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SMAPS - SWOT for Marine Applications in the Polar Seas

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Motivation:

- The polar seas are among the most vulnerable regions on Earth to climate change
- Rising temperatures and increased freshwater inflow cause sea level changes and impact regional and global ocean currents
- The sea ice cover makes a reliable sea level determination very challenging and requires sophisticated data processing procedures
- SWOT can contribute significant new insights into polar sea level and ocean current changes through its innovative instruments and new types of observations

Scientific goals:

- **Capability analysis** of SWOT for polar ocean studies by incorporating contemporaneous altimetry missions
- **Development** of methods for the identification of leads and for the determination of sea surface heights and geostrophic ocean currents
- **Performance assessment** by conducting statistical reliability analyses and comparisons with existing datasets from conventional altimetry
- **Combination** of SWOT with missions to extend the observation period and further improve the spatiotemporal resolution

Realization of goals through development of:

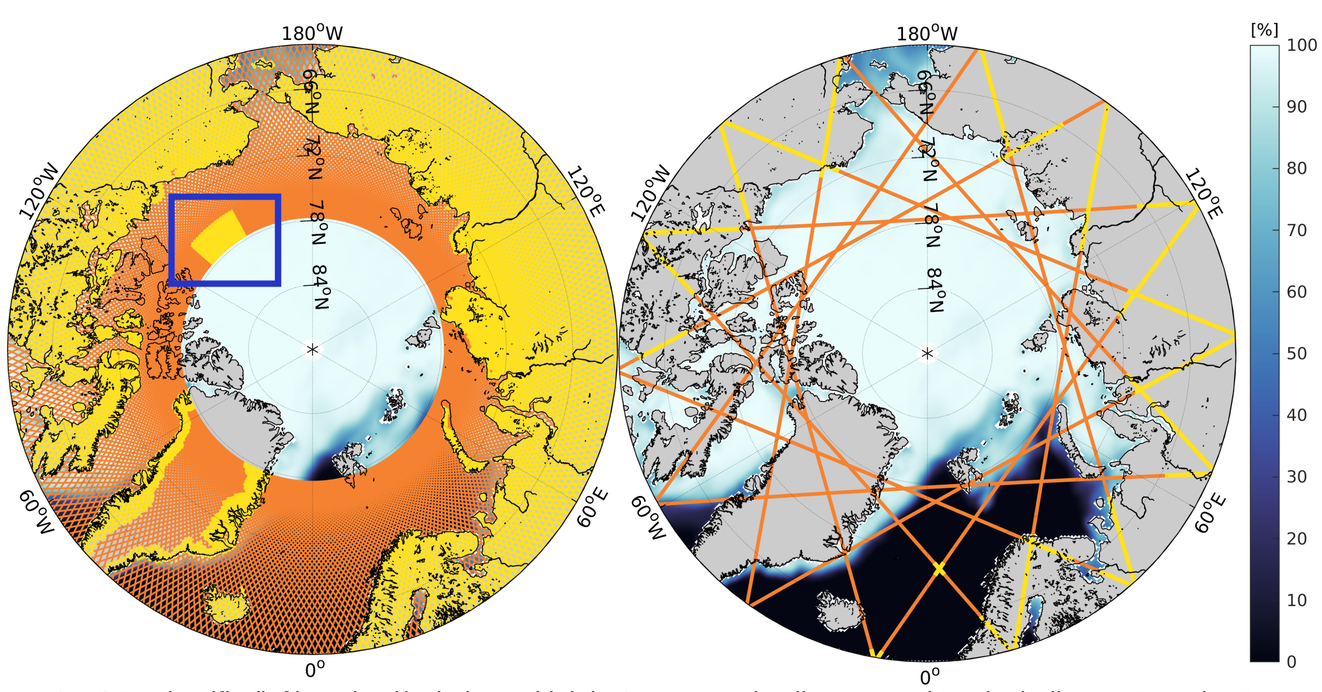
- Unsupervised open water detection (sea ice classification) applied to KaRIn observations
- Gridding strategies for KaRIn sea surface heights
- Determination of geostrophic currents from KaRIn swath-data
- Validation techniques and procedures for altimetry swath-data
- Combination strategies with existing altimetry observations

➢ Tasks are divided into 4 Work Packages:

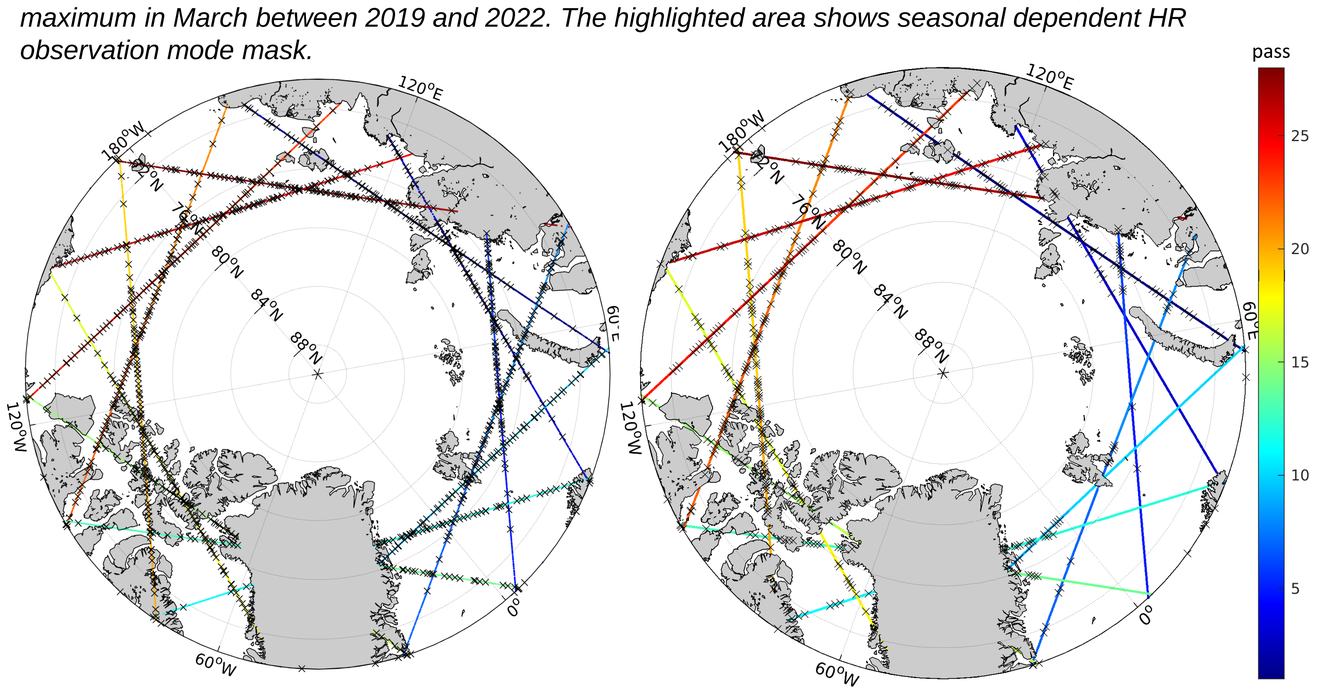
- **WP1: Open Water Detection**
- **WP2: Sea Surface Heights**
- **WP3: Geostrophic Currents**
- **WP4: Regional Impact Analysis**

First investigations and impressions:

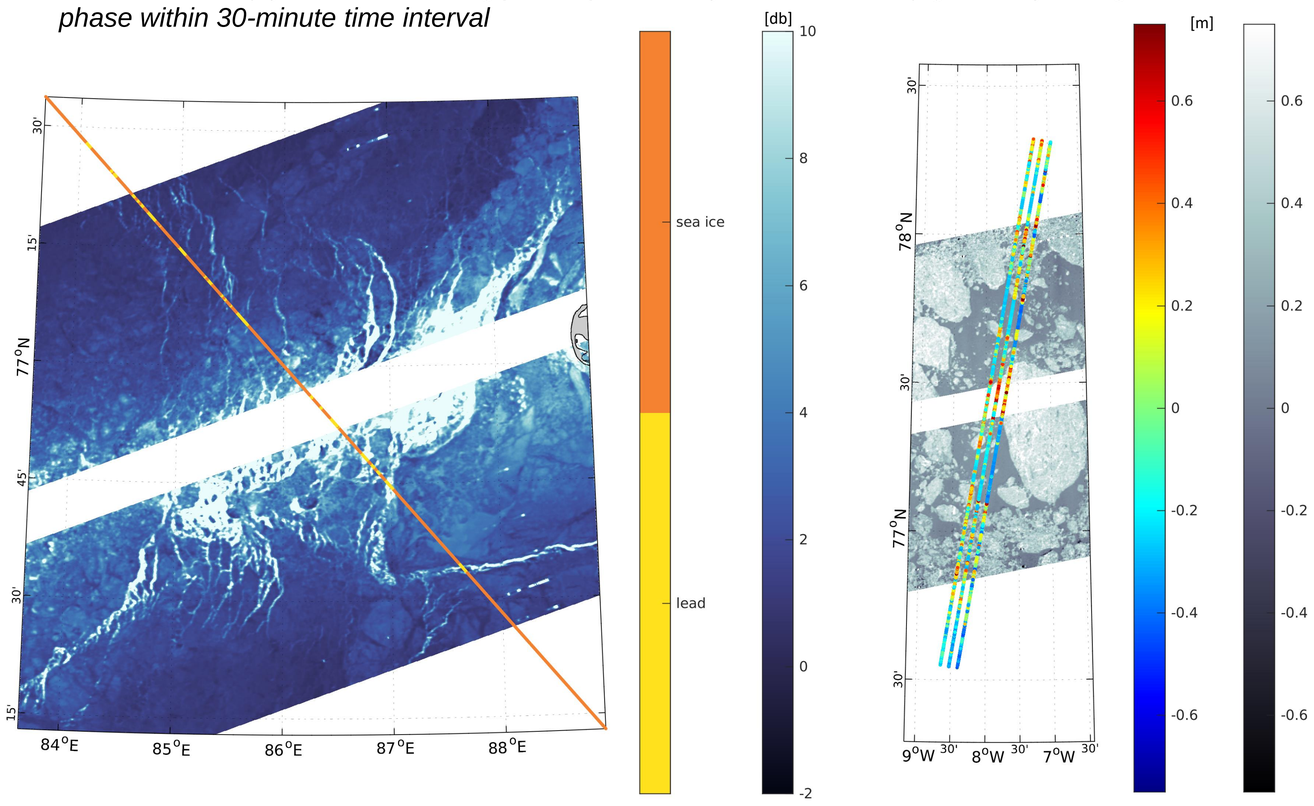
- SWOT data: *L2 LR SSH Unsmoothed (250m)*
- Large number of cross-overs with SARAL and ICESAT-2 (during SWOT CAL/VAL) within 30-minute time difference enables direct comparisons
- Comparison with SARAL Ka-band waveform classification (Müller et al., 2017) reveals promising results and shows good accordance
- Initial comparisons with ICESAT-2 and SWOT KaRIn sea level anomalies (SLA) show a high level of detail resolution and strong similarities
- Inclusion of Cryosat-2 (SARIn and SAR) is currently running!



▲ *SWOT scientific (left) and cal/val phase (right). Orange and yellow ground tracks indicate LR and HR observations against the background of mean sea ice concentration (Fetterer et al., 2017) for sea ice maximum in March between 2019 and 2022. The highlighted area shows seasonal dependent HR observation mode mask.*



▲ *Cross-overs (**X**) of SARAL drifting phase (left,~1000) and ICESAT-2 (right,~500) during SWOT cal/val phase within 30-minute time interval*



▲ *Comparison of SARAL open water detection (Müller et al., 2017) with SWOT L2 LR SSH Unsmoothed backscatter observations (left) and ICESAT-2 sea level anomalies (ATL07) with SWOT 250m KaRIn SLA (right)*

Summary and outcomes:

- Main objective of the project is to scientifically exploit the capabilities of SWOT for polar ocean studies, combined with a careful evaluation and validation using contemporaneous altimetry missions
- Provision of sea ice (open water) flagging for SWOT nadir and swath data in the ice-covered ocean
- Level 4 gridded datasets of sea surface height, geostrophic currents and sea ice concentration
- Level 4 dataset of SWOT observations combined with data from existing altimetry missions

References:

Müller F. L., Dettmering D., Bosch W., Seitz F.: Monitoring the Arctic Seas: How Satellite Altimetry Can Be Used to Detect Open Water in Sea-Ice Regions. Remote Sensing, 9(6), 551, (2017), 10.3390/rs9060551
Fetterer, F., K. Knowles, W. N. Meier, M. Savoie, and A. K. Windnagel. Sea Ice Index, Version 3. 2017, Distributed by National Snow and Ice Data Center. https://doi.org/10.7265/N5K072F8. Date Accessed 08-02-2022

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