NATIONAL SCIENCE CENTRE
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Sea ice, wind waves and coastal erosion in Hornsund, Svalbard

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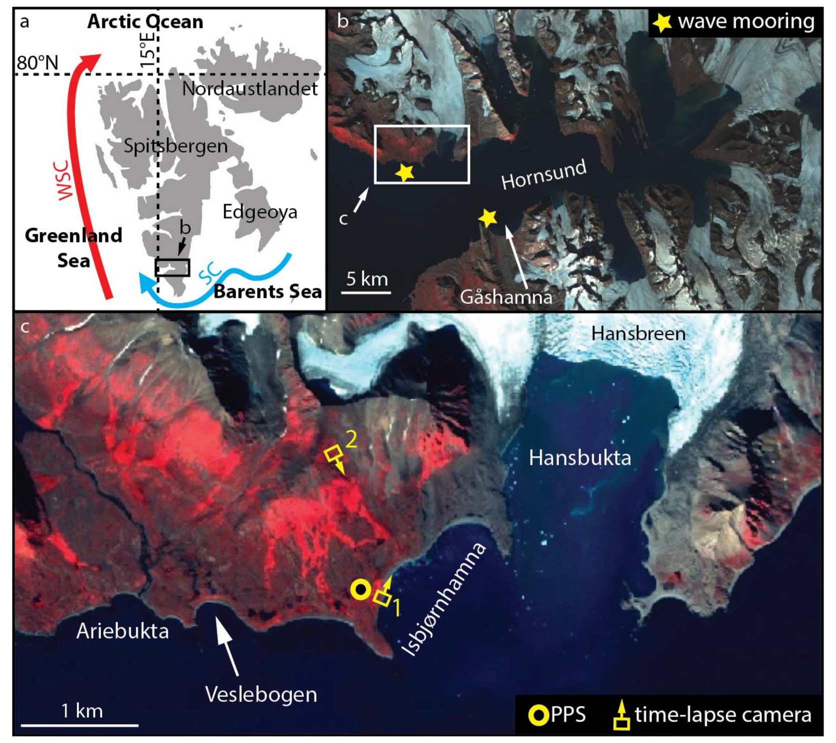
STUDY AREA



WSC = West Spitsbergen Current; SC = Sorkapp Current; PPS = Polish Polar Station
b-c) Copernicus Sentinel-2 false colour scene 1.08.2020

BACKGROUND

Average fast ice coverage in Hornsund in April - the month with most sea ice - decreased from 52.6% in 2000-2005 to 35.2% in 2006-2014 [1].

West of Hornsund, the number of annual storms (Hs > 2.5 m; Hs increase ≥1 m ; interval between consecutive storms ≥ 72 h) increased at a rate of 2 storms per decade and the total storm duration increased at a rate of 4 days per decade between 1979 and 2015, with typical values of 10-40 storms/year and 20-80 days/year [2].

The average 1960-2011 shoreline retreat rate in Isbjornhamna, a bay in central Hornsund with the Polish Polar Station infrastructure, was 0.26 m/yr [3].

REFERENCES
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[3] Zagórski et al. 2015. Multidecadal (1960-2011) shoreline changes in Isbjornhamna (Hornsund, Svalbard). Polish Polar Research 36(4): 369-390.
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[6] Herman et al. 2019. Wind wave variability in Hornsund fjord, west Spitsbergen. Estuarine, Coastal and Shelf Sciences 217: 96-109.
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[9] Norwegian Meteorological Institute Ice Service, https://cryo.met.no/en/latest-ice-charts (accessed: 2023-02-28).

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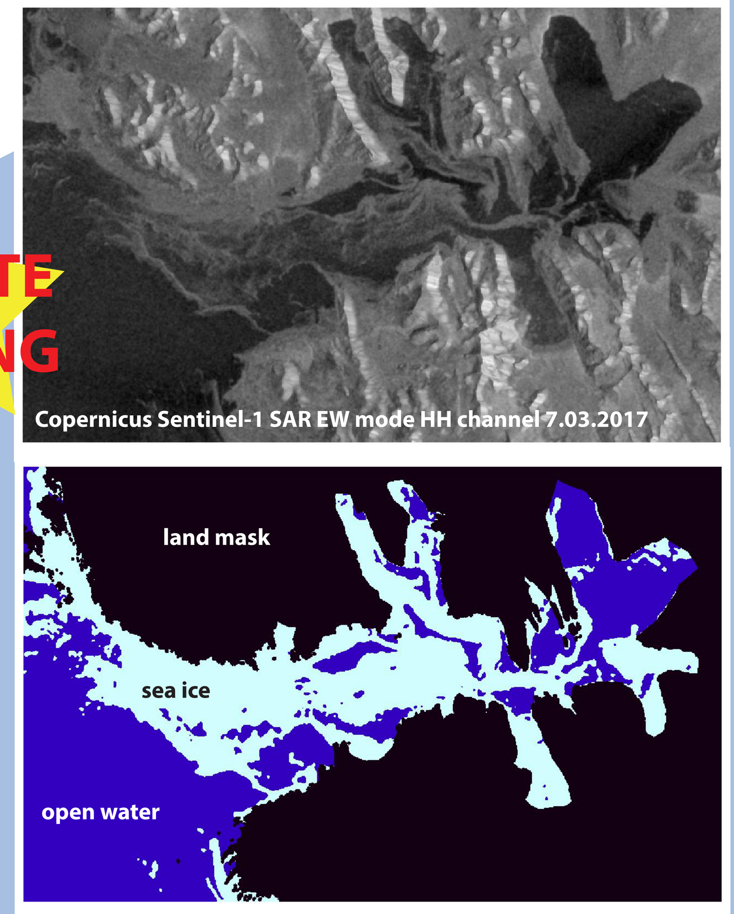
SEA ICE

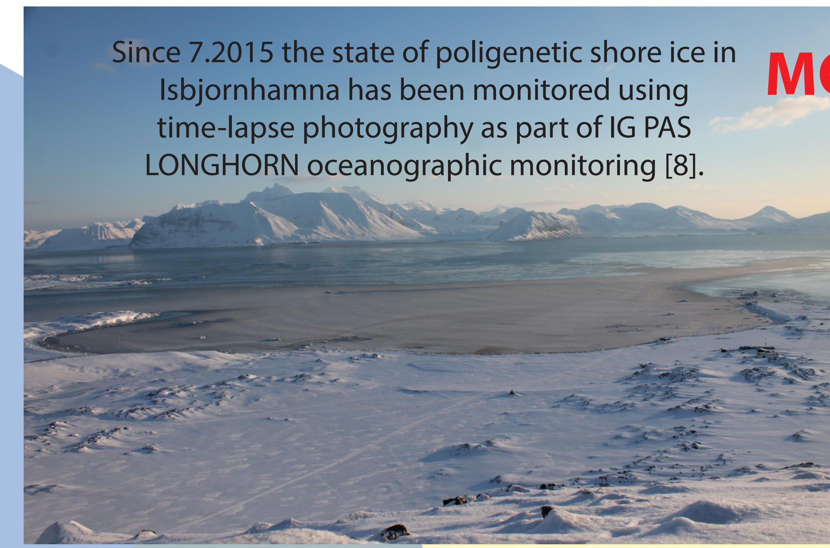
REMOTE SENSING



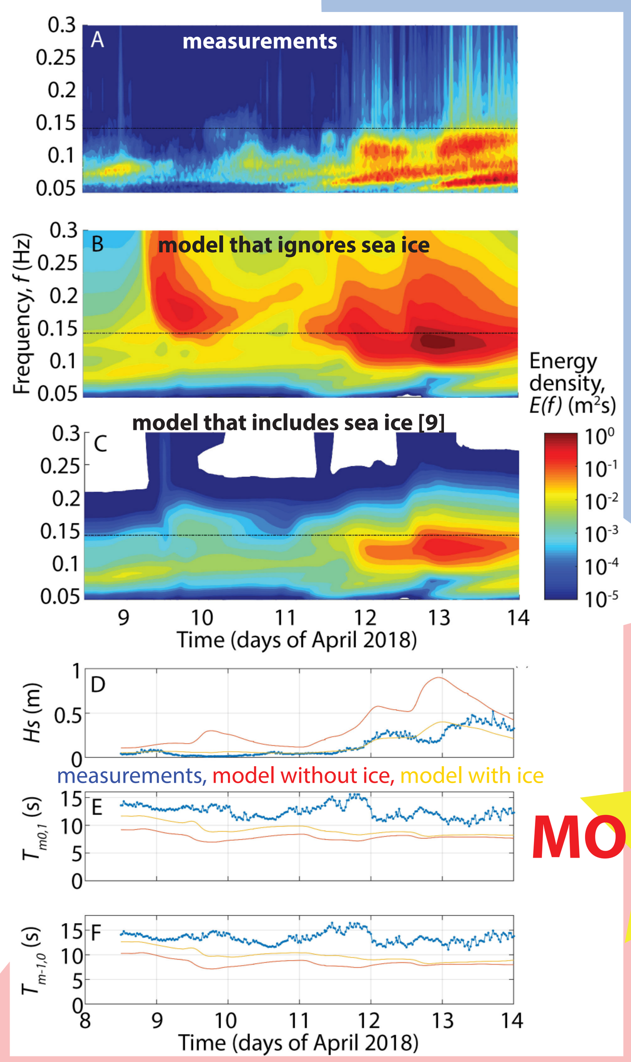
We use the full Sentinel-1A/B SAR set (since 10.2014) to create daily sea ice maps at 50 m resolution using automated segmentation and classification, and manual sea ice/open water class assignment [4].

MONITORING

Since 7.2015 the state of poligenetic shore ice in Isbjornhamna has been monitored using time-lapse photography as part of IG PAS LONGHORN oceanographic monitoring [8].



MODELLING



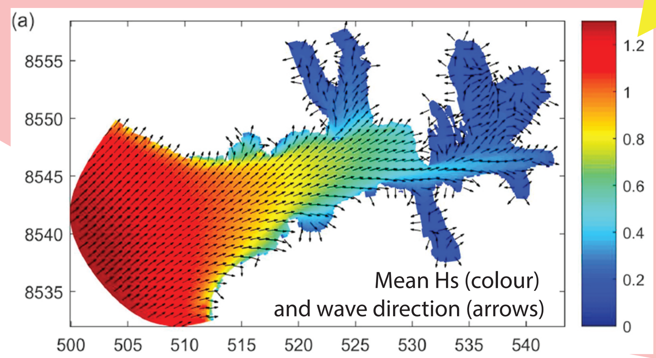
When sea ice is present outside and inside the fjord, the SWAN set over-estimates significant wave height (Hs) and total wave energy, and under-estimates wave period (Tp). Including sea ice concentration in the model improves its performance [5].

Through the combination of long-term monitoring, field experiments, remote sensing and modelling we are trying to understand wind wave impact on High Arctic beaches.

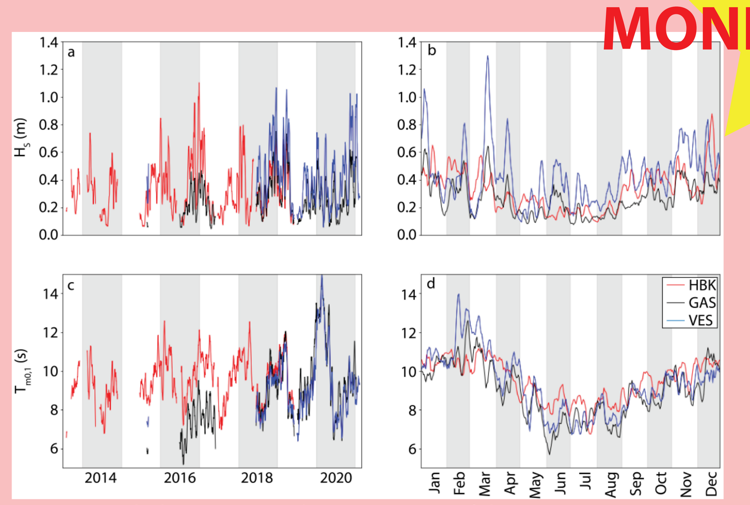
WAVES

MODELLING

A set of three nested Simulating Waves Nearshore (SWAN) models was used to reconstruct wind wave conditions in Hornsund. The model tested well (Hs $R^2 \geq 0.89$) against *in situ* measurements for two 4-month sea-ice free periods of 8-11.2015 and 2016 [6].



MONITORING



HBK = Hansbukta, GAS = Gashamna, VES = Veslebogen

Since 7.2013 nearshore (8-23 m) wind wave conditions in bays of northern and southern Hornsund have been monitored as part of IG PAS LONGHORN oceanographic monitoring [7, 8].

COAST

FIELD EXPERIMENTS

We use Uncrewed Aerial Vehicle (UAV) and Structure-from-Motion (SfM) to build 3D models of Isbjornhamna and Veslebogen beaches and to detect volumetric changes at a range of temporal scales (events, seasons, years).

FIELD EXPERIMENTS

We use high-frequency time-lapse photography to understand how nearshore wind wave conditions translate into beach water levels.

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CoolCoasts