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Tracking changes in the TransPolar Drift via altimetry and model data.

Francesca Doglioni[a], Robert Ricker[a], Benjamin Rabe[a] Claudia Wekerle[a], Torsten Kanzow[a]   contact: **francesca.doglioni@awi.de**

a. Alfred Wegener Institute for Polar and Marine Research

Background

The **TransPolar Drift (TPD)** is a surface stream transporting fresh water and ice across the Arctic Ocean. In recent decades, the Transpolar Drift has been subjected to a strong **intensification**, observed by tracking the ice drift.

New satellite altimetry missions, such as **CryoSat-2**, launched in 2010, open the possibility further investigate the changes happening in the **ice-covered ocean**. However, since deriving sea surface height over leads requires dedicated algorithms, the current availability of **basin-wide datasets is still limited.**

In our study, we generated a **pan-Arctic Sea Level Anomaly (SLA)** dataset for the period **2011-2018** from Cryosat-2 observations**.** Using SLA-derived geostrophic velocities and ocean-sea ice model data, we aim at studying the **variability of the ocean TPD** and understand its **changes** in relation to ice decline in the Arctic Ocean.

Method

In this poster we present our SLA dataset, created by combining **Cryosat2 observations** from leads reprocessed by the Alfred Wegener Institute and observations in open ocean from the Radar Altimetry Database System (**AWI-RADS**). We compare here the AWI-RADS SLA variability with an independent altimetry dataset.

Results:

Observed **rising sea level near the North Pole** suggests changes in the strength and path of TPD in the period 2011-2018;

AWI-RADS sea level anomalies show strong **average correlation of 0.72** with existing dataset;

Dynamic Atmosphere effect represent a large component of the Arctic shelves sea level variability;

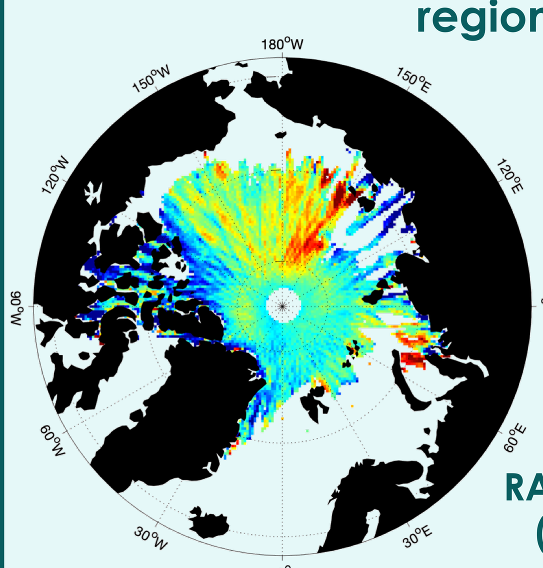
There is a need to support research going towards **unified methods** to retrieve SLA from satellite observations over ice-free and ice-covered regions.

1. Monthly maps, Cryosat-2

a. Merging data over leads and open ocean

DATA

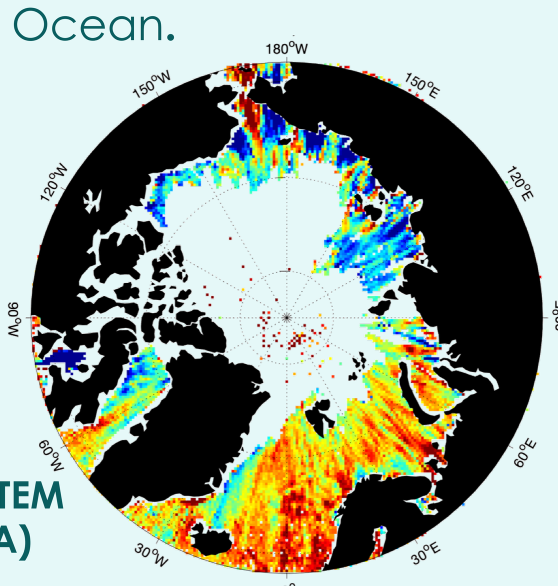
We combined **sea level anomaly** observations in **open ocean and ice-free regions** to cover all of the Arctic Ocean.



ALFRED WEGENER INSTITUT [1]
(ice-covered areas)

+

RADAR ALTIMETRY DATABASE SYSTEM
(ice-free areas, TU Delft + NOAA)



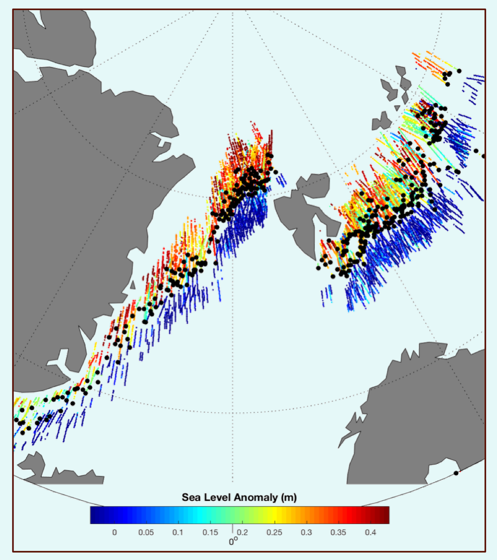
CONSISTENCY OF OPEN-OCEAN AND ICE-COVERED DATA

Dynamic Atmosphere Correction was substituted to Inverse Barometer in ice-covered regions since it reduced SLA standard deviation to a larger extent, especially timescales 20d > T > 5d.

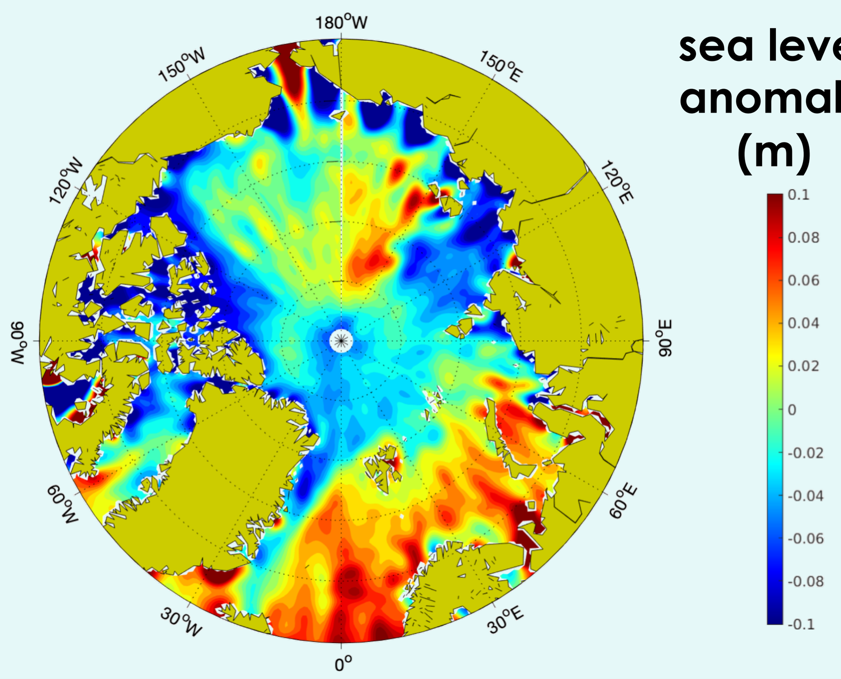
Eastern Siberian Shelves, SLA stdev (cm)

Period (days)	Uncorr. SLA	SLA minus InvBar	SLA minus DAC
T > 20d	11.0	7.7	6.9
20d > T > 5d	6.6	7.5	2.8
T < 5d	8.1	8.4	5.5

Ice covered data were corrected for **leads/open ocean bias**



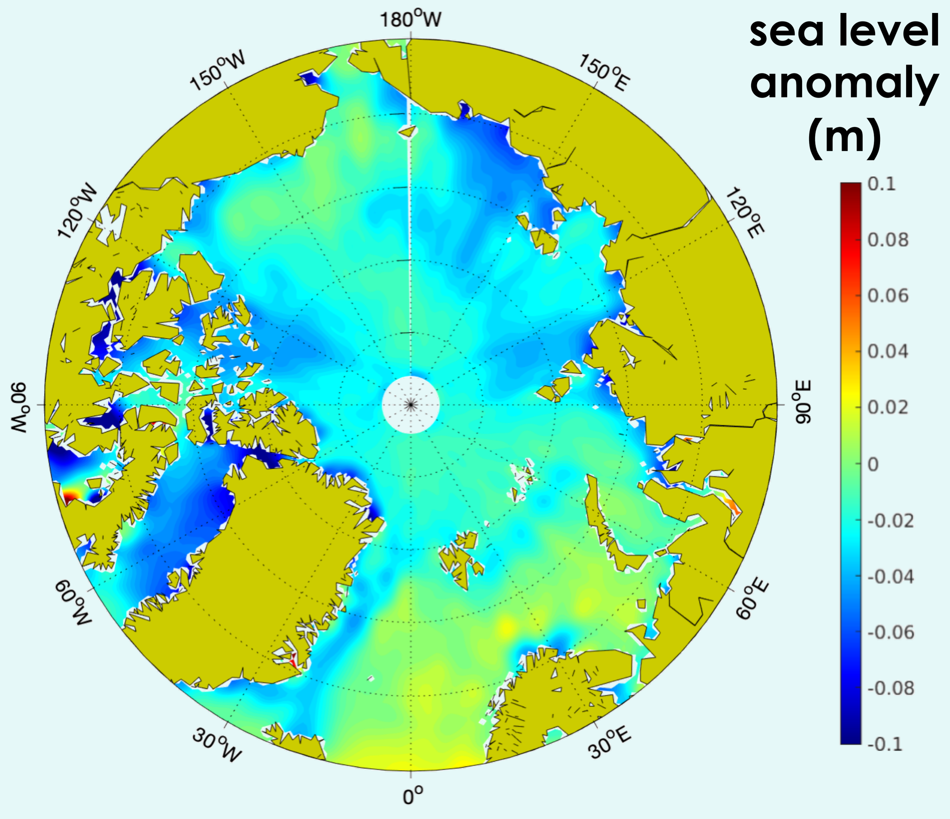
b. Interpolation



We used the Data-Interpolating Variational Analysis code (**DIVA**) to interpolate over a **regular lat/lon grid**

← **Example: October 2014**

2. Mean Sea Level Anomaly, 2011-2018

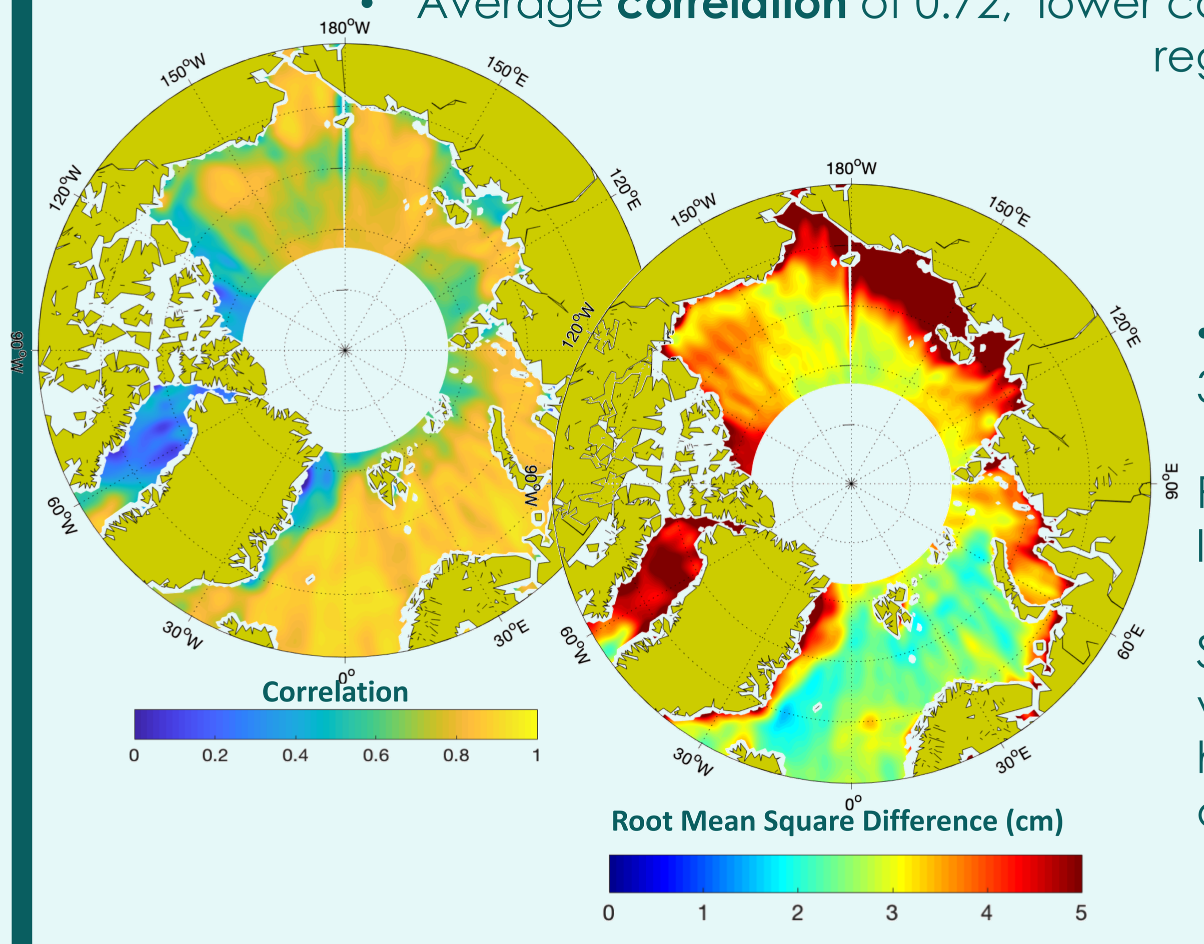


- We observe sea level **rise in Beaufort Gyre**, extending towards North Pole.
- Probable **underestimation of SLA at ice edge** due to peripheral leads reflection.
- Average SLA in the regions of **Nordic Seas and Barents Sea** seem to be much higher than the **Arctic interiors**.

3. Comparison with *Armitage et al. 2016*[2]

Correlation and RMSD of sea level anomaly, 2011-2014

- Average **correlation** of 0.72; lower correlation is found in regions of fewer leads (Canadian Archip., Greenland).



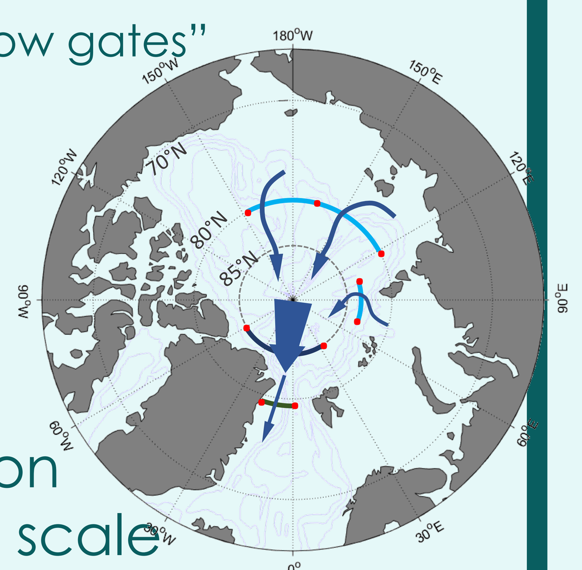
- Average **RMDS** of 3.8 cm; highest RMSD:

Regions of fewer leads;

Siberian Shelves: fewer valid observations, high difference btw IB and DAC corrections.

FUTURE WORK

Analysis of TransPolar Drift variability at "flow gates" (altimetry and model data):



1) What is the **variability of ocean TPD** at interannual to decadal timescales?

2) Has **ice decline** changed the correlation between ocean TPD variability and large scale wind **atmospheric forcing** since 1980? Is it the same for ice?

References

1. Ricker et al. (2014), *Sensitivity of CryoSat-2 Arctic sea-ice freeboard and thickness on radar-waveform interpretation*, doi:10.5194/tc-8-1607-2014
2. Armitage et al. (2016), *Arctic sea surface height variability and change from satellite radar altimetry and GRACE, 2003–2014*, doi: 10.1002/2015JC011579