MOSAiC goes O2A - Arctic Expedition Data Flow from Observations to Archives and Analysis

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Alfred Wegener Institute
Helmholtz Centre for Polar and Marine Research
Bremerhaven

EGU General Assembly 2020

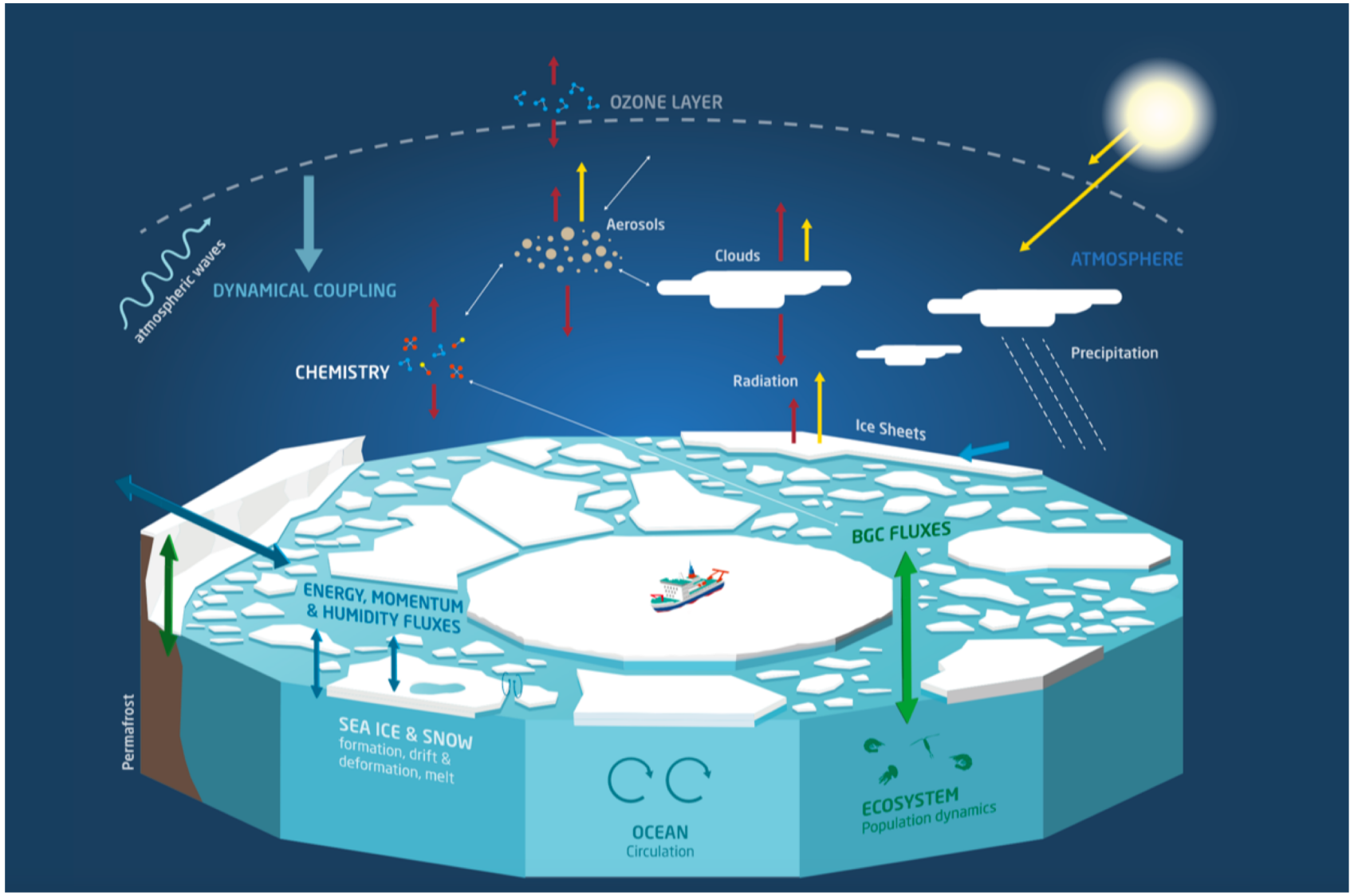
05.05.2020

MOSAiC - Multidisciplinary drifting Observatory for the Study of Arctic Climate

- Largest Arctic research expedition ever
  - to describe the processes coupling the atmosphere, sea ice, and ocean
- large suite of in-situ and remote sensing observations of physical, ecological and biogeochemical parameters
- Integrates between disciplines and between observations & models
- Will lead to breakthrough in Arctic climate science.
- More than 60 institutions, 17 nations
- A total of ~600 people will operate in the central Arctic
- estimated up to 600 to be registered data users

www.mosaic-expedition.org

Main scientific focus areas



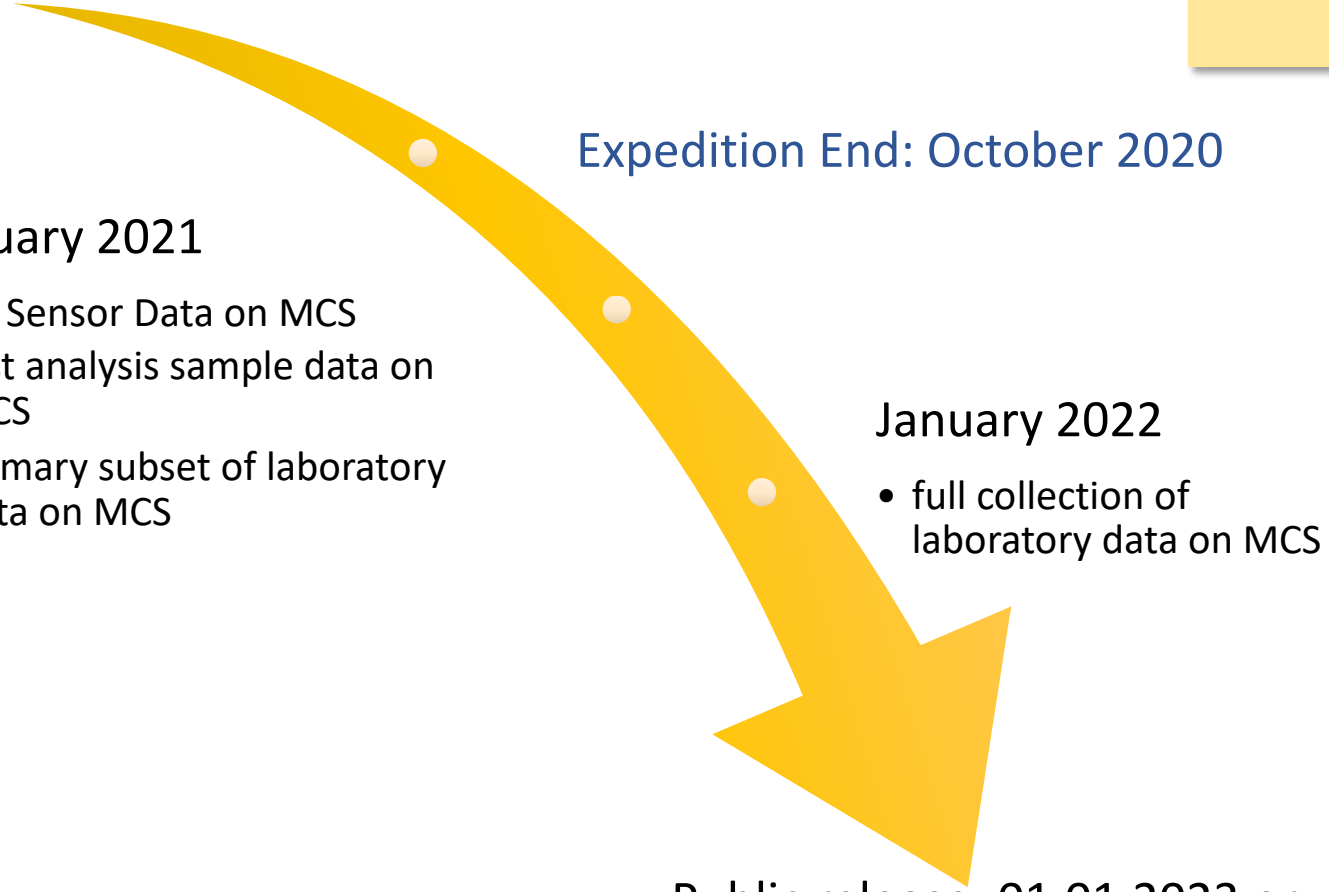
www.mosaic-expedition.org

MOSAiC Data Policy

- project's success relies upon professional coordination and data sharing across the participants
- transparent Data Policy is essential to achieve MOSAiC science objectives, to facilitate collaboration, and to enable broad use and impact of the MOSAiC data legacy

Expedition Start 19.09.2019

- First data back on land: January 2020



Expedition End: October 2020

January 2021

- All Sensor Data on MCS
- fast analysis sample data on MCS
- primary subset of laboratory data on MCS

January 2022

- full collection of laboratory data on MCS

Public release: 01.01.2023 or earlier!

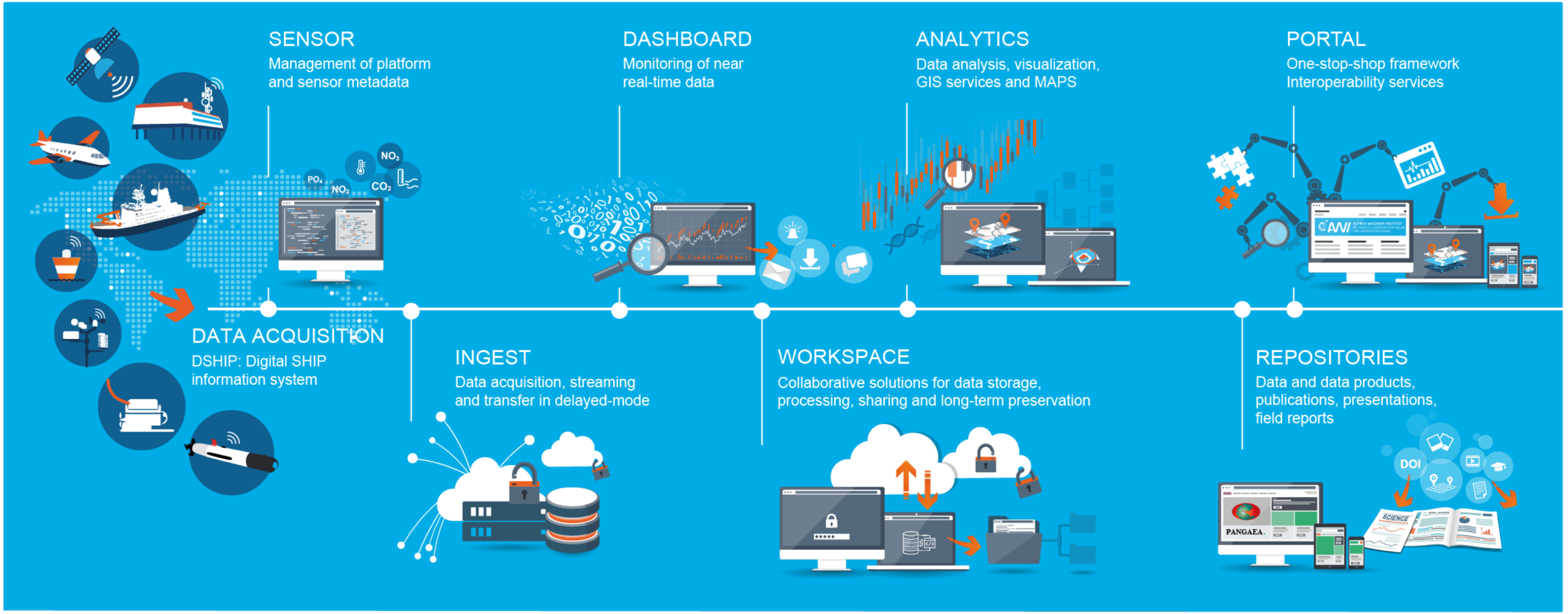
MOSAiC Central Storage (MCS)

- Aboard Polarstern: basis for gathering data along the year of operation
- On land: central and reliable storage and working database of MOSAiC data.

https://spaces.awi.de/display/EFPW/MOSAiC+Data+Policy

Observation to Archives and Analysis (O2A)

https://spaces.awi.de/display/DM/

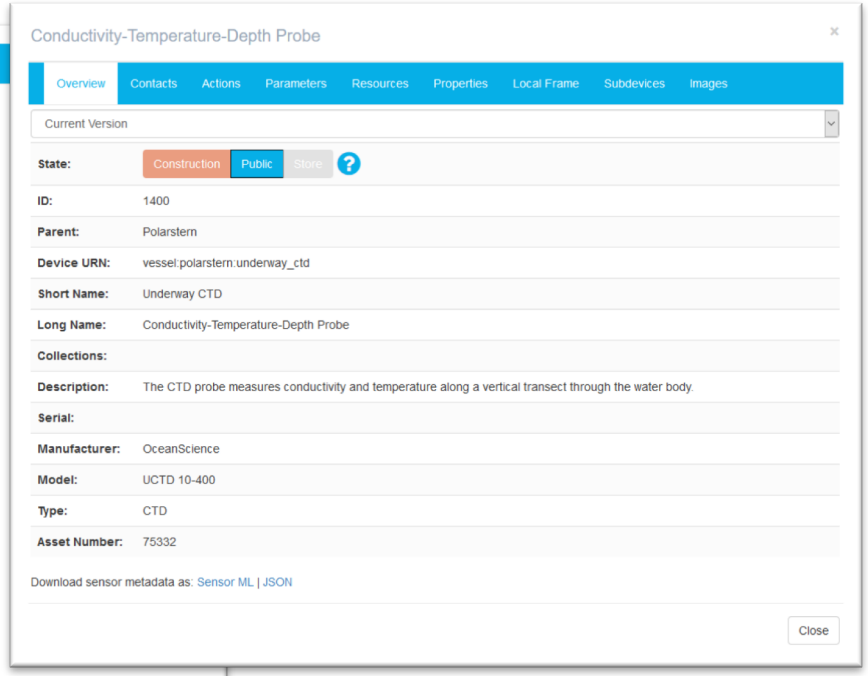


Metadata Description → Data Acquisition → Data Ingestion → Data Storage → Data Monitoring → Data Analysis → Data Archiving

Koppe, R. , Gerchow, P. , Macario, A. , Haas, A. , Schäfer-Neth, C. and Pfeiffenberger, H. (2015): O2A: A Generic Framework for Enabling the Flow of Sensor Observations to Archives and Publications , OCEANS 2015 Genova . doi: 10.1109/OCEANS-Genova.2015.7271657

SENSOR.awi.de

- … a sensor information system to create and manage meta data of scientific devices



Sensor Metadata Description | Data Acquisition | Data Ingestion | Data Storage | Data Monitoring | Data Analytics | Data Archiving

HELMHOLTZ

DSHIP ActionLog

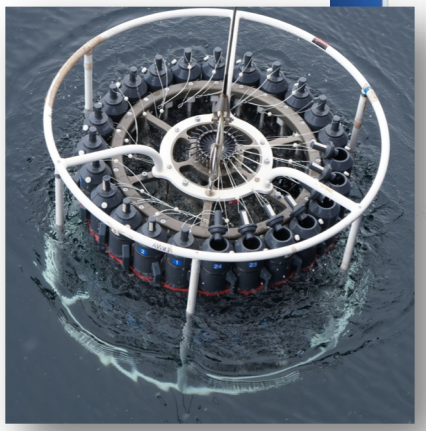
- … an interactive logbook of measurement and sampling activities

DSHIP MOSAiC20192020/1 || 75° 08,241' N 039° 07,762' E || 2019-09-22 … werum

DShip_ActionLog +

DShip_ActionLog

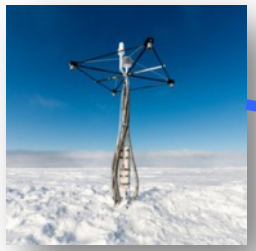
Activity - Device Operation	Timestamp	Device	Action	Latitude	Longitude	Depth (m)	Speed (kn)	Co
PS122/1_4-1 CTD_SBE9plus_485	22.09.2019 09:...	Conductivity-Te...	information	75° 07,932' N	039° 05,969' E	184.0	13.1	
PS122/1_3-1 topAWI	22.09.2019 09:...	Towed Ocean ...	information	75° 05,362' N	038° 51,058' E	186.0	13.3	
PS122/1_2-1 AIRGUN_PS	22.09.2019 08:...	Air Gun	profile start	74° 59,125' N	038° 15,496' E	177.0	13.3	
PS122/1_1-1 topAWI	21.09.2019 18:...	Towed Ocean ...	information	73° 08,358' N	029° 49,934' E	267.0	12.7	
PS122/1_0_Underway-60 Weather	20.09.2019 17:...	Weather Station	station start	69° 40,773' N	018° 59,799' E	0.0	0.0	

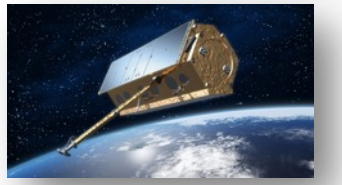


- werum.de
- dms.awi.de/

werum SOFTWARE & SYSTEMS

Data Ingestion via different channels…





Iridium satellite link to earth station, followed by Iridium satellite link for downloading to Polarstern

RadioLAN

LAN

USB-Disc („delayed mode“ data)

Ingest raw data

Files

Device Drivers

Parameter values

MOSAiC Central Storage raw data & workspace (700 TB with backup)

Sensor Metadata Description | Data Acquisition | **Data Ingestion** | Data Storage | Data Monitoring | Data Analytics | Data Archiving

MOSAiC Central Storage

- … naming convention derived from SENSOR.awi.de

SENSOR.awi.de

vessel:polarstern:ctd_watersampler:SBE3plus_temperature_sensor

- Platformtype
  - Platform
    - Device
      - Subdevice
        - Sensor 1
        - …

- vessel
  - polarstern
    - ctd_watersampler
      - SBE3plus temperature sensor
        - temperature

MCS

- vessel/polarstern/ctd_watersampler/SBE3plus_temperature_sensor/DEVICEOPERATION_ID…/SensorFile.xxx
- vessel/polarstern/ctd_watersampler/SBE3plus_temperature_sensor/DATE…/File.xxx

- vessel:polarstern:ctd_watersampler:SBE3plus_temperature_sensor:temperature

Sensor Metadata Description | Data Acquisition | Data Ingestion | **Data Storage** | Data Monitoring | Data Analytics | Data Archiving

Computer Network on board and on the ice…

RadioLAN connection

Internet Satellite connections

SENSOR, DSHIP, Dashboard, … Applications

Polarstern Network

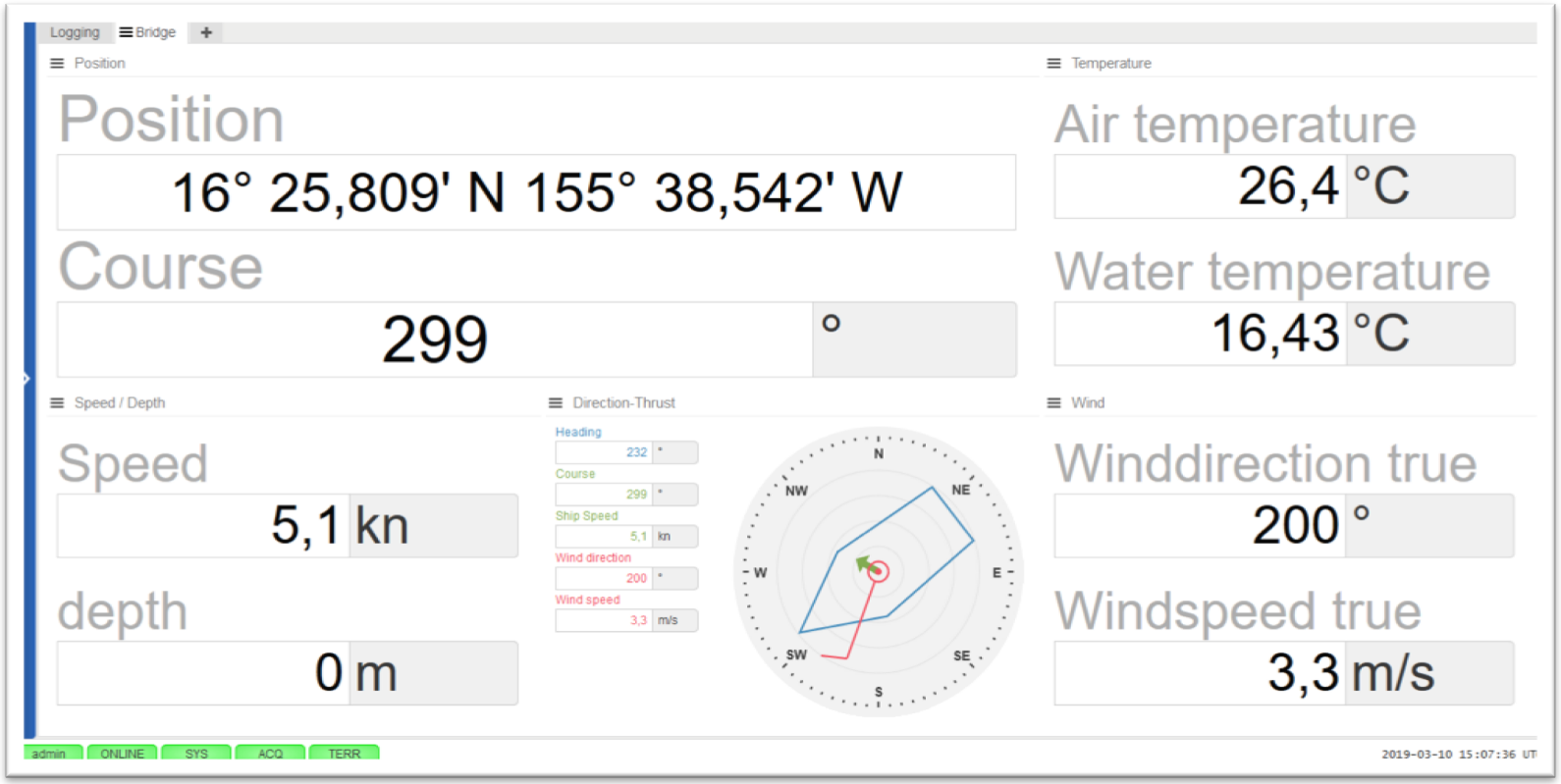
Network between Polarstern and RadioLAN, LAN, etc...

Fiber optic cable LAN connection to cities

User notebooks, PCs, VMs, tablets, mobile phones

DSHIP raw data

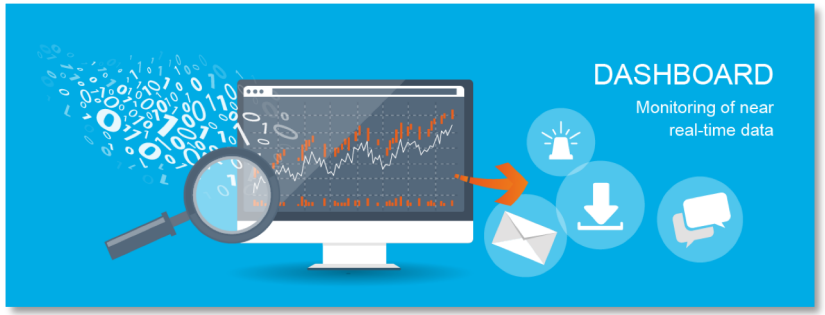
- Monitoring near real-time data from ship sensors

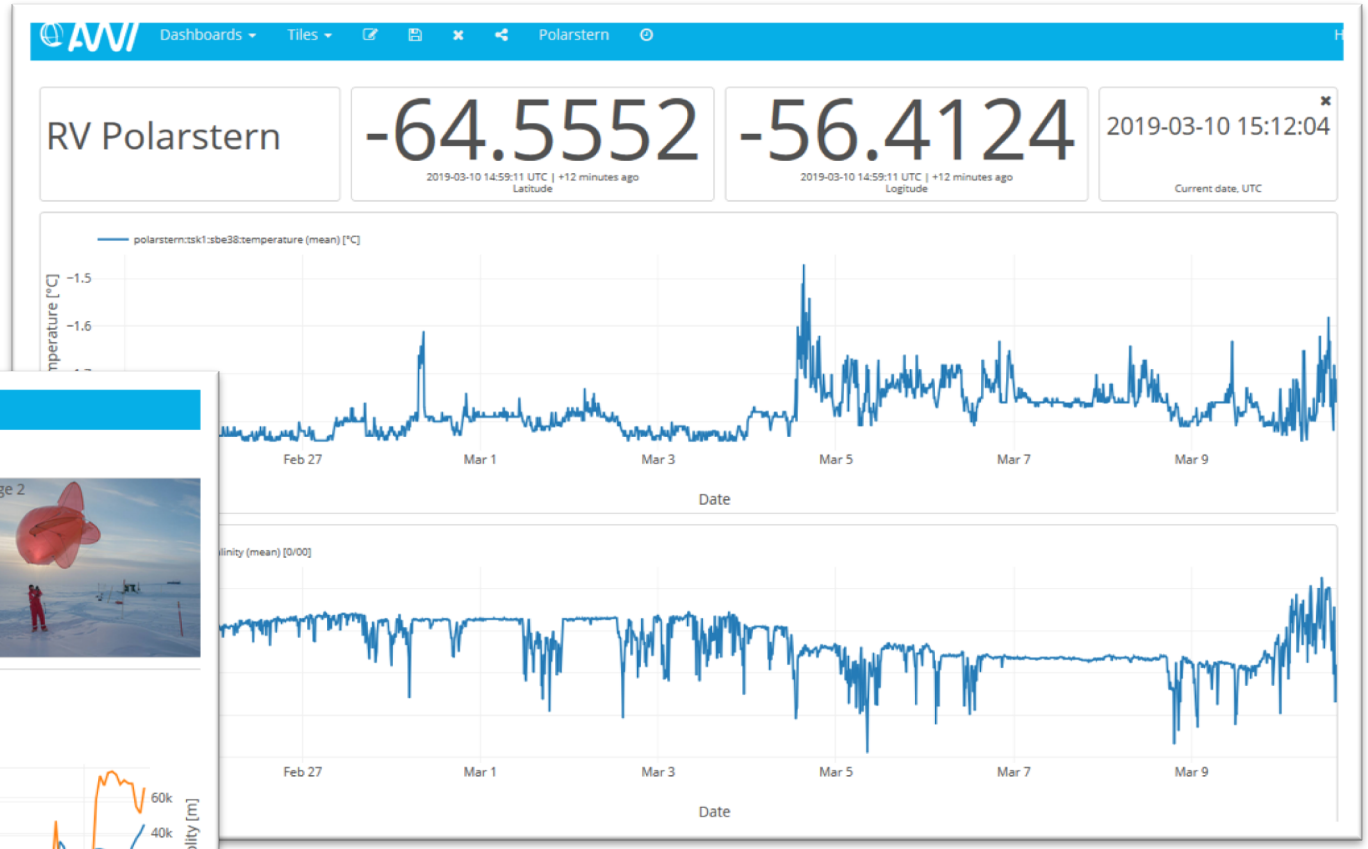


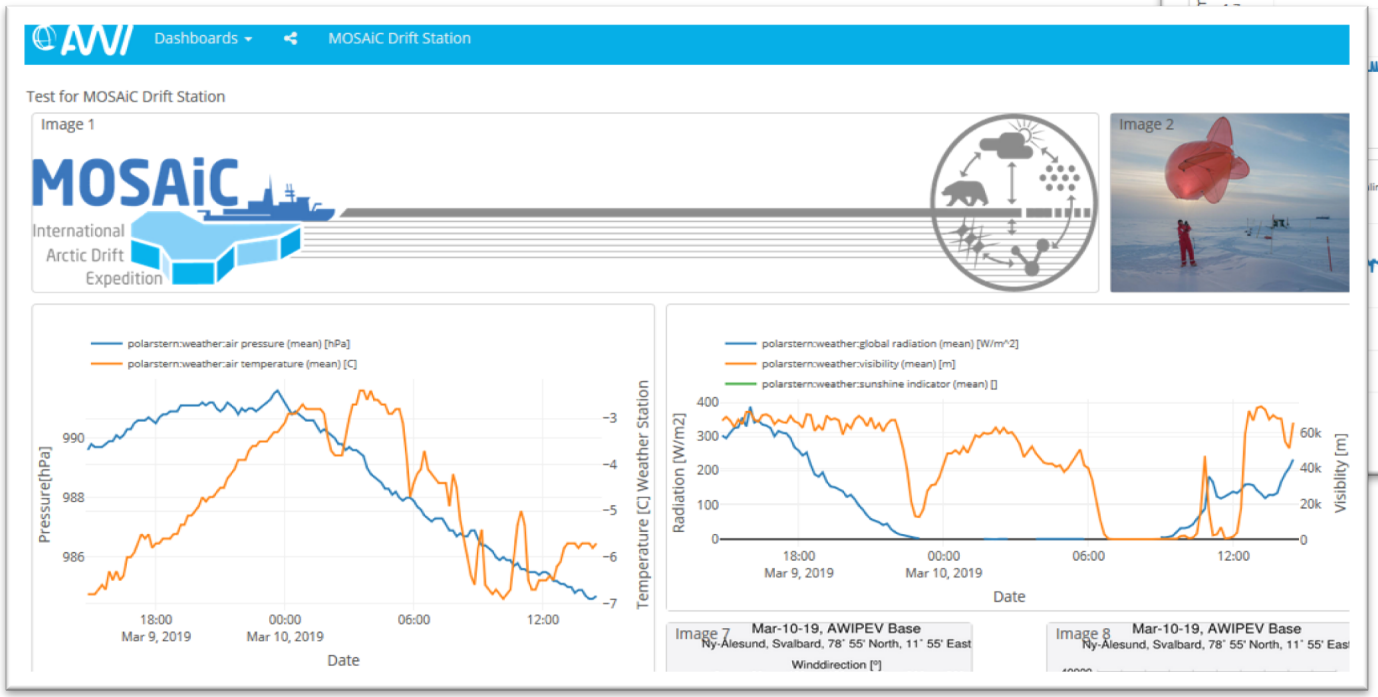
- werum.de
- dms.awi.de/

Dashboard.awi.de

- Monitoring of near real-time and delayed-mode data







Sensor Metadata Description | Data Acquisition | Data Ingestion | Data Storage | **Data Monitoring** | Data Analytics | Data Archiving

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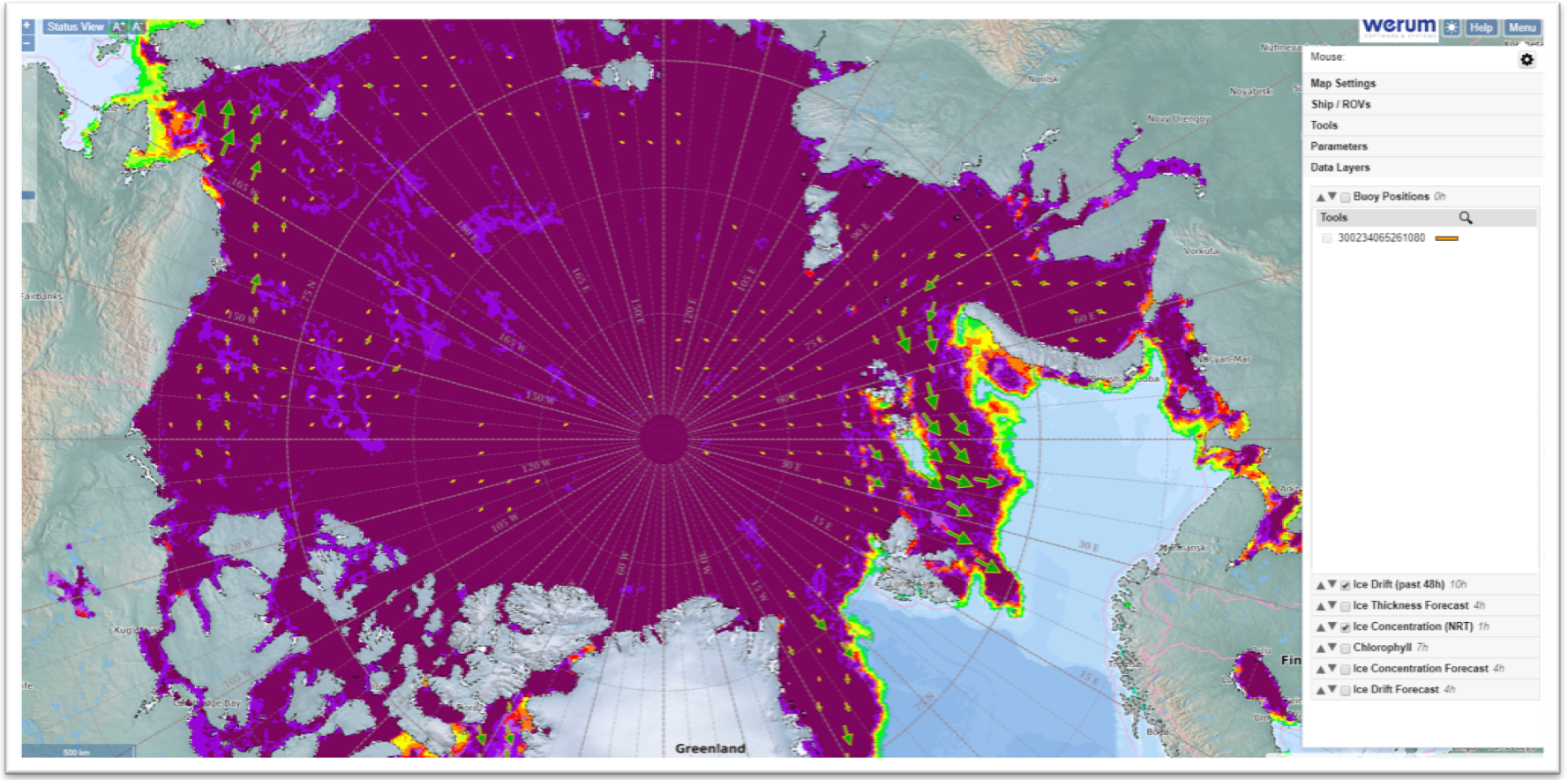
MapViewer

- …browser based mapping and viewing system
- decision support on board



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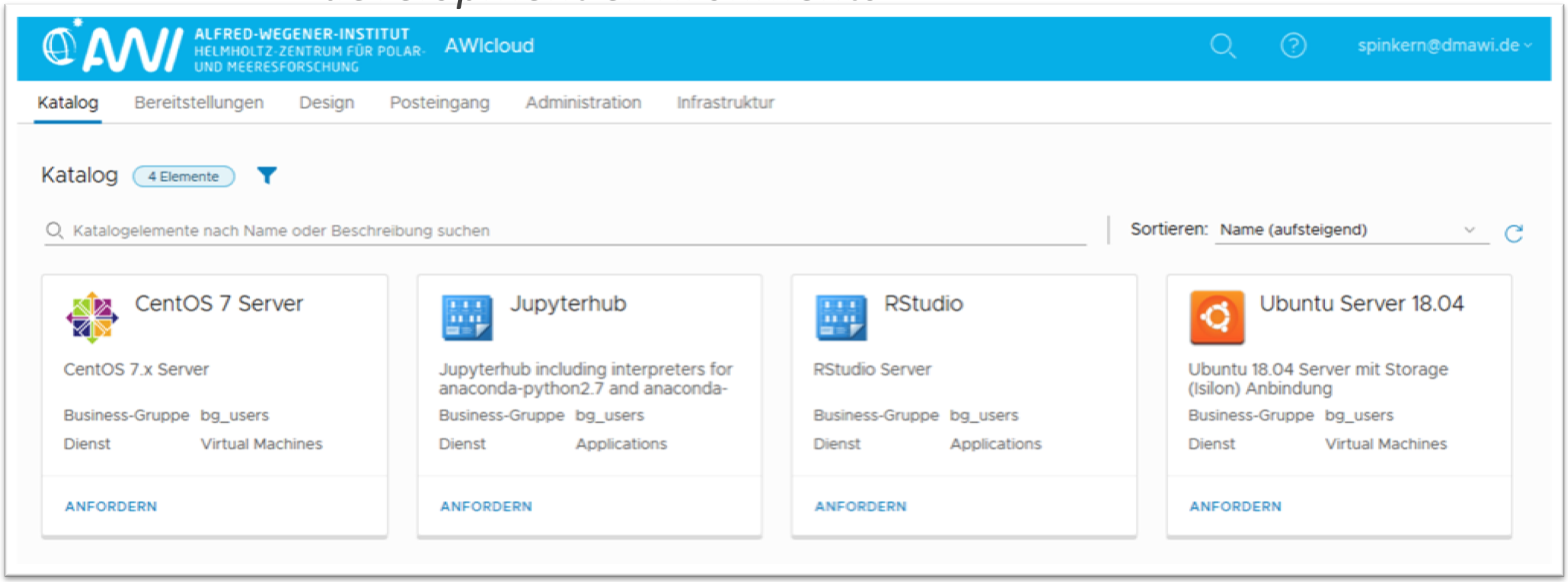
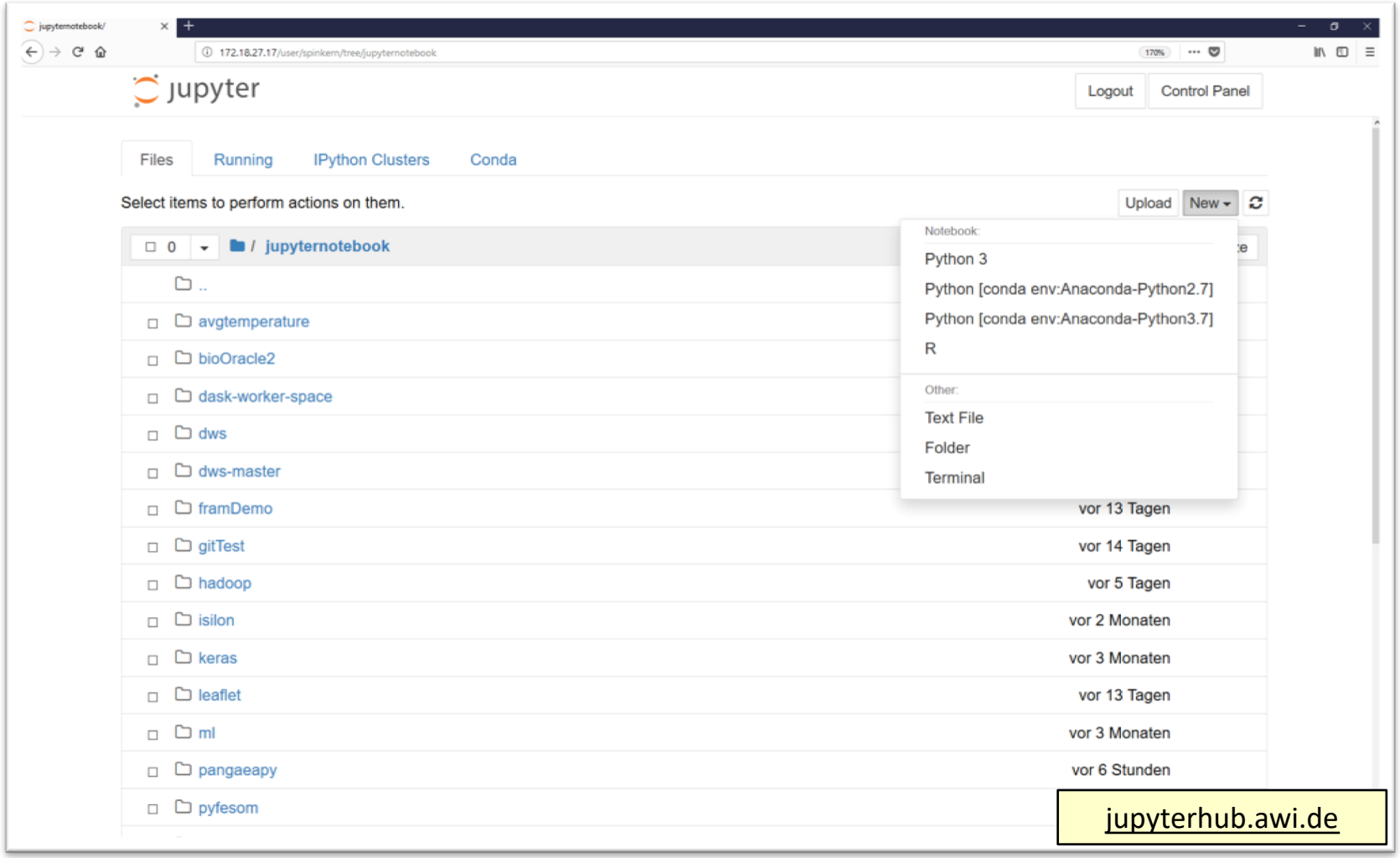
Workspace solution used by O2A framework

- *Marketplace for ordering pre-installed virtual machine different operating systems and development environments*



jupyterhub.awi.de

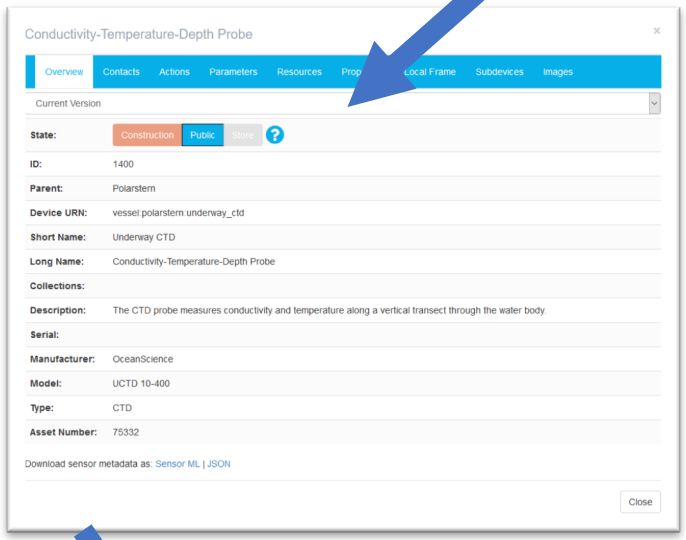
- *pre-installed environments*
- *access to persistent storage*



Data Flow Overview

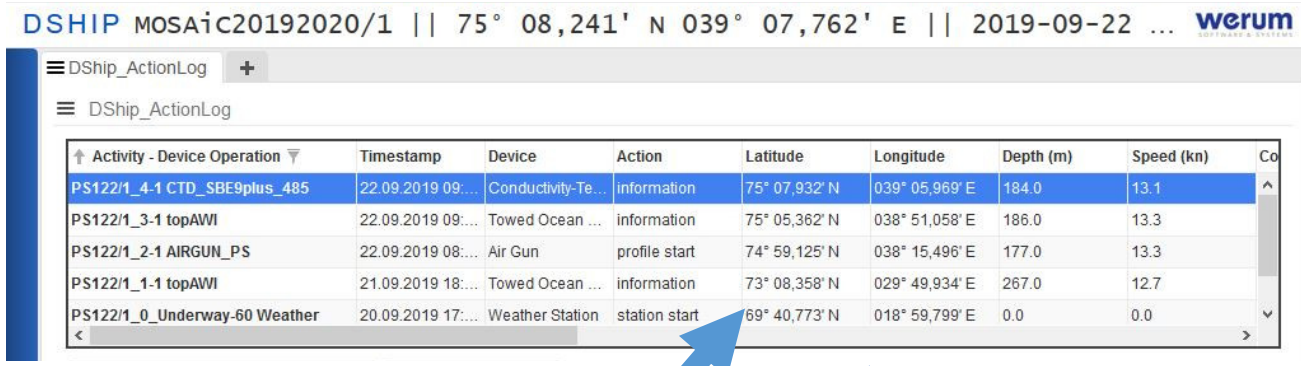
Devices registered in SENSOR.awi.de

SENSOR



Synchronized:
Devices and
Device Operations

DSHIP-ActionLog



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PS122/1_2-1 AIRGUN_PS	22.09.2019 08:...	Air Gun	profile start	74° 59,125' N	038° 15,496' E	177.0	13.3	
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PS122/1_0_Underway-60 Weather	20.09.2019 17:...	Weather Station	station start	69° 40,773' N	018° 59,799' E	0.0	0.0	

Log device operations:
Directly in DHSIP,

or via import from log files
(e.g generated by IceFloeNavi-App)

Storage MCS

vessel/polarstern/ctd_watersampler/SBE3plus_temperature_sensor/DEVICEOPERATION_ID/

Directory structure on MOSAiC Central Storage
derived from SENSOR (and DSHIP-ActionLog)

IceFloeNavi-App

Synchronized:
devices & device operation

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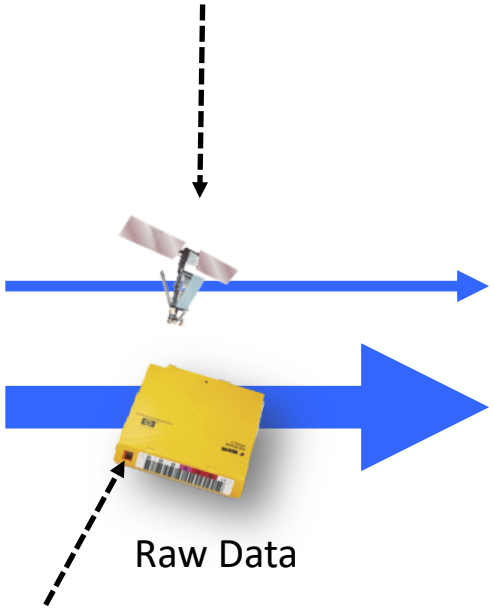
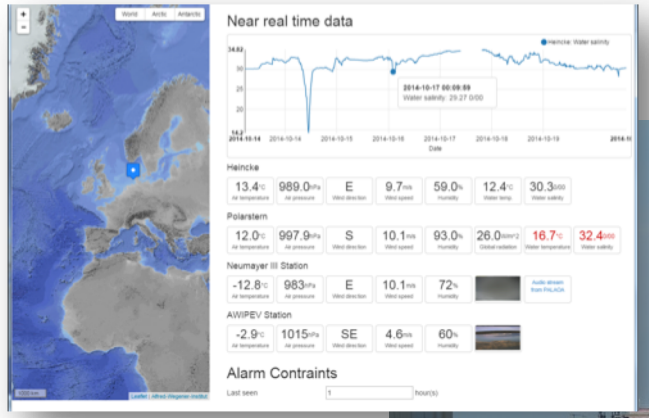
Transfer of data to the AWI for early sharing among the consortium

Via internet satellite connection

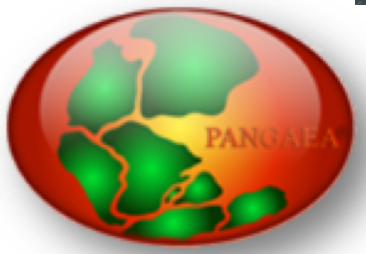


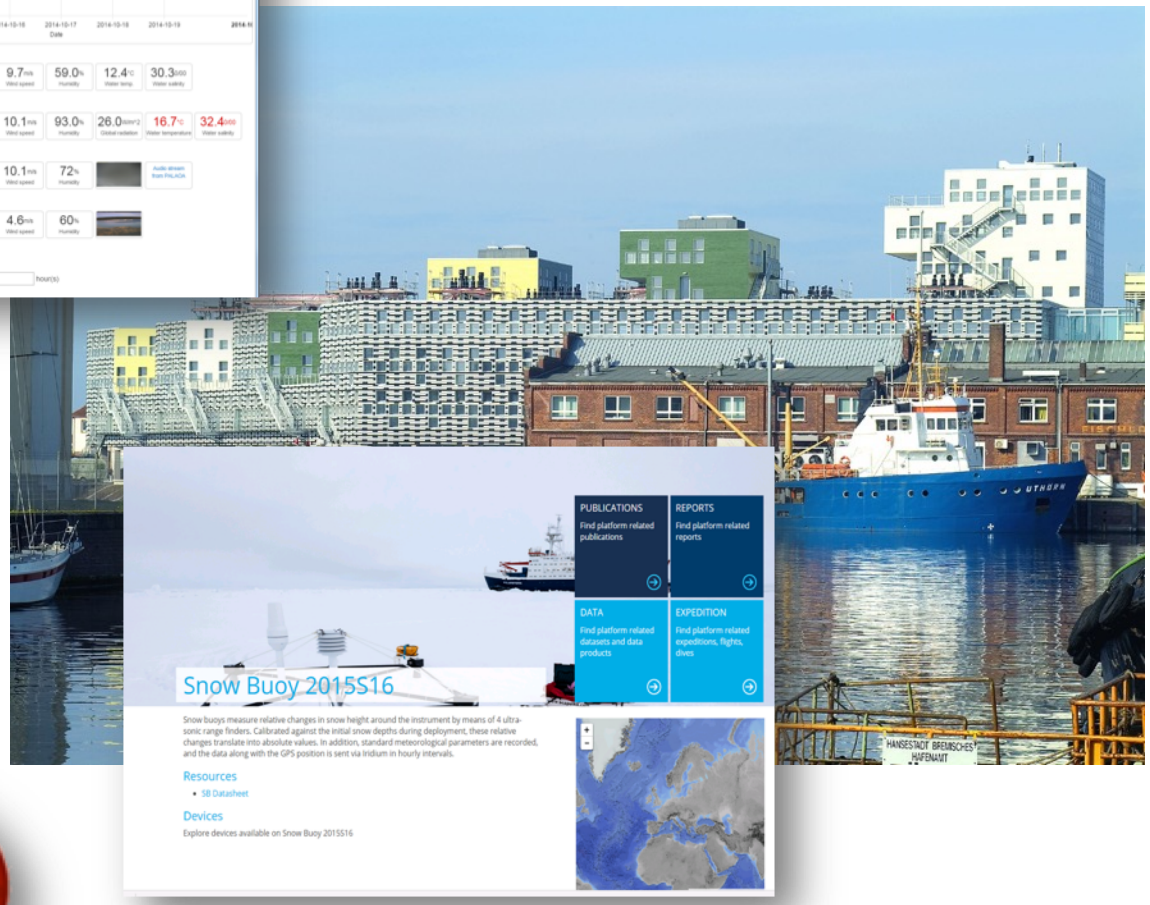
Raw Data

Onshore Data Transfer



Land-MOSAiC Central Storage





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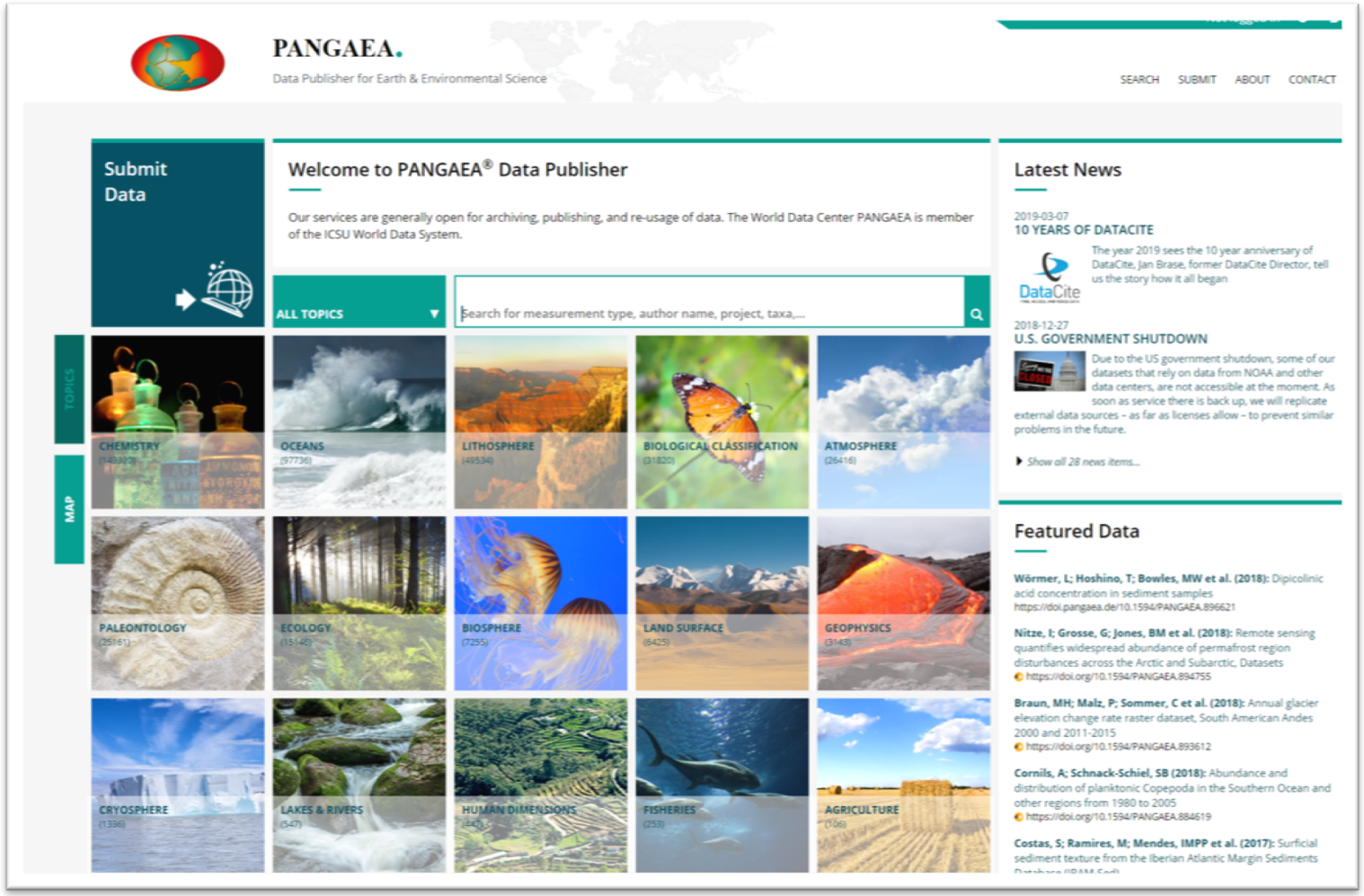
- *submit and share data*
- *search, find, combine and reuse data*



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Sensor Metadata Description → Data Acquisition → Data Ingestion → Data Storage → Data Monitoring → Data Analytics → Data Archiving

✓ *Metadata + Data = citable data set*

PANGAEA.
Data Publisher for Earth & Environmental Science

SEARCH SUBMIT ABOUT CONTACT

Citation: **Rex, Markus (2020):** Links to master tracks in different resolutions of POLARSTERN cruise PS122/1, Tromsø - Arctic Ocean, 2019-09-20 - 2019-12-13. *Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, PANGAEA,* https://doi.org/10.1594/PANGAEA.911224

Always quote above citation when using data! You can download the citation in several formats below.

RIS Citation | BibTeX Citation | Copy Citation | Facebook | Twitter | Show Map | Google Earth

Other version: Master track of POLARSTERN cruise PS122/1 in 1 sec resolution (zipped, 34.3 MB)

Further details: Generalized master track of POLARSTERN cruise PS122/1
Station list of POLARSTERN cruise PS122/1
Trackline map and processing report for navigation sensors from POLARSTERN cruise PS122/1

Project(s): **Multidisciplinary drifting Observatory for the Study of Arctic Climate** (MOSAiC)

Coverage: *Median Latitude:* 84.972877 * *Median Longitude:* 120.353461 * *South-bound Latitude:* 69.679426 * *West-bound Longitude:* 18.996638 * *North-bound Latitu*
Date/Time Start: 2019-09-20T17:50:00 * *Date/Time End:* 2019-12-13T09:04:45

Event(s): **PS122/1-track** * *Latitude Start:* 69.679550 * *Longitude Start:* 18.996650 * *Latitude End:* 86.593190 * *Longitude End:* 119.241500 * *Date/Time Start:* 201
Campaign: PS122/1 (MOSAiC20192020) * *Basis:* Polarstern * *Method/Device:* Underway cruise track measurements (CT) * *Comment:* Troms

Parameter(s):

#	Name	Short Name	Unit	Principal Investigator	Method/Device	Comment
1	DATE/TIME	Date/Time				Geocode
2	LATITUDE	Latitude				Geocode
3	LONGITUDE	Longitude				Geocode
4	Speed	Speed	kn		Calculated	10-min average
5	Course	Course	deg		Calculated	10-min average

Data

Download dataset as tab-delimited text *(use the following character encoding:* UTF-8: Unicode (PANGAEA default) *)*

1 Date/Time	2 Latitude	3 Longitude	4 Speed [kn]	5 Course [deg]
2019-09-20T17:50	69.67955	18.99664	0.001	226.2
2019-09-20T18:00	69.67955	18.99664	0.001	13.0
2019-09-20T18:10	69.67955	18.99664	0.000	90.0
2019-09-20T18:20	69.67955	18.99665	0.001	90.0
2019-09-20T18:30	69.67955	18.99664	0.001	270.0
2019-09-20T18:40	69.67955	18.99664	0.001	173.4
2019-09-20T18:50	69.67943	18.99680	0.047	155.1
2019-09-20T19:00	69.68379	19.02526	3.889	66.2
2019-09-20T19:10	69.70578	19.04519	8.299	17.4
2019-09-20T19:20	69.73755	19.04487	11.441	359.8
2019-09-20T19:30	69.76527	19.10146	12.221	35.2

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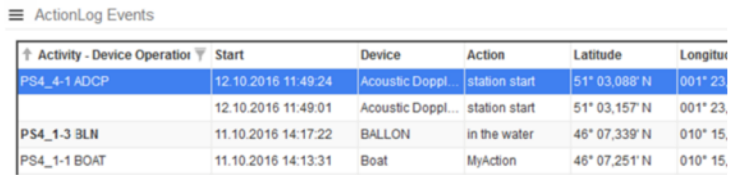
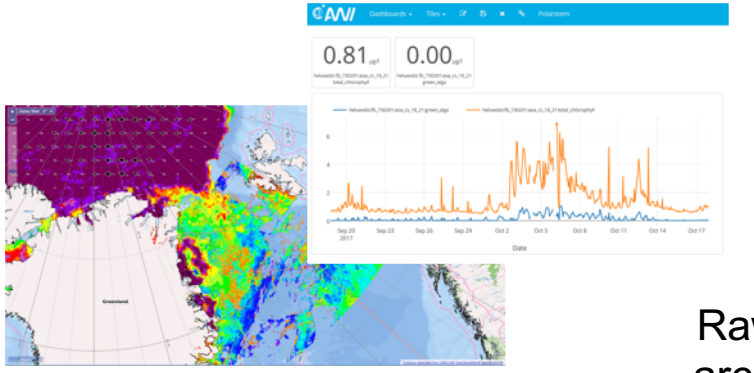
Sensor Metadata Description | Data Acquisition | Data Ingestion | Data Storage | Data Monitoring | Data Analytics | Data Archiving

Summary





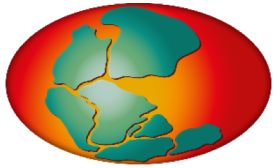
SENSORWeb at AWI and onboard of Polarstern

Acquisition organized by MOSAiC groups. DSHIP-ActionLog for Device-Operation ID management

DSHIP-Mapviewer and DASHBOARD at AWI and onboard of Polarstern

Raw and primary data archiving at AWI. Data transfers after legs or parts during legs

Sensor Metadata Description → Data Acquisition → Data Ingestion → Data Storage → Data Monitoring → Data Analysis → Data Archiving



Data transfer via satellite, local LAN, radio LAN as stream and/or in delayed mode

MOSAiC Central Storage and workspace

Using workspace and Marketplace (VM) e.g. with Jupyter Notebook (R or Python) or Bash-Script or or …?