Measurements of ice content and structure, sedimentology and methane concentration in the core showed changes that result from the warming that has occurred since flooding. During this time, the top of the ice-bearing permafrost (IBPF) degraded from 0 to 28.8 m b.s.l. at the borehole site, a mean degradation rate of more than 5 cm per year. Geoelectric resistivity measurements corroborate this observation and show a decline of the IBPF with increasing distance from shore. The cored sediments bore similarities to other Siberian sites, where material below the syngenetic ice complex deposits is exposed, but the primary differences observed before and after degradation were the effects of infiltrating sea water and evidence for the oxidation of methane following degradation. Analyses of the

sediment and pore water chemistry demonstrate that sea water is probably advected to the IBPF, which contributes to permafrost degradation.

TP3-O-12: Stories of the Past – Frozen archives tell about Alaskan landscape dynamics

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The arctic environmental change is of global ecological and socio-economic relevance. Permafrost processes are key drivers of arctic terrestrial ecosystems and they are crucial for understanding the regional landscape evolution.

This study provides insights into past landscape dynamics on the Seward Peninsula in Northwest Alaska (USA) based on sediment cores from drained lake basins. A multi-proxy approach is applied covering methods of sedimentology, biogeochemistry, geochronology, and micropaleontology (ostracoda, testate amoeba) to understand the formation and demise of the former thermokarst lake and its deep basin as a typical example for thermokarst systems in vast Arctic lowlands.

Thermokarst can be triggered but also interrupted by global climate change (e.g. rapid warming and wetting in the Early Holocene), regional environmental change (e.g. due to nearby volcanic eruptions and tephra deposition) or local disturbance processes (e.g. lake drainage).

We found that the development of a drained lake basin can undergo several cycles of aquatic and terrestrial phases. The investigated basin started as a Mid-Wisconsin wetland developing on an ice-rich permafrost terrain about 45,000 years before present. The potential initial lake evolution during a wetter interstadial phase in the Late Pleistocene was disturbed by falling of a thick volcanic tephra about 40,000 years before present associated with a phreatomagmatic eruption of a nearby Maar lake. Loess-like sedimentation and aggradation of ice-rich permafrost occurred during the following stadial period. By about 300 years before present, a new thaw lake developed at our study site and expanded rapidly to a 20 m deep and 500 m x 300 m wide basin. The lake drained recently in the early 2000s and permafrost started reforming again.

The presented study demonstrates how active and dynamic but also how sensitive periglacial landscapes are – in the past, present and most possibly in the future. This needs to be considered when discussing our 'Anthropocene' future in the framework of climate change.

TP3-O-13: Airborne measurements of methane fluxes in permafrost landscapes (AIRMETH)

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One of the most pressing questions with regard to climate feedback processes in a warming Arctic is the regional-scale greenhouse gas release from Arctic permafrost areas. The Airborne Measurements of Methane Fluxes (AIRMETH) campaigns are designed to quantitatively and spatially explicitly address this question. Ground-based eddy covariance (EC) measurements provide continuous in-situ observations of the surface-atmosphere exchange of energy and matter. However, these observations are rare in the Arctic permafrost zone and site selection is bound by logistical constraints among others. Consequently, these observations cover only small areas that are not necessarily representative of the region of interest. Airborne measurements can overcome this limitation by covering distances of hundreds of kilometres over time periods of a few hours.

During the AIRMETH-2012 and AIRMETH-2013 campaigns aboard the research aircraft POLAR 5 we measured turbulent exchange fluxes of energy, methane, and (in 2013) carbon dioxide along thousands of kilometres covering the North Slope of Alaska and the Mackenzie Delta, Canada. Time-frequency (wavelet) analysis, footprint modelling, and machine learning techniques are used to extract spatially resolved turbulence statistics and fluxes, spatially resolved contributions of land cover and biophysical surface properties to each flux observation, and regionally valid functional relationships between environmental drivers and observed fluxes that can explain spatial flux patterns and – if available in temporal resolution – allow for spatio-temporal scaling of the observations.

This presentation will focus on 2012 methane fluxes on the North Slope of Alaska and the relevant processes on the regional scale.

TP3-O-14: Zooming out: from local snapshots to a pan-arctic inventory of Arctic ponds and lakes

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The millions of ponds and small lakes in Arctic lowlands have been identified as biogeochemical hotspots with high process rates regarding the turnover of energy and carbon. The rapidly warming Arctic climate does affect the surface inundation due to changes in the water balance and/or permafrost degradation which directly alters the exchange of energy and carbon between the surface and the atmosphere. However, these water bodies with surface areas smaller than 1 km² are not captured on a global scale due to the low resolution of global maps. High-resolution imagery allows mapping ponds and small lakes but provides only limited coverage. This study aims to identify landscape-specific parameters which allow upscaling high-resolution but local water body size distributions to the pan-arctic scale.

Water bodies are mapped from aerial, TerraSAR-X and Kompsat-2 imagery with resolutions of 4 m and better in 9 major Arctic landscapes in Russia (Lena River Delta, Yamal Peninsula, Indigirka Lowlands), Canada (Canadian High Arctic, Mackenzie River Delta, Yellowknife) and Alaska (Barrow Peninsula, Yukon Delta, Seward Peninsula). Water body size distributions are parameterised via their mean, standard deviation and skewness. We assess (i) similarities between the high-resolution distributions and existing regional and global water body databases, as well as (ii) the variability of water body size distributions within and between regions and (iii) relate regional differences to hydrological, geomorphological and permafrost processes.

Ponds make more than 95% of the total number of water bodies in all landscapes except the Mackenzie Delta, where they contribute only about 75%. Within-landscape variability is low in all study areas which allows the estimation of regional distributions. The statistical properties of these regional distributions can be used to incorporate ponds and small lakes into larger-scale climate and ecosystem models. This study provides a pan-arctic estimate of small ponds and lakes which represents a baseline against which to evaluate climate-induced changes in the distributions of Arctic water bodies.

TP3-O-15: Combining remote sensing and field studies for assessment of land surface dynamics in sub-arctic environments

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The Yamal peninsula, north-western Siberia, is a landscape in transition. Permafrost conditions are expected to change within this century due to climate warming. Human activities have increased in Western Siberia during recent decades due to gas and oil exploration.

Land surface dynamics including e.g. landslides, lakes and wetlands and their relation to the underlying permafrost are investigated within the COLD Yamal project (combining remote sensing and field studies for assessment of landform dynamics and permafrost state) which is an Austrian-Russian joint research project funded by the Austrian Science Fund (FWF, I1401-N29) and the Russian Foundation for Basic Research (RFBR, 13-05-91001-AH8 a). The Earth Cryosphere Institute has been involved in long-term permafrost monitoring in this region for more than 30 years and has established a comprehensive geospatial database. State-of-the-art remote sensing technologies, specifically microwave remote sensing, are to be used to further develop monitoring schemes in this region.

Synthetic aperture radar data have been proven to be suitable for monitoring hydrological properties including thaw lakes typical for tundra environments and are therefore a useful method to monitor changes in this region. Lake datasets representing intra- and inter-annual dynamics available within the framework of the ESA DUE Permafrost and ESA STSE ALANIS-Methane projects have been analysed. Significant seasonal changes which overlap long-term dynamics have been identified for the Yamal peninsula as well as key sites of the PAGE21 project (www.page21.eu).

TP3-O-16: Arctic wind waves characteristics from satellite altimetry data

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Results of wind-generated waves research in Kara, Laptev and East-Siberian Seas are presented. The study is based on ENVISAT RA-2 and SARAL/AltiKa satellite altimeters data. Only fully enclosed ice-free areas are considered in this study to eliminate possible swell influence and focus on wind waves only. Resulting database for 2002-2013

consists of 2152 sets of measurements of significant wave height (SWH), wind speed and area size. Further analysis is performed in terms of dependence of dimensionless SWH on dimensionless ice-free area. Wave heights and ice-free areas were scaled using measured wind speed and acceleration due to gravity. Resulting dependencies are compared with known empirical relations for wind wave generation at fetch-limited conditions.

TP3-O-17: Regional characteristics of Siberian snow cover changes

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Based on the regional climate model COSMO-CLM (CCLM), a reconstruction of Siberian climate has been conducted to study the regional patterns of current snow cover changes with focus on snow accumulation considering snow water equivalent (SWE) and snow cover extent. The regional climate hindcast at 50 km horizontal resolution was driven by NCEP-R1 for the period 1948-2010.

The results show strong seasonal and spatial variability for the climatological standard period of 1981-2010. During fall mean SWE trends are very heterogeneous indicating mainly a decline or increase of -5 to 5 mm per decade over the entire domain. Strongest increases in fall occur along e.g. the Central Siberian Plateau, Sayan Mountains and Verkhoyansk Mountains. In winter mean SWE decreases slightly south of Lake Baikal, northeast of Mongolia and northern China ranging from 5 to 10 mm per decade. At single areas SWE decreases 20 mm per decade according the reconstructed data. Along the most elevated parts at the Central Siberian Plateau and Verkhoyansk Mountains the loss of snow accumulation reaches up to 30 mm per decade. Strongest increases are evident west, northwest, and northeast of Lake Baikal and along the coast of Sea of Okhotsk with local maxima up to 20-30 mm per decade along the Sayan Mountains and Stanovoy Range. In terms of snow cover extent, the transition season spring and fall show stronger interannual variations than the winter season. The overall decrease of snow cover extent in spring since the early 1980s has slowed down in the recent years to 2010.

TP3-O-18: Physically Accurate Soil Freeze-Thaw Processes in a Global Land Surface Scheme

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Transfer of energy and moisture in frozen soil and hence the active layer depth, are strongly influenced by the soil freezing curve which specifies liquid moisture content as a function of temperature. However, the curve is typically not represented in global land surface models. In this work, we develop a physically accurate model of soil freeze-thaw processes, suitable for use in a global land surface scheme.

We incorporated soil freeze-thaw processes into a model for the transfer of heat, water and vapour in soils, including isotope diagnostics - Soil-Litter-Iso (SLI, Haverd & Cuntz 2010). Fluxes of energy and moisture are coupled in SLI using a single system of linear equations and the extension to include freeze-thaw processes and snow maintains this elegant coupling. Iterations are avoided which results in the same computational speed as without freezing.

SLI accurately solves the classical Stefan problem and reproduces the freezing front which is observed in laboratory experiments (Hansson et al. 2004). SLI reproduces seasonal thawing and freezing of the active layer to within 3 K of the observed soil temperature and to within 10% of the observed volumetric liquid soil moisture at a permafrost site in Tibet (Weismuller et al. 2011). The freezing-soil formulation is tested in the presence of snow, using measurements at an orchard site in Idaho. The model reproduces well observed snow-water equivalents and soil temperatures. It is, however, sensitive to fractional snow cover because of the coupled formulation. SLI was run globally on 1x1 degree grid as the soil part of the land surface scheme CABLE. We could therefore demonstrate that this detailed and physically-realistic formulation is fast enough to be a feasible alternative to the much simpler default soil-scheme in CABLE. It reproduces very well the extent of permafrost and matches observed snow water equivalent in the whole northern hemisphere.

Poster presentations:

TP3-P-01: Optical properties of Arctic aerosols studied within the framework of the iAREA research program

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The iAREA project (www.polandaod.pl) started on 16 August 2013 and is planned to be completed on 15 August 2016. It is combined of experimental and theoretical research in order to contribute to new knowledge on the impact of absorbing aerosols (AA) on the climate system in the European Arctic. According to the IPCC reports and findings of researchers around the world absorbing aerosols are considered to be important contributors to the global warming, as they are a crucial component for the energy balance in the climate system.

The main goal of the iAREA project is to quantify the impact of the vertical profile of absorbing aerosols on direct radiative forcing in the European Arctic. This will be made through the experimental studies of various physical processes involving absorbing aerosols (mainly soot from human-made and natural sources, mineral dust and volcanic) and by numerical modelling of aerosols and by developing of a methodology to retrieve vertical profiles of the aerosol single-scattering properties.

The scope of the work within the project facilitates the determination of the degree of the impact, which man-made aerosols over the European Arctic have on the total radiative forcing. Finally, we want to show that the estimation of the impact of absorbing aerosols on the climate system requires an integrative approach which combines the actual observations of vertical variability with the global circulation/transport model simulations.

This research has been made within the scope of the iAREA program of the Polish-Norwegian Funding Program.

TP3-P-02: Changes in Temperature and Radiation at the Arctic Station Ny-Ålesund (79°N, 12°E)

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The Arctic is considered to be most sensitive to climate change, with warming in the Arctic occurring considerably faster than the global average. Several positive feedback mechanisms contribute to the 'Arctic amplification', including e.g. the snow/sea ice – albedo feedback. Moreover, clouds, water vapour and their radiative feedbacks are recognised as important issues in the arctic climate, and atmospheric circulation changes augment the meridional transport of water vapour to the Arctic. All of these processes impacting arctic climate are important concerning local feedbacks with the underlying surface but also global feedbacks on the energy balance of the planet. Altogether, radiative fluxes play a key role in the complex Arctic region. At Ny-Ålesund (78.9°N, 11.9°E), Svalbard, surface radiation measurements of up- and downward short- and longwave radiation are operated since August 1992 in the frame of the Baseline Surface Radiation Network (BSRN), complemented with surface and upper air meteorology since August 1993. Over the 21-year observation period, ongoing changes in the Arctic climate system are reflected. Particularly, the observations indicate a strong seasonality of surface warming and related changes in different radiation parameters. The annual mean temperature at Ny-Ålesund has risen by +1.3 ± 0.7 K per decade, with a maximum seasonal increase during the winter months of +3.1 ± 2.6 K per decade. In the recent warmer winters, precipitation has often occurred in the form of rain rather than snow. At the same time, winter is also the season with the largest long-term changes in radiation, featuring an increase of +15.6 ± 11.6 $W*m^{-2}$ per decade in the downward longwave radiation. Furthermore, changes in the reflected solar radiation during the months of snow melt indicate an earlier onset of the warm season by about one week compared to the beginning of the observations.

TP3-P-03: Retrieving sea ice concentrations from 1.4 GHz brightness temperature measurements

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Arctic sea ice is one of the components of the climate system reacting most sensitively to the warming climate. The sea ice concentration is of special interest for physical reasons as it governs the heat exchange between ocean and atmosphere, for biological reasons as lower sea ice concentrations allow higher photosynthesis rates and for economic reasons as possible ship routes may open in an ice-free Arctic in summer. However, existing high-frequency microwave products of sea ice concentration have suffered from large sensitivities towards the state of the atmosphere and from large uncertainties regarding the sea ice concentration range between 0 and 50%. We applied an existing algorithm to retrieve sea ice concentrations from the low-frequency microwave 1.4 GHz brightness temperatures measured by ESA's Soil Moisture and Ocean Salinity (SMOS) satellite. We demonstrated that the wide range between the emissivities of open water and sea ice at 1.4 GHz causes a high sensitivity towards sea ice concentrations between 0 and 50%. Additionally, the atmospheric influence at 1.4 GHz is small. Our results do show physically plausible sea ice concentrations below 50% during the melting period 2012, which are not shown by high-frequency sensors. A validation with the Multisensor Analysed Sea Ice Extent (MASIE) product showed good agreement for the area enclosed by at least 15% of sea ice during the Arctic Cyclone in August 2012. These are important achievements because we show that it is possible to retrieve reliable and plausible sea ice concentrations between 15 and 50 % from SMOS data which have not been displayed by high-frequency microwave sensors. During winter, the sea ice concentration retrieval from SMOS data is difficult because the brightness temperature is more sensitive towards sea ice thickness than towards sea ice concentration.

TP3-P-04: Arctic sea level change over the past 2 decades from GRACE gradiometry and multi-mission satellite altimetry

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The Arctic is still an extremely challenging region for the use of remote sensing for sea level studies. Despite the

availability of 20 years of altimetry, only very limited sea level observations exist in the interior of the Arctic Ocean. However, with Cryosat-2 SAR altimetry the situation is changing and through development of tailored retrackers dealing with presence of sea ice within the radar footprint, we can now develop sea surface height and its variation in most of the Arctic Ocean. We have processed 3 years of Cryosat-2 data quantified as either Lead or Ocean data within the Cryosat-2 SAR mask in the Arctic Ocean. By carefully reprocessing and reediting conventional altimetry from ERS-1/ERS-2 and Envisat, we have now been able to derive a multi-decadal time series using far more remote sensing data in the interior of the Arctic Ocean than ever before.

Through recently acquired gradiometer observations from the ESA GOCE mission, we are now able to derive a mean dynamic topography of the Arctic Ocean with unprecedented accuracy to constrain the Arctic Ocean circulation controlling sea level variations in the Arctic. We present both a new estimation of the mean ocean circulation and new estimates of large scale sea level changes based on satellite data and perform an estimation of the freshwater storage increase over the last decade using temporal gravity changes from the GRACE satellite.

TP3-P-05: Thermophysical properties of seawater for climate change

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The global warming, melting of ice, greenhouse gas effect, the Gulf Stream and other processes in nature, in oceans and atmosphere play an important role for climate change. These processes directly depend on the properties of seawater. The majority of water on earth is seawater from a sea or ocean. The density of seawater changes in dependence on the depth below sea surface because of the pressure dependence from the depth of sea.

Some of the important atmospheric gases are added to seawater from the atmosphere through the constant movement of the sea surface by wind and waves. Compared to the other atmospheric gases, the amount of carbon dioxide dissolved in saturated seawater is unusually large. Direct storage and sequestration of captured CO_2 in the deep ocean has been considered as a means to mitigate global warming.

During many years the Institute of Technical Thermodynamics of University of Rostock together with the department of Heat and Refrigeration Techniques of the Azerbaijan Technical University analysed thermophysical properties of seawater samples from various parts of the earth, e.g. from the North Atlantic Ocean, Pacific Ocean, Mediterranean Sea, Caspian Sea, Baltic Sea, Dead Sea, Black Sea, Bosporus etc. An empirical equation of state for the calculation of various thermophysical properties (density, vapour pressure, solubility, isothermal compressibility, isobaric thermal expansibility, differences in isobaric and isochoric heat capacities, thermal pressure coefficient, internal pressure, secant bulk modulus etc.) of seawater was constructed.

TP3-P-06: POLYAR - Process of Organic transport to the Lakes of the Yamal Region

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Climatic and environmental fluctuations in the permafrost zone lead to activation of various cryogenic processes. This activation results in a strong impact on redistribution of substances and changes in biochemical composition of the water bodies. Lakes in the Arctic are good indicators of changing natural conditions. These indicators are expressed in both areal changes of thermokarst lakes, and changes in biochemical composition of water.

In this regard, the main purpose of the study is the development of the model of processes influencing the cDOM concentrations in Arctic lakes in permafrost landscapes. The model is based on in-situ measurements of aquatic parameters and land parameters, remote sensing of aquatic parameters and land parameters and topographical data. The key sites, where water samples were previously collected and more sampling is planned are: coastal zone of Yamal and Gydan, Central Yamal with tabular ground ice in the geological section. As Yamal peninsula is a very specific territory, comparison with data collected from the Lena delta is planned as well. The work is the joint research of staff from Arctic and Antarctic Research Institute, Alfred Wegener Institute and Earth Cryosphere Institute SB RAS.

TP3-P-07: Ice, water, fire: Changes in the permafrost landscape of central Yakutia, 2000-2011

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The focus of this research has been on detecting changes in lakes vegetation, land surface temperatures, and snow

cover, using data from remote sensing. The study area covers the main (central) part of the Lena River catchment in the Yakutia Region of Siberia (Russia) where continuous permafrost coverage's is up to 90%. The remote sensing analyses are based on MODIS (NASA) and Landsat (USGS) satellite data. Time series of remote sensing products of MODIS land surface temperature were produced for the study region between 61°N and 65°N, and between 117.5°E and 131.5°E. The MODIS Land Surface Temperature level 3 product, MOD11C3 are configured on a 0.05° latitude/longitude MODIS Climate Model Grid (CMG) raster. The LST product is a monthly composited average and represents clear-sky LST values. The monthly land surface temperatures were analysed over the eleven-year-interval from May 2000 to April 2011. Linear trend calculations for the 11-year temperature measurement interval were performed separately for each two-month interval in each pixel, using the least squares method. Water bodies were extracted using the Landsat Short Wave Infrared SWIR band 5. Within the study region's 315,000 km^2, the total area covered by lakes increased by 17.5% between 2002 and 2009. The lake increase differs between 42-11% depending on the region. The overall trend in land surface temperature is around 0.15 °C/year, but with seasonal warming trends in April-May of up to 0.45°C/year in some areas and cooling of -0.2 to -0.3 °C/year in July-August in other areas. These regional differences and potential causes of the land surface temperature changes will be discussed with respect to land cover changes.

TP3-P-08: Regional variability of methane fluxes in the permafrost landscape of the Mackenzie River Delta, Canada derived from airborne measurements

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Wetlands are the dominant natural source of methane release on a global scale. Estimates about the contribution of Arctic permafrost wetlands to the emission are still uncertain and need further assessment. A reason for that variability is the heterogeneity of the Arctic permafrost landscapes. They extend over large areas and are characterised by temporally and spatially varying environmental properties like land cover, surface temperature or soil water content. With chamber and tower measurements, exchange processes of matter fluxes have been determined for decades and have contributed to our understanding of the underlying processes. These results give an idea about possible changes in the future related to changing climatic conditions. For conclusions on a regional scale, however, these measurements cannot represent the true spatial variability of these fluxes, due to their local quality. Regional information about the fluxes, especially methane fluxes, is indispensable for assessing and predicting the climatic importance of the Arctic permafrost regions. To overcome this spatial limitation we use airborne measurements. During the Airborne Measurements of Methane Fluxes (AIRMETH) campaigns we conducted low level flights across the Mackenzie River Delta in Canada in the summers of 2012 and 2013. With statistical methods, the measured methane fluxes are related to relevant spatio-temporal meteorological information and surface properties derived from remote sensing products. Here we will show first results of the spatial variation of methane fluxes in the Mackenzie River Delta in 2013.

TP3-P-09: Variability of surface energy fluxes over high latitude permafrost wetlands

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Arctic ecosystems are undergoing a very rapid change due to the global warming and their response to climate change has important implications for the global energy budget. Therefore, it is crucial to understand how energy fluxes in the Arctic will respond to any changes in climate related parameters. However, attribution of these responses is challenging because measured fluxes are the sum of multiple processes that respond differently to environmental factors.

Here, we present the potential of environmental response functions for quantitatively linking energy flux observations over high latitude permafrost wetlands to environmental drivers in the flux footprints. We used the research aircraft POLAR 5 equipped with a turbulence probe, fast temperature and humidity sensors to measure turbulent energy fluxes across the Alaskan North Slope with the aim to extrapolate the airborne eddy covariance flux measurements to the entire North Slope.

After thorough data pre-processing, wavelet transform is used to improve spatial discretisation of flux observations and to quantify biophysically relevant land cover properties in the flux footprint. A boosted regression trees technique is then employed to extract and quantify the functional relationships between the energy fluxes and the environmental drivers. Finally, the resulting environmental response functions are used to extrapolate the sensible heat and water vapour exchange over spatio-temporally explicit grids of the Alaskan North Slope. The supplemented simulations from the Weather Research and Forecasting (WRF) model were

used to explore the dynamics of the atmospheric boundary layer and to examine results of extrapolation.

TP3-P-10: ESA DUE PERMAFROST: Circumpolar Remote Sensing Service for Permafrost – Evaluation and Application Case Studies

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The objective of the ESA Data User Element DUE Permafrost project (2009-2012) has been to establish a Remote Sensing Service for permafrost applications. The project team developed a suite of remote sensing products indicative for the subsurface phenomenon permafrost: Land Surface Temperature (LST), Surface Soil Moisture (SSM), Surface Frozen and Thawed State (Freeze/Thaw), Terrain, Land Cover, and Surface Water. Snow parameters are being developed through the DUE GlobSnow project (Global Snow Monitoring for Climate Research, 2008-2011). The remote sensing service also supports the FP7 funded project PAGE21 - Changing Permafrost in the Arctic and its Global Effects in the 21st Century.

Operational remote sensing derived variables may provide a means for bridging the gap between the local-scale observations and coarse-scale gridded simulated parameters. Case studies of model evaluation using satellite-derived surface parameters from the ESA DUE Permafrost dataset (https://www.geo.tuwien. ac.at/permafrost) and climate model runs from the Helmholtz Climate Initiative REKLIM (Regionale KlimaAnderungen/Regional climate change) (http://www.reklim.de/en/home/) have been initiated. We discuss the outcome of intercomparison substudies on simulated fields of surface temperature and ground frozen, non-frozen state simulated by the regional climate models HIRHAM for the circumpolar domain and COSMO-CLM for Central Siberia.

TP3-P-11: A decade of decreasing Arctic sea ice cover: Implications for Cape Farewell

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A reduction in Arctic sea ice may on a decadal scale lead to more sea ice around southern Greenland, since the export through the Fram Strait and along the East Greenland coast may be enhanced. Arctic sea ice is exported along the east coast of Greenland. multi-year ice reach Cape Farewell in December and January, but the amount varies from year to year, and due to the dominating north-westerly winds it only passes the cape sporadically in winter. Therefore the multi-year ice in southern Greenland has a maximum in early summer, with large interannual variability in maximum extend. Here we investigate the relationship between the interannual variability and the ice conditions in the Arctic Ocean and Fram Strait.

We introduce a new high resolution simulation of the Arctic and North Atlantic oceans covering the last decade, made with the DMI Arctic Ocean Model system (DMI-ACOM). It consists of the 3D ocean model Hycom coupled with the sea ice model CICE and run in 10 km resolution. DMI-ACOM is utilised for a number of studies of the Arctic and provides a seamless model simulation from 2003 to today, including a 10-day operational forecast.

A correct simulation of the sea ice in the Cape Farewell area in southern Greenland is challenging, since it requires correct simulation of the ice export along the East Greenland coast, the interplay of East Greenland and Irminger ocean currents and the effect of local weather systems. The modelled sea ice characteristics are validated against the DMI ice chart archive and ice drift estimates based on satellite measurements. The validated model results for southern Greenland sea ice is related to the decrease in Arctic Sea ice during the study period and the sea ice export through the Fram Strait.

Session Abstracts Topic 4:

The land surface in the climate system

TP4-O-01: On the relevance of mesoscale transport for in-situ energy balance measurements

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Mesoscale transport of energy and matter between the surface and the atmosphere often occurs in the form of non-propagating turbulent organised structures or thermally-induced circulations. Spatially resolving measurements are required to capture such fluxes and, thus far, airborne measurements are the only means to accomplish this. In contrast, tower-based eddy-covariance measurements are conducted at one point and therefore inherently cannot capture the total atmospheric exchange, which is recognised as a major contributor to the energy balance closure problem. As long as there are mean vertical thermal and humidity gradients in the atmospheric boundary layer, with a higher potential temperature and specific humidity in the surface layer than in the outer layer, such organised structures will lead to a systematic underestimation of turbulent energy fluxes from eddy-towers. Firstly, we address the question of how deep such meso-γ scale motions penetrate into the surface layer. We present indications from Doppler-LiDAR, airborne and tower-based measurements, which show that mesoscale motions can indeed be found quite close to the surface, but the mesoscale effect vanishes when measurements are actually conducted within the roughness sublayer and when shear stress is sufficiently large to break up mesoscale contributions into smaller eddies. This is illustrated by observations from Germany and Israel. Secondly, we investigate whether the common practice of adjusting the measured eddy tower fluxes for energy balance closure by conserving the Bowen ratio is supported by experimental evidence. Mesoscale and small-scale turbulent fluxes from four different flight campaigns are presented, which were carried out on board of the Canadian Twin Otter (National Research Council of Canada) and the German Polar 5 (Alfred-Wegener Institute) research aircraft over different landscapes in Canada and Alaska.

TP4-O-02: Influence of airflow characteristics on the locating of wind farms in forests

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The work deals with the problem of the wind farms installed in forests and proposed a suitable locating of it. Using a Doppler, Wind LIDAR (Light Detection And Ranging), the airflow characteristics above a forest and hence the velocity profile were investigated. Based on wind velocity measurements the wind energy and hence the power of wind turbine were determined. In the front of the forest the kinetic energy of the wind is decelerated and a part of the energy conserved in the eddy zone and some others are converted upward in kinetic energy and the power increased. At the sharp edge of the forest the flow separated above the high vegetation roughness and there is a decrease of the wind velocity in the separation region and hence the power decreases up to a minimum value. At the contraction area the velocity increased rapidly and hence the power reached its maximum value. Expansion region occurs after a flow contraction, as a consequence and behind the forest. However the velocity was decelerated and the power of the wind turbine is decreases. The installation of a wind turbine at the contraction region short after the sharp edge of the forest is very significant. The results are very useful to increase technical capacity to locate favourable wind system sites, reduce uncertainty in the prediction or validation of the characteristics and thus assist in the sizing and performance prediction of wind systems.

TP4-O-03: Investigating the consequences of climate change under different land use regimes – the Global Change Experimental Facility (GCEF)

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Climate change and land use changes are considered to be the most important threats to biodiversity and ecosystem functioning. Besides empirical studies and modelling approaches, manipulative field experiments are urgently needed to understand underlying processes, deduce indicators, develop strategies for sustainable land use, and steer some key processes. Previous experimental approaches have often considered individual global change factors separately, and the few multi-factorial experiments conducted so far used a rather small plot size. Their results, however, suggest that combined effects of global change factors may be profoundly different from the sum of single effects.

None of the previous experiments did explicitly consider different land use options in combination with climate change scenarios. Furthermore, experiments conducted on a smaller spatial and temporal scale may ignore key processes of ecosystem responses to global change.
We therefore established a field-based experimental platform which allows the parallel manipulations of land use scenarios and a selected climate change scenario. Increased night temperatures in combination with a changed precipitation pattern (e.g. summer drought) is applied to different types of farming (conventional, organic) and grassland management (intensive vs. extensive, mowing vs. grazing).

The ultimate aim of the experiment is the assessment of the combined effects of climate change and land use on ecosystem functions and ecosystem processes. We will especially focus on biotic and abiotic soil processes, biotic interactions as well as microevolutionary changes of plant species and their consequences for ecosystem dynamics, stability and productivity. The results will help to develop strategies for sustainable land use under global change.

TP4-O-04: Ecosystem response in the initial revitalization phase - A multi-year record of greenhouse gas exchange after peatland rewetting

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Restoration attempts to re-establish the natural functions of disturbed ecosystems, such as long-term carbon (C) storage. The restoration process may not run strictly linear and may take several years to centuries depending on the level of disturbance. Particularly, the start of the revitalisation measures might initiate an abrupt shift in the C-cycle of disturbed ecosystems. Among terrestrial ecosystems, peatlands exhibit the most efficient C sinks. However, most of the central European peatland area has been drained for agricultural use and has thus been turned into a potent source of carbon dioxide (CO_2). Indeed, an increasing number of peatlands have been recently rewetted with the main aim of decreasing the CO_2-emissions. However, this effect is often overcompensated by high methane (CH_4) emissions. Long-term monitoring projects that evaluate the restoration impact on ecosystem greenhouse gas budgets are urgently needed for modellers and decision-makers.

We present a 5-year data record of CH_4 and CO_2 emissions from a rewetted, brackish fen, starting at the last year before rewetting (2009). Rewetting had complex impact on growing season net ecosystem exchange of CO_2 (NEE): Not only ecosystem respiration (Reco) decreased due to anaerobic conditions, but also canopy photosynthesis (CP) declined since vegetation suffered from the rapid rise in water level. Since both, CP and Reco, decreased by approximately the same amount, the rewetting effect on the NEE was marginal and the fen remained a net CO_2 sink throughout all 5 growing seasons. In contrast, CH_4 emissions increased 100-fold up to 2700 $kg*ha^{-1}$ in the first year after rewetting, but dropped continuously in the following years. Four years after flooding, the fen still exhibits a net warming effect on climate. However, plant vitality is stabilizing and the contribution of CH_4 fluxes to the global warming budget is decreasing. Thus, the fen may turn towards climate neutrality or even into a greenhouse gas sink in the future.

TP4-O-05: Climate change impairs nitrogen cycling in European beech forests

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Beech forests on marginal calcareous soil are widely spread in Central Europe and provide – beside their economical values – important ecosystem services such as carbon storage, removal of reactive nitrogen from the biosphere and groundwater protection. The potential vulnerability of these ecosystems to reduced soil water availability in a changing climate has been associated with large-scale loss of ecological services and economical value. However, the mechanisms of climate change impacts on European beech forests are largely unknown and mainly ascertained to plant physiological limitations under drought. Recently, it has been proposed that reduced soil water availability may promote nitrogen (N) limitation of European beech due to impaired microbial N cycling in soil, but this hypothesis has not yet been tested. Here we present data on the influence of climate change on N transformation in the beech-soil

interface. We show that nitrate (NO_3) is the dominant N source for beech natural regeneration. Reduced soil water content caused a persistent decline of ammonia oxidising bacteria and therefore, a massive attenuation of gross nitrification and NO_3- availability in the soil. Consequently, NO_3- and total N uptake by beech seedlings were strongly reduced and impaired growth of beech seedlings was observed within two growing seasons. These findings support a dramatic decline by 78% of the distribution of beech forests on calcareous soils in Europe until 2080 predicted by statistical modelling. Therefore, the present results question the sustainability of European beech forests on marginal soils in the 21st century.

TP4-O-06: Climate and CO_2 effects on the vegetation of southern tropical Africa over the last 37,000 years

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The savannah vegetation of southern tropical Africa is characterised by co-dominance of C4-grasslands and C3-woodlands. Long-term variations in the tropical savannah vegetation in arid and semi-arid climates are commonly considered to be primarily sensitive to precipitation and atmospheric CO_2 concentrations. In our study we propose that also temperature changes should be considered when assessing the effect of a changing climate on tropical savannahs. We combine BIOME4 vegetation simulations with climate simulations and climate reconstructions to understand vegetation changes in southern tropical Africa of the last 37,000 years. Precipitation and vegetation reconstructions stem from the same marine sediment core near the Zambezi River mouth, temperatures were reconstructed from lake sediments within the Zambezi catchment. Our simulations demonstrate that temperature changes can reconcile a seemingly inconsistent evolution in precipitation, atmospheric CO_2 and vegetation change. We focus on two periods for which the vegetation reconstructions cannot be explained alone by precipitation changes and changes of atmosphere CO_2:

(i) For the Holocene, we force BIOME4 simulations with reconstructed atmospheric CO_2 concentrations, and spatial and seasonal climate patterns from the early- and mid-Holocene (9 and 6 ka BP) simulations with a global climate model.

(ii) For the glacial period, we analyse idealised experiments based upon reconstructed temperature, precipitation and CO_2 at 31, 28 and 21 ka BP. Our study shows that both Holocene and glacial simulations of vegetation cover exhibit good agreement with reconstructed C4:C3 ratios when temperature changes are taken into account. Adapting and refining this approach might permit to constrain continental temperature reconstructions or to evaluate the sensitivity of vegetation models to long-term climate variations.

TP4-O-07: Experimental evaluation of flux footprint models Experimental evaluation of flux footprint models

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The widespread use of footprint estimates in conjunction with eddy covariance measurements illustrates that flux footprint modelling is an important and therefore commonly used data quality assessment tool in micrometeorology. Mostly, analytical and computationally inexpensive models are applied, although their assumption of homogeneous turbulence is usually not fulfilled in practical flux measurement conditions. This difficulty raises the question of how reliable footprint model results are at real-world flux sites. In order to evaluate the models' performance, we conducted tracer experiments at a grassland site in Graswang, southern Germany. The site is part of the TERENO. net pre-Alps observatory and is located on a flat alluvial valley bottom (ca. 1 km wide), flanked by steep sides. An artificial tracer (methane) was released continuously over one averaging period from a surface source of 1 m^2 size. The measured flux contributions from the tracer source are compared to those predicted by footprint models. In this way the accuracy of the modelled two-dimensional flux footprint is evaluated and the dependence of model quality on turbulence structure is analysed. Furthermore, we investigate the extent to which potential sources on the downwind side of the measurement system contribute to the flux. We compare our measurements to estimates of analytical models as well as models based on Lagrangian stochastic particle dispersion. First results indicate that even analytical models perform adequately, except that they miss downwind source contributions which can be important.

TP4-O-08: Measuring and modelling greenhouse gas pollution swapping of methane (CH4) and nitrous oxide (N2O) in a diversified rice cropping system

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Traditional paddy rice cultivation is a large source of atmospheric methane (CH_4). Increasing water scarcity in SE Asia led to the trend of converting historical paddy rice fields to upland crops such as maize which may decrease on the one hand the CH_4 source strength but on the other hand could increase emissions of nitrous oxide (N_2O). Therefore, we compared CH_4 and N_2O losses from both a paddy rice – paddy rice cropping rotation and a maize – paddy rice rotation. Both gases were continuously measured at subdaily temporal resolution with a fully automated state-of-the-art static chamber system providing highly resolved greenhouse gas emission patterns. Experiments were carried out in the dry and wet season of 2012 at experimental fields of the International Rice Research Institute (IRRI) on the Philippines. In addition, we conducted a modelling study with the ecosystem model LandscapeDNDC, which had been extended by a newly developed biogeochemical model that captures key processes of production, consumption and transport of both greenhouse gases. The new model allows for a continuous simulation of the transition of lowland and upland crops. In order to provide a holstic measure of environmental impact of food production, we computed the yield-scaled global warming potential for both rotations. Experiments as well as model results clearly showed a 'pollution swapping' of greenhouse gas emissions from CH_4 in paddy rice fields to N_2O in maize fields. However, increased N_2O emissions did not outweigh decreased CH_4 emissions so that the paddy-maize rotation showed a decreased yield-scaled global warming potential. The LandscapeDNDC model framework has been exclusively designed to allow coupling to more complex external hydrology models and thus can be used now to assess regional water balances and greenhouses gas emissions in mixed upland and lowland systems.

TP4-O-09: MODIS Land Surface Temperature Assimilation and Verification at Rur Catchment

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The 1 km remote sensing products of Land Surface Temperature (LST) are available operationally from MODIS (Moderate-resolution Imaging Spectroradiometer). There are four measurements per day from MODIS Terra/Aqua sensors with low measurement error (around 1 K). In this study, MODIS LST products were assimilated into the Community Land Model (CLM) to improve the soil moisture, soil temperature, latent and sensible fluxes estimation. Remote sensing of soil moisture has severe limitations for the Rur catchment given the spatially highly variable landuse distribution and coarse resolution of passive microwave remote sensing; LST assimilation could be an alternative for the improvement of soil moisture simulation given the coupled water and energy balances at the land surface. In this study the assimilation algorithm Local Ensemble Transform Kalman Filter (LETKF) with the state augmentation method is used. Vegetation and soil properties are also updated in some simulation scenarios. Besides soil temperature, also soil moisture is explicitly updated by LETKF on the basis of the LST-measurements. The atmospheric forcing data, vegetation properties (leaf area index, etc.) and soil properties (sand and clay fraction, etc.) are randomised to represent the model uncertainties. The assimilation results were evaluated against measured soil moisture, soil temperature and latent and sensible heat fluxes obtained for the Eifel/Lower Rhine Valley Observatory of TERENO.

TP4-O-10: Global assessment of trends in wetting and drying over land

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The 'dry gets drier, wet gets wetter' (DDWW) paradigm has become commonplace in studies and assessments of future climate change. Many studies extrapolate the DDWW paradigm to assess historic changes over land, although analysis of continental dryness trends yield contradicting results and the DDWW evidence is mostly substantiated with oceanic data. So far, long-term land-based studies on dryness trends have only relied on a few datasets and single indices, thereby not accounting for data and methodological uncertainties. Here we provide for the first time a comprehensive and robust assessment of historic land dryness changes by analysing more than 300 combinations of precipitation, evapotranspiration and potential evaporation datasets. The realism of each combination is benchmarked against the Budyko curve and those combinations performing well are used for trend analysis. Our results confirm previously identified hot spots of changing dryness (e.g. drying trends in the Mediterranean and East Asia and wetting in the eastern U.S.), but also highlight that over large extents of global land area (75.4%) robust dryness changes cannot be detected. Within the 24.6% land area fraction with robust changes, only the minority (10.8%) confirms the DDWW paradigm. Of the remaining regions 9.5% display opposite changes (i.e. wetting dry areas and drying wet areas) and another 4.3% display drying/wetting in transitional climate regions. In particular, some humid regions have experienced increasing dryness (and vice versa) with potential consequences for a wide range of socio-economic sectors.

TP4-O-11: Role of soil moisture for dry biases over Amazon and Congo catchments simulated by MPI-ESM

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A common deficiency of current state of the art global climate models and Earth System Models (ESMs) is the simulation of dry biases over various continental regions. While part of the biases originate from remote or coupled atmosphere-ocean processes and deficits of the ESMs, part of the biases are related to shortcomings in the simulation of land surface hydrology. This may also be the case for dry biases over the Amazon and Congo catchments simulated by MPI-ESM. Hagemann et al. (2013) evaluated the MPI-ESM ensemble of CMIP5 simulations and found that the coupling to the ocean leads to a large negative precipitation bias over the Amazon catchment throughout the whole year, which is primarily induced by biases in simulated SST patterns and associated moisture transport. But they also noted that an insufficient representation of land surface processes is probably contributing to the dry bias during the boreal summer that is persistent in the fully coupled ESM and in the ESM versions driven by observed SST and sea ice (AMIP-type). Some studies also claim that biases over the Amazon catchment may feedback on the circulation and associated moisture transport. As soil moisture-atmosphere feedback effects play an important role in several regions of the globe, the role of soil moisture for the Amazon and Congo dry biases simulated by MPI-ESM shall be investigated in more detail. Thus, four AMIP-type sensitivity simulations will be conducted where the soil moisture is kept a) in a dry state and b) in a wet state and where it is prescribed either globally or only regionally over the two catchments. Differences in surface water and energy fluxes will be compared to the reference simulation, and potential model deficits related to the summer dry bias will be highlighted. Implications for improvements of the JSBACH land surface model will be stated, which may also be advantageous for other ESM groups whose ESM simulations suffer from similar biases.

TP4-O-12: Influence of recent climate change on groundwater temperatures in shallow aquifers

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Variations in meteorological patterns due to climatic changes are known to have a substantial influence on the hydrological cycle. However, most studies focus on the hydrological processes at the surface and equivalent studies on groundwater response to recent climate change are limited. While the consequences for groundwater recharge and water availability were investigated by several studies, the implications for the long-term development of shallow groundwater temperatures (GWT), as an important driver for water quality, are not comprehensively understood. In this study, the coupling of GWT and local annual air temperatures is statistically examined for a period of forty years with regard to abrupt shifts in the long-term annual mean. GWT were measured in four observations wells in two different aquifers in Germany. In order to bring the local changes in the context with large-scale climatic changes, we also analyze averaged time series of air temperatures regionally and globally. In all time series of groundwater temperatures two statistically significant abrupt upward shifts in the long-term mean temperature could be identified. These shifts are related to preceding shifts in the long-term mean of local air temperatures, which are in turn associated with abrupt increases in regional and global mean air temperatures. The observed direct coupling of air and groundwater temperature development shows that groundwater temperatures in shallow aquifers, which are linked to the atmosphere through the unsaturated zone, exhibit a pronounced coupling to short-term changes in air temperature. These findings and the correlation of the identified local shifts with abrupt regional and global increases indicate that a large number of aquifers are prone to be influenced in a similar way. Thus, further atmospheric warming is likely to have a significant influence, not only on soil temperatures, but also on temperatures of subsurface water resources.

TP4-O-13: Development and application of a coupled atmospheric-hydrological model system, suitable for regional spatial and climate relevant temporal scales

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Climate and land use changes are important drivers for changes in the hydrological cycle. For investigations of the non-linear connections in the hydrological cycle caused by climate and land-use change, the feedback mechanisms among the atmosphere, land surface and subsurface play a crucial role. The quantification of such feedback mechanisms requires a coupled modelling system, comprising both an atmospheric and a hydrological model.

In our approach, we combine the regional atmospheric model WRF-ARW and the distributed hydrological model HMS. Both use the same land surface model (Noah-LSM) and share compatible water and energy flux formulations. Due to the suitability of HMS for medium and large scale

hydrological applications, this model system allows to study hydro-meteorological fluxes at regional spatial and climate relevant temporal scales. In addition to the coupling of the atmospheric and hydrological models we implemented methods to represent the interaction between groundwater and soil moisture of the LSM.

The model system is applied for the Poyang Lake basin in South-West China, a region that is characterised by tremendous land use changes in the last decades. Its catchment size is approximately 160,000 km^2 and our coupled model system simulates its full regional water cycle with a spatial resolution of 10 x 10km^2.

The application of the developed coupled model system consists of three main steps: First, the identification of a suited WRF-ARW setup for the target region; secondly, the setup and calibration of HMS driven by meteorological observation data and thirdly, the performance of fully coupled WRF-HMS simulations combining the identified stand-alone WRF and HMS setups for the Poyang Lake basin.

We outline the integration of the hydrological model HMS into WRF-ARW and present simulation results of all three steps which are required to investigate the full regional water cycle for the Poyang Lake basin with the novel developed coupled modelling system.

TP4-O-14: Feedbacks of the land surface and urban areas on precipitation in the Netherlands

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Large urban areas have been shown to influence temperature and precipitation amounts, area, and triggering (e.g. Kalnay and Cai 2003; Shepherd 2005). However, little research has been conducted on the influence of urbanisation within Europe (only Trusilova et al. 2009; Trusilova et al. 2008). For this work the Weather Research and Forecasting (WRF) model is used to investigate the impact of soil moisture and urban areas on precipitation in the Netherlands. We analyse a 4-day case study in spring and a composite event (based on 12 single day events) for autumn. The results for autumn are still in progress, but can be shown at the time of the conference. In spring, we find a positive soil moisture-precipitation feedback, i.e. wet soils increase precipitation. We quantify the strength of this feedback using the ratio of evaporation to precipitation and find an average of more than 65%.

We execute two additional experiments in which urban areas in the Netherlands are expanded and one in which urban areas are completely removed. Within existing urban areas the average maximum diurnal urban heat island increases by 2 K under an urban coverage scenario for 2040. Expansion of urban areas results in an increase of the sensible heat flux, deeper planetary boundary layer and more stable atmosphere, similar to reducing soil moisture. Through this mechanism, expanding urban areas reduces precipitation by a moderate amount of 2-6%. In all our simulations convection depends more on moisture than on temperature. This dependence stresses the importance of the initial state of the land surface to the formation of precipitation. We show that land use and land cover changes (including urbanization) play a major role in energy partitioning at the surface and have the potential to amplify droughts and extreme precipitation through their influence on the hydrological cycle.

TP4-O-15: The impact of groundwater-soil moisture coupling on WRF-Hydro modelled water budgets and surface exchange: a case study for the Ammer catchment in Southern Germany

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Regional dynamical atmospheric models exhibit considerable sensitivity to land-surface characteristics and states. The level of complexity that is used to describe water transport and storage in the vadose and phreatic zone has a major impact on spatial pattern generation and land-surface exchange quantities. Spatial redistribution of infiltration excess water on the land-surface and lateral groundwater transport can lead to substantial differences when compared to column based free drainage vertical exchange concepts that are typically used with land-surface models. Furthermore, a consistent description of the regionally closed water balance is often lacking for local dynamical atmospheric downscaling applications.

We present a fully two-way groundwater-soil-atmosphere coupled model system that allows for horizontal redistribution of surface and sub-surface water, cross compartment vertical interaction and thus direct feedback between the atmospheric boundary layer and hydrological processes. Moreover, the closure of the regional water balance is possible. A simple two-dimensional groundwater model is implemented to simulate lateral flow within the saturated zone. The interaction between phreatic and vadose zone is realised with a state dependent Darcy flux parameterisation.

The two way groundwater coupled WRF-Hydro model is applied for the Ammer river located in Southern Germany. It drains an area of around 700 km^2, with alpine characteristics in southern part of the catchment. After an initial observation driven calibration of the stand-alone hydrolo-

gical part, fully coupled WRF-Hydro simulations, forced by the global ECMWF ERA-INTERIM boundary conditions, are performed. The impact of groundwater coupling on water budgets, storage states and land-surface exchange is analysed for a simulation period of several months.

Poster presentations:

TP4-P-01: The influence of dynamic vegetation models including harvest on the energy fluxes and the feedback effects between weather and land surface models

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Recent studies show that uncertainties in regional and global weather and climate simulations are partly caused by inadequate descriptions of the soil-plant-atmosphere system. Particularly relevant for the improvement of regional weather forecast are models which better describe the feedback fluxes between the land surface and the atmosphere, which influences surface temperature, surface air pressure and the amount and frequency of precipitation events. Aim of this study was to examine the influence of different management strategies and the use of dynamic vegetation models to energy fluxes at the land surface boundary layer.

For this study the land surface model Expert-N was used, which is fully coupled to the 'Regional Climate and Weather Forecast Model' (WRF). Where the standard model NOAH distinguish between vegetation class specific monthly changing soil cover values (leaf area index) and defined soil characteristics, Expert-N is an ecosystem model that allows the application of more mechanistic soil and plant sub-models including the management of soil and vegetation and effects of water and nutrient availability on plant growth are considered.

The influence of different harvest scenarios on the energy fluxes is discussed. The simulation shows the high impact of vegetation management on the energy fluxes which caused significant differences between weather characteristics such as the simulated surface temperatures and precipitation events on the regional scale. Therefore, we conclude that weather forecast on the regional scale could be significantly improved by modelling approaches that better describe the dynamic of vegetation growth.

TP4-P-02: High Resolved Long Term Simulation for a Complicated Forest Catchment with Litter Layer and Fractured Bedrock System

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Soil water content plays a key role in water and energy balance in soil, vegetation and atmosphere. According to Wood et al. (2011) there is a grand need to increase global-scale hyper-resolution water-energy-biogeochemistry land surface modelling capability. However, such a model scheme should also recognize the epistemic uncertainties on the characteristics and processes of a grid element, as well as the nonlinearity and hysteresis in its dynamics. Unfortunately, currently it is not clear how to parameterise hydrological processes as a function of scale and how to test deterministic models with regard to epistemic uncertainties. In this study, high resolution long-term simulations were conducted in a highly instrumented TERENO hydrological observatory (Wüstebach catchment). Soil hydraulic parameters were derived using inverse modelling with the Hydrus-1D model using the global optimisation scheme SCE-UA and soil moisture data from a wireless soil moisture sensor network. The estimated parameters were then used for 3D simulations using the integrated parallel simulation platform Parflow-CLM. The simulated soil water content, as well as evapotranspiration and runoff, were compared with the field observation to illustrate how well the model was able to reproduce the water budget dynamics. With variable model setup scenarios, we investigated how depth-to-bedrock and lateral flow processes above the underlying fractured bedrock affects the simulation results. Furthermore, we also explored what role the overlying litter layer plays in the simulation of water flow processes.

TP4-P-03: Short-rotation forestry vs. rapeseed - what about GHG emissions?

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Bioenergy crops have been used to reduce greenhouse gas (GHG) emissions and to mitigate global warming risks. In Germany, more than 2 million ha were under bioenergy crop cultivation in 2012; more than 40% of this area occupied by rapeseed. Our research aims to study soil respiration at sites under rapeseed cultivation as well as willow and poplar short-rotation forestry (SRF) used for biomass extraction. Rather than the physiological differences between the two crops, managing SRF is completely different from rapeseed in terms of tillage, chemical usage and harvesting – all affecting the rate of GHG emissions from soil. Preliminary results show significant differences in soil respiration; the rapeseed and grassland emit higher CO_2 than SRF site (ca. 150 and 200% respectively).

TP4-P-04: Use of eigendecomposition in a parameter sensitivity analysis of the Community Land Model

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This study explores the use of eigendecomposition in a sensitivity analysis of the Community Land Model CLM, revision 3.5, with respect to its parameterisation. Latent heat, sensible heat, and photosynthesis are used as target variables. The eigendecomposition of a sensitivity matrix, containing numerically-derived sensitivity measures, can be used to study parameter significance. Existing parameter ranking and selection methods are examined. Furthermore, a new parameter significance ranking index is proposed which is working in concert with a new proposed selection criterion. This methodology explicitly takes parameter covariations into account. The results are consistent and similar to the most elaborate method tested in this study, but the new method has fewer assumptions. The number of significant parameters depends on the degree of variation that a single parameter is allowed to generate in the cost function. The method declares two thirds out of 66 parameters to be significant model parameters for an allowed change of 1%, and only 10 parameters for an allowed change of 10% of the cost function. The sensible heat flux is shown to be the least sensitive model output in comparison with latent heat or photosynthesis. Parameters that determine maximum carboxylation and the slope of stomatal conductance are very sensitive for photosynthesis whereas soil water parameters are significant for latent heat and C4 photosynthesis. It is concluded that the proposed procedure is parsimonious, can analyse sensitivities of more than one model output simultaneously and helps to identify significant parameters while taking parameter interactions into account.

TP4-P-05: Climate change indicators and vulnerability of boreal zone applying innovative observation and modelling techniques (MONIMET)

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EU Life+ project MONIMET (LIFE12 ENV/FI/000409) is implementing a new innovative approach to in situ monitoring and mapping of climate change indicators that have an influence on the mitigation potential and vulnerability estimates of boreal forests and peat lands. The approach is based on a combination of different information sources describing phenology, CO_2 and CH_4 exchange, land cover, snow evolution and albedo. The information sources include in situ observations and earth observation data as well as ancillary data supporting vulnerability assessments. JSBACH and PRELES models are applied to describe climate and land surface fluxes of carbon and water by different boreal ecosystems. Project objectives include 1) collecting information, data and expertise from various sources in order to build a comprehensive platform for analysing climate change effects on seasonal dynamics of various phenomena, 2) creating links between existing monitoring mechanisms such as ICOS and EO systems (GMES) and other projects related to ecosystem monitoring, 3) creating new webcam monitoring system in order to facilitate Earth Observation and ground based systems by providing time-series of vegetation and ground observation for calibration and validation, 4) synthesising modelling and observation approaches to identify climate change indicators and finally 5) utilising the climate change indicators together with ancillary model and experimental results in creating vulnerability maps of boreal zone in connection to climate change scenarios.

TP4-P-06: Eddy covariance CO_2 and CH_4 fluxes in a re-wetted fen in NE Germany

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Carbon dioxide (CO_2) and methane (CH_4) are the most abundant greenhouse gases after water vapor (H_2O). Considerably high emissions of CO_2 are known from drained and degraded peat lands. Restoring degraded peat lands is expected to reduce their greenhouse gas contribution to the atmosphere in the long term although CH_4 release may increase, especially in the first years after rewetting. To inform and improve management decisions, the effect of restoration has to be quantified and greenhouse gas dynamics following re-wetting have to be understood.

Using the eddy covariance (EC) technique we investigate methane and carbon dioxide flux dynamics between the atmosphere and highly degraded minerotrophic fen grassland, which was flooded in 2004/2005. The study site is located in the Peene River valley (53°52´N, 12°52´E), NE Germany, and part of the Terrestrial Environmental Observatories Network (TERENO) spanning across Germany. Water table fluctuates between 30-80 cm and the area is densely covered by several helophytes and hydrophytes typical for this stage of rewetting. We used the LI-7200 enclosed CO_2/H_2O and LI-7700 CH_4 analysers. The usual biometeorological data were logged continuously.

We will present flux data covering one year since the system was newly established. Previous measurements at the study site by a steady state flow-through chamber system revealed continuing high methane release, especially during warm periods. Thus, the climate impact of the fen is still not declining after 9 years of rewetting.

TP4-P-07: The impact of land cover generated by dynamic vegetation model on present and future climate over East Asia

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This study investigates impacts of land cover change in summer climatology over Asia, which is simulated by a dynamic vegetation model. The climate model in this study has systematic biases of underestimated rainfall around Korea and overestimation over the South China Sea. Land surface process accompanies additional direct radiative effects over dust-producing regions. The direct radiative effect of dust increases the rainfall dry biases. Relatively, land surface physical processes are related to local temperature biases such as warm biases over Northern China. In timeslice runs for future climate, as dust loading changes, anticyclonic flows are simulated over South China Sea, resulting in reduced rainfall over the South China Sea and more rainfall towards Korea and Southern China. Contrasting to the rainfall changes, land cover change and the associated dust radiative effects are very small in future projections of temperature, dominated by atmospheric CO_2 increase. Results in this study suggest that the land cover in the dynamic vegetation model can affect model systematic biases in regional scale over dust emission source regions such as Asia. Especially the analysis for the associated dust radiative effects with land cover is important to understand future changes of regional precipitation in global warming.

TP4-P-08: Sensitivity study on land-atmosphere coupling over the Amazon

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Regional climate models (RCMs) are state-of-the-art tools used for understanding the past, present and future climate at regional and local scales. RCMs are also applied for fundamental process studies of the regional earth system, such as the land-atmosphere coupling in the Amazon Basin, which is the largest river basin in the world and also where the largest rainforest is located.

Modelling studies have shown a systematic warming in the Amazon Basin especially during spring, indicating a misrepresentation of land-atmosphere interactions. Models have mainly underestimated the large rooting depths of the Amazon forest. Increasing the rooting depth in the densely forested region will increase the access to stored water in the deep soil during dry periods and will eventually lead to local cooling and moister air.

To reduce the overestimation of near surface temperatures in the Amazon Basin, sensitivity studies are conducted using the three-dimensional, hydrostatic regional climate model REMO, which has been developed at the Max Planck Institute for Meteorology in Hamburg, Germany. The model domain covers the continent of South America at a horizontal resolution of about 50 km with 31 vertical levels. Four case studies of varying values of the permanent wilting point parameter for duration of two years are designed in this study. By lowering the permanent wilting point parameter in the land surface scheme of REMO, the rooting depth is indirectly extended to increase the access to stored water. This method leads to higher latent heat fluxes while the sensible heat fluxes remain almost constant. The increase of moisture in the air via an increase in the rate of evapotranspiration has led to an evaporative cooling of about 3 K in the Amazon basin during spring. The modified version of REMO is then extended to a 20-year simulation to investigate the impact on the local climate.

Session Abstracts Topic 5:

Atmospheric composition and climate: Interactions from global to regional scales

TP5-O-01: From local process studies to global scale impacts

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Recent field experiments and laboratory chamber studies have instigated renewed interest in fundamental atmospheric chemical processes involving the oxidation capacity of the atmosphere and photochemical ozone formation in the troposphere. Among these issues are the postulation of so-called radical recycling mechanisms in the oxidation of isoprene (Fuchs et al., 2013), which would reconsolidate field measurements with model simulations in various regions of the world, where relative low levels of nitrogen oxides coincide with high levels of reactive volatile organic compounds (Hofzumahaus et al., 2009). A second issue that is of large relevance for the ozone budget in the planetary boundary layer and thus ozone air pollution arises from strong experimental evidence of a hitherto unknown mechanism for the formation of nitrous oxide (HONO) in the gas-phase (Li et al., 2014). We present results from simulation chamber and field measurements and numerical modelling work to elucidate some of these processes and assess their consequences for the chemical composition of the troposphere.

TP5-O-02: Is there a link between the Zugspitze ozone trend and climate change?

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The continual increase of ozone and ^{7}Be at the Alpine summit station Zugspitze (2962 m a.s.l., Garmisch-Partenkirchen, Germany) between the mid-seventies and 2000 has led to systematic efforts for identifying and quantifying its reasons, starting in the late 1990s (STACCATO and ATMOFAST projects). Data filtering by Scheel based on the ozone, relative-humidity (RH) and ^{7}Be measurements has shown that the only strong positive trend in the Zugspitze ozone between the seventies and 2000 is related to air masses descending in deep stratospheric intrusions. The stratospheric contribution to the Zugspitze ozone has roughly doubled to about 20 ppb since the beginning of the observations 1978, the impact being much lower at the neighbouring site Wank (1780 m a.s.l.). It is reasonable to assume that this increase in ozone is related to climate change, and also its end after 2000. However, in contrast to the temperature development, the Zugspitze ozone has undergone even a puzzling trend reversal in recent years. We hope that our planned revised data filtering (based on the refined strategy of Trickl et al., Atmos. Chem Phys. 10 (2010), 499-524), can give some hint on the nature of this development, one possibility being a change in seasonal cycle. The results should be more quantitative than anticipated from the Zugspitze humidity measurements (RH > 10 %): In a separate study with our water-vapour lidar, we found surprisingly dry conditions (RH 0 to 2 %) even in thin intrusion layers (submitted for publication). This suggests that the stratospheric nature of these layers is mostly preserved during the subsidence to the Alpine summit level.

TP5-O-03: Source attribution of tropospheric ozone using tagging techniques

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The transport of chemical species in atmosphere from one region (state, country or continent) to another has been a major goal of several studies due to its importance to local air quality, and consequently human health and climate. Global chemical transport models have been used in a variety of ways to determine source attributions at given locations and source-receptor relationships. We have expanded one existing ozone tagging technique with a limitation of one tag to multiple tags and have implemented it in the Community Atmosphere Model Version 5 (CAM5) part of the Community Earth System Model (CESM). The model performance test shows that this multiple tags procedure is much more time efficient than the one tag procedure. It could save about 70% of simulation time, in case of the simulation with 100 tags. One simulation of tagged NO emissions from the HTAP (Hemispheric Transport of Air Pollution) regions with our multiple tagging procedure has been performed, as an example of application in identifying source contributions based on NO emissions in a given state of the atmosphere and quantifying the ozone budget. For global surface O_3, the largest contribution is from Non-Arctic/Antarctic Ocean (17%), followed by North America (11.1%), South America (8.6%) and stratosphere (8%). The local source always contributes the largest part of surface O_3 for every region. For example, for Europe, the local source contributes 60% of surface O_3, followed by non-arctic/Antarctic Ocean (19%) and Russia, Belarussia, Ukraine (9%). The effect of the replacing of O_3 tag by the 'null cycle' ($O_3 + NO \rightarrow NO_2 + O_2$) is also discussed. Diagnosis of ozone production chemical regime based on difference between sources of radicals and NO_x shows that at the model surface, much of the continental land mass is VOC limited about 50% of the time during daylight hours. However, through the depth of the troposphere, NO_x limited conditions prevail, except in a shallow layer over the northern

midlatitudes. To identify the source of O_3 from different VOCs, NO to NO_2 conversion by VOC oxidation is also tagged. We use additional tags to track the NO_2 converted by tagged VOCs and their intermediate oxidation products. Preliminary results of one simulation with multiple tags of O_3 sources are presented.

TP5-O-04: Ozone production in models and the role of NMVOC speciation

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Non-methane volatile organic compounds (NMVOCs) and nitrogen oxides (NO_x) are key precursors in the formation of tropospheric ozone. Ozone is an air pollutant with significant adverse health effects for humans as well as ecosystems. In addition, it is a greenhouse gas that has implications for short-term climate forcing. NMVOCs in emission inventories are typically provided as total NMVOCs without speciation information included. Which individual compounds or compound groups the total NMVOCs are speciated into for model input is determined by the chemical mechanism employed. Speciation information exists from a variety of sources, however these are typically extremely uncertain, often outdated and show significant differences in their breakdown and attribution of species within the same sector.

While an update to the NMVOC speciation is needed, it is important to understand what level of detail is appropriate for such an update, given the potential expense associated with such work. As the chemical mechanisms are necessarily a simplification of the real-world conditions, the possible extent of influence NMVOCs have on ozone production in models could be significant based on the speciation, or model mechanisms could have a greater influence. To understand this, an investigation of the effect of speciation for the solvent sector, as well as chemical mechanism was carried out using a box model under idealised conditions. Differences of up to 40 $\mu g*m^{-3}$ of ozone were observed among speciations using the same mechanism. This is then followed up with more realistic regional modelling studies using the WRF-Chem model over the European domain. The results from the modelling work and the implications for understanding policy decisions aimed at controlling ozone will be discussed.

TP5-O-05: 4d var data assimilation for the anthropogenic emission estimation

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A key for better understanding the complex atmospheric processes is the quantitative determination of the emission patterns. That is why our study deals with the estimation of the anthropogenic emission strength and the chemical evolution of urban air-sheds, using the technique of Inverse Modelling.

The chemical four-dimensional data assimilation system applied within the European Air Pollution and Dispersion chemistry-transport model and its inverse modelling module (EURAD-IM) is already generalised by including not only chemical state estimates but also emission rate optimisation.

The main achievement which guarantees chemical consistency of the emitted species is their assimilation together with their products, e.g. ozone. This achievement follows the objectives of data assimilation and, together with the high horizontal resolution and the nesting technique, provides an accurate and consistent image of the atmosphere.

In the present work a novel approach has been produced, resting on an improved estimation of the multivariate covariance matrices of the optimisation problem. This is done by updating the emission factor error covariance matrix to 24 emitted species and by adapting the adjoint code to the new online emission model by TNO. Joint optimisation of the initial values of the chemical constituents and the emission rates takes place in the study of special episodes: an ozone episode in July 2010 and an aerosol episode in 2012 at the region of NRW, as well as a high OH episode during the PEGASOS 2012 campaign in Po valley. The nesting techniques applied go from 15 km resolution for the European domain down to 5 km resolution for Central Europe and end with 1 km resolution for NRW, implying an indispensable knowledge of the emission patterns. For the assimilation, different kinds of observational data are used, giving a more efficient result.

TP5-O-06: Global composition-climate interactions and regional change: The two-way interaction

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Global and hemispheric scale composition-climate interactions are an important driver of regional change. The most prominent example is the ozone hole in the Southern Hemisphere. The ozone hole triggers a climate change signal over the Antarctic Peninsula that can be observed and verified by modelling. A number of physical processes transfer a signal originating in stratospheric polar ozone into the troposphere, including the surface. One of the processes involved is a change in seasonality of the so-called Brewer-Dobson circulation (BDC). The BDC is the large scale overturning circulation in the stratosphere that transports air masses from the tropics (ascending branch) to higher latitudes (descending branch). The ascending branch of the BDC, in conjunction with the tropical tropopause layer, forms the main transport gateway for trace gases (including

water vapour, ozone depleting substances and greenhouse gases) from the troposphere to the stratosphere and from low to high latitudes. Considering the ozone-induced climate impact and the associated hemispheric change in the BDC, it is clear that the hemispheric setting is not just a boundary condition for the regional change. In fact, the regional change is impacting its own boundary condition. Here we strengthen the argument that capturing this two-way interaction is important for reliable climate change assessments.

TP5-O-07: Quantification of cloud susceptibilities to ice nuclei

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A large contribution to processes involved in the climate system is made by clouds. These may consist of liquid water, ice or both simultaneously, which is determined not only by temperature and humidity conditions but also by the presence of aerosol particles. Depending on fundamental properties such as liquid and ice water content, clouds modify the radiative budgets of the earth's atmosphere and surface.

However, the interdependencies of aerosols and cloud microphysical processes, among which is primary ice formation, contribute to considerable uncertainties in cloud models. Although it is known that in a large range of thermodynamic conditions aerosol particles are required to initiate ice formation, identifying and characterising the effect of specific ice nuclei is among current scientific efforts.

Here we attempt to quantify the change of cloud macrophysical and radiative properties with varying aerosol background concentrations. We adapt the concept of susceptibilities for mixed-phase and ice clouds which has up to now been applied primarily to liquid clouds, defining the susceptibility S as the derivation of a quantity Q with respect to aerosol concentrations N. A focus of our study is the comparison of different model approaches. The classical method is the direct comparison of two independent model runs, where the whole range of microphysical and macrophysical feedbacks contributes to different cloud properties in a perturbed simulation. Our alternative method relies on a single simulation which incorporates two microphysical schemes in parallel with different aerosol concentrations. Since in the latter case only microphysical feedbacks contribute to the properties of perturbed clouds, we expect to be able to draw conclusions on the importance of macrophysical feedbacks on perturbed clouds in different cloud regimes.

First results are shown, comparing a persistent Arctic mixed-phase stratocumulus cloud layer and a convective system with respect to their sensitivity to different ice nuclei species. Results are based on three-dimensional large eddy simulations with a two-moment representation of cloud microphysical interactions.

TP5-O-08: The impact of biogenic bromine emissions from the oceans on atmospheric chemistry in a changing climate

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Bromine from very short-lived substances, primarily from natural oceanic sources, contributes substantially to the halogen loading of the free troposphere and stratosphere with an important impact on atmospheric chemistry. This source of atmospheric bromine has so far been ignored in most chemistry-climate model simulations of tropospheric and stratospheric ozone trends. Here we will present chemistry climate model simulations over the past decades including the biogenic emissions of bromine from the oceans and their impact on atmospheric chemistry and ozone trends. We will discuss possible interactions between oceanic emissions, atmospheric chemistry and climate change.

TP5-O-09: Seasonality of the mean age in the UTLS region: Hemispheric differences and impact of the Asian monsoon

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The seasonality of the composition of air in the UTLS region is determined by the seasonality of different transport processes such as convection, Brewer-Dobson circulation (BDC) and two-way irreversible isentropic transport across the tropopause. While the subtropical jets form a strong transport barrier between the tropics and extratropics during winter (seasons are related to the northern hemisphere), this barrier weakens significantly in the northern hemisphere during summer. This is a result of the hemispheric asymmetry of the land-sea distribution and of the orography, which leads to hemispheric differences in the distribution and intensity of the wave drag driving the BDC.

Based on a multi-annual CLaMS simulation covering the period from 2001 to 2012 with model transport driven by the ECMWF ERA-Interim re-analysis, we discuss the seasonality of the mean age (measuring the mean transport time of an air parcel traveling from the boundary layer) in the tropical tropopause layer (TTL) and in the extratropical lowermost stratosphere (LMS). During the considered period, the simulated trace gases (like CH_4, N_2O, F11, CO_2, CO, H_2O and O_3) are in fairly good agreement with in-situ and satellite observations, especially in the lower stratosphere and around the tropopause.

In the TTL, the mean age shows a pronounced annual cycle that is driven by the seasonality in tropical upwelling and horizontal transport from the extratropics (inmixing) with youngest air during late boreal winter and oldest air during late boreal summer, respectively. On the other side, strong hemispheric differences can be diagnosed in the polar high latitude LMS. Here, air in the northern hemisphere is much younger during summer than during the same season on the southern hemisphere. A regionally resolved climatology of the mean age further shows youngest air in the TTL in winter above the West Pacific warm pool, whereas in summer, the Asian summer monsoon forms the key pathway for transport into the LMS.

By quantifying the wave forcing in terms of the transformed Eulerian mean formalism (TEM), we derive the respective climatology of dynamical sources (EP-flux divergence) and explain transport and its seasonality within this framework. This way, we trace back the seasonality and hemispheric differences of the mean age to the respective differences in the strength of the arctic and Antarctic polar vortices, different climatological patterns of the upper tropospheric anticyclones and of the orographic Rossby waves in the troposphere. By analysing the TEM version of the transport equation we also quantify the impact of the residual circulation and of eddy-mixing on causing the mean age seasonality. Regionally resolved analysis emphasizes the importance of the Asian continent and in particular of the Asian monsoon on the composition of air in the UTLS region over the northern hemisphere.

TP5-O-10: Comparison of merged profile ozone satellite observations (1984-2011): Assessment and implications in terms of ozone recovery

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The successful implementation of the Montreal Protocol has led to reductions in stratospheric halogen loading, which is expected to result in less chemical depletion of ozone and thus increased stratospheric ozone amounts. To unambiguously identify a positive ozone response directly attributable to declining halogen levels, consistent long-term observations of the ozone profile are required. Although near-global vertically-resolved satellite observations of ozone have been made since 1979, no single instrument has covered this entire period, meaning that merged data series combining several instrument records are required to fully understand long-term ozone changes. As part of the Si2N (SPARC/IOC/IGACO-O3/NDACC) initiative, all available merged long-term datasets were compared and assessed. Seven such datasets, each based on a varying combination of instruments including SBUV/2, SAGE-2, HALOE, UARS-MLS, OSIRIS, SAGE-3, GOMOS, ACE-FTS, and Aura-MLS, were investigated. Although these datasets have been validated independently, no thorough intercomparison has so far been carried out. The analysis covers the period 1984–2011, for which all datasets are available, and reveals that they all represent seasonal and interannual variability well, with those datasets based on the same underlying instruments tending to be more similar, despite different merging techniques being used. A multiple linear regression analysis reveals that long-term ozone trends are similar in the period prior to 1997, but show more diversity for the 1998-2011 period. This is likely due to the fact that for this period a larger variety of instruments are used post-SAGE2. These results have important implications in terms of the detection of ozone recovery resulting from the reduction in stratospheric halogen loading and since these datasets are valuable in terms of both validation of chemistry-climate models and as the basis of input for models that do not include interactive chemistry.

TP5-O-11: Regional influence of solar variability on European climate

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Solar variability related to irradiance and energetic particle forcing could be an important source of natural climate variations superimposed on the human-induced warming since the late twentieth century in particular on the regional scale. Because of its prominent 11-year cycle, solar variability offers a degree of predictability and could potentially enhance decadal scale predictions. Understanding the influence of solar variability on climate requires knowledge of solar variability, solar-terrestrial interactions and observations, as well as mechanisms determining the response of the earth's climate system.

We will summarise our current understanding of the impact of solar irradiance and energetic particle forcing on the atmosphere with special focus on the regional changes over the North Atlantic and Europe from observational and modelling studies. We will present feedback mechanisms for the solar signal transfer and discuss the importance of the solar cycle for decadal climate predictions.

TP5-O-12: NOy transport from the lower thermosphere and its impact on ozone in a chemical transport model

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Transport of NO_x from the lower thermosphere to the mesosphere and subsequently to the stratosphere during polar winters can be an important supply of additional NO_y in the middle atmosphere besides N_2O oxidation. This mechanism couples solar and geomagnetic activity to the chemical budget of the middle atmosphere and can in principle affect climate via chemical-dynamical interaction and stratosphere-troposphere coupling. As part of the upper branch of the meridional circulation of the middle atmosphere, the downward transport of NO_x in the mesosphere shows a strong seasonal cycle and interhemispheric differences. For example, in the Arctic especially after strong sudden stratospheric warming, the downward transport can be very effective. Here we use the ERA-Interim analyses to probe different dynamical situations in arctic winters how strong their impact on the chemical state in the middle atmosphere could be under realistic forcing conditions of the indirect particle effect.

TP5-O-13: Regional air quality in European urban areas – A WRF-Chem modelling study

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In 2050, 70% of the global population is expected to live in urban areas. Climate change will render these areas more vulnerable to heat waves, which often are accompanied by severe air pollution problems. The Urban Heat Island (UHI) is a feature that adds to the general temperature increase that is expected. Decreasing the UHI would impact air quality as well, because heat influences mixing layer depths and secondary flow systems, accelerates air chemical processes and often also increases the emission of primary pollutants due to increased demand of energy, e.g., for air conditioning. Finding adaptation strategies to mitigate future heat and air quality related problems is thus of great importance.

In this study, the meso-scale model WRF-Chem is used to investigate the effect and the potential of strategies to simultaneously mitigate UHI and air quality problems. A multi-layer urban canopy model is coupled to WRF-Chem and the urban area of Stuttgart is taken as one example.

With this model setup we investigate the effect of e.g. high reflective surfaces and urban greening on mitigating the UHI and the related impact on air quality. In order to account for a scenario expected in future climate, input data from the European heat wave in summer 2003 have been chosen. The results show that the UHI effect can be substantially reduced. The impacts on air quality depend on the chosen UHI mitigation strategy and on biogenic and anthropogenic emissions and weather conditions. For instance, urban greening can increase the emission of biogenic compounds (BVOCs) and thus negatively influence air quality.

The model investigations are completed by measurements, e.g. by monitoring mixing layer depths and secondary flow features and by setting up air composition measurements in urban environments where anthropogenic and biogenic emissions are close together.

TP5-O-14: Evaluation of impact on air quality by changes on public transportation: a case study of a Brazilian city

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In this work, we performed an evaluation of the impact on air quality considering the replacement of diesel buses system public transportation in a Brazilian metropolitan area (Curitiba, Southern Brazil) by metro system. To perform this study we used the Weather Regional Forecast Chemical model (WRF/chem) to estimate the impact on air quality and CO_2 emissions. Simulations were performed from July 14th to July 17th 2008. For initial conditions we used the average emission factors from buses, emission inventory developed by Martins et al (2012), reanalysis from NCEP. Ozone data available in region was also used to evaluate the results. It was found that vehicular emissions are the main source of ozone precursors in urban area. However, for PM10, industrial sources are also important. In the scenario when buses were replaced by metro system, it was found a reduction until of 30% in CO concentrations in central area of city. The same behaviour was found for PM10 and NO_x. For ozone, no significant reduction was found. For CO_2 according mass balance applied (top-down method from IPPC) approximately 74.8 tons of CO_2 per day would be left emitted by changes on public system transportation in Curitiba city.

TP5-O-15: Weather and ambient air pollution - Health effects and potential interactions

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Health effects of weather and ambient air pollution have been assessed most often separately so far. However, their interactions may be essential for predicting the consequences of climate change on population health on a regional level, especially in urban areas. Within the ongoing REKLIM project, we aim to study the associations between exposures to air temperature as well as air pollution and health data in the region of Augsburg, Germany.

Measurements of air temperature and relative humidity are conducted at 35 locations spread over the urban area of Augsburg. Exposures to air temperature, relative humidity and air pollution (particulate matter in different size fractions, black smoke, nitrogen oxides, and ozone; available from other projects) will be estimated at the residential addresses of approximately 2400 individuals participating in the Cooperative Health Research in the Augsburg Region (KORA) FF4 study, by applying land-use regression (LUR) models. These annual averages will be used to assess the effects of weather and air pollution on cardiovascular and respiratory function.

Results: Preliminary descriptive statistics of the first year of measurements (December 2012 to December 2013) indicate high temporal correlation between the different monitoring locations for both air temperature (spearman correlation coefficients $r > 0.92$ on a daily basis) and relative humidity ($r > 0.83$), with no differences in the correlations comparing summer to winter. However, the different sites show some spatial variability with average daily mean temperatures ranging from 9.1°C to 12.8°C and an average relative humidity ranging from 67.3% to 83.7%. The spatial differences are more pronounced during summer.

Spatial variability in air temperature – as indicated by the different monitoring locations – in combination with air pollution will be relevant for predicting future, regional health impact of climate change.

TP5-O-16: Secondary aerosol formation from stress-induced biogenic emissions and possible climate feedbacks

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Secondary organic aerosol (SOA) is formed by oxidation of Biogenic Volatile Organic Compounds (BVOC). Besides constitutive emissions like monoterpenes (MT) trees emit sesquiterpenes (SQT), methyl salicylic acid (MeSA), green leaf volatiles (GLV) and other BVOC when they are exposed to e.g. biotic stressors. As climate warming may deteriorate the living conditions of trees, which could lead to altered Stress Induced Emissions (SIE), it is important to understand how SIE affect SOA formation and aerosol climate couplings.

Experiments were performed in the Jülich Plant Atmosphere Chamber using plants suffering from insect or pathogen attacks, and featuring SIE. We determined SOA yields for SIE and emission ratios of SIE/MT.

SIE showed SOA yields of 20-30%, a factor of 3-6 higher than constitutive MT emissions. Stress induced changes of BVOC emissions strongly impacted BSOA formation, causing increased (SQT, MeSa, C17-BVOC) or decreased (GLV) SOA formation. Implementing the experimental results in the EMEP model, together with estimated fractions of stressed trees for mid-latitude and Boreal regions, showed that SIE-SOA may dominate biogenic SOA.

Biotic stress that increases SIE thus supports negative climate feedback. This may be effective already today. But heat and drought can turn the negative feedback into a positive feedback in forests dominated by de-novo emitters. Since it is likely that climate change will affect SIE from vegetation, SIE and their BSOA formation potential have to be considered in future climate scenarios.

TP5-O-17: Ultrafine particles and rainfall trends: evidence from airborne studies?

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Modification of cloud microphysics by anthropogenic aerosols is well known since several decades. However, how the underlying processes lead to changes in precipitation is by far less confirmed. A variety of factors affect the production of rain in a way that causality between increasing aerosol load in the atmosphere and a change of annual rainfall is very difficult to confirm. What would be expected as an effect of additional cloud condensation nuclei is a shift in the spatial and temporal rainfall distribution towards a lower number of days with low rain intensity and more frequent or more vigorous single events. In fact such a shift has been observed in several locations worldwide and has been suggested to be caused by increasing aerosol load, however, without further specification of the nature and number of the aerosols involved. Measurements of aerosols, which can be important for cloud properties, are extremely sparse and no long term monitoring data sets are available up to now.

The problem of missing long-term aerosol data sets that can be compared to available meteorological data can

possibly be resolved in certain areas where well-characterised aerosols from sources with well-known history were introduced in otherwise pristine areas. Of special interest are ultrafine particles that are not interacting with short wave radiation. Their climatic impact is solely restricted to cloud processes, brightening and droplet size changes, leading to rainfall modification. We investigated aerosol sources and current ultrafine aerosol number, size and spatial distributions with airborne measurements in the planetary boundary layer over two regions in Australia that are reported to suffer from extensive drought and occasional torrential rainfall. Within these regions, water vapour (dewpoint) in the atmosphere is reported to increase slowly and constantly. Such an increase of the total water in the planetary boundary layer could imply also an increase in annual precipitation as observed globally in many other locations elsewhere. The observed contrary regional decline of rainfall thus might be explained by a local to regional scale physical process modifying cloud properties in a way that rainfall spatial, temporal and intensity distributions are modified.

We observed enhanced numbers of anthropogenic ultrafine particles as precursors of cloud condensation nuclei from well documented sources. We are thus able to reconstruct also their historical development even without having a continuous data record. The derived aerosol trends are well in agreement with the observed negative trends in precipitation based on the assumption that the ultrafine particles lead to CCN and that these additional CCN in a first step delay the production of raindrops allowing more efficient horizontal transport to redistribute rainfall.

TP5-O-18: The anthropogenic contribution to black carbon concentrations in South Africa

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South Africa has one of the largest industrialised economies in Africa that continues to grow. Particularly activities in the Johannesburg-Pretoria area with a population of more than 10 million result in high emissions and local pollution. Despite its vulnerability to the impacts of air pollution, Africa is one of the least-studied continents in atmospheric sciences.

This study analyses the contribution of anthropogenic emissions to the total BC concentrations in South Africa by conducting modelling experiments with the Weather Research and Forecasting (WRF) model including chemistry and aerosols (WRF-Chem). The model domain covers large parts of Southern Africa with a horizontal resolution of 15 km. The model is integrated from September through December 2010 for which a comprehensive set of BC measurements is available.

The modelled BC concentrations are compared with measurements obtained at the Welgegund station situated ca. 100 km west of Johannesburg. The Welgegund data set is one of the most comprehensive and regionally representative BC measurements in South Africa currently available. The BC concentrations at Welgegund are impacted by air masses representing the regional background and by pollution plumes from the industrialised areas around Johannesburg and Pretoria.

The first part of this study presents an in-depth evaluation of WRF-Chem with observational data from ground-based measurement stations, radiosondes, and satellites. The second part presents the results from two sensitivity studies assessing the anthropogenic contribution to BC in South Africa. In the first sensitivity study anthropogenic BC emissions are deactivated and emissions from open burning are scaled down to pre-industrial values. The second sensitivity study also takes into account co-emitted species, i.e. emissions of OC, SO_2 and SO_4, in order to estimate the overall effect of anthropogenic BC emissions on aerosol loading, aerosol optical depth, and heating rates.

TP5-O-19: Air quality modelling in the Kathmandu Valley and surroundings

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The city of Kathmandu in Nepal has been rapidly growing over the last two decades and is now experiencing one of the worst air pollution problems in South Asia. The SusKat project (Sustainable Atmosphere for the Kathmandu Valley) is aiming at addressing air pollution in Nepal in a science-based way with a special focus on the Kathmandu Valley. One of the main activities includes a measurement campaign (SusKat-ABC) in Nepal that took place from December 2012 through June 2013. In order to support the analysis and interpretation of the measurement data as well as to improve the understanding of the meteorological and chemical processes leading to the observed high pollution levels in the valley, model experiments with the Weather Research and Forecasting (WRF) model including chemistry and aerosols (WRF-Chem) are being performed.

Due to the high impact of the meteorology on air quality the initial focus of this study is to identify the dominant large scale weather patterns and to better understand the main meteorological circulation in the valley. To this end the WRF model was set-up over South Asia, Nepal and the Kathmandu Valley using a nested approach. A second focus is to look into long-range transport of particulate matter (PM) and black carbon (BC) into and out of the valley to quantify the contribution of the valley to the regional air pollution. Because of the complex topography of the Himalayan Mountains the modelling of this region is very challenging

and requires a careful evaluation of both simulated meteorology and air quality. First results of WRF-Chem simulations show that a the choice of the model settings including e.g. the schemes for radiation, aerosols and dust and of the input data such as the emissions is important to reproduce the observations taken during the SusKat-ABC campaign reasonably well.

Poster presentations:

TP5-P-01: Simulating the ozone distribution over Europe in May 2008 with a new photolysis module for COSMO-ART

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Atmospheric chemistry is driven by solar radiation induced photodissociation of atmospheric trace gases. Thus, the calculation of the actinic flux and hence of the photodissociation frequencies is an essential part in the simulation of atmospheric trace gas distributions.

PAPA, the original photolysis module of COSMO-ART, calculates the photodissociation frequencies by using a look-up table of photolysis frequencies for specific heights and a pre-calculated actinic flux profile. As the actinic flux is calculated down to wavelength of 290 nm only, the PAPA module is limited to the calculation of tropospheric photodissociation frequencies.

As an alternative we replaced the PAPA module by an adjusted version of Fast-JX. Thereby the online calculation of the actinic flux which includes wavelengths down to 170 nm depending on the actual state of ozone, temperature, pressure, relative humidity and liquid water path result in photolysis rates which are usable for the simulation of tropospheric as well as stratospheric trace gas distributions.

In this study, we present a comparison of the photolysis rates calculated by PAPA and Fast-JX and use the regional chemical transport model COSMO-ART to investigate the sensitivity of the simulated ozone distribution over central Europe in May 2008 to the photolysis rates calculated by the two photolysis schemes implemented in COSMO-ART.

TP5-P-02: Horizontal water vapour transport in the lower stratosphere from subtropics to high latitudes during boreal summer

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We compare global water vapour observations from MLS and simulations with the Lagrangian chemical transport model CLaMS to investigate the pathways of water vapour into the lower stratosphere during northern hemisphere (NH) summer. We find good agreement between the simulation and observations, with an effect of the satellite averaging kernel especially at high latitudes. The Asian and American monsoons emerge as regions of particularly high water vapour mixing ratios in the lower stratosphere during boreal summer. In NH mid and high latitudes, a clear anti-correlation between water vapour and ozone daily tendencies reveals a large region influenced by frequent horizontal transport from low latitudes, extending up to about 450 K during summer and fall. Analysis of the zonal mean tracer continuity equation shows that close to the subtropics, this horizontal transport is mainly caused by the residual circulation. In contrast, at higher latitudes, polewards of about 50 N, eddy mixing dominates the horizontal water vapour transport. Model simulations with transport barriers confirm that almost the entire annual cycle of water vapour in NH mid latitudes above about 360 K, with maximum mixing ratios during summer and fall, is caused by horizontal transport from low latitudes. In the model, highest water vapour mixing ratios in this region are clearly linked to horizontal transport from the subtropics, in particular from the Asian monsoon region.

TP5-P-03: Stratospheric chemistry and gravity wave drag within a coupled AOGCM

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The coupled atmosphere-ocean-sea ice model ECHAM/MPIOM-ISP in different setups was utilised to carry out equilibrium simulations focusing on feedbacks between stratospheric ozone and the general circulation of the atmosphere. Such feedbacks are detected by comparing simulations with enabled and disabled interactive stratospheric chemistry, where the disabled version used fixed ozone climatology within the models radiation scheme. Due to historical reasons, this was first done in a ECHAM4 setup with a spectral resolution of T30, but meanwhile enhanced to ECHAM5 / T63. On one hand, a comparison of the results for the differing model setups supports the robustness of major signals as a weakening of the stratospheric polar vortex in response to ozone adjustments within the interactive case of the stratospheric chemistry. Nevertheless, on the other hand, the model state also shows a high sensitivity to gravity wave drag changes as e.g. induced by the enhanced model resolution. The role of gravity wave drag as a dynamical key factor for climate models is investigated by a sensitivity study using the ECHAM5/T63 setup with differing ‘tuning‘ of the gravity wave drag scheme.

TP5-P-04: Modelling feedbacks between biogenic emissions and air chemistry from site to globe

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Changes in CO_2 levels and climate are expected to significantly alter the emission capacities of vegetation, leading to changes in trace gas emissions from plants, particularly isoprenoids. This, combined with changes in anthropogenic emissions, has the potential to impact tropospheric air chemistry, i.e. ozone levels and aerosol formation. Ozone and CO_2 are affecting plant physiology with positive as well as negative impacts on emissions. However, no regional or global model today is capable of considering these feedbacks.

We present the implementation of a new model describing light-dependent emission of volatile organic compounds (BVOC) that derives isoprenoid production directly from the electron transport potential and consumption from photosynthesis. Photosynthesis information requirements are designed to be met by many recent land-surface models that apply the Farquhar assimilation scheme, e.g. JULES or CLM.

The new approach has the advantages that 1) the commonly observed decrease of (isoprene) emission with increasing CO_2 air concentration is considered by the competition on energy between photosynthesis and emission processes, and 2) air pollution impacts may be considered as inducing emissions by activating emission enzymes as well as decreasing substrate supply from photosynthesis, and 3) many environmental drivers of BVOC emissions are implicitly considered in the description of plant photosynthesis and phenology, reducing the demand for species-specific emission parameters.

We investigate the parameter sensitivity of the suggested model as well as the sensitivity of emissions to a range of environmental conditions with a particular focus on CO_2 responses. We present evaluation at the site level and compare the model with other approaches. Finally, we demonstrate the implementation into a coupled global-air chemistry model and discuss the requirements to properly parameterise plant functional types.

TP5-P-05: Understanding ozone pollution: A comparison of chemical mechanisms

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Tropospheric ozone (O_3) is a short-lived climate forcing pollutant produced by reactions of volatile organic compounds (VOCs) and nitrogen oxides (NO_x) in the presence of sunlight. This complex chemistry is represented in models using a chemical mechanism whose level of detail is dependent on the modelling study. For example, global/regional modelling studies use a more simplified chemical mechanism than process oriented box modelling studies. This has given rise to a number of chemical mechanisms that use different approaches to reducing the number of chemical species and reactions as well as the representation of emitted VOCs. The resulting mechanisms have differing treatments of VOC degradation which affects the amount and timing of ozone production. These discrepancies could impact predicted air quality levels in urban emission scenarios.

In this study, Tagged Ozone Production Potentials (TOPP) [Butler et al., 2011] are calculated for a number of VOCs using chemical mechanisms that are typically utilised in regional and global modelling studies. The TOPP values obtained are compared to those calculated with the latest version of the near-explicit Master Chemical Mechanism (MCM v3.2). TOPPs measure the effect of VOC degradation on the odd oxygen family (O_x) which includes O_3, nitrogen dioxide (NO_2) and other species whose cycling effect O_3 and NO_2 production. TOPP values are obtained via a box model run lasting seven diurnal cycles and tagging all the organic species produced during VOC degradation. This tagging approach enables the O_x production to be attributed back to the emitted VOC and allows a detailed comparison of the tropospheric chemistry described in the mechanisms.

Initial results indicate that lower O_3 production is achieved when less explicit chemistry is used. This is traced back to how quickly the emitted VOC is broken down into degradation products with a lower number of carbon atoms. VOCs are broken down more slowly in more explicit mechanisms which results in more degradation steps through which more O_3 can be formed.

TP5-P-06: Contributions of road traffic emissions to tropospheric ozone on global and regional scale

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Road traffic is an important source of anthropogenic emissions. Especially the emissions of nitrogen oxides (NO_x), carbon monoxide (CO) and non-methane hydrocarbons (NMHC) are important, as they are precursors for the formation of ozone within the troposphere. This process of ozone formation is strongly non-linear and differs significantly between urban and rural areas. Despite this non-linearity most urban areas cannot be resolved explicitly in current global chemistry-climate-models with a resolution around 2°. This leads to a mixing of emissions from rural and urban areas within one grid box. Especially when

investigating emissions from sectors which are strongly bound to urban areas an increased resolution of chemistry-climate-models is desirable to account for such regional effects.

For this reason we investigate the impact of road traffic emissions with the MECO(n) model-system (MESSy-fied ECHAM and COSMO models nested n-times). This model system features an on-line coupling of the regional scale chemistry-climate-model COSMO/MESSy (in one direction) with the global chemistry-climate-model EMAC. New boundary conditions for the dynamical and chemical fields are provided every time step of the global model. In addition, we are using the same chemistry module MECCA and diagnostic methods on both scales, making our model chain as consistent as possible. To quantify the contribution of the road traffic emissions to tropospheric ozone we use an accounting system of the relevant reaction pathways of the different species from different sources (called tagging method).

Due to our consistent model chain we are able to compare our results on the global and the regional scale directly. Therefore we can quantify the effects of the horizontal resolution and analyse if such increased resolutions are important for detailed ozone diagnostics. We present first results of our simulations focusing on the different effects on the global and the regional scale.

TP5-P-07: Cluster analysis of European surface ozone observations for evaluation of MACC reanalysis data

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The high density of European surface ozone monitoring sites offers unique opportunities for the evaluation of chemistry climate models. We analyse the regional representativeness of European ozone measurements through Cluster Analysis (CA) of European air quality data (Airbase) from about 1500 stations. The resulting clusters are used as means to stratify the comparison with the corresponding model output interpolated to the site locations. The model used is the Model of Ozone and related Tracers (MOZART) that is applied in the Monitoring Atmospheric Composition and Climate (MACC) project.

Two different CAs are implemented: in the first one monthly averaged diurnal variation of the individual ozone time series for the period 2007-2010 are used as initial set of variables. This CA finds 5 clusters, mainly distinguished by the mean ozone concentrations. It also reveals differences in seasonal-diurnal cycles, showing typical patterns of the ozone behaviour for traffic, urban, sub-urban, rural and elevated regions. The second CA uses the same set of variables, but normalised on the total mean for each station. It reveals 4 groups differing mainly by diurnal and seasonal amplitudes but including also information on variability. Here, elevated locations don't form a separate group as in the first analysis, but instead are subsumed in the cluster of relatively clean stations. Other clusters keep the features of the ozone behaviour for traffic, urban and sub-urban regions.

When grouped according to the corresponding Airbase clusters, the MOZART model output does not show clearly distinguishable patterns between groups, although some features of the ozone behaviour are reproduced. In accordance with the observations, all MOZART cluster averages exhibit diurnal maxima between noon and 3 pm. In contrast, seasonal variations are somehow worse described than diurnal. The model is not able to capture characteristics of seasonal cycles in clusters, as well as tends to overestimate ozone concentrations of clusters with polluted signatures indicating a high bias. While some of these differences reflect the fact that a coarse resolution model cannot resolve urban-scale photochemistry very well, other discrepancies clearly point to model deficits in process descriptions. In particular, for the stations, which show a seasonal maximum in spring, the model generates a broad summer maximum in June-July.

TP5-P-08: Effect of 'low-wind' circulation types on air pollution conditions in present and future climate

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Air pollution has become a serious problem in many industrialised and densely-populated urban areas due to its negative effects on human health, infrastructure and the natural environment. The concentration of air pollutants is the result of several factors, including emission sources, lifetime and spatial distribution of the pollutants, atmospheric properties and interactions, wind speed and direction, or topographic features. Episodes of air pollution are often associated with stationary or slowly migrating anti-cyclonic (high-pressure) systems that reduce advection, diffusion, and deposition of atmospheric pollutants. Certain weather conditions facilitate the concentration of pollutants, such as the incidence of light winds reducing the efficiency of long-range transport of pollutants. Overall, low wind or no wind results in stagnant conditions allowing pollutants to build up over an area which is a serious threat to human health. Therefore, the atmospheric circulation plays an important role in air quality conditions that are affected by both synoptic and local scale processes. Moreover, changes in synoptic-scale patterns affect directly the transport of pollutants. Given the relevance of the synoptic-scale circulation on air quality, the focus of this project is to investigate the relationship between atmospheric circulation patterns and the concentration of air pollutants, as well as their residence time. Large-scale circulation patterns have been widely used for many purposes in clima-

tology, biometeorology, atmospheric, physics, and chemistry. Therefore a classification of atmospheric circulation is used as a tool to analyse the relationship between episodes of air pollution to the various synoptic weather situations. Moreover, this relation will be assessed under present climate conditions in different locations as well as under future climate scenarios.

TP5-P-09: Analysis of the WRF-Chem simulations contributing to the AQMEII-Phase II exercise with respect to aerosol impact on precipitation

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In order to quantity feedback effects between air quality and meteorology the second phase of the AQMEII (Air Quality Model Evaluation International Initiative; http://aqmeii.jrc.ec.europa.eu/) model intercomparison focused on online coupled meteorology-chemistry models. Seven of the participating groups contributed simulations with WRF-Chem (Grell et al., 2005) for Europe. In order to study the impact of the aerosol direct and indirect effect on predicted meteorological variables and on pollutant distributions the simulations included different degrees of feedback, ranging from no aerosol effects at all to the inclusion of the aerosol direct radiative effect plus aerosol cloud interactions and aerosol indirect effect. Pronounced feedback effects were found for the 2010 Russian wildfire episode. The strongest and most persistent feedback due to the indirect aerosol effect was found for regions with very low aerosol concentrations like the Atlantic and Northern Europe. There, the predicted low aerosol concentrations result in very low cloud droplet numbers which lead to over Northern Scandinavia in summer in almost one degree higher mean temperatures. Precipitation over the Atlantic Ocean was up to 30% higher when predicted aerosol concentrations were accounted for cloud droplet formation.

TP5-P-10: Development and model application of a new parameterization framework for the heterogeneous ice nucleation in tropospheric clouds

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Aerosols of different nature induce interactions and processes of importance for the earth's atmosphere. They e.g. directly affect the radiative budget and essentially influence the formation and life cycles of clouds through ice nucleation processes. Hence, aerosols and their ice nucleating ability are an important input parameter for weather and climate models.

During the previous years, the AIDA (Aerosol Interactions and Dynamics in the Atmosphere) cloud chamber was used to extensively measure, under nearly realistic conditions, the ice nucleating properties of different aerosols.

Numerous experiments were performed with a broad variety of aerosol types and under different freezing conditions. A reanalysis of these experiments offers the opportunity to develop a uniform parameterisation framework of ice formation for many atmospherically relevant aerosols in a broad temperature and humidity range. The analysis includes both deposition nucleation and immersion freezing.

The aim of this study is to use the AIDA data set for developing a comprehensive parameterisation for heterogeneous ice formation mainly by using the ice nucleation active site (INAS) approach. The new parameterisation is implemented in the COSMO- ART model and applied in case studies in different regions and considering different cloud types.

This contribution will show the new parameterisations for immersion freezing and deposition nucleation of soot aerosols and desert dust particles. First model runs on the role of heterogeneous ice nucleation in cirrus formation will also be shown and the model results will be compared with in-situ measurements.

TP5-P-11: Improvement of atmospheric pollen load forecasts by using dynamic plant growth models: Suitability of temperature sum models to simulate birch flowering periods on regional scale

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Persons susceptible to allergenic pollen grains need to apply suppressive pharmacy before the occurrence of the first allergy symptoms.

Patient-targeted medication could be improved if forecasts of the allergenic potential of pollen emissions and the actual allergenic potential are precise on regional scale. The allergenic potential is determined by the biochemical composition. In plant tissue the biochemical composition may change within hours due to resource availability for plant growth and plant internal nutrient re-mobilisation, and the organ specific demand.

These processes highly depend on both, the environmental conditions and the development stage of a plant. Therefore, dynamic plant models that consider the dependence of the chemical composition of tissue on the development stage of the plant embedded in process-based ecosystem models seem promising tools to improve forecasts of pollen emissions; however, today dynamic plant growth is widely ignored in simulations of atmospheric pollen loads.

In this study we analyse to which extent frequently-applied temperature sum models could simulate the onset of flowering of birches on a regional scale in Bavaria. Temperature sum models integrate average temperatures above a base temperature below which no further bud development is assumed. In this study we achieved the best simulation results using base-temperatures below 0 °C, which is much lower as frequently used base temperatures. A more regional calibration of the models to sub-regions in Bavaria with comparable climatic conditions further improved the simulation results indicating the need for a more local adjustment of birch phenology models. The simulation results may be biased if the base temperatures are assumed constant for all birches and are transferred to other regions with different climatic or environmental conditions, or when applied to extrapolate birch pollen seasons to future climate conditions.

TP5-P-12: Heat waves, urban vegetation and air pollution

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Fast-track programs to plant millions of trees in cities around the world aim at reduction of summer temperatures, increasing carbon storage, storm water control, and provision of space for recreation and poverty alleviation. Although these multiple benefits speak positively for urban greening programs, the programs do not take into account how close human and natural systems are coupled in urban areas. Elevated temperatures together with anthropogenic emissions of air and water pollutants distinguish the urban system. Urban and sub-urban vegetation responds to ambient changes and reacts with pollutants. Neglecting the existence of this coupling may lead to unforeseen drawbacks of urban greening programs. The potential for emissions from urban vegetation combined with anthropogenic emissions to produce ozone has long been recognised. This potential increases under rising temperatures. Here we investigate how global change induced heat waves affect emissions of volatile organic compounds (VOC) from urban vegetation and corresponding ground-level ozone levels. We also quantify other ecosystem services provided by urban vegetation (e.g., cooling and carbon storage) and their sensitivity to climate change. In this study we use Weather Research and Forecasting Model with coupled atmospheric chemistry (WRF-CHEM) to quantify these feedbacks in Berlin, Germany during the heat waves in 2003 and in 2006. We highlight the importance of the vegetation for urban areas under changing climate and discuss associated tradeoffs.

TP5-P-13: A study of reactive nitrogen intrusions into the stratosphere with vertically extended EMAC.

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The impact of the variable solar activity on the tropospheric weather and climate is a subject to active discussions within the scientific community and a topic of steady attention from the general public. Over decades it has been thought that such an impact may be provided by the direct changes in the radiation budged. Lately, the triggering of atmospheric composition changes by high-energetic precipitating particles was suggested as another possible mechanism linking solar variability and the earth‘s climate. More specifically, the events of the downward transport of the reactive nitrogen presumably from the MLT to the stratosphere under the polar winter conditions have been observed by satellite instruments, such as MIPAS on-board the ENVISAT. Such intrusions may have a significant impact on the NO_y budget of the middle atmosphere and hence on the ozone chemistry.

The aim of the project is to bridge the gap between climatology and space science because such atmospheric coupling can only be captured and understood in models describing all involved regions consistently, including chemical tracers spanning the thermosphere to the stratosphere. We report the results of the vertically extended version of the EMAC Climate Chemistry model. The extension should allow to realistically simulating mesosphere/lower thermosphere coupling processes. The model climatology and the passive tracer experiments are going to be presented.

TP5-P-14: Teaching a basic understanding for the material networks of Planet Earth with simple, global, dynamic material flow models

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The long term development of Planet Earth is governed by complex, dynamic networks of material flows. These flows connect the spheres of Earth (Atmos-, Bio-, Hydro-, Litho-, Kryosphere) in complex ways but with different kinetics which are also influenced by external variations (gravitation, energy exchange). For the development of a basic understanding of these interactions, global, dynamic but simple models help. They are designed with a dynamic modelling tool (GoldSIM®). For a time frame of more than 20 and less than 1000 years, a window of statistically constant parameters exists.

Within this window of stability, global, dynamic but simple models can be designed. They consist of reservoirs (sources, sinks) and material flows among them as well as the parameters for the flows. With a simple model comprising atmos-, bio- and lithosphere plus the connecting material flows, it is possible to design a first simple but powerful model. By adding the oceans and the connecting material flows, one sees the big influence of these elements. To reduce complexity, the material network is broken down into independent ones of key components such as H_2O, N_2, O_2, others and, as the basic of life, the carbon-network. The C-network offers the possibility to tackle key questions of climate change and thus was modelled first. Other networks will follow.

Taking the climate parameters atmospheric CO_2-content ($ppmvCO_2$) and Global Mean Surface Temperature (GMST) as modelling targets, it is possible to compare the results with existing scientific data. The comparison for the backward calculation till 1850 is very good and thus the model is used to model future scenarios. Results of these future scenarios are in good accordance with similar IPCC forecasts.

TP5-P-15: Five years observations the urban atmosphere by ceilometer, sun photometer and ozonemeter over Sofia, Bulgaria (2009-2013)

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This work describes analysis of ground based observation of aerosol optical depth (AOD), water vapour content (WVC), total ozone (TO) and height of planetary boundary layer (PBL) carried out during a period of five years (2009-2013) over mountain valley - Sofia (42° 39' N, 23° 23" E, 591 m a. s. l.).

The paper presents some results from the investigation of the aerosol structure of the atmosphere by means of a ceilometer- lidar CHM15k, sun photometer Microtops II, ozonemeter Microtops II and an automatic meteorological station. The combination of ceilometer and sun photometer measurements provides comprehensive information on both the total aerosol optical thickness in the entire atmosphere as well as the vertical structure of aerosol optical properties.

Atmospheric aerosol is known to considerably influence the earth's radiative budget and to make an impact on air quality. The influence of aerosols strongly depends on their spatial distribution and optical properties.

Additional resource of information about the origin of the aerosol layers detected by the ceilometer CHM15k offered the HYSPLIT back trajectory model, BSC-DREAM8b dust model data and the database of atmospheric radio sounding profiles from Department of Atmospheric Engineering of Wyoming University (USA) are also used.

The ground-based observations from ozonemeter Microtops II are compared with satellite observations of Ozone Monitor Instruments (OMI) over Sofia (Bulgaria).

TP5-P-16: Extreme values analysis of air quality pollutants in the two largest metropolitan areas of Brazil

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Air quality has been significantly influenced by emissions resulting from mobile and stationary sources that also affect people's health and the environment in general. The harmful effects are more evident in megacities such as the metropolitan areas of São Paulo (MASP) and Rio de Janeiro (MARJ). Therefore, this study aimed to compare the standards of air quality in these two regions through the application of extreme values theory for ozone (O_3) and inhalable particulate matter (PM10). The generalised extreme value distribution (GEV) was applied to the monthly maxima of hourly concentration measures clustered in two seasonal groups. Also, generalised Pareto distribution (GPD) was applied to the exceedances of threshold (95% quantile) of the daily maximum concentrations. We used data from 1996 to 2011 in MASP and from 2005 to 2011 in MARJ. The GEV approach showed that in MASP, the probability of occurrence of extreme values depends on the time of the year analysed i.e. for PM10 the possibility is higher in Nossa Senhora do Ó for winter and in Ibirapuera for spring/summer. For O_3, it occurs in Ibirapuera for winter and in Pinheiros during spring/summer. The MARJ presented more chance to record high levels of concentration of PM10, which also occurs in MASP. It was observed in the MASP, based in results from GPD model, that the station with the higher probability of extreme value occurrence for PM10 is Parque D. Pedro II and for O_3 is Pinheiros. However, the Ibirapuera

station showed the highest number of exceedances to the threshold for both pollutants. In MARJ, PM10 was more likely to have higher values of concentration, while in MASP it was O_3. Furthermore, it was observed in MASP a defined pattern of pollutants concentrations in different times of the year such as winter and summer, which did not occur in MARJ.

TP5-P-17: Climate change and influence of smoke from wildfires to health of population in megacities

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SEVER-FIRE is a new global mechanistic fire model which calculates number of human-induced and lightning fires as well as area burnt and carbon and particle emissions for both cases. The model operates at a daily time step and uses climate data (daily minimum/maximum temperature, daily precipitation/convective precipitation and daily shortwave radiation) as an input. The model works in an interactive mode with a dynamic global vegetation model (DGVM), which provides fuel content and moisture and receives back amount of biomass burnt. SEVER-FIRE applies at a variable spatial resolution and for regional and global scale. This model was applied for simulation of Russian wildfires in 2010 as an example of influencing of smoke from wildfires to health of population in the nearest megacities.

The fires were set due to extremely hot weather started in Central Russia in the end of June 2010 and lasted during almost two months till the end of August 2010. The long period average monthly temperatures for the two heat wave months in almost entire European part of Russia were exceed 8-9 °C with an absolute record summer temperature for Moscow 38.2 °C. Moscow, the largest megacity of Europe (16 billion inhabitants) was covered by thick smoke for several weeks. The air quality in the city was significantly affected by excessive amount of carbon monoxide, nitrogen oxides and aerosols during the fires outbreak. Most dangerous and even lethal for the population was air pollution with particulate matter PM10. Concentrations of PM10 according to our calculations were ten times higher in comparison with pre-fire level in Moscow region during August 2-10, 2010, when large smoke plume has covered entire capital agglomeration of Russia.

By comparing the effects Indonesian fires had in 1997 on Singapore, we found that at least 450 deaths related to cardio-vascular and respiratory problems happened during August 2-10 2010 in Moscow. Thus, particulate emissions from wildfires are becoming pressing health problem for Moscow in conditions of more frequent circulation blockings caused by climate change. We make simplified estimates of a potential health risk in large cities due to aerosol emissions from wildfire for other megacities (Moscow, Los Angeles, Singapore, Kuala Lumpur and Sydney).

TP5-P-18: Influence of biogenic and anthropogenic factors on pollen allergenicity and allergic sensitization

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Evidence is compelling for a positive correlation between urbanisation and increment of allergic sensitisation and diseases. The reason for this association is not clear to date. Some data point to a pro-allergic effect of anthropogenic factors on susceptible individuals. Data analysing the impact of environmental – natural and anthropogenic – factors on the allergenicity of allergen carriers such as pollen grains are scarce. This study evaluates the effect of natural (e.g. climate) and anthropogenic (e.g. traffic pollutants) factors on birch pollen in a holistic approach. Moreover allergenicity of pollen will be placed in context to allergic sensitisation and symptoms of subjects (KORA-FF4) living in the surrounding of the respective tree. The results of this study will significantly add to our understanding how urbanisation and climate change influence the allergenicity of birch pollen and how this will impact on allergic sensitisations and symptom severity. Therefore birch trees from urban and rural sites in the surrounding of KORA subjects in Augsburg were selected and sites were characterised for NO_2 and O_3 by passive samplers (n=40). Temperature, NO_x, PM2.5, PM10 and black smoke exposition of the trees will be determined by temperature- and pollution models. Pollen was categorised according to maturation state and allergenicity was analysed by ELISA for Bet v 1, LTB4 and PGE2. First results show that urban trees are exposed to significant higher NO_2- and lower ozone concentrations, while Bet v 1 concentrations of urban and rural trees do not significantly differ. The results of this study will significantly add to our understanding how urbanisation and climate change influence the allergenicity of birch pollen and how this will impact on allergic sensitisations and symptom severity.

TP5-P-19: Increase in northern hemisphere stratospheric hydrogen chloride over recent years

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The abundance of chlorine in the earth's atmosphere increased considerably during the 1970s-1990s, following large emissions of anthropogenic long-lived chlorine-containing source gases, notably the chlorofluorocarbons (CFCs). The chemical inertness of CFCs allows their transport and mixing throughout the troposphere on a global scale before they reach the stratosphere where they release chlorine atoms that cause ozone depletion. The large ozone loss over Antarctica was the key observation which stimulated the definition and signing of the Montreal Protocol in 1987, an international treaty establishing a schedule to reduce the production of the major chlorine- and bromine-containing halocarbons. Owing to its implementation, the near-surface total chlorine concentration showed a maximum in 1993, followed by a decrease of 0.5-1 %/yr, in line with expectations.

Remote-sensing data revealed a peak in stratospheric chlorine after 1996, then a decrease at rates close to -1%/yr, in agreement with the surface observations of the chlorine source gases and model calculations. However, here we present ground-based and satellite data which show a recent and significant increase in hydrogen chloride (HCl), the main stratospheric chlorine reservoir, starting around 2007 in the northern hemisphere (NH) lower stratosphere, contrasting with the ongoing monotonic decrease of near-surface source gases. Using model simulations, we attribute this trend anomaly to a slowdown in the NH atmospheric circulation, occurring over a few consecutive years, transporting more aged air to the lower stratosphere, characterised by a larger relative conversion of source gases to HCl. This short-term dynamical variability will also affect other stratospheric tracers and needs to be accounted for when studying the evolution and recovery of the stratospheric ozone layer.

Session Abstracts Topic 6:

Extreme meteorological events and their impacts in a changing climate

TP6-O-01: Projection of occurrence of extreme heat waves in Europe with heat wave magnitude index

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Heat waves are defined as prolonged periods of extremely hot weather and their magnitude and frequency are expected to increase in the future due to climate change.

Here we present a new Heat Wave Magnitude Index (HWMI) based on the analysis of daily maximum temperature from European Observation dataset (E-OBS), in order to classify the strongest heat waves that occurred in Europe from 1961 until 2013. In addition, results from five bias-corrected regional climate models provided by the ENSEMBLES project and from the Coordinated Regional climate Downscaling EXperiment (CORDEX) are used to project future occurrence and severity of heat waves under different emission scenarios, i.e. A1B, RCP4.5 and RCP8.5. Understanding and quantifying the present-day heat waves on a unique scale is a crucial basis for a reliable projection into the future.

By analysing observed and modelled daily maximum temperatures in current climates, we conclude that in Europe heat waves have been increasing in frequency and magnitude in the most recent decade (2004-2013) compared to the past decades. Moreover, model predictions suggest an increased probability of occurrence of severe heat waves in the coming 30-90 years: in particular, by the end of the century, and under the most severe IPCC AR5 scenario, events of the same severity as the 2010 Russian heat wave will become the norm and are projected to occur as often as every two years in the studied region.

TP6-O-02: Causes for cold biases in a regional reanalysis of weather and climate in Berlin, Germany, and their implications for analysing heat-stress events

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Heat stress is one of the hazards expected to increase in the future due to global climate change. Many epidemiological studies could show the close links between elevated air temperatures and increased morbidity and mortality, which are not restricted to subtropical and tropical regions but also common in cities at higher latitudes such as Berlin (52.5° N). Heat-stress risks are particularly high in urban regions, since urban climate modifications of regional weather conditions tend to increase heat-stress hazards.

This study analyses the applicability of a numerical weather prediction (NWP) model for generating a high-resolution regional reanalysis data set for investigating the impact of elevated air temperatures on heat-stress risks in Berlin, including an assessment on the effect of densely built-up areas as amplifier of heat-stress hazards. The latter implies that reanalysis data must be suitable for analysing heat-stress events both in urban and rural areas. However, NWP models like the Weather Research and Forecasting (WRF) model used in this study are known to notoriously produce cold biases in near-surface air temperature, which might hamper or even prevent its application for this purpose. Indeed, we identified cold biases, which were found within the city, and also at a nearby rural site (Lindenberg) for which extensive data from field observations are available.

We will present and discuss a comparison between reanalysis and field data with respect to cold biases in air temperature and their causes. We will also show if, how and how far these biases could eventually be reduced. Finally, we will briefly discuss why these biases do not seriously affect temporal analyses of heat-stress events in Berlin.

TP6-O-03: Heat-stress events and excess mortality in Berlin, Germany, as resolved by a regional reanalysis of weather and climate

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Heat stress is one of the hazards expected to increase in the future due to global climate change. Recently, an epidemiological study could show for Berlin that episodes of elevated air temperatures regularly occurring two or more times in each year are related with increased mortality rates, such that about 5% of all deaths in Berlin in the period from 2001 to 2010 can be attributed to heat stress (Scherer et al., 2013). This implies that not only rare extreme weather events (heat waves) are responsible for excess deaths due to heat stress (including indirect effects) but also non-extremal weather conditions with recurrence intervals of less than one year.

In this study, we will show how far the method of defining heat-stress hazards influences assessment of excess mortality risks in Berlin. Heat-stress hazards may be defined by using data from weather stations at different sites in Berlin. Regarding utilisation of future climate projections, a definition based on gridded atmospheric data would be beneficial. Then, applicability of such data for risk assessment must be validated. We will discuss a first attempt to quantitative assessment of heat-stress related mortality risks using data from a regional reanalysis of weather and

climate in Berlin, which is currently performed. A 10 km gridded data set of hourly temporal resolution is already available for the time period from 2001 to 2012. The reanalysis will be further down-scaled to a 2 km grid and continuously updated in the future.

TP6-O-04: Assessment of a Multi Model Ensemble to Forecast the European 2003 Drought

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Agricultural droughts are considered among the most catastrophic natural disasters because they have the potential to diminish crop yields causing economic damage or threatening the livelihood of societies. An agricultural drought occurs if a soil moisture index is falling below a threshold (typically, a quantile that is equalled or exceeded 20% of the time). State of the art drought monitoring and forecasting systems combine information from various observational data sources to provide the best possible estimate of current drought conditions. Additionally, some of these systems also incorporate seasonal meteorological forecasts to estimate future drought conditions. Meteorological forecasting skill, however, in particular that of precipitation, is limited to a few weeks because of the chaotic behaviour of the atmosphere. One of the most important challenges in drought forecasting is to understand how the uncertainty in the atmospheric forcings (e.g. precipitation) is further propagated into hydrologic variables such as soil moisture. A large atmospheric ensemble has the potential to overcome the aforementioned challenge. The North-American Multi-Model Ensemble (NMME) is the latest collection of a multi-institutional seasonal forecasting ensemble and allows testing the hypothesis that a large meteorological ensemble increases drought forecasting skill at various lead times. The aforementioned hypothesis is tested for the European 2003 drought event. The monthly NMME forecasts are bias-corrected and downscaled to daily values to force the mesoscale hydrological model (mHM). Preliminary results indicate that the full NMME leads to more robust drought statistics than those obtained if only limited forecasts are considered.

TP6-O-05: Statistical Analysis of Future Projections of Extreme Winds and their inclusion in Current Infrastructure Planning

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Extreme winds cause vast amounts of damage every year and this represents a major concern for numerous industries including construction, insurance, afforestation, wind energy and many others. Improving our understanding of extreme events and estimating how their frequency and magnitude are likely to vary in the future is a critical component of climate change adaptation. Accurate projections of these changes will be invaluable to decision makers and to society as a whole.

Extreme winds over Europe have been estimated using a peaks-over-threshold method and the Generalised Pareto Distribution (GPD) to obtain the projected change in the 50-year return wind, along with the associated uncertainties. This was done for four downscalings consisting of two different GCMs downscaled using two different RCMs. This approach allowed for an inter-comparison of the extreme wind between different GCM-RCM combinations. It was found that for most of Europe the change in the 50-year return wind projected by the models was smaller than the uncertainty associated with the statistical estimation of such a rare event; and far smaller than the inter-model spread in the 50-year return wind.

Large-scale construction projects often require an assessment of extreme winds, which is based only upon the historical observations of wind, when the climate was approximately stationary. Under a changing climate, infrastructure built to last for the next fifty years or more may experience events not seen in the observational period. A case study is presented for the newly completed Hardanger Bridge in Norway which demonstrates one novel method for incorporating estimates of future changes in extreme winds into the design process. Given the close collaboration with the engineers involved in the bridge's construction, the method was tailored to fit with existing practices and standards.

TP6-O-06: Past and future changes of wind storms - latest achievements and current activities at HZG

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For more than 10 years now wind storms have been subject of research at the Institute of Coastal Research of the Helmholtz-Centre Geesthacht (HZG), Germany. In the centre of interest are the most extreme storms in various regions, ranging from polar lows in the Arctic, medicanes over the Mediterranean, typhoons or hurricanes in the tropics to even the large scale cyclonic weather systems in the extra-tropics.

Several of our recent studies have applied Regional Climate Models to dynamically downscale coarse global data and post-process them to high resolution information of the atmosphere. These data are capable of representing even the smaller types of storm, which makes them detectable by automated tracking procedures. For the past, analysis of the tracking outcomes generally reveals a high inter-decadal variability of the storm numbers, but no systematic change in their frequency, whereas most of our future studies resulted in a decline in their annual occurrences.

Analogous to the regional studies we currently implement our technique to a global model of the atmosphere and dynamically downscale NCEP/NCAR re-analyses. This will result in a high-resolution long-term data set of the entire atmosphere. Current activities investigate the representation quality of typhoons and other storms in these data. Their statistics, impacts, links between occurrences in different regions and links to prevailing driving conditions for these storms will be investigated and first results will be discussed.

TP6-O-07: Impact of temporal and spatial resolution on extreme event statistics and its implications on climate modelling

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The distribution function of precipitation intensity is very sensitive to the temporal and spatial resolution of the data. Especially extreme convective events that occur on short temporal and small spatial scales are averaged out at lower resolutions.

In this study we analyse radar data over whole Germany for the years 2007-2008 separated into two seasons and for north and south Germany. Evaluation of the high resolution radar data over two years and over large regions allows quantification of the statistical aggregation behaviour in time and space. In addition we separate the precipitation events in convective and stratiform types using synoptic observation data. Investigating the spatial and temporal characteristics of both types of events separately and gaining knowledge about the severity of each type of event at different resolutions, is very important for climate modelling. Both types of precipitation events have different physical characteristics and will most likely respond differently to temperature increases that can be expected in most parts of the world in the future. For the assessment of changes in precipitation characteristics and further use in impact modelling, it is important to know how valid the simulated precipitation is at different spatial and temporal scales. In this poster we present the different scaling relationships of extreme precipitation intensities of convective and stratiform events that were aggregated over time and space, with a focus on the implications for climate modelling.

TP6-O-08: The impact of Atlantic multi-decadal variability on European precipitation extremes

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Over the last two decades, Central Europe has experienced several devastating floods associated with extreme precipitation events. Initial studies indicate that at the Northern hemispheric scale, trends in extreme precipitation are at least partly attributable to anthropogenic climate change. Yet at the continental scale, in particular for Europe, trend patterns are inconsistent with a tendency towards higher extremes in Northern Europe during winter.

Recent studies highlight that internal climate variability strongly affects or even masks anthropogenic climate change trends over several decades. There is evidence that European climate, for instance, is considerably influenced by the Atlantic Multi-decadal Oscillation (AMO). The AMO is a sea surface temperature see-saw in the North Atlantic with a period of roughly 60 years. In the late 1990s the AMO shifted to a positive phase.

Here we investigate the influence of the AMO on extreme precipitation events over Europe, characterised as the 10-year return level of daily precipitation, individually for each season. Results for observations indicate a similar pattern as for mean precipitation, but are inconclusive as only 1 1/2 AMO cycles are observed during which a reasonable spatial coverage of daily resolved precipitation data is available. Therefore we complement this investigation by the analysis of 1000 year-long control simulations with the Kiel Climate Model (KCM; ECHAM5 coupled with NEMO ORCA2). The simulations have been carried out at a horizontal resolution of T63 with 47 vertical levels for the atmosphere and show a realistic AMO pattern.

The simulations corroborate a considerable influence of the AMO on European extreme precipitation. The pattern and sign of the influence depends on the season and shows a pronounced North-South gradient. We also present the associated anomaly patterns of the large scale atmospheric circulation.

TP6-O-09: Storminess over the North Atlantic and Northwestern Europe – A Review

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More than 200 relevant articles on storms over the North Atlantic and northwestern Europe were analysed for their long-term storm frequency and intensity trends. The numerous studies sometimes show contradictory results.

For a systematic review, the study results were grouped according to different geographical areas, data used, and time periods regarded. To analyse past variations in storm climate, proxy data and in situ measurements were used. Some articles derive storm trends directly from wind speed measurements, but more often proxies based on surface pressure readings are used to derive geostrophic wind speed. Reanalysis data for the last decades and longer were analysed as well. Storm trends were also extracted from regional and global climate model data.

Storm trends derived from reanalyses data and climate model data for the past are mostly limited to the last four to six decades. Most of these studies show an increase in storm activity over the high-latitude North Atlantic and a decrease for lower latitudes. This increase lasts from the 1970s until the mid-1990s and can also be seen in proxy data. But for articles which use proxy, measurement, or model data that cover more than the last 100 years this increase is just part of their large decadal variability. Also the North Atlantic Oscillation reflects these long-term fluctuations. Overall, these long-term studies show either no trend or a decrease in storm numbers, especially over the British Isles, the North Sea, and the northeast Atlantic. For the Baltic Sea about the same number of studies give an increase, a decrease, or no trend at all. A decrease was found for central Europe. Trends in storm activity thus depend critically on the time period analysed and the selected geographical region. For future scenarios until the year 2100 trends in storm numbers differ and depend largely on the model generation used. But most studies show an increase in future storm intensities for all geographical regions analysed.

TP6-O-10: The influence of atmospheric water transport on precipitation variability on the Tibetan Plateau

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The Tibetan Plateau (TP) experiences high precipitation variability leading to dry spells and droughts, as well as to severe snow- and rainfall events and subsequent floods. However, there are strong differences between regions and seasons, which are not yet well understood for present-day climate conditions, making statements for past and future climates highly speculative. Studies on atmospheric water transport (AWT) to and on the TP are therefore required to investigate how far present-day precipitation variability can be explained by variable moisture supply. In this presentation, we will focus on atmospheric processes suppressing precipitation.

Unfortunately, data from field observations are sparse, and gridded data from global reanalyses are available for coarse grids only. Recently, a new high-resolution regional reanalysis dataset, the High Asia Reanalysis (HAR), was generated to overcome these limitations and was made available to the public (www.klima.tu-berlin.de/HAR). The HAR provides hourly gridded data for the entire TP and adjacent mountain regions at 10 km grid spacing starting from September 2000. Since data for more than one decade are now available, precipitation variability can be analysed from seasonal to interannual time scales.

After presenting the HAR dataset we will discuss the role of AWT variability for suppression of precipitation in different regions and seasons. We will show that atmospheric dynamics is important in this respect, not only by its control on AWT, but also due to independent processes like subsidence and vertical wind shear in the upper troposphere, which weaken or even inhibit deep convection and subsequent precipitation.

TP6-O-11: The impact of a warmer Mediterranean Sea on Central European summer flooding

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Central European climate is influenced by the Mediterranean Sea, which experienced a strong increase in sea surface temperature (SST) during the last four decades. One example of extreme weather events are cyclones following the 'Vb' pathway. These cyclones are generated over the Mediterranean Sea, travel north-eastwards around the Alps and then hit central European countries. The events carry large amounts of moisture and cause extreme precipitation and subsequent flooding, particularly in summer.

To analyse the potential impact of increased Mediterranean SST on extreme precipitation in Europe, a series of simulations with the atmospheric general circulation model ECHAM5 has been carried out. ECHAM5 was run at high horizontal resolution (T159) and integrated for 40 years in each experiment. The control run is forced by SST and sea ice concentration (SIC) climatologies from 1970-1999. A warmer climate is simulated using global climatological SST and SIC from 2000-2012. To disentangle the impact of the Mediterranean Sea, another simulation was performed with the same global SST and SIC as in the control run, but with the 2000-2012 SST climatology restricted to the Mediterranean and Black Seas. 20-season return levels were derived as a measure of extreme precipitation for daily and five day precipitation in JJA (June, July, and August). These return levels are estimated as quantiles of a stationary generalised extreme value distribution.

Although the number of Vb cyclones does not increase, precipitation return levels in JJA show an increase along the

Vb cyclone track for daily (up to ~63%) and for five day (up to ~76%) precipitation extremes. The strongest increase in precipitation extremes is located in western Hungary, in the Danube catchment area. Cyclone tracks at days of seasonal maxima of precipitation in this area are dominated by Vb types. This finding suggests further increases in European summer flooding, should Mediterranean SST continue to increase.

TP6-O-12: The extreme flooding of July 2012 in Krymsk, Russia, from a climate perspective

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Long term observations in Europe show regional trends towards increased intensities of mean and extreme precipitation. Much of the increase in extreme precipitation has been attributed to strong increases in convective precipitation in response to warmer temperatures.

One of Europe‘s most extreme precipitation events of recent years occurred in July 2012, when a mesoscale convective system along Russia‘s Black Sea coast dumped over 250 mm of rain in a matter of hours, with a subsequent downslope deluge causing 172 deaths in the nearby town of Krymsk. Understanding mechanisms behind recent extremes and attribution to specific forcings have been identified as key focuses for future research into the link between extreme events and a warmer climate. We thus investigate the contribution of warming sea surface temperatures (SST) in the Black Sea, which have risen locally by over 2 K since the 1980s, to the magnitude of the extreme precipitation event near Krymsk.

We carry out ensemble sensitivity simulations using a spectrally nudged limited area model. The model is run over the eastern Black Sea using multiple-nested sub-domains, increasing to 600 m in convection-resolving resolution. The event is first verified in an ensemble using observed forcings. A second ensemble in which the observed warming trend since the 1980s is removed from the forcing SST field is then created.

Our results show that the extreme precipitation would not have been possible without the warming that has taken place in the Black Sea since the 1980s. Increased heat and moisture fluxes from the warmer SST cause moisture content and temperature in the lower atmosphere to increase by over 10% and 1.5 K, respectively. This increases maximum instability by a factor of 3 near the coastal hills, allowing deep convection to be triggered and total precipitation in the Krymsk region to increase by over 400%, also suggesting the existence of regional tipping points for extreme precipitation events.

TP6-O-13: Space-time variability of flooding across Germany

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During the last decades, several destructive floods in Germany led to the impression that the frequency and magnitude of flooding have been increasing and climate change is one of the potential causes. Against this background, we study the space-time variability of flood magnitude across Germany. The analyses are based on time series of annual maximum streamflow from a large number of catchments with a common observation period of 70 years. The gauges are distributed all over Germany and cover different flood regimes. By applying different time series analysis methods, fluctuations, gradual trends and step changes in flood magnitude and changes in flood seasonality are identified and their significance is tested. The stability of changes in space is analysed. This study design allows drawing conclusions about the influence of climate on the observed flood changes. The spatial and seasonal coherence of the observed flood changes suggest that a significant fraction of these changes are climate-driven.

TP6-O-14: Increasing risk of compound flooding from storm surge and rainfall for major US coastal cities

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When storm surge and heavy precipitation occur concurently, the potential for significant coastal flooding is much greater than from either in isolation. Exploring the probability of these ‘compound events’ and understanding the processes driving them are essential to mitigate the associated high impact risks. For the contiguous United States, the likelihood of the joint occurrence of the two phenomena is largely unknown. Here we show – using storm surge and precipitation records spanning the last century – that the risk of compound flooding is high for the US east and Gulf coast, but mostly confined to the southern part on the west coast. The number of compound events has increased significantly over the last century along large coastline stretches including many of the major coastal cities. For New York City (NYC) – as an example – this increase is attributed to a shift towards storm surge weather patterns also favouring high precipitation. These synoptic scale

changes are closely linked to large scale and low-frequency climate variations. Our results demonstrate the importance of assessing the risk of compound flooding within the design process of coastal and urban infrastructure in a non-stationary framework and to explore the potential effects of climate change on these high impact events.

TP6-O-15: Coastal flooding in Denmark – future outlook

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Water loading from all directions due to river discharge, precipitation, groundwater and the sea state (i.e. mean and extreme water levels) need to be carefully considered when dealing with flooding hazards at the coast. Flooding hazard and risk mapping are major topics in low-lying coastal areas before even considering the adverse effects of climate change and sea level rise (SLR). From an assessment of Danish sea extremes from historical evidence, tide gauge series, and space measurements, we discuss the current and future hazards, exposure, and vulnerability to flooding along the diverse Danish coastline in the transition between the Baltic Sea and the North Sea. The evaluation of the extreme statistics and their applicability in flooding hazard and risk management, and a presentation of the hazard and risk mapping performed through the implementation of the EU Floods Directive using the German XtremRisk approach, form the basis for projecting potential impacts of flooding due to climate change (SLR and increased storminess). Central to this impact assessment are also the evaluation of natural meteorological variability, robustness of the statistics, physical changes, local subsidence, land-use, protection measures a.o. that must be taken into account in order to evaluate current and future flooding hazards and management options. We provide examples from Danish case-studies underlining the necessity of including these factors and we outline an interdisciplinary approach to bring this knowledge together to enable a practice-oriented methodology that combines their effects and future sea extremes in hazard and risk mapping and climate change adaptation schemes in Denmark.

TP6-O-16: Flash flood emergency planning and warning for the City of Luebeck based on hydrodynamic modelling

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Heavy rainfall events can cause severe damage through urban flash floods on a local scale. The project RainAhead has been conceived to reduce potential risks caused by urban flash floods for the City of Luebeck. The project's main objective is to develop a planning and warning tool to improve the flood damage mitigation and the emergency service's effectiveness.

The project includes an assessment of potential climate change impacts with respect to heavy rainfall. A vulnerability map will be created containing information on areas and objects susceptible to urban flooding. A detailed 1D/2D coupled hydrodynamic simulation will show flow paths of surface water (2D), bottlenecks in the urban drainage system (1D) and potentially flooded areas. The information will be used by the planning tool, which shows different planning scenarios and their consequences. The warning tool will combine the vulnerability map, modelling results and the current weather situation, and will issue real-time warnings for objects that would be subject to flooding. RainAhead is funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMUB).

TP6-O-17: Hail hazard in Europe: Analysis based on the overshooting cloud top (OT) proxy and reanalysis data

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In the absence of large scale observing networks for hail, continental-scale climatological studies have to rely on proxies derived from remote-sensing observations such as radar and satellite products.

Overshooting of air masses atop thunderstorm anvil clouds (overshooting top, OT) was proven to be a reliable indicator of severe thunderstorms, including hail and can be detected from routine weather satellite observations due to very low cloud top temperatures. In combination with hail reports from the ESWD, the OT observations form 2004-2011 are used to build a climatology of hail events in Europe and to derive a stochastic risk model that is applied in the insurance industry.

A hazard map, featuring high frequency regions neighbouring the Alps and the Pyrenees, will be presented. Further maxima in the near Massif Central and in central Eastern Europe confirm the impact of topography on hailstorm frequency.

Meteorological conditions in the proximity of OT detections and ground hail reports respectively, are evaluated in the ERA-INTERIM reanalysis and the key parameters identified. Spatial variations within Europe and differences between the OTs and ESWD hail reports are discussed. These results can hint on biases of the OT proxy, but also the future evolution of hail hazard in the context of a changing climate.

TP6-O-18: Hail hazard in Germany related to orographic and atmospheric characteristics

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Severe thunderstorms associated with large hail occur frequently during summer in Germany. Despite their local-scale dimensions of a few kilometres only, these events can cause substantial damage to buildings, cars and crops. An example for the large damage potential is the Reutlinger hailstorm on 28th July 2013, which caused losses in the order of 2 billion euros.

Due to a lack of appropriate direct hail observations, three-dimensional radar reflectivity from the radar network of German Weather Service (DWD) is used to estimate hail signals in high spatial resolution. Additional filtering with lightning detections and tracking of the signals improve the reliability of the detected hail streaks, yielding a unique radar-based hail climatology and event set for Germany. Analyses show a high spatial variability in the frequency of hail events, which is caused by the superposition of large-scale climatology and local-scale flow dynamics. Most of the hail maxima are located downstream of low mountain ranges. Additional simulations with the numerical weather prediction model COSMO in a semi-idealised setup show that flow convergence at lower levels downstream of the mountains play a major role for the specific distribution of the hail events. These convergence zones tend to occur especially for low Froude number flows, where the flow is expected to go partly around the mountains.

Additional ERA-Interim and CFS reanalyses are used to investigate ambient conditions prevailing on the detected hail events. According to this analysis, most of the observed hail events occurred during pre-frontal conditions, where an upper-level trough approaches from the west. During those situations, convective instability, for example expressed by the vertical gradient of equivalent potential temperature, reaches a maximum. Mid-level temperature lapse rate is highest, producing high CAPE values, especially over the southern parts of Germany, where hail occurs most frequently.

TP6-O-19: Changes in the hail potential over past and future decades using a logistic hail model

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This study investigates to what extent the convective potential related to hailstorms has been changing during the past decades and which changes are expected to occur in the future. In Germany, due to the local-scale nature of hail and a lack of suitable monitoring systems, hailstorms are not observed comprehensively over a long period of time. This constraint significantly hampers statistical analyses of the hail frequency including estimation of trends. In view of this fact, different proxies (indirect climate data) obtained from regional climate models are statistically analysed to infer the probability and intensity of thunderstorms or hailstorms. To improve the diagnostics of hail events by considering various factors relevant for the formation of hail, a logistic hail model has been developed by means of a multivariate analysis method. This statistical model is based on a combination of appropriate meteorological parameters (convective parameter, moisture content, etc.) and synoptic weather types. The output of the model is a new index that estimates the potential of the atmosphere for hailstorm development, referred to as potential hail index (PHI).

Validations with independent data sets confirm the reliability of the model results. For Germany, the logistic hail model applied to reanalysis data over past decades shows a markedly north-to-south gradient in PHI with a maximum in the south. Applied to an ensemble of seven regional climate model simulations, it is found that the potential for hail events will increase in the future (2021 – 2050) compared to the past (1971 – 2000); but only in the northwest and south of Germany this increase is statistically significant.

Furthermore, a modified version of the logistic model was developed to identify the hail potential across Europe. Applied to a long-term downscaled reanalysis run of 60 years, hardly any significant changes in the hail potential are found in Europe. Reason for this is the high annual variability in PHI with a periodicity of 35-40 years.

Poster presentations:

TP6-P-01: What do we know about impacts of extreme weather on plant pests - nearly nothing?

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Extreme weather events will become more frequent and intensive. Extreme events this means that climatic variability will increase. An increased climatic variability can have significant effects on organisms and ecosystems. Thus extreme climatic events are currently emerging as one of the most important aspects of climate change. Under the current climate, plant pests (plant pathogens, weeds and insect pests) cause significant economic losses resulting from reduced productivity and quality. Plant pests will be influenced by climate change. This will influence the economic impact of plant pests. The rapidly growing body of climate change literature in the past 20 years gave a lot of

hinds. What does the voluminous and mostly good research tell us about extreme weather and plant pests? Surprisingly only a handful of work has dealt with impacts of extreme weather on plant pests. Our literature survey started on February 2013 concerning the literature published since 1945 and is continued monthly. In the database 'Web of Science' the mode 'Advanced Research' was used and a combination of 'extreme weather terms + plant terms + plant pest terms' was entered. For field crops 965,510 single combinations and for minor crops 516,334 single combinations were queried until May 2014. The data base identified 358 papers concerning the influences of extreme weather on incidence of pests of wheat, barley, maize, beet, potato, rape, forage crops and grassland and 45 papers of pests of wine, hope, apple and asparagus. After considering the results of secondary analysis, only 63 papers were relevant to describe influences of extreme weather on pests of field crops, and 13 were relevant to pests of minor crops. The single data for relevant sources found will be presented. However, projections of future impacts of extreme weather on plant pests cannot be made with a high level of confidence and are hard to judge. A great deal of hard work for scientists remains to close research gaps.

TP6-P-02: Climate variability, climate change and extreme events in Ethiopia

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Climate variability, climate change and extremes have received increased attention in recent years, since they can have overwhelming impact on environment and society. The study of climate extremes is rather complex due to the excessive statistical limitations inherent to extreme analysis. Then the analysis is done use precipitation and Temperature extreme events over Ethiopia. The aim of this study is to describe temporal trends in extreme weather events and their spatial distribution in Ethiopia, based on geographic regions of the country. In this study, daily precipitation data as well as maximum and minimum temperature data for the period 1975-2010 were used. 172 locations where considered for the analysis. We calculated 27 core set of extreme weather indices for individual stations as well as regionally. ReclimDex program was used to perform a bootstrapping procedure to provide cross validation of the values. In the result, no consistent pattern of changes in precipitation extremes could be detected from the majority of precipitation indices. Among precipitation indictors, the highest proportion of stations showing significant trend was only 34% for simple daily intensity index (SDII) of which 62% stations showed negative trend. In contrast, Most of the temperature indictors showed consistent significant trends. Among temperature indictors, 45-60% stations showed significant trend for the percentile indicators, of which the tendency towards + /or –ve trends range between 70-90% the observed increasing changes in warm extremes (i.e warm night and warmest night) are consistent with a warming planet. Concluding, the heterogeneous behaviour identified in most extreme precipitation indicators might be attributed to the high variations in geographical features.

TP6-P-03: Analysis of the variability of extra-tropical cyclones at the regional scale for the coasts of Northern Germany and investigation of their coastal impacts

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The evaluation of long-term changes in storms is very important for coastal areas and protection measures. Therefore storm variability on a regional scale for the coast of Northern Germany shall be analysed. In order to derive changes in storm intensity, it is essential to analyse long, homogeneous meteorological time series. Wind measurements often suffer from inconsistencies which arise from changes in instrumentation, observation method or station location. Reanalysis data take into account inhomogeneity of observation data and convert these measurements into a consistent gridded data set with the same grid spacing and time intervals. This leads to a smooth, homogeneous data set but has relatively low resolution (about 210 km for the longest reanalysis data set). Therefore a high-resolution regional atmospheric model will be used to bring these reanalyses to a higher resolution, using in addition to a dynamical downscaling approach the spectral nudging technique. This method 'nudges' the large spatial scales of the regional climate model towards the reanalysis, while the smaller spatial scales are left unchanged. It was applied successfully in a number of applications, leading to realistic atmospheric weather descriptions of the past.

The regional climate model used for this work is the COSMO-CLM. It simulates the last 65 years (1948 to today). A resolution of 2.8 km for the Northern German area will be used to detect even small-scale effects. The resolution can be reduced to 1 km for individual areas of interest to analyse small islands (as Foehr or Amrum) and their effects on the atmospheric flow more closely. The first steps are to compare the results of different model runs with various resolutions with observation data. The model results have a negative temperature anomaly of 2 K in the winter time and a weaker negative anomaly in the summer time.

TP6-P-04: Influence of internal climate variability on estuarine sediment dynamics

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Climate variability influences the sediment yield in German North Sea estuaries such as the Elbe. The maintenance of the navigable water depths in the estuaries is strongly influenced by fresh water discharge and requires dredging and disposal of large amounts of sediments. A clear task for the improvement of sediment management is to evaluate the basic influence between the hydrological regime and a persisting low fresh water discharge. Especially long-lasting (several weeks) low discharge events highly affect the transport of suspended sediment upstream in the estuary due to the intensification of tidal pumping. Therefore, we focus on two questions:

(1) How often and in which seasons do persistent low discharge conditions occur?

(2) How are these persistent run-off conditions related to internal modes of climate variability?

For this study, we investigate the daily Elbe discharge at the station Neu-Darchau for the years 1902-2013. We perform a hierarchical cluster analyses to group the discharge of the single water years into typical discharge modes. These clusters show distinct interannual to multidecadal variability. We analyse these clusters to evaluate the relationship with synoptic weather patterns to foster a climate dynamical interpretation. We thus evaluate the correspondence of our clusters to large scale climatic conditions such as sea surface temperatures, sea ice as well as the general atmospheric circulation patterns based on Hadley Centre's sea level pressure (HadSLP2) and sea ice datasets (HadISST1), which cover the period of our fresh water discharge time series.

Climate dynamical interpretations are especially important for an enhanced understanding of estuarine sediment dynamics. It is suggested that global warming will especially affect high northern latitude winter temperatures. This leads to a northerly shift if the sea ice edge and thus subsequently to an increase of blocking highs over Siberia and Scandinavia which transports cold and dry air masses towards Europe. This scenario leads to anomalous low Elbe river discharge and thus to an increase of upstream transport of fine sediment in the Elbe estuary due to an increased effect of tidal pumping. This mechanism is also consistent with the results from the KLIWAS ensemble project which demonstrates a decrease of winter discharge during winter.

TP6-P-05: Study of heat waves and hot spells in Southern Brazil

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Climate change influences the frequency and intensity of extreme meteorological and climatic events, causing serious effects on the environment. Temperature extremes in particular are associated with the occurrence of heat waves and hot spells which have impacts on human health, energy consumption and ecosystems. IPCC observations since 1950 suggest that the number of cold days/nights has globally decreased and the number of hot days/nights has increased. In most regions of the world it is believed that the duration and the number of heat waves and hot spells had increased. But this increase tendency is not homogeneous. For this reason, it is necessary to study the distribution of temperature extremes, which permit to calculate the probability of occurrence of a specific event and its recurrence in a given area. In this study we analysed the occurrence of extreme temperatures in the Paraná River basin, the most important economic Brazilian region, in the southeast of South America. Higher minimum temperatures, around 24 °C (ref. 95 Percentile), predominate in the west of the basin, dropping to 19-21 °C for the largest part of the east, except to the coast zones. For the maximum temperatures, it was observed the 95th percentile values ranging from 28 °C (east portion of the basin) to 36 °C (west and coastal areas). The occurrence of hot spells - days with minimum and maximum simultaneously within the 5% - showed a variable distribution, but with predominance in part of the coastal zones and south of the basin. In terms of long-term trend, an increase in the number of hot spells was observed in the last two decades when compared to the whole dataset. The results of this work suggest that hydroelectricity involved sectors should be aware the relationship between temperature and power consumption. As indicated by previous studies in North America and Europe, for low latitudes regions, the power consumption increases with increasing temperature.

TP6-P-06: Extreme rainfall events and the vulnerability of the biomass and hydro sectors in the Paraná River Basin – South America

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Biomass represents 31% of all energy consumed in Brazil. It is used in the form of ethanol and represents half of all burned fuel by the Brazilian light fleet. Hydro provides 14% of all energy and 70% of electricity. Therefore, Brazilian

economy is strongly dependant on these two sources of renewable energy and three quarters of that renewable energy comes from the Paraná River basin in the southeast of South America. In this work we explore the rainfall behaviour in that energy-strategic basin and assess the vulnerability of the region for extreme rainfall events. The results indicate that the most intense rainfall events tend to follow a northeast-southwest line. For a reference value of 80 mm accumulated daily rainfall it was observed that it ranges from 3 events (north of the basin) to 5 events (south of the basin). Less intense rainfall (less than 5 mm), in contrast, dominated in the northeast, around 44% of rainy days, decreasing to 30% of rainy days in the southwest. The percentage of rainy days ranges from 26% in the west region to 37% in the coastal region of the Southwest of South America. In terms of long-term trend, no clear trend in rainfall was observed. However, in terms of flow, the southern portion of southeast South America shows increase while the northern part shows decrease. A hydrologic model was also applied to the Ivaí River, an important tributary of Paraná River and the only midsize river still free of dams. The simulations indicated that changes in land cover significantly impacts the flow. The results of this study suggest that companies and government agencies involved with biomass and hydro energy sectors should be alert not only to the issue of climate change but also the dynamic associates to land use and land cover, including the use of modern modelling tools, once that the type of land cover may explain significant parts of the trend in observed flow rates.

TP6-P-07: Large-scale characteristics of top 20 heat waves in Korea

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In this study the major characteristics of heat waves that have occurred in Korea are analysed using the top 20 heat waves which are selected based on Kim et al. (2014)'s heat wave total index (HWTI) for 40 years from 1973 to 2012. Results show that the magnitude of HWTI for top 20 heat waves has a large range from 321.9 to 2393.7 due to the difference in daily maximum temperature, the number of stations and the heat wave period, indicating that because the HWTI can simultaneously express the strength of a heat wave, the scope of its impact and its duration, the ranking of heat waves is very reasonable. Using a large-scale structure, especially in synoptic scale, we separated the top 20 cases into three types, i.e. subtropical low pressure/typhoon (T-type), weakened Okhotsk high pressure (O-type) and extended north pacific high pressure (H-type), which account for about 65%, 25%, and 10% of heat waves respectively. In case of the T-type, occurrence and intensity of heat wave was closely related to the north-south dipole pattern with anomalous low pressure formed over Taiwan by the typhoon that approaches the Korean Peninsula, and the anomalous high pressure that settles on the Korean Peninsula. This dipole pattern continuously provides not only anomalous downward motion in the Korean peninsula, but also anomalous flow over the southern part of the Korean peninsula. In addition, large-scale characteristics of the O-type and H-type heat wave are discussed.

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TP6-P-8: Changes in extreme rainfall in East Asia: comparison of historical and future projection by using general extreme value distribution

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Attempts to assess the changes between the observed (or historical) and future projected daily rainfall extremes for 274 stations throughout east Asia have been made with descriptive statistics and extreme value analysis. For the comparison, three different periods and four different data sets are considered: observation and historical data from 1976 to 2005 (period 0), simulation from 2021 to 2050 (period 1) and from 2066 to 2095 (period 2). The historical and projected rainfalls are obtained from RCP 2.6, 4.5, 6.0 and RCP 8.5 scenarios, which are based on a regional climate model HadGEM2-AO. For the comparison of extreme values, the 20- and 50-year return levels and the return period estimates are obtained by using the best one between two extreme value distributions, the method of L-moments and the regional frequency analysis. From the descriptive statistics, we find that the numbers of heavy rainfall events will increase in the future. The total precipitation is projected to remain unchanged or slightly increased, compared to the observation. From the extreme value analysis, we realize that a 1-in-20 year and a 1-in-50 year annual maximum daily precipitation will likely become a 1-in-12 year and a 1-in-24 year event, respectively, when compared to the historical data, by the end of the 21st century. But this finding is based on only one simulation model, which confines the confidence of the result and suggests an ensemble approach based on multiple models to get more reliable result.

This research was supported by a project NIMR-2012-B-2.

TP6-P-9: Assessing changes in observed and future projected precipitation and temperature extremes: In East Asia via Bayesian model averaging

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There are various developed models for forecasting future weather, few studies however on the uncertainty of the models. In this study, we developed uncertainty evaluation techniques for future weather prediction models based on Zhu et al. (2012). In addition, the technique of east Asia weather prediction models based on 26 different RCP 2.6, RCP 8.5 scenarios CMIP5 model data are applied to the uncertainty. Attempts to assess the changes between the observed (or historical) and future projected daily temperature extremes for 91 stations throughout east Asia have been made with descriptive statistics and extreme value analyses. For the comparison, three different periods and four different data sets are considered: observation and historical data from 1971 to 2000 (period 0), simulation from 2041 to 2070 (period 1) and from 2071 to 2098 (period 2). Using Bayesian model averaging techniques for East Asia, we calculated among and within model uncertainty of the data for weather models. The result is that among uncertainty is larger than within uncertainty, so applying Bayesian model averaging techniques, the greater uncertainty in the model gives less weight to predict precipitation intensity. From the extreme value analysis applying Bayesian model averaging, increasing trends and temperature in the median from period 0 to period 1 and to the period 2 are observed. For the 20-year return level, median increases in the return level are observed about 13% the period 1 and about 20% of the period2. For the 50-year return level, median increases in the return level are observed about 17% the period 1 and about 27% of the period 2, respectively.

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TP6-P-10: A non-linear link between anomalous winter weather regimes over Northern Eurasia and Arctic sea ice reduction

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The first decade of the 21st century has been the warmest in the instrumental record for the global surface temperatures. At the same time, a number of anomalously cold winter weather regimes have been observed in Northern Eurasia, in particular in Europe, in the beginning of the 21st century. These regimes have been often linked to the formation of blocking anti-cyclone centred south of the Barents Sea (BS) which has been observed with increased frequency during the last decade. The increased occurrence of such anomalously cold winters coincided with a strong reduction of winter Arctic sea ice cover (ASIC), especially in the BS, suggesting a possible connection. To study the possible link we performed simulations with a high-resolution global atmospheric general circulation model (AGCM) forced by a set of multi-year sea ice anomalies observed during the last decades. The regional circulation response to reduced ASIC in 2005-2012 exhibits a statistically significant anti-cyclonic surface pressure anomaly and a surface temperature response similar to that observed also accompanied by a weak negative feedback on the North Atlantic Oscillation (NAO). The results suggest that the recent BS sea ice reduction may have been responsible for the recent anomalously cold winters in Northern Eurasia. Importantly, the response to extensive ASIC in 1966-1969 also shows the similar anti-cyclonic anomaly and opposite sign feedback on NAO. This suggests a non-linear atmospheric circulation response to the ASIC decline during the last 40 years that has been previously suggested by idealised AGCM simulations. The results indicate at the important role of the Barents Sea region - a region with strongest variability of the heat exchange between ocean and atmosphere in winter time – in formation of anomalous weather regimes over Northern Eurasia.

Session Abstracts Topic 7:

Integrated strategies for climate change mitigation and adaptation

TP7-O-01: 'Your climate – not mine.' Towards a place-based perspective on regional climate change adaptation and mitigation

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Studies on the social and cultural dimensions of perceiving and framing climate change (CC) have gathered momentum in recent years. Primarily sociologists, anthropologists, geographers and environmental psychologists have continuously contemplated the socio-cultural facets of CC impacts by applying a variety of qualitative and quantitative methods. Especially researchers from human geography and environmental psychology have recently highlighted the relevance of so-called place-based approaches for investigating the underlying social representations and practices of place-attachment in the context of CC. The conceptual relation between CC mitigation and CC adaptation connected with sense making and place-attachment has thus rarely been addressed. The paper takes this gap as a starting point to conceptually explore the still unused potential of a place-based approach for analysing the regional meaning of climate change because CC means different things to people and lay person's understanding differs from scientific definitions. The approach is applied to data raised in Germany based on a cadastre of centennial natural extreme events and a population survey on CC perception. The aim of the paper is threefold: to investigate the potentials of a place-based approach for CC adaptation and mitigation, to empirically analyse the regional processes of meaning making with regard to CC and finally to assess the relation of regional responsiveness to CC. It is hypothesised that the focus on the regional scale will provide a place-based vision of social meanings attributed to CC which are a basic ingredient for developing grounded strategies for CC adaptation and mitigation.

TP7-O-02: Regional climate change perception of land use experts in the North German Plain

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Climate change is clearly beyond dispute and a crucial challenge for mankind on a global as well as on a regional scale. To cope with climate change and to implement adaptation and mitigation measures on the regional scale, the involvement of regional land use experts is very important. As a first step towards such a regional implementation, the question has to be asked if climate change is perceived by those experts and to what extent. In our study we followed a cross-sectoral approach, analysing primarily the land use sectors agriculture, forestry and water resource management. We present results from 60 semi-structured expert interviews conducted in four case study regions in the North German Plains as well as results from a survey (n=36) amongst regional land use experts. Even if Germany may not be as affected by climate change as other regions, our results show that:

(1) Climate change is clearly perceived on the regional scale with water scarcity as the most important aspect

(2) Impacts on land use are observed with a strong focus on agricultural land regardless of the experts sectoral affiliation and

(3) Climate change is clearly considered to entail much more risks than opportunities, especially due to water scarcity.

Our results clearly indicate climate change awareness amongst land use experts in the North German Plain. Also the interdependence of the land-use sectors can be shown. Therefore a cross-sectoral approach should be pursued in analysis as well as the implementation of adaptation and mitigation measures on the regional scale. Further analysis of already established adaptation and mitigation measures on a regional scale should be conducted. The study was carried out within the research project 'NaLaMa-nT- Nachhaltiges Landmanagement im Norddeutschen Tiefland' (Sustainable Land Management in the North German Plain) within the frame of the FONA program initiative funded by the German Federal Ministry of Education and Research (BMBF).

TP7-O-03: Climate change through a multicultural lens: the relevance of investigating migrants´ framing of climate change.

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The current discussion revolving around climate change has been dominated by scientific knowledge. Along with it, it has been acknowledged that when communicating climate change to the public, an existing gap between scientific and lay knowledge emerges and consequently, attempts of establishing adaptation and mitigation measures have failed. Being aware of the limits that this approach imposes, there have been efforts to fill this gap by applying methods and theories stemming from social science, anthropology, geography and environmental psychology. Still, most studies are permeated by the notion that scientific knowledge is the exclusive source of the unique understanding of climate change, and thus neglecting the social and cultural dimension of it. Challenging this view, the present paper highlights the relevance of a grounded social approach that

acknowledges and investigates the cognitive, emotional and cultural aspects exerting an impact on generating knowledge about climate change.

Building upon a cultural perspective, the paper focuses on migrants´ perceptions of climate change as a sociocultural example. Migrants are an integral part of the society, they represent almost 15 % of the population in Germany and on global level the migration process is expected to increase greatly in the next decade. Nevertheless, they are widely neglected in the climate change literature. With this 'migrant perspective', the aim of this paper is to contribute conceptually through an innovative approach to the social science investigation of climate change and to explore multicultural climate change framing to be integrated in adaptation and mitigation measures.

TP7-O-04: Insights into flood precautionary behaviour of private households in Can Tho city in the Mekong Delta

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Flood risk is projected to increase in many places due to the effects of climate change and the ongoing intensification of human activities in risk-prone areas. These projections and the considerable uncertainties associated with these developments increasingly require integrated approaches in flood risk management. In addition to flood protection, private precautionary measures aim at reducing the potential negative consequences of floods. Since private precautionary measures have become an integral component of contemporary flood risk management, insights into flood precautionary behaviour are important.

This study is grounded on the Protection Motivation Theory (PMT), which refers to the cognitive process that people undergo when evaluating their own ability to avoid a certain risk. Results of a survey among 858 flood-prone households in Can Tho city in the Mekong Delta, Vietnam are presented. It is shown that flood-coping appraisal is an important variable in terms of precautionary behaviour. Thus, risk communication should focus more on the potential of precautionary measures to effectively reduce flood damage, as well as on information about how to implement such measures in practice.

TP7-0-05: Integrative concept climate protection & adaption

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This research project is about the development of an integrative spatial concept which connects possible spatial strategies, climate protection and adaption and proposes an overview about the required transforming processes towards a NATURE-ORIENTATED, CLIMATE-FRIENDLY METROPOLITAN REGION 2050. Climate change and climate impacts require in consequence of knowledge of their anthropogenic causes a changed handling of space and nature. The PROJECT NATURE is the centric content base of the INTEGRATIVE SPATIAL CONCEPT, which combines in a transdisciplinary approach different spatial strategies (NATURE DEVELOPMENT – URBAN RESTRUCTURING – ENERGY TRANSFORMATION) within the context of the specific conditions of the Rhine-Neckar Metropolitan Region and the City of Mannheim in Germany in order to bring forward societal participation and spatial transformation. The research objective is to develop simultaneously an integrative spatial concept, which could work towards a corresponding result on both regional and local levels towards a NATURE-ORIENTATED, CLIMATE-FRIENDLY METROPOLITAN REGION BY 2050,to achieve clarity about how the different strategies and actions need to be positioned in relation to one another from a spatial point of view in order to achieve spatial sustainability even in an aesthetic sense, to identify potential actors and implementation instruments in conjunction with spatial planning and politics and to think through the applicability of these strategies to other European Metropolitan Regions. In connection and interaction of the strategies Nature Development – Urban Restructuring – Energy Transformation a development path of sustainable spatial development will be developed in an ecological, aesthetical and sociopolitical regard.

TP7-O-06: Regional governance and management for drought adaptation in North-West Europe – insights from the DROP project

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North-West Europe will increasingly face drought periods that will affect inter alia agricultural production, natural ecosystems and fresh water supplies. In addition to implementing adaptation measures, enhancing water governance is crucial for effective drought adaptation. The DROP project uses a double approach, both implementing innovative measures on the ground, and using governance assessment to identify possible improvements to regional governance settings in 6 case study areas. This paper presents the results of this 2nd approach.

The basis for the analysis is a governance assessment tool adapted for the analysis of droughts and water scarcity. The bare-bones of the model is a matrix in which five govern-

ance dimensions are evaluated according to four qualitative criteria. This tool is elaborated from a concept of 'governance' as a modification and extension of the concept of 'policy'. The paper introduces this Governance Assessment Tool and presents insights of its application in 6 case study areas: Flanders (BE), Somerset (UK), Eifel-Rur (DE), Vilaine (FR), Vechtstromen (NL) and Groot Salland (NL).

Interviews with an extensive set of stakeholders involved in the management of water resources form the basis for the analysis. The paper presents

a) a review of the assessments of current governance settings in these regions and

b) a cross-region comparison of the approaches suggested to address regional shortcomings ('barriers and hindrances')

A particular emphasis will be placed on lessons considered to be transferable between regions and which enhance or broadens the range of possibilities for drought management in the individual case study areas.

TP7-O-07: Adapting to climate change: terroir elements of Uji Tea and its challenges

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The ongoing changes in the climatic behaviour have become more evident with continuous increase of its intensity degree. Although these changes are mostly region-specific, they directly affect the agriculture industry, especially those who are utilising unique local conditions in their production. As a part of the terroir elements, the microclimatic conditions of an area have a great influence towards other terroir elements such as soil condition or traditional agricultural knowledge developed from that area. As the oldest and most famous tea producing area in Japan, Uji area's reputation profited from its terroir and ongoing traditional agricultural practices. Changes in its climatic condition have affected the tea cultivation, especially quality and quantity of the tea products. If the intensity of temperature fluctuations and extreme weather events increases, the tea-growing region as a whole will be at risk and these changes will threaten the socio-economic structure of the farmer community. To ensure the sustainability of this area and to protect while utilising its traditional agricultural knowledge, the application of precision agricultural systems is inevitably required. Through monitoring important bio-climatic indicators, farmers can swiftly adapt to the ongoing climatic changes and thus be able to predict harvest quality and quantity. By utilising bio-climatic indicators, methods and timing for cultivation intervention can be effectively selected. In addition, new methods of tea cultivation would be constructed using bio-climatic indicators data on the basis of traditional agricultural knowledge. Through this framework, tea farmers in the Uji area would be able to actively adapt with the changing terroir conditions while maintaining and enhancing its agricultural products' values.

TP7-O-08: The knowledge hub 'FACCE MACSUR' modelling European agriculture with climate change for food security

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The knowledge hub 'FACCE MACSUR' is a network of currently 270 scientists from 18 European and associated countries working on the projection of climate change effects and socio-economic changes on agriculture. This concerns crop and grassland production, meat production, farm management related to adaptation and mitigation measures and development of price relations on national to global markets. The emphasis lies on linking models and data across scientific disciplines. Collaborative efforts in the network include interactions with decision-makers, farmers and other stakeholders, agreement on common modelling scenarios for joint evaluation, comparison of model performance, cooperation with other projects (e.g. AgMIP), and development of new research projects, organisation of training courses and workshops and advancement of modelling methodologies. Researchers in the network are funded by their institutions and, in most cases, national contracts. The wide range of activities is presented at this conference by examples of scenarios (regional representative agricultural pathways) and regional integrated case studies from Finland, Austria and Italy. Further information on the project is available from http://macsur.eu with reports on http://ojs.macsur.eu and conference proceedings on http://ocs.macsur.eu.

TP7-O-09: Urban adaptation to heat: what can we learn from subjective heat stress of urban citizens in context of everyday life?

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Given the urbanisation trend and higher probability of more frequent and longer heat waves in central Europe, heat discomfort is a growing concern in urban climate change adaptation which is addressed from various perspectives such as urban microclimate, urban and spatial planning, human work performance and economy, human health, and social vulnerability. In order to develop adaptation strategies, it is important to better understand how urban citizens experience heat stress in everyday life and to know factors that make a difference for higher or lower heat stress. Therefore, a questionnaire survey on subjective heat stress and coping strategies in context of everyday life was conducted after a hot weather period in summer 2013 in Karlsruhe, Germany. The 420 respondents reported different subjective heat stress levels in general as well as in different contexts and situations (at home during day or night, at work, during various activities). Data analyses further show

that the observed differences in subjective heat stress are associated both with human and environmental factors and that they differ for heat stress in various contexts. Surprisingly, elder respondents experienced lower subjective heat stress levels than younger ones, a result that - from the survey data - can be explained by different coping strategies. The respondents used several types of coping measures and strategies: behavioural measures that are integrated in daily routines or that change the daily routines themselves and structural or technical measures to keep the indoor temperature cool. Thus, subjective heat stress and coping with it is (1) multi-faceted and (2) provides several hints to be considered in urban adaptation to heat.

TP7-O-10: Welfare and distribution effects of heat waves in Switzerland: Do we need to adapt?

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According to the IPCC's fifth Assessment Report, the frequency, intensity and duration of extreme events like heat waves will increase significantly over the 21st century. Europe is identified as especially vulnerable to this inevitable impact of climate change. In contrast to other extreme climate events, heat waves cause a very high number of fatalities, while reported market damages are relatively low. This makes the assessment of economic consequences difficult. The existing literature predominantly measures damages from heat waves by estimating the number of fatalities or/ and by evaluating the excess mortality with the value of a statistical life. However, this approach is restricted to a monetary assessment of the damages from heat waves.

Our aim is to extend the literature about economic impacts of heat waves by developing a computable, dynamic Auerbach-Kotlikoff type model with overlapping generations to evaluate the welfare and distributions effects of heat waves in Switzerland. The purpose of this analysis is to account for the two main driving forces of vulnerability to heat waves: age and the degree of urbanisation. The heat island effect causes a heating-up of strongly built-up areas, which can result in temperature deviations of up to 10 °C between urban and rural regions. On the one hand, the household side of our model is disaggregated by the degree of urbanisation of the place of residence. On the other hand, the overlapping generations approach is able to account for the fact that especially very young and very old people are in danger of suffering from extreme heat. We are thus able to evaluate the effect of a high excess mortality in some age cohorts on welfare and distribution between age groups and regions. In a second step, the model is used to determine an efficient adaptation path and to compare different tax reforms to finance adaptation.

TP7-O-11: Green Technology solutions for climate change impacts reductions in Kerala State (India)

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Green Technology is the application of one or more of environmental sciences, green chemistry, environmental monitoring and electronic devices to monitor, model and conserve the natural environment and resources, and to curb the negative impacts of human involvement. When it comes to climate change, people look towards experts for solutions. There is no doubt that scientists and policy-makers must collaborate to find a solution to this complex problem. But we have much to learn from a community that is often overlooked.

The Kerala State recently created a Directorate of Environment and Climate Change to deal with the impacts and implications of climate change in the state. An 'Environment Impact Assessment Authority' was formed for monitoring and assessing the environmental impacts. State budget for 2010-11 included a 'green budget' with a corpus fund to be used for regeneration of forests and related activities. This green budget is the first of its kind in India and will be replicated in other Indian states in the future. A momentum was created in Kerala to utilise more 'renewable energy sources' like wind, solar, hydro power, tide, waste etc. Subsidies were given at household level for using renewable energy sources such as bio-gas plants, solar energy and wind energy. The implementation of the carbon credit program is successful by supplying CFL lamps through Government Departments. This program has been replicated and scaled up in other states based on the level of success. The project 'My Tree Program' is a joint program of forests and education departments as a mitigation program on the impacts of climate change. The scheme aims for tree planting with involvement and participation of school children.

TP7-O-12: Climate change adaptation, MNC strategy and environmental pragmatism: a cross-country perspective

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The extant literature and scientific evidence primarily blame the activities of corporations for causing extensive environmental degradation and climate change. However, it has been found that their business competitiveness is likely to increase if they operate in an environmentally sustainable manner. Consequently, an increasing number of corporations are formulating and implementing environmentally pragmatic strategies. While the academic literature is primarily focused on corporate environmental strategies

aimed at reducing environmental harms and mitigating climate change, it hardly focuses on strategies that are to address or adapt to, the various impacts of climate change on business operations. Although MNCs in both developed and developing countries are impacted by climate change, the nature of their responses is likely to vary. This paper aims to explore how multinational corporations (MNCs) in Australia and Bangladesh formulate and employ their climate change adaptation strategies. It primarily presents data from MNCs dealing with agricultural seeds while limited data from pharmaceutical and mining sectors have also been presented to indicate any cross-sectoral variations. Based on a qualitative research, the paper argues that no specific pattern of adaptation strategies exists across MNCs. They either follow a 'deliberate' strategy following a 'precautionary' approach, or an 'emergent' strategy relying on a 'wait and see' approach. Most of the companies also follow a 'subliminal' strategy contributing to climate change adaptation using a 'business-as-usual' approach. While agricultural seed MNCs follow a mix of 'deliberate' and 'subliminal' strategy, pharmaceutical and mining MNCs primarily follow 'subliminal' strategy. In Bangladesh, MNC strategies are influenced and dictated more by government policy interventions and consumer concerns about relatively more predictable climatic impact. However, in Australia, such strategies are mostly guided by individual corporate policies with little influence of consumer concerns about climate change predictability. The paper presents some implications for national policies, corporate strategies and consumer welfare relevant to climate change adaptation.

TP7-O-13: India-Europe strategic cooperation for tackling climate change and its impact on global peace and security

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The global average temperature on the earth's surface has been increasing at a very rapid pace and it is affecting both the developed and developing countries. The consequences due to climate change are being viewed as the foremost problem of the 21st century. The unequivocal warming of the earth's climatic system has led to serious damage to the environmental components. The challenges imposed by climate change are affecting at the regional, national and international level and is even having serious implications in terms of environmental and human security. Rise in sea level, melting of ice glaciers, damage to ecosystems, spread of diseases, biodiversity loss, increasing weather extremes, changes in rainfall patterns etc. are some of the impacts of climate change that pose serious risks to our socio-economic, political, and environmental harmony. Hence, there is a need for the developed and developing countries to work together in order to combat the global challenges caused by climate change.

This paper deals with the contemporary changing nature of geopolitics to geoeconomics and the significance of strategic cooperation between India and Europe for mitigating the impacts of climate change. An attempt has been made to assess the measures taken by India and Europe for combating the challenges of climate change and its impacts on global peace and security.

TP7-O-14: Using the analytical tool SWOT for planning climate change adaptation strategies – a case study for the Lusatian river catchments

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Within the framework of the 'Innovations Network Climate Change Adaptation Brandenburg Berlin' (INKA BB), the sub-project 21 focuses on the improvement and refinement of modeling tools for an integrative management of water quantity and quality in the Lusatian river catchments of Spree, Schwarze Elster and Lusatian Neisse. These catchments are profoundly disturbed by long term lignite mining activities. The potential impacts of climate and land use change on natural discharges are simulated under the consideration of various sources of uncertainties and constitute the input for the integrative modelling tool for water quantity and quality. With this tool, the effectiveness of climate change adaptation strategies can be evaluated, discussed and customised in cooperation with regional stakeholders and practitioners on the river catchment scale. For this purpose, the analytical tool SWOT (strengths, weaknesses, opportunities, threats) was applied three times during the project duration of five years for

1) a comprehensive situation analysis and laying a foundation for a transparent, collaborative definition of the project objectives (1st year)

2) after the first implementation and evaluation phase (3rd year)

3) after the second implementation and evaluation phase (last year).

The results of the strategic project planning and management approach proved to be suitable in working together with regional stakeholders and practitioners. However, adaptation to climate change is not high on the agenda for many regional stakeholders and practitioners. This is due to the fact that more urgent problems are of higher importance at present in the Lusatian river catchments, such as flood risk management, water quality problems and the lack of staff, especially at the regional environmental administration. Moreover, the weather conditions during the last years, with comparably wet summers, let concerns about climate change fade to a certain degree.

TP7-O-15: Indicator-based methodology for the climate change risk vulnerability analysis

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The IPCC's 'Fifth Assessment Report: Climate Change 2013' provides scientific evidence on the ongoing environmental changes in connection with climate change. Concerning our society and the industrial sector in particular, the efforts to mitigate or adapt to these incontrovertible challenges are subject to the decision-makers' risk assessment and their individual and collective risk perception. In order to support risk response and strategies for adaptation on the municipal level, we suggest an indicator-based methodology (Merz 2011). For this, firstly highly disaggregated information on the municipal economic structure are collected and generated, e.g. by regionalising national input-output tables (Flegg & Webber 1997). Additionally, high-resolution climate projections provided by the Institute of Meteorology and Climate Research (IMK-TRO) at the Karlsruhe Institute of Technology (KIT) are also evaluated on this level. Combining this information on communities' fragility and exposure gives an indication on the climate change risk vulnerability and can support integrated strategies for mitigation and adaptation.

The described methodology is exemplarily demonstrated for the Metropolitan region of Stuttgart comprising more than 400 communities. For one climate change induced extreme weather event relevant indicators will be identified and used in the high-resolution vulnerability analysis from which then protection and adaptation strategies can be derived and prioritised.

First stakeholder consultations have shown that the indicator-based methodology for climate change risk vulnerability analysis is easily comprehensible and therefore quickly accepted by decision makers. The methodology's modular structure allows a flexible adaptation of indicators to available data sources making it a suitable tool for analysing a wide range of climate change induced risks on all aggregation levels from municipal to European scale.

TP7-O-16: Policy-oriented local climate change risk assessment and evaluation

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Decision makers on the local level of planning regions are facing several key challenges regarding the knowledge base for climate change adaptation at the interface between the environmental sciences and risk management practice. These challenges refer to (i) the complexity of climate change impacts, (ii) uncertainties involved in climate change projections and impact assessment, (iii) evaluation of the impacts as societal risks and opportunities, and (iv) usability of information from impact assessment and evaluation for the multi-actors management.

Against this background, a methodology is being developed for local climate change risk assessment trying to advance treatment of complexity, uncertainties, evaluation, and usability in a policy-oriented manner. First, complexity of climate change impacts is addressed focusing interlinked multiple cause-effect interrelations and indicators for major environmental functions and societal utilisations through coupled modelling also considering societal change. Second, uncertainty bandwidths originating from underlying climate projections (ensembles) and impact assessment are calculated and mapped with high spatial resolution. Third, impacts with their uncertainties are evaluated as risks or opportunities with reference to existing legal norms from environmental laws and spatial planning provisions. Fourth, usability of all information is facilitated through new spatial decision support system (SDSS) technologies that transform expert knowledge in typical use cases of risk management practice using domain modelling.

The SDSS technologies are seen as a means of bridging gaps at the science-policy interface. Thus, this interface is also investigated from a social science perspective in the light of formulation and implementation of climate change risk management strategies. Hereby, the contents, societal context and process of collaboration between decision makers are considered based on findings from strategy research.

TP7-O-17: The challenge of measuring 'success' in transdisciplinary evidence-based stakeholder dialogue processes: potentials and pitfalls of quantitative and qualitative metrics

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Various societal systems around the globe have endorsed a scientific-evidence based technocratic approach to decision-making. Thus the question is not if we should invest in science, but rather to what extent and in which way. What do stakeholders expect in return? And in which way would they like to be involved or have the scientific output presented? These questions are central to understand the reasons for policies, the ways in which policies are formulated, processes of policy implementation, and the effects policies have on people and society.

Such issues surface especially in coastal and marine ecosystems in the context of climate change, where a whole bundle of different utilisations as well as different geo-biophysical units clash together. This calls for inter-

disciplinary and transdisciplinary research efforts that effectively bridge the gap between different spheres of knowledge. Although each discipline defines scales in a slightly different way, both ecological and social processes roughly correspond to certain spatial scales. However, while natural scientists operate with relatively well-defined hierarchical systems of analysis, social scientists employ a far greater variety of scales with a less precise scale definition. This given, metrics of 'success' that effectively measure and demonstrate the impact of science for society on an evidence-based manner are difficult to develop. This is rooted in several different aspects, one of which pertains to the role of evidence within knowledge generation, knowledge sharing, combining knowledge and knowledge-based decision-making.

Possible potentials and pitfalls of quantitative and qualitative metrics are discussed and future challenges outlined. A blueprint for a globally focused but regionally evidence-based criteria framework for stakeholder dialogue processes remains to be worked out.

TP7-O-18: Providing information - enabling knowledge – a case study in Northern Germany

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Agriculture, tourism and energy supply are examples for weather-sensitive sectors in Northern Germany. These sectors need to adapt to climate change in Northern Germany. The North German Climate Office was established in 2006 at the Institute of Coastal Research at HZG to answer climate-related questions in Northern Germany. While natural science is analysing the sensitivity of complex systems to natural and human influences, an additional infrastructure is needed to enable knowledge as a basis for decision-making processes. The North German Climate Office maintains an intensive stakeholder dialogue to generate decision-relevant information based on regional assessments and data available for Northern Germany. About once a week, a dialogue event takes place, many individual requests are answered and interviews are given to the media. From these activities, information demands of different stakeholder groups are localized to develop decision-relevant information products which may serve a broader group with similar information needs.

TP7-O-19: Transdisciplinary communication processes supporting integration strategies

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In order to tackle the grand challenge of climate change with a range of integrated strategies, science communication with various stakeholders in politics, economics, the media and the civil society is required. However, theoretical insights on transdisciplinary communication processes and empirical case studies of individual approaches have not yet been systematically reviewed. Therefore, it is needed to better understand the communication processes of transdisciplinarity and above all an integrated research approach of both, academia and partners from the societal problem field.

In order to better understand transdisciplinary communication, the research project 'Transdisciplinary Communication Processes' reviews and synthesises the scientific literature on the issue from a range of disciplines and specialties. A special focus lies on the aspects of social-ecological research and stakeholder engagement in climate change. The research outcomes aim to present an overview of approaches, benefits, and good-practice-examples of integrating science and practice in transdisciplinary communication in various processes of climate change mitigation and adaptation.

TP7-O-20: Which land use strategies are appropriate and feasible for climate change mitigation? Stakeholder assessments and policy instruments in Germany

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Land use and land use changes are considered drivers of greenhouse gas emissions. Therefore and in addition to existing societal expectations concerning land use management, it is increasingly demanded that land use shall also contribute to climate change mitigation. In Germany in 2012, 53% of the land was used for agriculture (with a long-term declining tendency), 30% for forestry and about 13% for settlement and transportation (both increasing). Stakeholders in all of these sectors and on all governance scales develop land management strategies and adopt policy instruments to contribute to climate change mitigation. Yet many of these strategies and instruments also have an impact on other land use sectors and bring about new land use conflicts. Thus, mere sector-specific management strategies and policy instruments are inadequate.

Set against this background, the ongoing research initiative CC-LandStraD focuses on both sector-specific and inter-

sectoral land use strategies for climate change mitigation in Germany. In our paper we will present findings concerning mitigation options via land use from two angles: (a) the perspective of national stakeholders representing all major land use sectors and (b) the statutory and informal system of climate-relevant planning instruments which is of crucial importance for contemporary land use governance. These two perspectives provide insights on which land use strategies are (more) appropriate and feasible in climate change mitigation but also concerning the limits of the cross-sectoral approach.

Poster presentations:

TP7-P-01: Spatio-temporal statistical analysis of the CO2 balance of the terrestrial vegetation

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The study of sources and sinks of carbon dioxide is of interest in many research disciplines and in political negotiations on climate change mitigations. The most important source/sink for the global carbon dioxide balance is the global vegetation, which acts as a sink during the photosynthesis and at the same time as a source of CO_2 as plants use the produced chemical energy for building up biomass and for cell respiration. In natural science, the Gross Primary Productivity (GPP) of the terrestrial vegetation, in effect the produced chemical energy from photosynthesis has been analysed frequently. However the net effect of vegetation on CO_2 emissions (Net Primary Productivity (NPP)) on a global spatial scale and on an intra-annual time basis has not yet been well discovered. This study addresses this problem from a spatio-temporal statistical point of view. We make use of remotely sensed observations of the vertical profile of CO_2 concentrations obtained from the Greenhouse Gases Observing Satellite (GOSAT) and observations of the GPP derived from data of the MODIS satellite mission on the primary production of vegetation. A space-time linear mixed effects model was fitted to the data, which is able to capture spatial and temporal autocorrelation of ground CO_2 concentrations and as well the spatial and temporal cross-correlation between CO_2 and the GPP through latent spatial and temporal random processes. In that way we were able to obtain spatio-temporal predictions of the influence of vegetation on surface CO_2 concentrations and discover the source/sink activity of vegetation on a global spatial scale with 1° x 1° resolution and in a nearly weekly time resolution and we think that this product is potentially valuable for a variety of research fields.

TP7-P-02: The interrelationship between individual and community engagement in dealing with climate change

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Dealing with climate change involves mitigation and adaptation infrastructures and technologies, which often initiate developments in and near homes and communities. Opposition against these developments such as wind farms in rural areas is widely recognised in research and public. In contrast, it is less understood how attitudes and acceptance towards such changes are formed and how people think about and engage with technologies and infrastructures in their daily lives. Thus, a new approach is needed which shifts the perspective to the social process of support. An important issue which has not been sufficiently addressed so far is the interrelationship between individual and community engagement. The paper investigates perceived challenges and opportunities of measures implemented on individual and community level. The conceptual framework includes elements from the theory of planned behaviour and protection motivation theory in order to explore attitudes towards behavioural options, social norms, and perceived behavioural control. The aim of the paper is to contribute to a better understanding of the interplay between individual and community engagement. Perception, acceptance and personal engagement are the basis for the future diffusion of climate change adaptation and mitigation measures.

TP7-P-03: Identifying synergies for climate change mitigation and adaptation at district level

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Measures for climate change mitigation and adaptation are often conceived separately within municipal administration although they can be highly interacting. For instance, counter measures to the urban heat island effect influence the cooling demand within buildings. Quantifying this potential synergy for different types of measures supports integrated urban planning for mitigation and adaptation.

Our methodological approach aims at coupling micro climatic modelling of outdoor thermal comfort for different urban morphology types (urban structural types) with building simulations of carbon emissions and indoor thermal comfort. In scenarios the impacts of future changes in climatic conditions and different mitigation and adaptation measures and combinations of measures are quantified.

A multi-criteria decision making approach will inform on which measures should be prioritised because they show

the largest benefits for mitigation and adaptation simultaneously. Further criteria for assessment will be developed by stakeholder integration in order to include dimensions of quality of life and biodiversity.

Three districts within Bavarian cities over 100,000 inhabitants were selected. Each of the case areas represents a different type of city district with high exposure to the climate change impact of urban overheating. Results are expected to serve as decision support for urban planners and the city administration to realize implementation of measures. This contribution presents the conception of the approach as well as first results on the benefits of integrated measures.

TP7-P-04: Communicating and visualising climate projections – assessment of user preferences and abilities in Germany

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The research on communicating climate change has long suggested that decision-relevant provision of climate science and related uncertainties needs to be audience-specific. In the field of climate adaptation, empirical evidence of the extent to which adaptation practitioners use and interpret visually communicated multi-decadal climate projections and their uncertainties in adaptation planning is however sparse.

Focusing on the communication of climate projections, this paper presents results from 32 semi-structured interviews, predominantly in the German federal state North Rhine-Westphalia and an online survey conducted with 103 adaptation practitioners at local and regional government level from across Germany. The interviews highlight that as many German officials consider local-level adaptation to be only in the starting blocks; climate projections are often regarded as too detailed and technical to be relevant for the current stage of adaptation planning. Consequently, we find that the use of climate projections in German Local Authorities is not of a homogenous nature but currently only seen in individual cases.

Furthermore, results from the survey show that even if adaptation practitioners were to use climate projections, their interpretation and inclusion in the planning process would vary substantially. The survey highlights that there are significant variations in how different graphical visualisations of climate projections that portray the same information content are interpreted, assigned user confidence in their own assessment, used and incorporated into the decision-making process.

Given the distinct variation in user understanding and preferences we suggest that providing multiple and complementary visual formats for the users is likely to address their preferences and differing needs for complexity more adequately than a ‘one-size fits all’ approach.

TP7-P-05: Adaptation of railway infrastructure to climate change. Lessons from the ARISCC project

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Railways have always been subject to the effects of the weather and were constructed to ‘survive’ natural hazards as infrequent phenomena. Since one leading assumption for decision makers also in railway companies is – bearing in mind all uncertainties on future climatic developments and local and regional climatic and meteorological characteristics – that today’s extreme weather may be tomorrow’s normal weather, and because it is felt that the consequences of climate change are advancing rapidly, there is an urgent need to develop and implement appropriate adaptation strategies for transport systems including rail.

The challenge for railways is not only to survive extreme weather conditions, but also to be prepared on time and to recover quickly from extreme weather and to be able to run in what are abnormal circumstances today. Railway infrastructure companies have to secure availability and functioning of the railway infrastructure under all conditions, also in cases of extreme weather events but also (in the mid- to long-term perspective) with changing climatic loads.

First steps towards adaptation measures are taking place at several European railway infrastructure companies. Adaptation measures and activities have been collected and assessed within the ARISCC project (Adaptation of Railway Infrastructure to Climate Change, funded by UIC, International Union of Railways). One result of the project is the development of an integrated natural hazard management including adaptation to climate change aspects, the results have been issued within a guidance document with recommendations for adaptation of railways (www.ariscc.org).

TP7-P-06: Urban vulnerability assessment based on socio-environmental fragmentation – supporting climate change response at local level

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The research approach presented by this contribution seeks to provide local, context-specific information regarding climate change impacts. It is innovative as it takes the concepts of fragmentation and vulnerability into account, combining them both theoretically and methodologically in an urban setting. In doing so, the contribution discusses to what extent and in what ways the two concepts are capable of providing a useful framework in order to assist cities in developing local responses to climate change related

hazards, with a focus on adaptation options. This approach integrates the dimension of fragmentation into the discussion and analysis of urban vulnerability in a way that is not yet reflected in the literature on either of these issues. It is argued that the resulting analysis allows for more context-specific conclusions on the role that fragmentation plays in the context of residents' vulnerabilities, and therefore provides an enhanced database for the formation of more adequate response measures. In addition, the approach also adds further insight into the still nascent concept of urban vulnerability and recognises that adaptation involves not only adapting to changing climate conditions, but also adapting to other changes such as urbanisation.

TP7-P-07: The disturbance climate in eastern of Democratic Republic of Congo

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In the DR Congo, in the South Kivu province, the influx of Rwandan and Burundian refugees in 1992 and 1994 and population displacement (1996 and 1998) caused massive deforestation and bushfire practices in the forests. Trees were felled to serve as firewood and construction material while bushfire was set to easily obtain cultivable land and extended to capture wild animals and pastoral aims. The region has two climatic seasons: rainy season which extends from September to June and dry season from July to August. The degrading of the environment led to massive climate change effects in 2006 and 2007 like never experienced before in the region: disruption of the agricultural calendar and a sharp heat increase. The crop period normally starting in September was postponed to December or January. Rain was rare throughout the region. River runoff decreased significantly, establishing a temporary drought. People and animals suffered severely from this climate change. Plant diseases developed, particularly the cassava mosaic disease that affected the staple food of the region and caused widespread famine.

Alarm calls from local leaders, civil society and development organisations on the climatic disturbance allowed administrative and NGOs to take action against the ecological catastrophe. The following measures were taken:

- Formal prohibition of cutting wood, unless officially permitted otherwise
- Priority reforestation of denudated areas
- Prohibition of bushfire
- Awareness campaigns about the dangers of massive tree felling and bushfire.
- Seven years later, the situation has not yet returned to normal. The agricultural calendar remains disturbed, the heat is still strong and rainfall less regular. Deforestation and bushfire were reduced but are still practiced. Currently, the solutions proposed by NGOs for the development of the area include:
- Support to the activities of civil society to strengthen the international legal framework for the sustainable management of natural resources and biodiversity conservation at provincial and national level
- Facilitate the exchange and development of technology for the conservation and sustainable use of biodiversity
- Initiate development projects to fight against climate disruption in this environment for the benefit of affected populations

The DR Congo has signed and ratified several international conventions for the protection of the environment. It is therefore desirable that the International Union for Conservation of Nature (IUCN) closely monitors the implementation of these conventions in the country.

Session Abstracts Topic 8:

Rapid climate change in the past – mechanisms, processes and regional patterns

TP8-O-01: Intra-interglacial climate variability in the North Atlantic during MIS 11

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A pronounced intra-interglacial MIS 11 cold event was revealed in the North Atlantic by sea surface temperature (SST) and salinity (SSS) reconstructions. SSTs were established using TEX86-indices derived from relative abundances of glycerol dialkyl glycerol tetraethers (GDGTs) of Thaumarcheota and alkenone-based Uk'37 indices. To assess variations in palaeo-SSS, the hydrogen isotopic (δD) compositions of long chain alkenones were determined. For further interpretation, the obtained SST and SSS reconstructions were compared to relative planktic foraminiferal abundances, ice rafted debris (IRD) counts and δ18O records from benthic and planktic foraminifera. According to our data, the temperature amplitude of the aforementioned cold event reached 7 °C. We assume that this value might combine the actual cooling with an additional effect of a vertical migration of the Thaumarchaeota to deeper and, therefore, colder water layers, which might occur due to an enhanced intensity of open ocean upwelling which is generally characteristic for this location during cooling episodes. This explanation is also supported by changes in stable oxygen isotopes of deep-living planktic foraminiferal species G. truncatulinoides (s) and (d). A pronounced increase of δ18O values contemporaneous with the cold event might indicate a change of habitat conditions of these species towards colder temperatures. Another evidence of enhanced upwelling intensity during this episode might be derived from increased relative abundance of planktic foraminiferal species G. bulloides, whose geographical distribution is related to upwelling zones. A salinity drop was registered before the SST decrease. Because the intra-interglacial MIS 11 cold event occurred during the phase of slowly decreasing benthic δ18O values, we assume that it might be related to the late phase of the circum-North Atlantic ice sheet decay. Therefore, its nature might resemble the one of the 8.2 ka Holocene event.

TP8-O-02: Glacial-interglacial variability change: a view beyond ice-cores

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The last glacial period was characterised by a highly variable climate including abrupt changes such as Heinrich and Dansgaard-Oeschger events. In contrast, the Holocene time period was observed as relatively stable. This variability change is often discussed based on data from polar ice cores, particularly from Greenland.

Here, we contrast the polar ice core-based variability change with the variability change recorded by a global compilation of multi-proxy records. Estimated spatial patterns of changes point towards mechanisms generating glacial and Holocene climate variability. Furthermore, our analysis allows insight into the abilities of the different proxy sensors concerning the recording of climate variability.

TP8-O-03: The Role of glacial/interglacial CO_2 and ice sheet changes for abrupt climate transitions

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The last glacial is characterised by abrupt climate changes on millennial timescales that are associated with major reorganisations in the Atlantic meridional overturning circulation. The climatic imprint can be identified in a variety of climate archives, including ice cores, marine and lacustrine sediment records. Many studies have investigated the causes of these changes, however as yet, there is no consensus referring the underlying trigger mechanisms and involved processes.

Here we use a comprehensive coupled atmosphere/ocean general circulation model in transient and equilibrium climate simulations to evaluate the importance of different abrupt climate change scenarios by a comparison to high-resolution lake sediment and inter-hemispheric ice core records. We find that minor changes in atmospheric CO_2 concentrations and Laurentide ice sheet configuration can trigger rapid climate transitions. It is shown that especially atmosphere-ocean feedbacks, which have been neglected in previous studies, are a key player of these transitions. The associated climate impacts not only provide a coherent explanation for the recorded changes in climate archives but also demonstrate that atmospheric CO_2 and ice sheet changes are potential triggers for abrupt climate changes in an alternative framework to classical North Atlantic freshwater hosing experiments.

TP8-O-04: Abrupt climate changes during the demise of the last interglacial across a transect from Greenland to the Mediterranean: regional similarities and differences

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The termination of the last interglacial (115-70ka) in Greenland is characterised by abrupt millennial-scale climatic fluctuations between warm interstadial and cold stadial conditions. These rapid climatic changes have been also identified across the North Atlantic Ocean and Western Europe, but establishing teleconnections between the mid-latitudes and polar regions is hampered by chronological uncertainties. Sedimentological and geochemical analyses of the varved sediments of Lago Grande di Monticchio in southern Italy provide annually resolved proxies, i.e., varve thickness and µXRF titanium intensities, which allow a comprehensive reconstruction of six independently-dated abrupt cold and relatively humid spells in the central Mediterranean, which are suggested to correlate with Greenland stadials. Although there is still uncertainty in the absolute dating of these oscillations, the estimates of the duration of the cold spells and the climate signal of the proxies allow the discussion of regional similarities and differences in amplitude and distinctiveness of the cold stages across a transect from Greenland to the central Mediterranean. In summary, our data confirm that the Mediterranean was very sensitive to North Atlantic climate variability during the transition from the last interglacial to the last glacial period and reacted abruptly and in phase, within the given dating uncertainty, with the rapid temperature changes recorded in Greenland; nevertheless discrepancies in the proxy response are observed for individual climatic transitions.

TP8-O-05: From warm to cold climate - the MIS 5-4 transition in sediments from the deep Dead Sea basin

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The Dead Sea and its Pleistocene precursor lakes accurately recorded climate change in the eastern Mediterranean region. The 460 m long sediment core 5017-1 was retrieved from the deepest part of the lake and archives the regional climate variability of the last 200-250 ka. Here, we focus on the upper part of the Samra Formation (ca. 135-70 ka BP) and the transition into the Lisan Formation (ca. 70-14 ka BP), which includes a layered salt sequence deposited during the MIS 5-4 transition. The analysed interval of 30 m covers a lower, ca. 20 m thick interval of alternating aragonite and detritus (aad) accumulated during more humid climatic conditions, which is followed by a ca. 10 m thick interval of predominantly layered massive halite, reflecting a dryer climate. We present a multi-proxy record including micro-facies analysis on large-scale petrographic thin sections, micro-XRF element scanning, grain size, and magnetic susceptibility measurements. These analyses allow a high-resolution characterisation of the sediments and interpretation in terms of depositional processes and their value as palaeoclimate proxies.

These data show a short-lived (abrupt) dry interval directly before the onset of the relatively humid conditions corresponding to the Lisan Formation, suggesting a millennial-scale dry period. This is in agreement with a previously identified depositional hiatus and associated erosional unconformity in the shallower areas outcropping at the margins of the lake. However, the deposition of glacial-like aad sediments prior to this pronounced dry event contrasts to previous analyses on outcrops. These sediments from the deep Dead Sea basin will hence allow understanding and better deciphering the depositional processes in relation with climatic change during the MIS 5-4 transition on centennial and millennial time-scales.

TP8-O-06: Atlantic Ocean forcing of northeast Brazilian precipitation during Heinrich Stadial 1

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Located close to the southernmost extension of the inner-tropical convergence, northeast Brazil is very susceptible to large changes in rainfall on interannual to millennial time scales. Previous studies showed that the glacial sedimentation on the continental slope off Northeast Brazil was characterised by pulses of terrigenous matter deposition due to increased continental precipitation and river runoff. A sustained wet period occurred during Heinrich Stadial

1, when the Atlantic meridional overturning circulation (AMOC) was reduced due to meltwater input to the North Atlantic. We report new data from a high resolution sediment core that allows to directly link the state of the AMOC with continental precipitation over northeast Brazil. Changes in Pa/Th ratios and dD of plant waxes indicate that both AMOC strength and precipitation over northeast Brazil were linearly coupled over Heinrich Stadial 1, with increasing precipitation during AMOC slowdown. This response pattern suggests that the southward displacement of the long-term mean position of the ITCZ is directly dependent on the magnitude of the AMOC slowdown.

TP8-O-07: Abrupt sea ice fluctuations in the subpolar North Atlantic at the end of the last glacial and their potential impact on ocean circulation changes

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Arctic sea ice is a crucial element within the global climate system. Reconstructions of its spatial and temporal variability in the geological past provide important information on oceanic-atmospheric feedback mechanisms and support the assessment of natural (i.e. non-anthropogenic) climate changes. The Fram Strait, the only deep-water passage connecting the Arctic and the Atlantic Ocean, is an ideal target area for palaeo-sea ice studies since changes in the export of Arctic sea ice into the North Atlantic are effectively recorded within local marine sedimentary archives.

We present a continuous and high-resolution sea ice record obtained from a sediment core from the western continental margin of Svalbard. The reconstruction of sea ice conditions is based upon the analysis of the sea ice biomarker IP25 and - for a comprehensive and more detailed evaluation of the sea surface conditions - phytoplankton derived biomarkers.

The late glacial period and the Last Glacial Maximum (LGM) are characterised by recurrent advances and retreats of sea ice at the core site. In contrast to the widely-acknowledged notion of an ice-free eastern corridor in the Nordic Seas (due to the continued inflow of warm Atlantic water) we attribute these sea ice fluctuations to a repeated decrease in the advection of Atlantic water during this critical time interval of Northern Hemisphere Ice Sheet growth. A long-lasting and perennial sea ice cover prevailed only at the end of the LGM and declined rapidly at about 17.6 ka BP - coincident with or even inducing the reduction of the Atlantic Meridional Overturning Circulation (AMOC) during Heinrich Event 1. Similarly, a second, short-lived maximum in sea ice coverage seems to be associated with another perturbation of the AMOC during the Younger Dryas. These reconstructions shed new light on the important role that sea ice probably played for the significant ocean circulation changes that characterised the last deglaciation.

TP8-O-08: Palaeohydrological changes during the onset of the Younger Dryas from the Rehwiese Palaeolake, Berlin, NE Germany and their regional context – a combined biomarker δD and carbonate δ^{18}O record

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The period of Greenland Stadial 1 (GS-1) during the Last Deglaciation, between 12,846 ± 138 and 11,653 ± 99 years BP is an ideal laboratory to study regional feedbacks during periods of abrupt climate change. High-resolution climate archives such as varved lacustrine sediments can be temporally linked on absolute time scales through tephrochronology and enable the identification of leads and lags in the different components of the climate system during abrupt climate change. Such regional leads and lags have been identified at the onset and during GS-1 in continental western and northern Europe (Lane et al., 2013; Lohne et al., 2013; Rach et al., 2014), likely related to shifts in the pathway of westerly winds into continental Europe. Here we present a new palaeohydrological record from NE Germany, which is under the influence of a more continental climate today, based on the analysis of lipid biomarker δD values and endogenic calcite δ^{18}Ocalc values. In agreement with studies from western and northern Europe, we find evidence for changes in NE Germany occurring before the onset of the classically defined Younger Dryas (12,680 BP). In particular lipid δD values as well as δ^{18}Ocalc values decreased at 12,740 years BP, possibly indicating the onset of cooling. However, changes were more subtle and less abrupt compared to changes at Meerfelder Maar (MFM), 500 km SW of the Rehwiese palaeolake and within the pathway of westerly wind systems. In addition, we find a prominent decrease in δ^{18}Ocalc values and lipid δD values at 12,580 years BP, which maybe the effect of the suggested southward shift of westerly wind systems on local climate, but which occurred 100 years after its effects became evident at MFM. Our new palaeohydrological record from NE Germany confirms the existence of temporal differences in the regional impact of GS-1 abrupt climate shifts and provides further insights into the response of the hydrological cycle to such shifts on a continental scale.

TP8-O-09: The use of tephras as tools for synchronizing palaeoclimate records – an example from late-glacial central European varved lake records

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Tephra layers are excellent isochrones for dating and synchronising sediment sequences from different environments due to their wide dispersal and their synchronous deposition from volcanic ash clouds. In particular, small and deep lakes are valuable archives for the preservation of tephras due to the continuous and undisturbed sediment record, as well as the high likelihood of varve formation enabling high-resolution environmental and climate reconstructions connected to independent and robust chronologies. The identification of tephras in sediments requires the detection and geochemical fingerprinting of only minor amounts of small volcanic glass shards, so-called cryptotephras that can be precisely correlated to their volcanic sources and specific dated volcanic eruptions. An example is given from the Late Allerød Laacher See Tephra (LST) from the Eifel Volcanic Field (12,880 cal yr BP) that has been identified in three varved records in Germany and Poland – Lake Meerfelder Maar, Rehwiese and Trzechowskie palaeolakes. The LST is an important isochron for synchronizing these records, allowing, for the first time, to investigate possible regional variations of environmental responses (e.g. abrupt lithological changes) in an almost 900 km long SW-NE transect in Central Europe. The study of lake responses to climate variability within a time window of 200 years before the onset of the Younger Dryas shows a striking coincidence of abrupt shifts in the three depositional systems at 12,680 cal yr BP, which might correlate with the biostratigraphically defined Allerød-YD transition. We suggest a synchronous climatic signal across central Europe that is likely triggered by changes in North Atlantic atmospheric dynamics. The high potential to discover other cryptotephras, i.e. from younger Icelandic eruptions, in these records provides a suitable tool to further test this hypothesis by establishing an even denser network of high-resolution lake records in Northern Europe.

TP8-O-10: Reconstruction of climate extreme indices over Europe from high resolution proxy data

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Interannual to decadal variability of climate extremes over Europe as captured by long-term observed records of cold (TN10p, CSDI and CFD), heat (TX90p and WSDI) and drought (CDD) extreme indices is investigated. We detect significant correlations between the dominant patterns of variability of these indices and various high resolution proxy records like stable oxygen isotopes from Greenland ice cores, accumulation from Northern Greenland, stable oxygen isotopes from Red Sea corals and lake sediments from central Germany. The analysis of long-term reanalysis data in combination with extreme climate indices and proxy data reveals that the variability in atmospheric blocking circulation in the North Atlantic region explains most of the identified relationships. We identify several persistent oscillations in the North Atlantic blocking variability at time scales of about 70 years and about 20 years which characterise also extreme climate indices variability from several regions of Europe. These oscillations, which are detected also in various proxy data, were related to the impact of the Atlantic Multidecadal Oscillation and of variations in solar activity on atmospheric blocking frequency. The role of large-scale climate modes and external forcing such as variability in solar activity in explaining these connections are also discussed. We argue that high-resolution proxy data can be used to reconstruct climate extreme indices variability during the recent past.

TP8-O-11: Simulated changes in wind extremes during the last millennium over northern Europe Simulated changes in wind extremes during the last millennium over northern Europe

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We analyse two millennium-scale regional climate simulations to compare the distribution and the low frequency variability of wind extremes over northern Europe over historical time scales. Special focus is put on the differences in frequency and intensity of wind extremes between the Medieval Warm Period (around 900-1350 BP), the Little Ice Age (around 1550-1850 BP) and today‘s warm climate conditions (since around 1850).

The changes in the statistics of extreme daily winds in these three periods are investigated by two methods: (a) estimation of the parameters of the Generalised Extreme Value distribution of daily winds and (b) Peak over Threshold.

The statistical significance of the changes in the wind statistics is ascertained by the application of several significance tests to both methods. The results are also applied to gliding temporal windows over the whole simulation period to obtain continuous time series. In addition, the statistical relationship between the changes in the wind statistics and the varying external forcing of the climate model simulations is analysed.

Both climate simulations were conducted with the regional climate model MM5, driven at the boundaries of the European domain by the global climate models ECHO-G and MPI-ESM, respectively. Both global climate model simu-

lations include reconstructed greenhouse gas atmospheric concentrations, total solar irradiance and volcanic activity as external forcing.

The results of this analysis may be compared to the outcome of recent proxy data analysis with special focus on changes in extreme wind conditions (e.g. strength, direction), such as those derived from lake sediments or dune systems.

The presented work is embedded in the collaborative project Climate Deposits in Coastal Dunes (CLISCODE) which aims on the reconstruction of changing regional storminess for the past centuries in the southern Baltic Sea area.

TP8-O-12: A robust chronology established by a multiple dating approach for the varved sediment record from Lake Czechowskie (Poland)

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Annually laminated (varved) sediment records are essential for detailed investigations of past climate and environmental changes as they function as a natural memory far beyond instrumental datasets. However, reliable reconstructions of past changes need a robust chronology. In order to determine Holocene inter-annual and decadal-scale variability and to establish a precise time scale we investigated varved sediments of Lake Czechowskie (53°52' N/ 18°14' E, 108 m a.s.l.), northern Poland. During two coring campaigns in 2009 and 2012 we recovered several long and short cores with the longest core reaching 14.25 m sediment depth.

Here we present a multiple dating approach for the Lake Czechowskie sediments. The chronology comprises varve counting for the Holocene time period and AMS 14C dating for the entire sediment record reaching back to 14.0 cal ka BP. The varve chronology for the last 50 years is confirmed by 137Cs activity concentration measurements. The good agreement between varve chronology and modelled age based on radiocarbon dates proves the robust age control. Derived age uncertainties range between 3 to 8% for the Holocene and 5 to10% for the Late Glacial period, respectively. Additionally, the detection of two crypto-tephras (scattered volcanic glass shards) provided independent anchor points confirming the established chronology. Microprobe analyses of glass shards from both tephra layers allowed to definite attribution to the Askja AD 1875 eruption in Iceland and the Laacher See Eruption (12,880 varve yrs BP) originating in the Eifel region, respectively. These volcanic ash layers can be further used as tie points to synchronize and correlate different lake records for investigating regional leads and lags of climatic and environmental changes. The resulting age model builds a robust base for high-resolution proxy data (e.g. sedimentological, geochemical and pollen data) time series as a prerequisite for future investigation of abrupt climate and environmental changes.

This study is a contribution to the Virtual Institute of Integrated Climate and Landscape Evolution Analysis (ICLEA) of the Helmholtz Association and the Helmholtz Association climate initiative REKLIM.

TP8-O-13: Towards retrieving Holocene climate changes in Western Europe from a high Alpine ice core

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Only ice cores from the Swiss-Italian glacier site Colle Gnifetti (4500 m a.s.l.) show snow accumulation rates low enough to offer climate proxy records which may cover a good deal of the Holocene. This glaciological setting, linked to very rapid annual layer thinning, prevents so far establishing an appropriate core chronology for the climatic interpretation of depth profiles available here on the stable water isotope and the atmospheric dust variability. In order to overcome this dilemma, a new large-caliber Colle Gnifetti ice core has been drilled to bedrock in 2013 and is now dedicated to the whole suite of modern ice core analyses methods that enable development of the Holocene core chronology. Already finished measurements include high-resolution continuous flow analyses (ion species, dust and stable water isotopes) accompanied by various electrical and physical core properties. Especially for the bottom core section where all stratigraphic dating methods fail and where maximum age already carries important climatic information, micro radiocarbon dating of particulate organic carbon matter is being applied at the 10 µg level. Along with climate proxy records, we present the current state of our dating exploration at the practical limit of annual layer counting as well as the experimentally and modelling based perspective for achievement of a self-contained radiometric dating of the oldest core sections (i.e. radiocarbon ages backed up by Beryllium-10 excursions).

TP8-O-14: A spatial reconstruction of European drought from a tree-ring stable isotope network

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A well-verified spatial reconstruction of European moisture variability back to 1600 AD was established from a network of tree-ring stable isotope records (C+O). Principle component regression and change point detection techniques have been applied and revealed strong coherences among the tree ring isotope records, convincing congruence with isotope theory and a powerful climate-proxy relationship with the summer Standardized-Precipitation-Evaporation-Index (SPEI; July-August).

The presentation will outline and discuss trends in the spatial extent of drought events, coherences with atmospheric regimes (SNAO) and comparisons with other European climate reconstructions.

Poster presentations:

TP8-P-01: Regional trends in the last two millennia in a comprehensive climate model simulation

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The climate of the last two millennia is influenced by different forcing agents acting on different time scales. On longer time scales, changes in orbital parameters are important, on shorter time scales changes in solar and volcanic activity, land use, and greenhouse gases come into play.

Here we present regional trends based on a comprehensive climate simulation of the last 2000 years with an Earth System Model (MPI-ESM-P), taking into account the various forcing factors. For the first time changes in volcanic activity going back to 100 BC are included.

The trends in near-surface temperature patterns indicate a variety of regional patterns that are not always in congruence with changes in external parameters. Especially the southern hemispheric continents show deviations from the directly induced changes due to changes in orbital forcings. However, volcanic eruptions are well reflected in hemispheric and continental temperatures.

A lagged response of negative temperature trends can be seen over the Arctic caused by a sea ice response due to a decrease in orbitally-induced summer insolation. A second regional response relates to changes over the African Sahel indicating an increase in temperatures. A third region standing out is located over the western Antarctic coastlines showing pronounced negative temperature trends.

The regional trend patterns indicate that internal feedbacks are strongly modulating and could offset or counteract changes in earth orbital parameters. The estimation of those trends is important because shorter fluctuations might be superimposed on those long-term trends. A second conclusion relates to the importance of the regional perspective because the temperature evolution displays considerable spatial heterogeneity even at long time scales as well.

TP8-P-02: Sea surface temperature trends in the North Atlantic and Pacific Oceans: models and observations

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We compare the ocean temperature evolution of the Holocene and Termination I as simulated by climate models and reconstructed from marine temperature proxies on a global scale. We use transient simulations from a coupled atmosphere–ocean general circulation model, as well as an ensemble of time slice simulations from the Paleoclimate Modelling Intercomparison Project (PMIP). Independently of the choice of the climate model, we observe significant mismatches between modelled and estimated SST amplitudes in the trends for the last 6000 yrs. Alkenone-based SST records show a similar pattern as the simulated annual mean SSTs but the simulated SST trends underestimate the alkenone-based SST trends by a factor of two to five. We test if such discrepancies can be caused by too simplistic interpretations of the proxy data. Our results indicate that modelled and reconstructed temperature trends are to a large degree only qualitatively comparable, thus providing at present a challenge for the interpretation of proxy data as well as the model sensitivity to orbital forcing. One possible drawback of present climate models is that they cannot represent spatially heterogeneous patterns and regional dynamics. On a hemispheric scale, one earlier hypothesis suggested a Holocene SST large-scale seesaw pattern between the North Pacific and North Atlantic. A long-term warming of the North Pacific Ocean was proposed whereas the North Atlantic experienced continuous cooling. However, new proxy-based results reveal a spatially diverse SST pattern in the subarctic Northwest Pacific, not supporting the hypothesis of a large-scale Holocene seesaw trend in SST development, but instead support a cooling trend in the Northwest Pacific Ocean. The heterogeneous pattern in the North Pacific suggests furthermore that the atmospheric dynamics plays a dominant role. A new climate model simulation suggests a weakened Aleutian Low during the Mid-Holocene, which is consistent with the Northeast Pacific cooling and Northwest Pacific warming trends, as

seen in the data. A positive feedback between SST changes and atmospheric circulation is proposed. Finally, we test the Pacific dynamics and Atlantic-Pacific teleconnections for freshwater housing for both for glacial and interglacial conditions. The experiments reveal a large difference in response between the background conditions which can be attributed to the open and closed Bering Strait.

TP8-P-03: Spectral analysis of Central European temperature data

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We analysed temperature records from six central European stations, reaching back until 1757. The Fourier spectrum consists of discrete frequency components, indicating dominant multi-periodic dynamics. For an unambiguous determination of the strongest frequency component of 200+ year period the recordings are obviously too short. The Spannagel Stalagmite which extends back 2000 yrs, was therefore additionally used. Its wavelet analysis shows this 200+ year cycle as the dominant dynamics for the last 1000 years.

Fourier synthesis using the six strongest frequency components reproduces in a remarkably precise way the central European temperatures of the last 200 years, suggesting that secular variations such as anthropogenic warming or cooling contribute little to the temperature changes.

The Fourier Synthesis shows that two cycles (periods of ca. 65 and 200+ years) represent the bulk of the temperature variations. While the about 65-year-cycle is readily identified as the AMO/PDO, the recent paper on solar activity and associated change of terrestrial temperatures once more confirms the dominance of the 200+ year cycle found by us and permits to identify it with the solar De Vries-Suess cycle. Antarctic ice core temperature data agree well with the European measurements, suggesting that the observations are a global phenomenon. We used Monte Carlo simulations to ensure the validity of our analysis statistically.

TP8-P-04: Rapid shifts in subarctic Pacific climate between 138,000 – 70,000 years ago

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During the last interglacial period, also known as Eemian (ca. 130,000 – 115,000 yrs. BP), global climate was supposed to be significantly warmer compared to temperatures of the recent Holocene. In particular, temperatures over Greenland and the Arctic Ocean were apparently up to 5 °C warmer than present and Arctic sea ice cover substantially reduced [CAPE Last Interglacial Project Members, 2006]. Thus, the Eemian is often regarded as an ideal showcase from the past to understand possible future warm climate dynamics. However, information of environmental changes under 'warmer-than-present' Eemian boundary conditions in the high-latitude regions of the Northern Hemisphere is still rather sketchy. Here we provide reconstructions of natural variability of sea-ice and sea surface temperature (SST) in the subarctic Pacific realm 138,000 – 70,000 years ago. Warmest sea surface conditions were found during the early Eemian interglacial (128,000 – 126,000 years ago) exceeding modern SSTs by approximately 2 °C. Other important features of subarctic Pacific climate evolution are pronounced oscillations in SST and sea ice on millennial time scales, which corresponds remarkably well with short-term temperature oscillations known from Greenland and the North Atlantic. Our results suppose a common forcing of high-latitude Northern Hemisphere climate, which seem to be closely related to dynamics of the Atlantic meridional overturning circulation (AMOC). However, immediate propagation of millennial-scale climate fluctuations far beyond the North Atlantic basin suggests a rapid circumpolar coupling mechanism probably acting through the atmosphere prerequisite to explain the apparent synchronicity of remote climatic reorganisations in the subarctic Pacific.

TP8-P-05: The sedimentary 'barcode' of past wind regimes: southern Baltic coastal dunes as climate archive

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Data obtained in the framework of the project cooperation 'Climate Signals in Coastal Deposits' imply that past variations of the wind regime are recorded by the sediments of southern Baltic coastal migrating dunes of the Gardno-Leba Lowland (Poland). Dunes in the study area are 250 to 550 m wide and up to 30 m high. Dune-internal architecture was imaged by means of ground-penetrating radar (GPR), a non-invasive method which allows for the detection of electromagnetic discontinuities in the sub-surface. These data show that the Leba dunes are composite sediment bodies formed by a 13 - 20 m thick basal unit of eastward inclined foresets partially covered by 2 to 8 m thick low angle cross-bedded deposits. Sedimentological investigation and GPR data show that heavy-mineral content throughout the dune bodies varies. Foresets enriched in heavy minerals in the GPR data are imaged as high amplitude reflection

packages, 1 to 4 m thick. These intervals are separated from each other by up to 10 m thick quartz-sand dominated foreset bundles characterised by low-amplitude reflections. Layers enriched in heavy minerals are the result of the eolian winnowing of lighter minerals. It is therefore proposed that the observed alternation of heavy-mineral enriched and depleted foresets represents a sedimentary barcode of past variations of the wind regime. Bundle counting indicates that the dunes bear an archive covering at least the past 46 years. Next steps of this project aim to correlate the regional meteorological-marine data set of coastDat (www.coastdat.de) with these sedimentological data.

TP8-P-06: Dynamic Bayesian models to assess palaeo-Arctic ice shelf extents

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The extent and configuration of former Arctic Ocean ice shelves and ice complexes is a subject of high scientific and societal relevance. It constitutes essential knowledge when analysing rapid changes in the arctic cryosphere, currently occurring at unprecedented pace. However, numerical modelling of ice dynamics is fraught by large uncertainties regarding both process understanding and space-time reconstructions. While uncertainty quantification plays a central role in climate projections, it is still in an infant stage in ice modelling.

The goal of this study is to reconstruct the configuration of arctic ice shelf complexes during former extensive glacial periods. We develop a Bayesian statistical model to describe palaeoarctic ice shelf configurations and quantify uncertainty. The core model consists of a stochastic partial differential equation, embedded in a Bayesian hierarchical framework. The statistical model should be seen as a computationally cheap alternative compared to so-called higher-order or full Stokes numerical ice models solving the Stokes equations, and allows simulations on millennial instead of centennial timescales.

In a first step, we consider the classical evolution equation of ice shelf thickness. This equation is then put into a stochastic framework with space-time Gaussian processes. In a second step, the model described above is fitted to several Antarctic ice shelves using present-day observations. The third step establishes a relation between present-day Antarctic ice shelf configurations and arctic palaeo ice shelf configurations. Finally, the consistency of the reconstruction is assessed by comparing modelled extreme ice drafts along ice shelf calving fronts to geological evidence on the form of ice berg scour marks on the Arctic Ocean seafloor, witnessing of the size of palaeoarctic ice shelf complexes.

TP8-P-07: Last interglacial surface water structure in the NW Mediterranean (Balearic) Sea: climatic variability and link between low and high latitudes

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A multi-proxy analysis based on planktic foraminiferal abundances and derived SSTs, abundances of alkenone compounds and alkenone SSTs as well as stable isotopes measurements was performed for Site 975 (ODP Leg 161) from the slope of the South Balearic-Islands basin (Western Mediterranean) across late MIS 6 to early MIS 5d periods with emphasis on the climate progression of the last interglacial period. A number of abrupt climate changes related to alternative influence of northern nutrient rich and southern oligotrophic water masses were revealed. Among climate fluctuations, Heinrich Event 11 and cooling events C 27, C 26, C 25, C 24, C23 which had been detected earlier in the North Atlantic, were recognised. However, in comparison to the eastern North Atlantic mid-latitude region, at Site 975 events C27 and C26 seem to be significantly more pronounced. This fact along with evidence of two-phase climate optimum with the SSTs maximum reached during its later phase implies close similarity in climate dynamics between the Western Mediterranean and the Nordic Seas. It is proposed that postglacial effects in the Nordic Seas had an influence on the western Mediterranean climate via atmospheric circulation and competed with the insolation effect.

TP8-P-08: Holocene palaeoenvironmental reconstructions from Eilandvlei and Groenvlei, Wilderness Embayment, South Africa

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The climate of southern Africa is strongly influenced by the interplay of oceanic drivers (the Agulhas and the Benguela currents) and atmospheric dynamics (the polar westerlies and tropical easterlies). The lakes, Eilandvlei and Groenvlei are located in the Wilderness Embayment, at the nexus

of these systems and are ideally situated to record their fluctuations. Therefore, sediment records from these lakes were sampled to improve the knowledge about land-ocean interactions during the Late Quaternary.

A 30.5 m sediment core was recovered from Eilandvlei, a brackish lake that is connected to the Indian Ocean via an estuary. Radiocarbon dating reveals a basal age of about 10,300 cal. BP. Up to now, this ultra-high-resolution record of environmental change during the Holocene represents a unique discovery for southern Africa. Using Ca and Sr XRF-scanning data from this sediment core, different phases of deposition can be reconstructed. While high Ca and Sr values can be linked to periods when the deposition of marine sediments was dominant, low Ca and Sr values are indicative for times during which the sediments were mainly characterised by a terrestrial origin.

Furthermore, a sediment core covering ca. 4,200 yrs cal. BP was obtained from Groenvlei, a lake to the east of Eilandvlei that has recently no connection to the ocean. The sediments of this lake are predominantly autochthonous carbonates. As XRD results show, there have been phases when calcite sedimentation was dominant indicating salinities similar to recent conditions. In contrast, during periods when aragonite was the dominant carbonate phase, it can be assumed that the lake water of Groenvlei was characterised by higher salinities. These higher salinities are either caused by an aboveground, direct connection to the ocean or by a lower precipitation/evaporation ratio. The latter seems to be more probable since there is a general lack of autochthonous foraminifera associations in the recovered sediment core.

TP8-P-09: The Virtual Institute of Integrated Climate and Landscape Evolution Analyses – ICLEA

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GFZ, Greifswald University, and the Brandenburg University of Technology together with their partner, the Polish Academy of Sciences, strive for focusing their research capacities and expertise in Helmholtz Virtual Institute for Integrated Climate and Landscape Evolution Analyses (ICLEA). ICLEA offers young researchers an interdisciplinary and structured education and promote their early independence through coaching and mentoring.

The long-term mission of the virtual institute is to provide a substantial data basis for sustained environmental maintenance based on a profound process understanding at all relevant time scales. The aim is to explore processes of climate and landscape evolution in an historical cultural landscape extending from north-eastern Germany into north-western Poland. The northern-central European lowlands will be facilitated as a natural laboratory providing an ideal case for utilising a systematic and holistic approach.

In ICLEA five complementary work packages (WP) are established according to the key research aspects. WP 1 focuses on monitoring hydrology and soil moisture as well as meteorological parameters. WP 2 is linking present day and future monitoring data with the most recent past through analysing satellite images. This WP will further provide larger spatial scales. WP 3-5 focuses on different natural archives to obtain a broad variety of high quality proxy data; Tree rings provide sub-seasonal data for the last centuries up to few millennia, varved lake sediments cover the entire research time interval at seasonal to decadal resolution and palaeosoils and geomorphological features also cover the entire period but not continuously and with lower resolution. Complementary information like climate, tree ecophysiological and limnological data etc. are provided by cooperating with associated partners.

TP8-P-10: A mid-Holocene shift and millennial-scale variations in North Pacific mesopelagic oxygenation and upper mixed layer hydrography

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The modern North Pacific Ocean is one major region of the world ocean where only mid-depth water layers are ventilated and re-supplied with nutrients which are mainly sourced from the subarctic Okhotsk Sea and precondition the North Pacific as substantial natural CO_2 sink. Fundamental regional environmental changes like sea ice decrease, transformations of nutrient inventories, and oxygenation were detected in the Okhotsk Sea based on relatively short instrumental records. Such changes are often attributed to global climate change. However, knowledge about the natural long-term variability beyond instrumental time series is extremely limited. The extension into past, warmer-than-present times by using palaeoceanographic, proxy-based time series thus helps establishing baselines of natural variations against which potential anthropogenic changes can be evaluated and local vs. larger regional patterns can be assessed.

Our proxy data-based study focuses on a collection of sediment records covering the last ca. 15,000 years with high temporal and spatial resolution. We decipher rapid changes in North Pacific Intermediate Water on centennial to millennial time scales and show that the current benign ventilation of the mid-depth North Pacific has only been prevalent for the last 2 ka. We provide evidence for a shift around 4-6 ka that changes the mid-depth Pacific oxygen character-istics, and ascribe the observed variations to intensity changes of the SE Asian Monsoon dynamics. Additionally, changes in flow speed and patterns of the Atlantic Meridional Overturning Circulation are reflected in our records of North Pacific mid-depth water mass dynamics, thus indicating a hemispheric teleconnection pattern between the Atlantic and Pacific realm during the Holocene.

TP8-P-11: INTegrating Ice core, Marine and TErrestrial records to understand abrupt climate changes

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Understanding the mechanisms and patterns of abrupt climate changes in the past requires an integrative approach that brings together palaeo-environmental and -climatic data from a diversity of archives from polar ice cores, to terrestrial and marine sediments. Comparison of such palaeoclimate records based on their independent timescales provides insights into leads/lags in the global climate system and the interaction between and environmental responses to different climate forcing mechanisms (Brauer et al., 2014). The robust integration of palaeoenvironmental data also provides critical tests of global and regional climate models which will improve our ability to model future climate change and ecosystem response. The INTIMATE network brings together palaeoclimate researchers working across a range of disciplines with the aim of combining our data to better reconstruct and understand past abrupt and extreme climate changes over the last 60,000 years. This includes data-model integration (Roche et al., 2014) as well as new regional compilations of palaeoenvironmental records providing insights into climatic gradients and variability across Europe (Feurden et al., 2014; Heiri et al., 2014; Moreno et al., 2014). The Greenland ice cores provide a continuous and decadally-resolved palaeoclimate signal for the high latitudes, forming the basis of the INTIMATE event stratigraphy (Blockley et al., 2012; Rasmussen et al., 2014; Seierstad et al., 2014). Where precise comparisons were possible between terrestrial archives and the Greenland ice cores, important insights into the phasing of events at abrupt climate transitions have been made (Lane et al., 2013; Rach et al., 2014).

TP8-P-12: Towards a more flexible representation of hydrological discharge transport in palaeoclimate modelling

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In the hydrological cycle vast amounts of water are moved between different parts of the climate system. Water that evaporates at the ocean surface may be transported over land masses, form clouds and precipitate over continents. Excess water that cannot be stored in soil, by vegetation, or as land ice forms runoff which is subsequently transported along the orographic gradient back to the ocean, where it may influence the regional sea water salinity budget, and subsequently impact on the buoyancy-driven part of ocean circulation.

Up until recently the focus of palaeoclimatic modelling on a global scale has been on applications where land surface conditions do not dramatically change during the course of a model simulation, and hydrological discharge routing in a climate model focused on high resolution but static discharge transport schemes, rather than on flexible discharge routing. Yet, the advent of fully coupled atmosphere-ocean-land-ice earth system models, with dynamic consideration of variations in land elevation and sea level height, represents a paradigm shift in palaeoclimatic modelling that poses new challenges for hydrological discharge transport schemes.

Here, we describe the design and evaluate the validity and performance of the Flexible Hydrological Discharge Model (FHD-Model) as an optional part of the European Centre Hamburg Model (ECHAM)/Max Planck Institute Ocean Model (MPIOM) coupled atmosphere-ocean model. In contrast to the standard hydrological discharge transport model used in ECHAM, the FHD-Model allows variations in sea le-

vel height to impact on continental discharge routing, and it accepts land surface elevation data of arbitrary resolution. These characteristics enable ECHAM/MPIOM to perform a hydrological discharge routing that is at all times during a simulation consistent with the current state of land surface and sea level conditions, and make ECHAM/MPIOM more suitable for use in combination with ice-sheet models.

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Übersicht über die erschienenen Hefte 2005-2013
Volumes published 2005-2013

2005/1 **19th Colloquium on Latin American Geosciences.** April 18-20, 2005, Potsdam. – 147 S. – *Verkaufspreis: € 14,-*

2005/2 **2nd European Conference on Permafrost.** Programme and Abstracts. June 12-16, 2005, Potsdam, Germany. – 224 S. – *Verkaufspreis: € 20,-*

2005/3 **22. Internationale Polartagung der Deutschen Gesellschaft für Polarforschung.** Programm und Zusammenfassung der Tagungsbeiträge. 18.-24. September 2005, Jena. – 151 S. – *Verkaufspreis: € 14,50*

2005/4 **2nd International Alfred Wegener Symposium.** Programme and Abstract. October 30 - November 02, 2005, Bremerhaven, Germany. – 115 S. – *Verkaufspreis : € 13,-*

2005/5 **DFG-SPP 1135. Dynamics of the Central European Basin System.** 4th Rundgespräch. November 30 - December 02, 2005, Eringerfeld, Germany. 136 S. – *Verkaufspreis : € 14,-* **vergriffen**

2006/1 **ICDP-Workshop PASADO. Potrok Aike Lake Sediment Archive Drilling Project.** Scientific Programme – Abstract Volume – Excursion Guide – Participants. March 15-19, 2006, Rio Gallegos, Santa Cruz, Argentina. – 90 S. – *Verkaufspreis: € 11,50*

2006/2 **150 Years of Neanderthal Discoveries. Early Europeans – Continuity & Discontinuity.** Congress, July 21st-26th, 2006 in Bonn, Germany. – 170 S. – *Verkaufspreis : € 17,-*

2006/3 **Shaping the Earth's Surface: Dynamics and Changing Environments.** GV International Conference 2006 and 96th Annual Meeting of the Geologische Vereinigung e.V. September 25-29, 2006, Potsdam, Germany. – 118 S. – *Verkaufspreis : € 14,-*

2006/3a **Geomagnetic Field Variations: Space-Time Structure, Processes, and Effects on System Earth. International Final Colloquium of the German Science Foundation Priority Programme 1097.** Jointly organized by the Deutsche Forschungsgemeinschaft and the Deutsche Akademie der Naturforscher Leopoldina. October 4-5, 2006. – 120 S. – *Verkaufspreis: € 14,-*

2007/1-2 **The Oceans in the Earth System.** International Conference 2007 and 97th Annual Meeting of the Geologische Vereinigung e.V. (GV), Bremen, Germany, October 1-5, 2007. – 267 S. – *Verkaufspreis: € 21,-*

2008/1 **23. Internationale Polartagung der Deutschen Gesellschaft für Polarforschung**. Münster, 10.-14. März 2008. Programm und Zusammenfassung der Tagungsbeiträge. – 107 S. – *Verkaufspreis: € 14,-*

2008/2 **12th International Palynological Congress (IPC-XII), 8th International Organisation of Palaeobotany Conference (IOPC-VIII)**. Abstract Volume. August 30 – September 5, 2008 in Bonn, Germany. – 337 S. – *Verkaufspreis: € 25,-*

2009/1 **KALMAR – First Bilateral Workshop on Russian-German Cooperation on Kurile-Kamchatka and the Aleutean Marginal Sea-Island Arc Systems.** Program and Abstracts. *Petropavlovsk-Kamchatka, Russia, April 27 - May 1, 2009.* – 73 S. – *Verkaufspreis: € 10,-*

2009/2 **System Erde – Mensch. Handlungsoptionen und Managementstrategien**. Dokumentation der Strategiekonferenz am 12. und 13. Juni 2008 in Berlin. Herausgegeben von Rolf Emmermann, Gerold Wefer und Volker Mosbrugger. – 118 S. – *Verkaufspreis: € 5,-*

2009/3 **Paläontologie. Schlüssel zur Evolution. 79. Jahrestagung der Paläontologischen Gesellschaft, Bonn, 5.-7. Oktober 2009**. Kurzfassung der Tagungsbeiträge. – 126 S. – *Verkaufspreis: € 14,-*

2009/4 **Annual Meeting of the German Association of Stable Isotope Research (GASIR).** Abstract Volume. **– Jahrestagung der Arbeitsgemeinschaft Stabile Isotope e.V. (ASI)**. Tagungsband. – AWI Potsdam, 5.-7. Oktober 2009. – 86 S. – *Verkaufspreis: € 10,-*

2009/5 **Klima im System Erde. Klimawandel – Antworten und Fragen aus den Geowissenschaften.** Zusammenfassung der Konferenzbeiträge, dbb-forum Berlin, 2. und 3. November 2009. – 89 + 36 S. – *Verkaufspreis: € 5,-*

2010/1 **Potrok Aike Maar Lake Sediment Archive Drilling Project.** Program and Abstract Volume of the 2nd International ICDP Workshop PASADO, Vienna, 1-2 May, 2010. Edited by Bernd Zolitschka. – 94 S. – *Verkaufspreis: € 12,-*

2010/2 **15th Conference of the International Work Group for Palaeoethnobotany, Wilhelmshaven, Germany, May 31 – June 5, 2010.** Programme and Abstracts. Edited by Felix Bittmann. – 207 S. – *Verkaufspreis: € 19,-*

2010/3 **2nd International Sclerochronology Conference, 24-18th July, 2010,** Mainz, Germany. Program and Abstracts. Edited by Bernd R. Schöne and Elizabeth V. Nunn. – 169 S. – *Verkaufspreis: € 17,-*

2010/4 **15th International Conference: International Bryozoology Association, Kiel, Germany, August 2-6, 2010.** Program and Abstracts. – 75 S. – *Verkaufspreis: € 10,-*

2010/5 **24. Internationale Polartagung** der Deutschen Gesellschaft für Polarforschung. Obergurgl, 6. bis 10. September 2010. Programm und Zusammenfassung der Tagungsbeiträge. – 101 S. – *Verkaufspreis: € 12,-*

2011/1 **Socio-Environmental Dynamics over the last 12,000 Years. The Creation of Landscapes II.** Open Workshop, 14th-18th March, 2011, Kiel, Germany. Programme and Abstract Volume. Edited by Graduate School "Human Development in Landscapes", CAU Kiel. – 114 S. – *Verkaufspreis: € 14,-*

2012/1 **3rd PAGES Varves Working Group Workshop**, Manderscheid (Germany), March 20-24, 2012. Program and Abstracts. Edited by Bernd Zolitschka. – 114 S. *Verkaufspreis: € 14,-*

2012/2 **Potrok Aike Maar Lake Sediment Archive Drilling Project – PASADO**. 4th International PASADO Workshop, Bremen (Germany), August 27-29, 2012, Program and Abstracts. Bernd Zolitschka (editor). – 48 S. – *Verkaufspreis: € 7,-*

2012/3 **Centenary Meeting of the Paläontologische Gesellschaft**. Programme, Abstracts, and Field Guides. 24.09.-29.09.2012, Museum für Naturkunde Berlin. Edited by Florian Witzmann and Martin Aberhan. – 242 S. – *Verkaufspreis: € 20,-*

2013/1 **Socio-Environmental Dynamics over the last 12,000 Years. The Creation of Landscapes III.** Open Workshop, 15th-18th April, 2013, Kiel, Germany. Programme and Abstract Volume. – Edited by Graduate School "Human Development in Landscapes", CAU Kiel. – 120 S. – *Verkaufspreis: € 14,-*

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