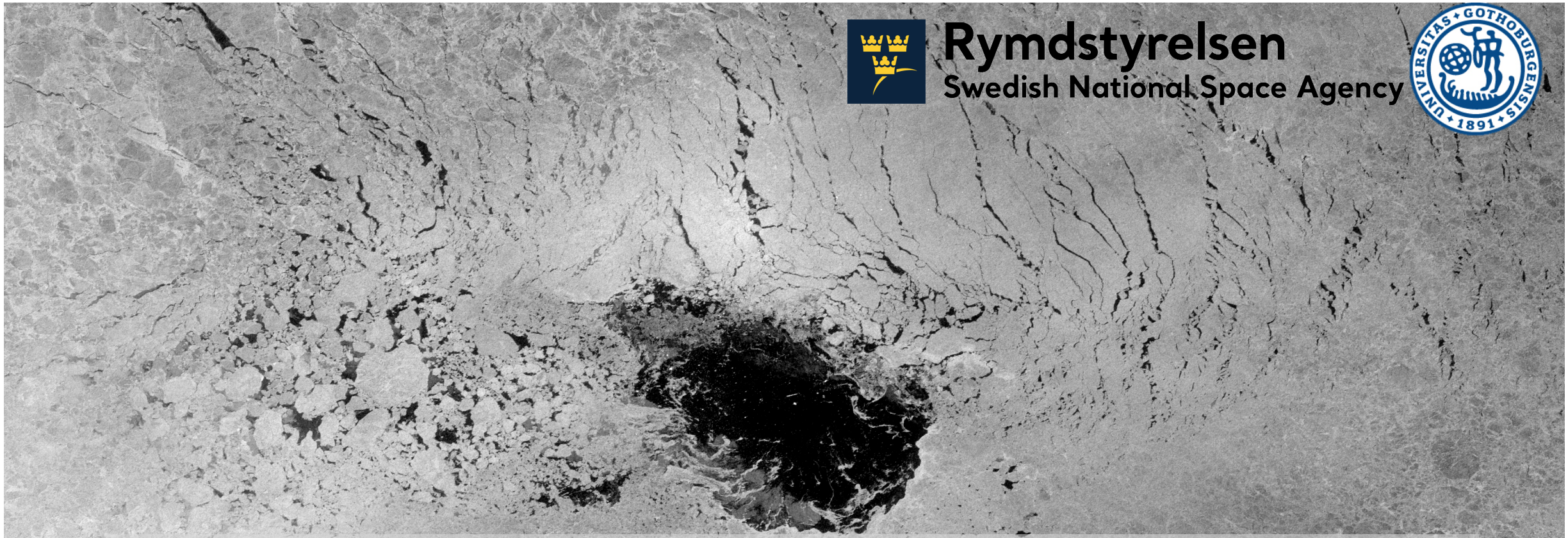

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Early detection of the Weddell polynya re-opening using SAR imagery

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Motivation

- Two theories why the Weddell Polynya opens:

1) Warm oceanic water upwelling from its nominal depth of several hundred metres to the surface where it melts the sea ice from underneath; or
2) Opening of **leads** by a passing storm

↳ Exchange heat, gas and moisture fluxes between the ocean and the atmosphere;

Remain open either by the atmosphere or ocean and grow.

- Planning of scientific expedition and for navigation purposes, early detection of sea ice opening is needed.

Objective

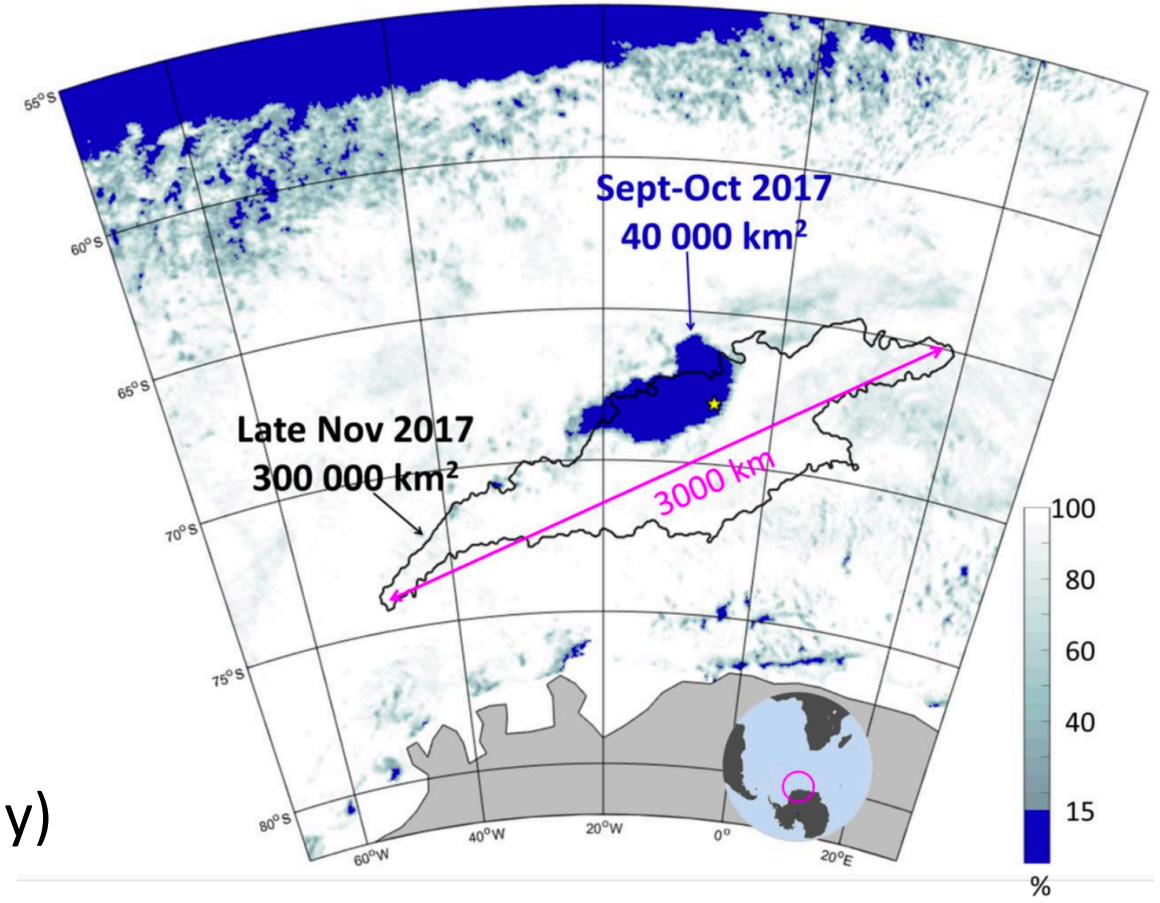
Estimate **how long in advance** the recent Weddell Polynya opening could have been **detected** by synthetic aperture radar (SAR) images due to the **decrease** of the **sea ice thickness** and/or **early** appearance of **leads**.

Data

SAR Sentinel-1 Extra Wide swath mode using co- and cross-polarised bands (HH and HV respectively)

Future work:

- Envisat + RADARSAT (C-band)
- ALOS-2 PALSAR-2 (L-band)



Weddell Polynya region. Sea ice concentration (%) from AMSR-2 (Heuzé, 2018)

Preliminary Results

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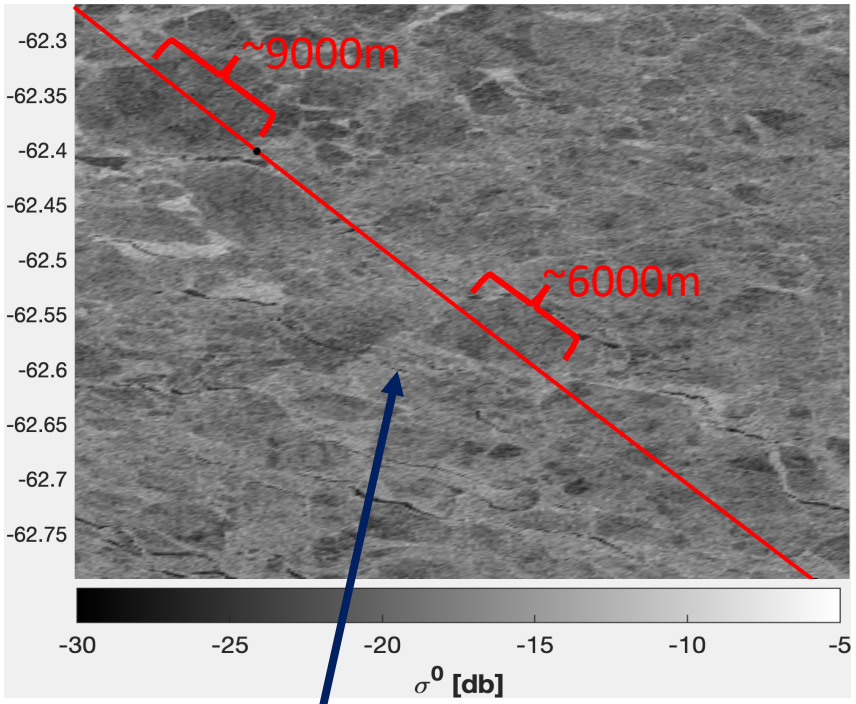
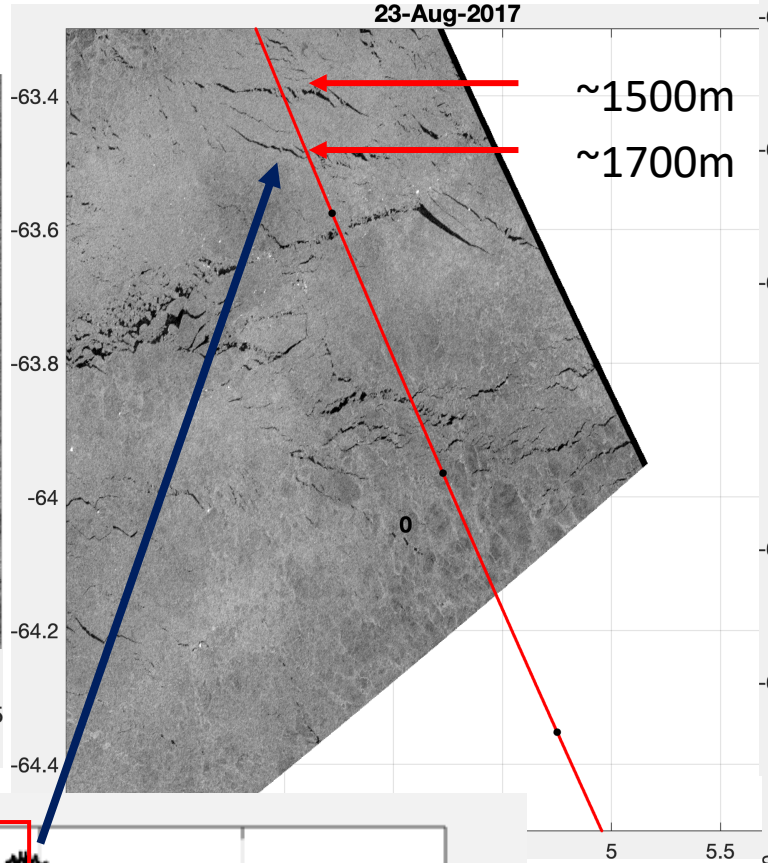
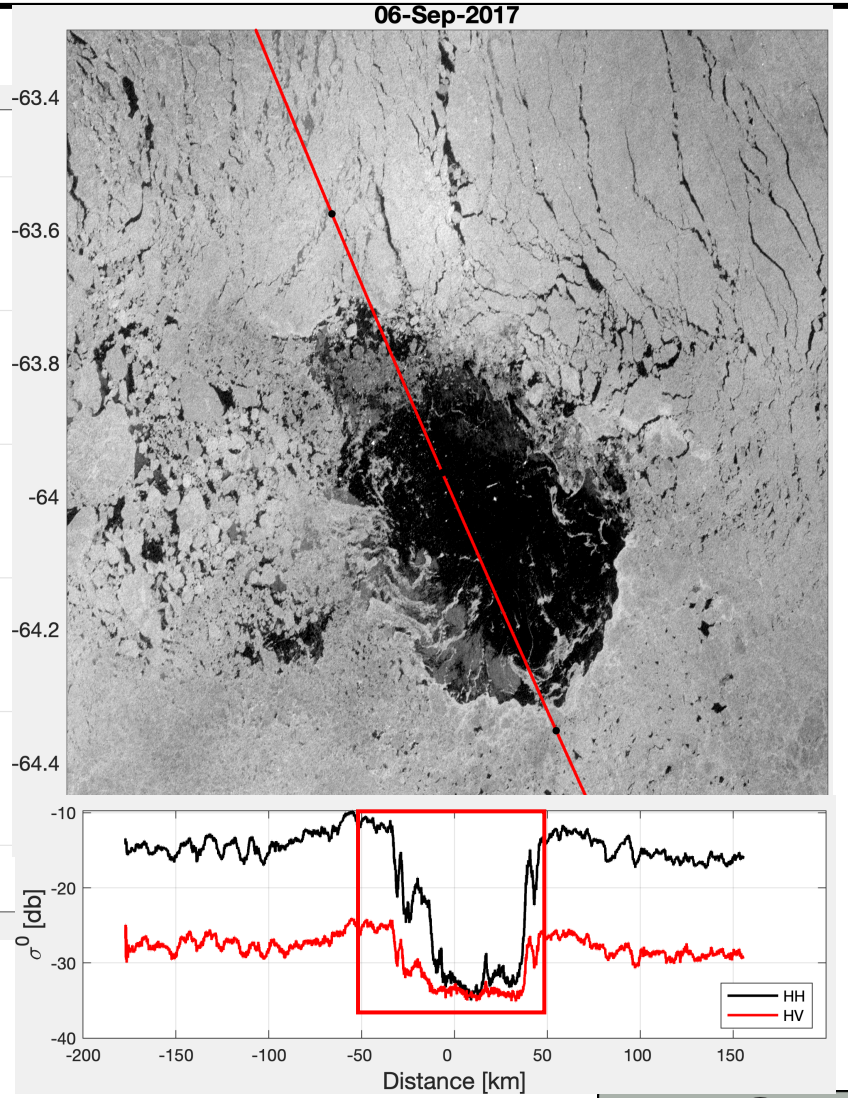
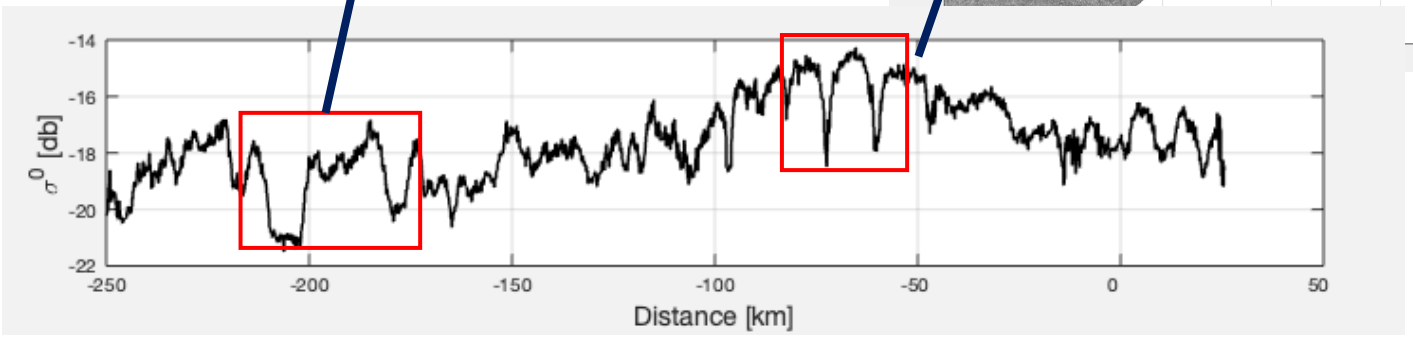
Difficulties to detect leads using Sentinel-1 HH-band alone









Preliminary Results

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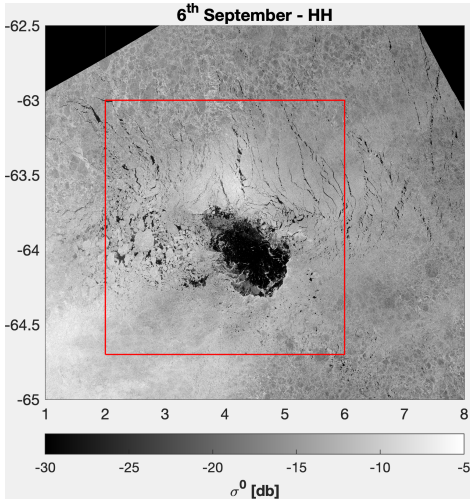
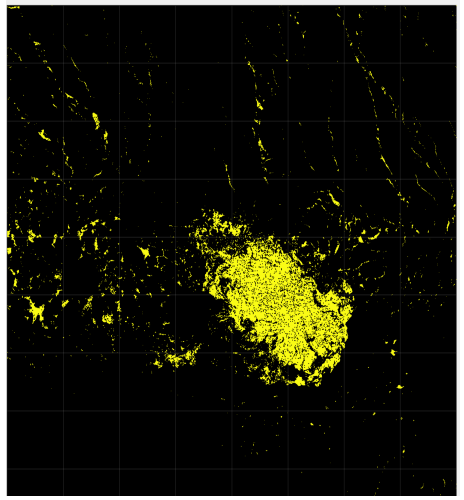
Leads detection using combined co- and cross-polarised bands (HH and HV);

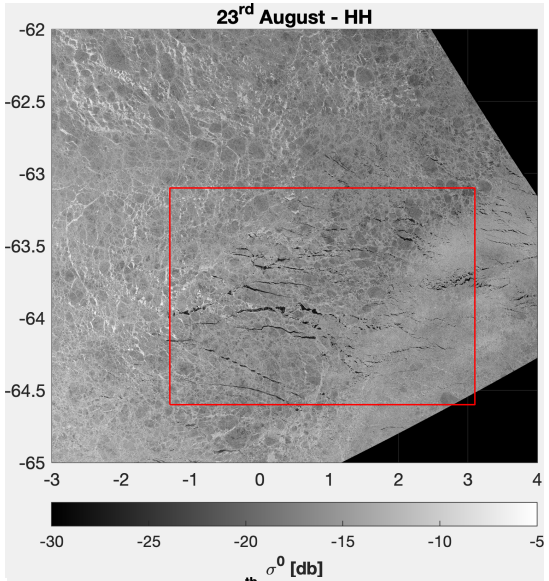
TRAINING

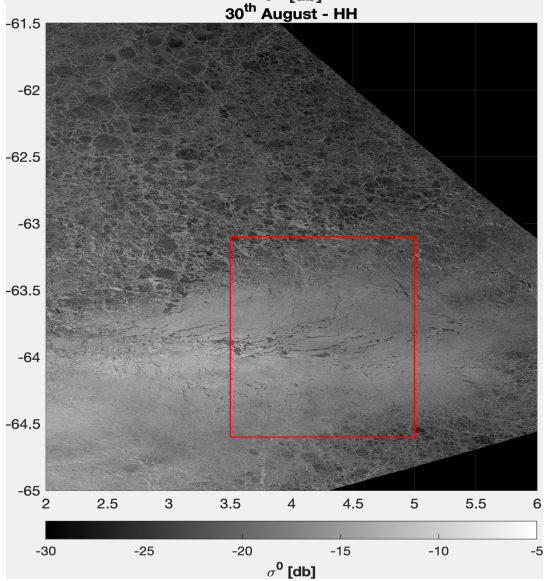


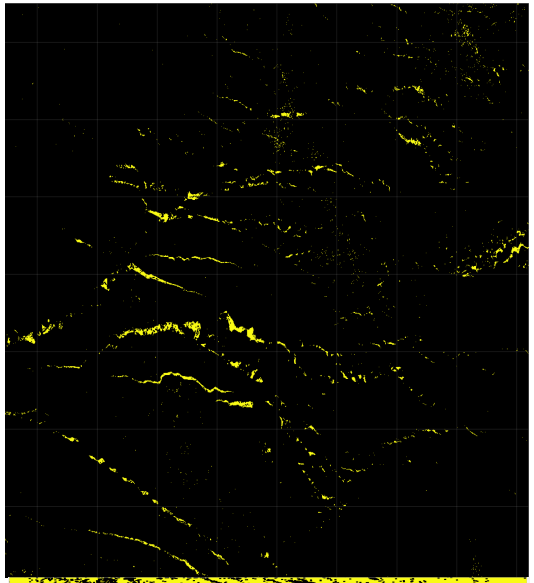


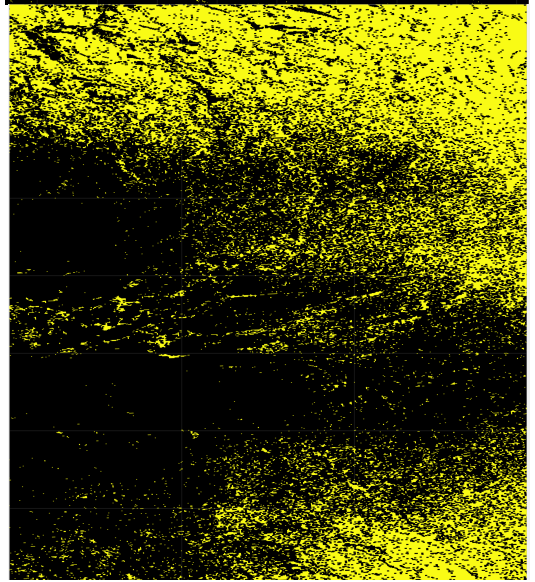
3 days after the opening

- HH
- HV
- HH/HV
- HH*HV









11 days prior the opening

4 days prior the opening

Ongoing and Future work:

- Improve the leads detection algorithm using Sentinel-1 for the Weddell Sea;
- Extend the method for other SAR products in C-band (Envisat and RADARSAT) and L-band (ALOS-2 PALSAR-2);
- Adapt the Artificial Neural Networks developed by Aldenhoff et al. (2018) to monitor changes in sea ice thickness over the polynya region → allowing us to distinguish three different categories: ice, thin ice, and open water;
- Integrate efforts from different sensors → e.g. SAR + Infrared (Heuzé & Lemos 2020 in The Cryosphere Discussions soon!).