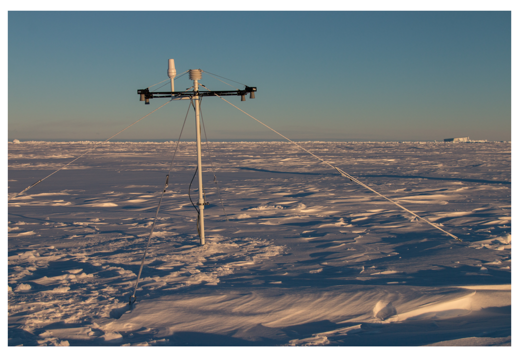
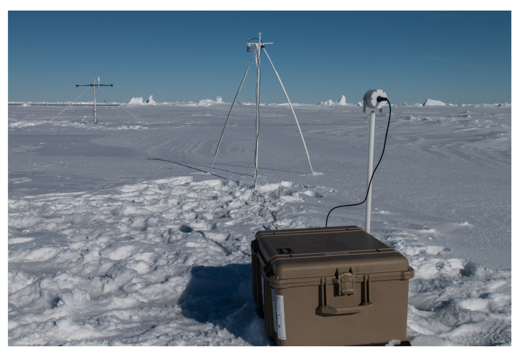
Fri_277_OS-7_1320

ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR-
UND MEERESFORSCHUNG

Stefanie Arndt, Leonard Rossmann, Louisa Tiemann, Mario Hoppmann, Marcel Nicolaus

Seasonality of Antarctic sea-ice and snow properties from autonomous systems

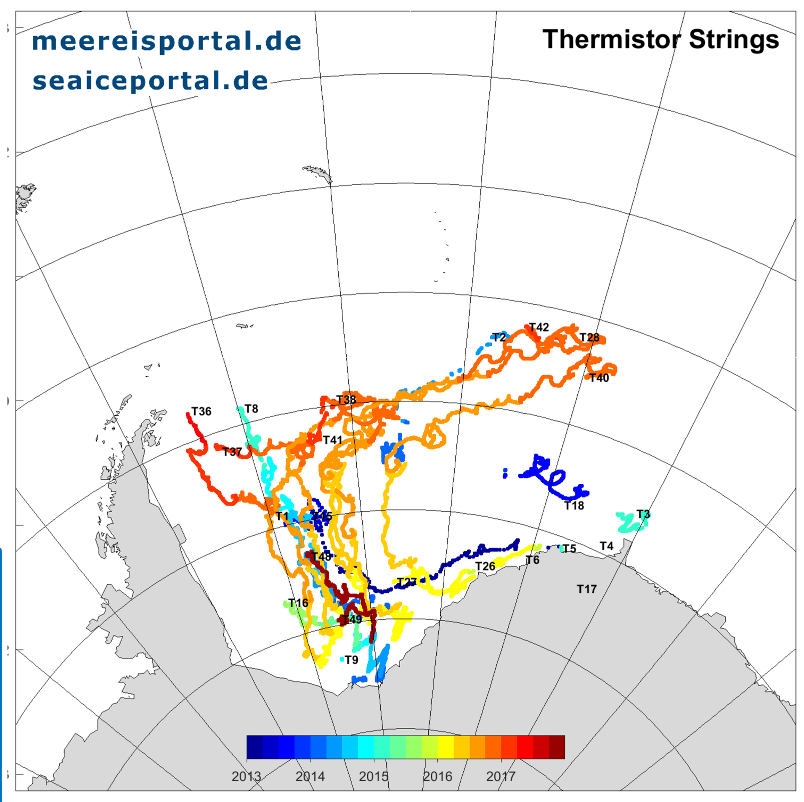
Introduction and Objectives

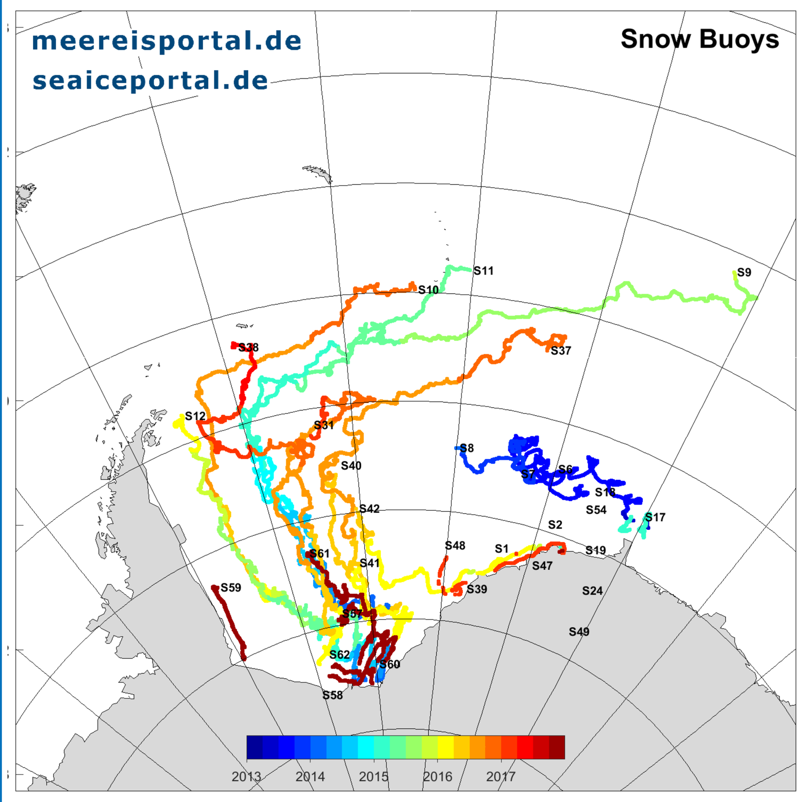
Studying seasonally varying snow and sea-ice properties in the ice-covered oceans is a key element for investigations of processes between atmosphere, sea ice, and ocean. A dominant characteristic of Antarctic sea ice is the year-round snow cover, which substantially impacts the sea-ice energy and mass budgets by, e.g., preventing surface melt in summer, and amplifying sea-ice growth through extensive snow-ice formation. However, substantial observational gaps in the description of year-round Antarctic pack ice and its snow cover lead to a limited understanding of important processes in the polar climate system.

Here, we introduce a unique observational dataset comprised of a number of key parameters relevant to the snow/ice and ice/ocean interface, recorded by a suite of snow and ice-mass balance buoys (IMBs) deployed in the Weddell Sea between 2013 and 2018.

Our results highlight that data from autonomous, ice-based platforms are important elements in better understanding sea-ice and snow properties, processes and their seasonal evolution. Results also improve the implementation of these processes in 1-D models (e.g. SNOWPACK).

All IMBs and Snow Buoys deployed in the Weddell Sea

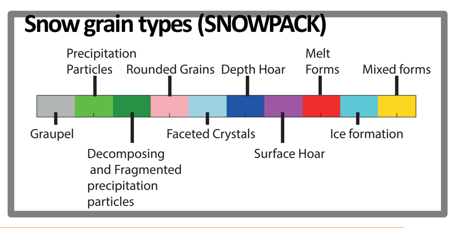




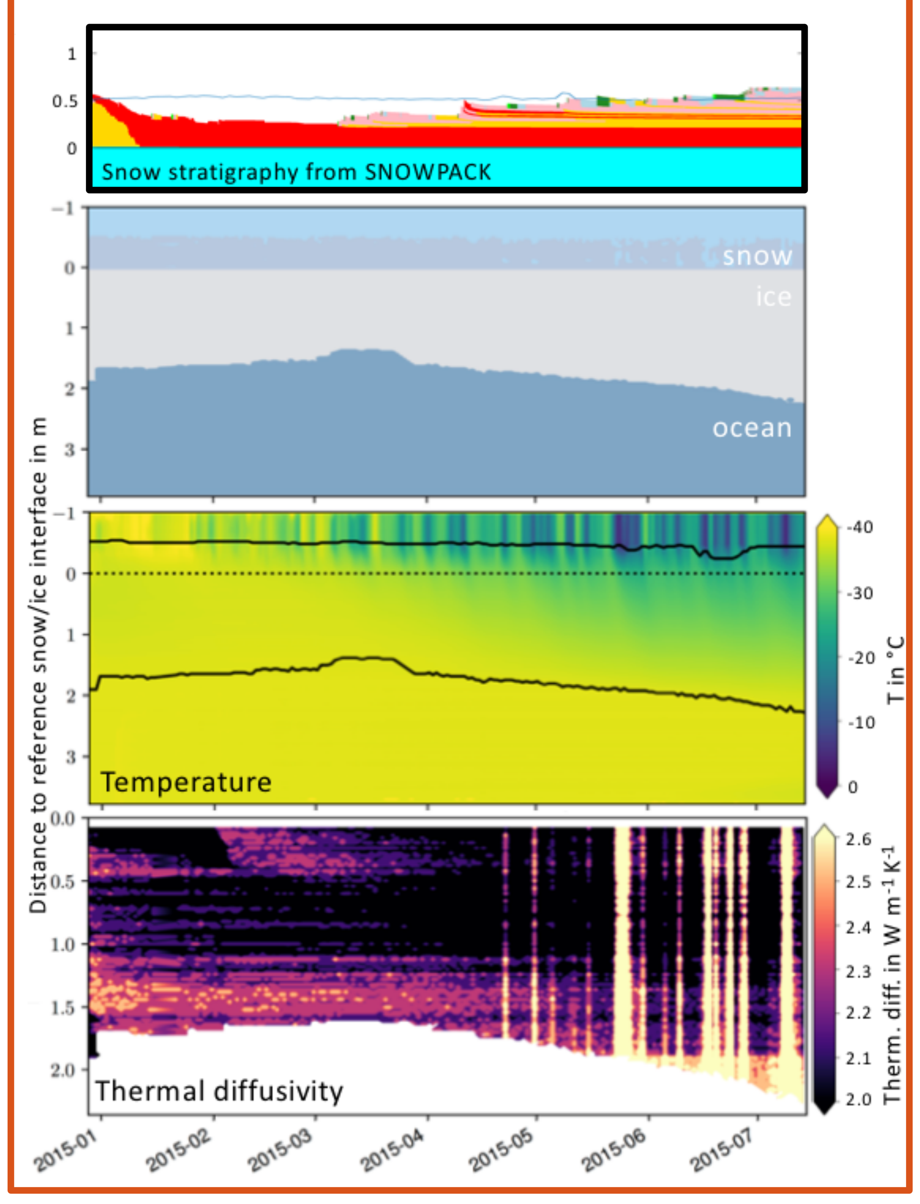
All data are provided at data.meereisportal.de

Co-deployed IMBs and Snow Buoys in the Weddell Sea (with a minimum life period of 6 months)

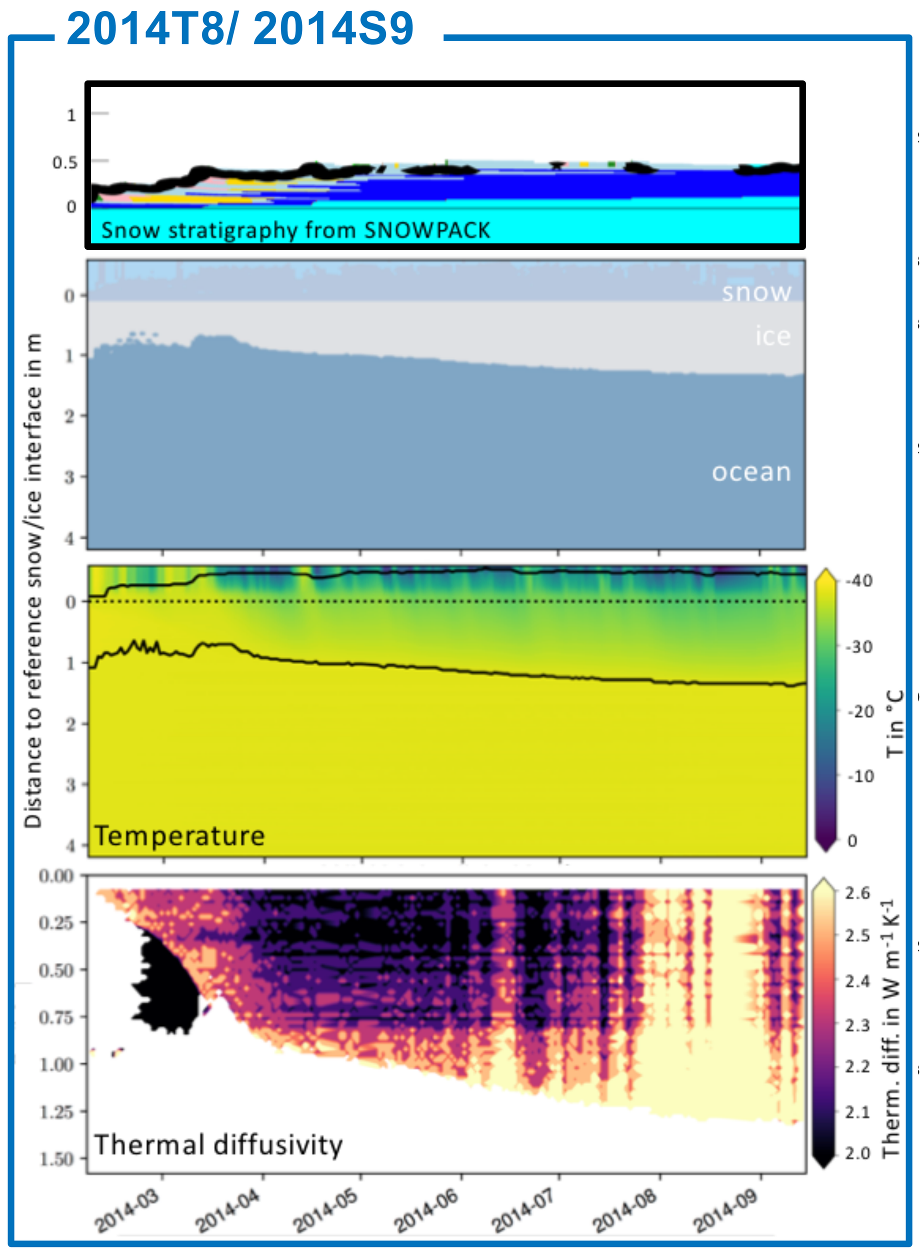
- Air/snow, snow/ice and ice/water interfaces from IMB data were picked according to the machine learning algorithm by Tiemann et al. (Polar2018, talk: Thu, 21 June, 16:00-16:15)
- Thermal diffusivity of the ice was determined according to Jackson et al. (2013)
- Evolution of snowpack properties were determined from the 1-D model SNOWPACK according to Lehning et al. (2002) and Rossmann et al. (Polar2018, poster: Fri_230_OS-5_343)



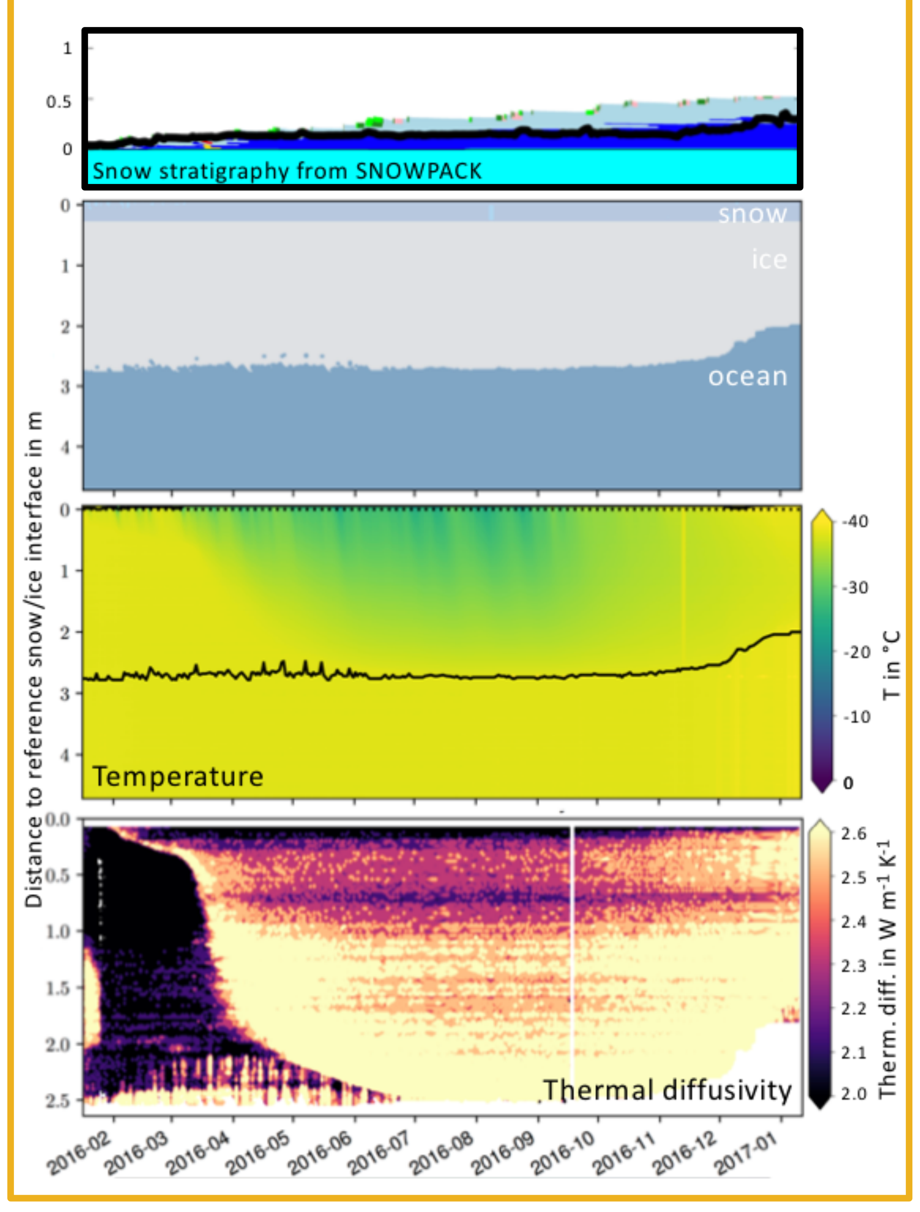
2014T17/ 2015S19



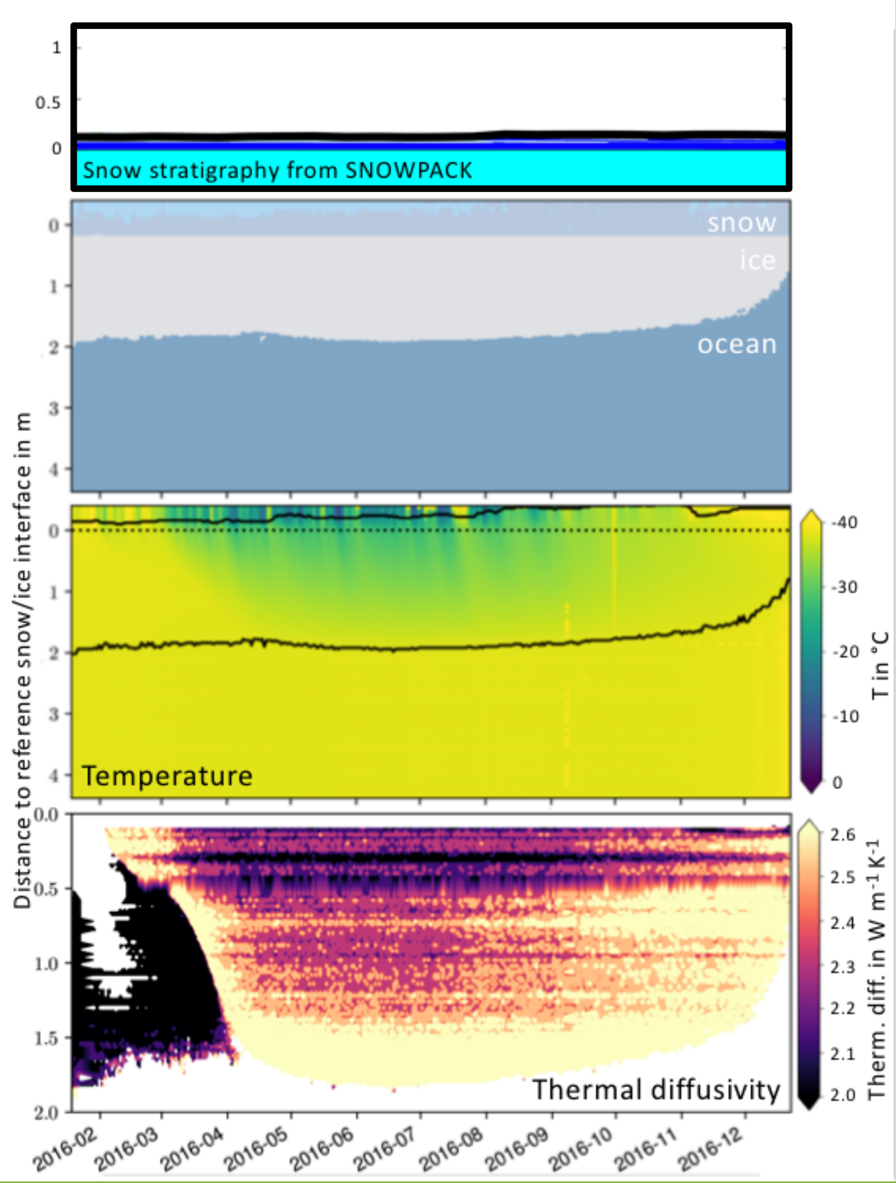
2014T8/ 2014S9

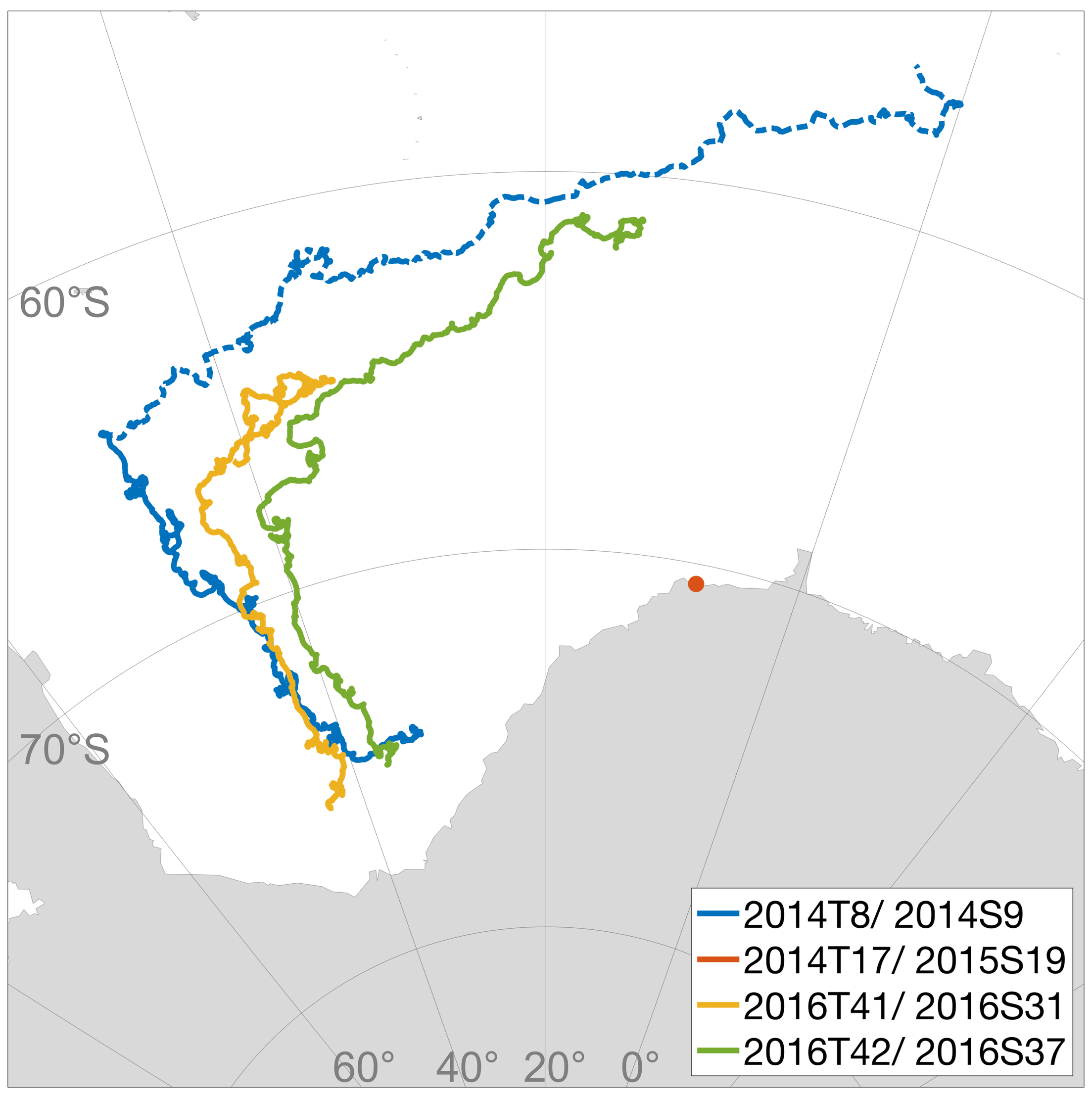


2016T41/ 2016S31



2016T42/ 2016S37

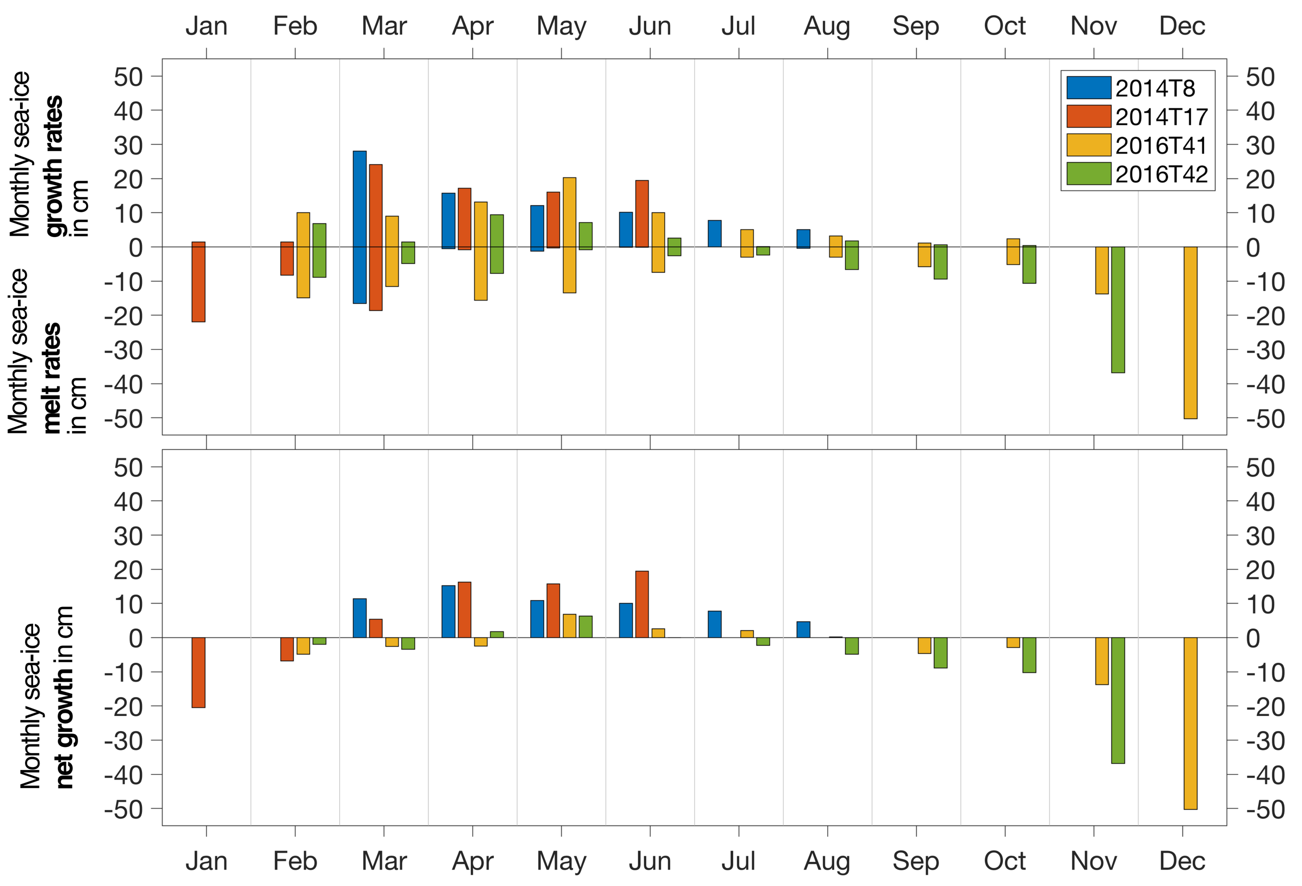




Results

- Significant **ice growth from April and June**, while actual **ice melt starts in September**
- **Highest monthly sea-ice growth rates** of about 10 cm in **May**
- **Highest monthly sea-ice melt rates** in the marginal ice zone of about 50 cm in **December**
- **Thermal diffusivity** gives indication on temporal evolution of **internal sea-ice structures**
- **Snow-ice formation** is widely determined by SNOWPACK model with **up to 15 cm** associated with increasing snow loads from winter onwards
- Widely **missing snow/air interface from IMBs** due to deployment set up
- Since 2013: **4** out of 21 **co-deployed IMBs and Snow Buoys** with a **life period > 6 month** in the Weddell Sea

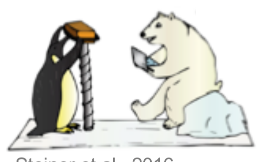
Sea-ice melt and growth rates



Outlook and future research questions

- Determining **internal sea-ice properties** by combining temperature and thermal diffusivity profiles
- Calculating **surface and energy budgets**
- Combining internal sea-ice and snow structures to gain knowledge on **processes at the snow/ice interface**

- How can we transfer the gained knowledge on local internal snow/ice properties and processes on **larger spatial scales** (satellite data grid cells)?
- What can we **learn from the Arctic and vice versa**?


Steiner et al., 2016

Lehning, M., P. Bartelt, B. Brown, and C. Fierz (2002), A physical SNOWPACK model for the Swiss avalanche warning Part III: meteorological forcing, thin layer formation and evaluation, Cold Regions Science and Technology, 35, 169-184.

Jackson, K., J. Wilkinson, T. Maksym, D. Meldrum, J. Beckers, C. Haas, and D. Mackenzie (2013), A novel and low-cost sea ice mass balance buoy, Journal of Atmospheric and Oceanic Technology, 30(11), 2676-2688.

stefanie.arndt@awi.de

ALFRED-WEGENER-INSTITUT HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG
HELMHOLTZ GEMEINSCHAFT
BREMERHAVEN
Am Handelshafen 12
27570 Bremerhaven
Telefon 0471 4831-0
www.awi.de