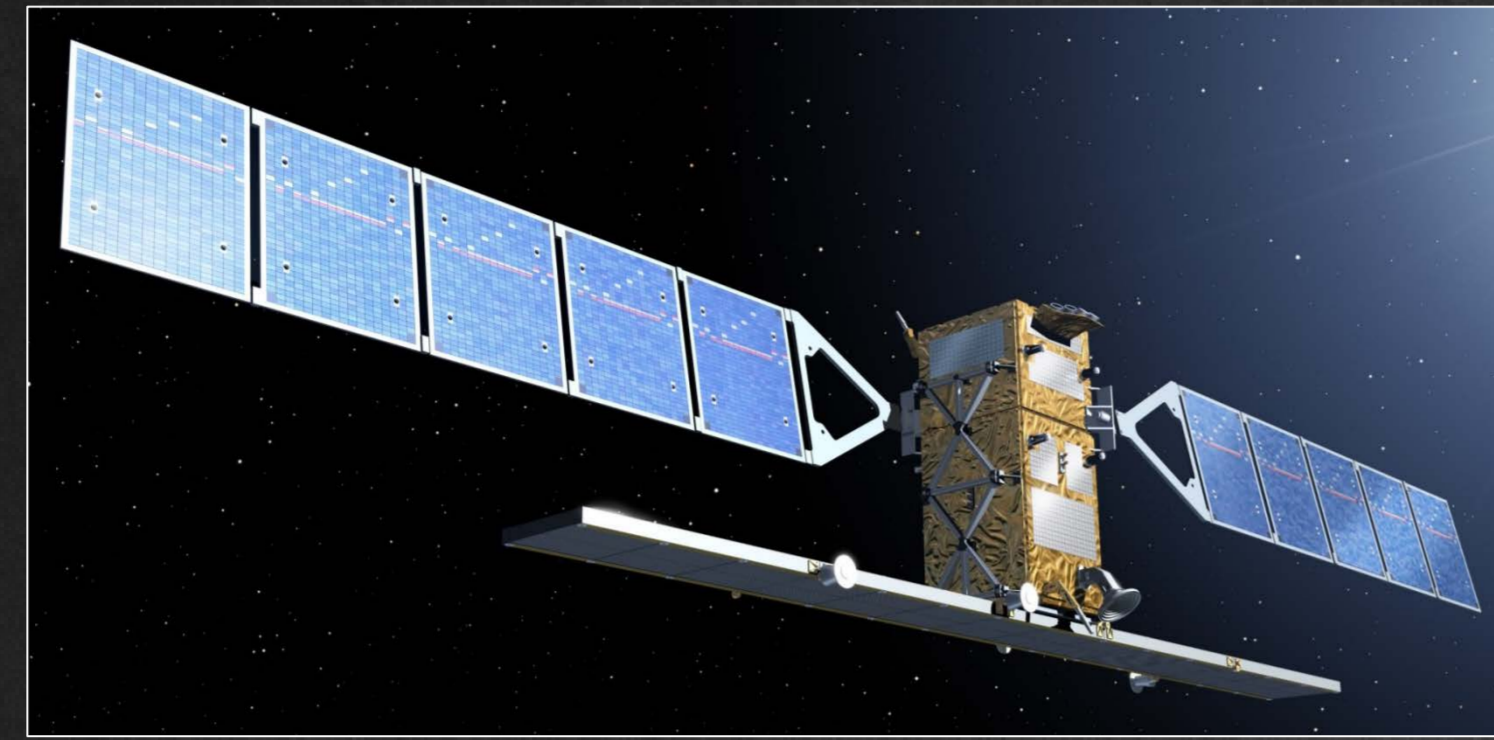


Geophysical and morphological processes in the Arctic coastal regions and marginal ice zone by using remote sensing data

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Summary

- Climate change severely affects Arctic coasts with erosion rates of up to 2-6 m per year
- Remote Sensing with SAR satellites allows estimating coastal erosion in the Arctic
- Supporting modelling and observation campaigns with sea state and coastline processor



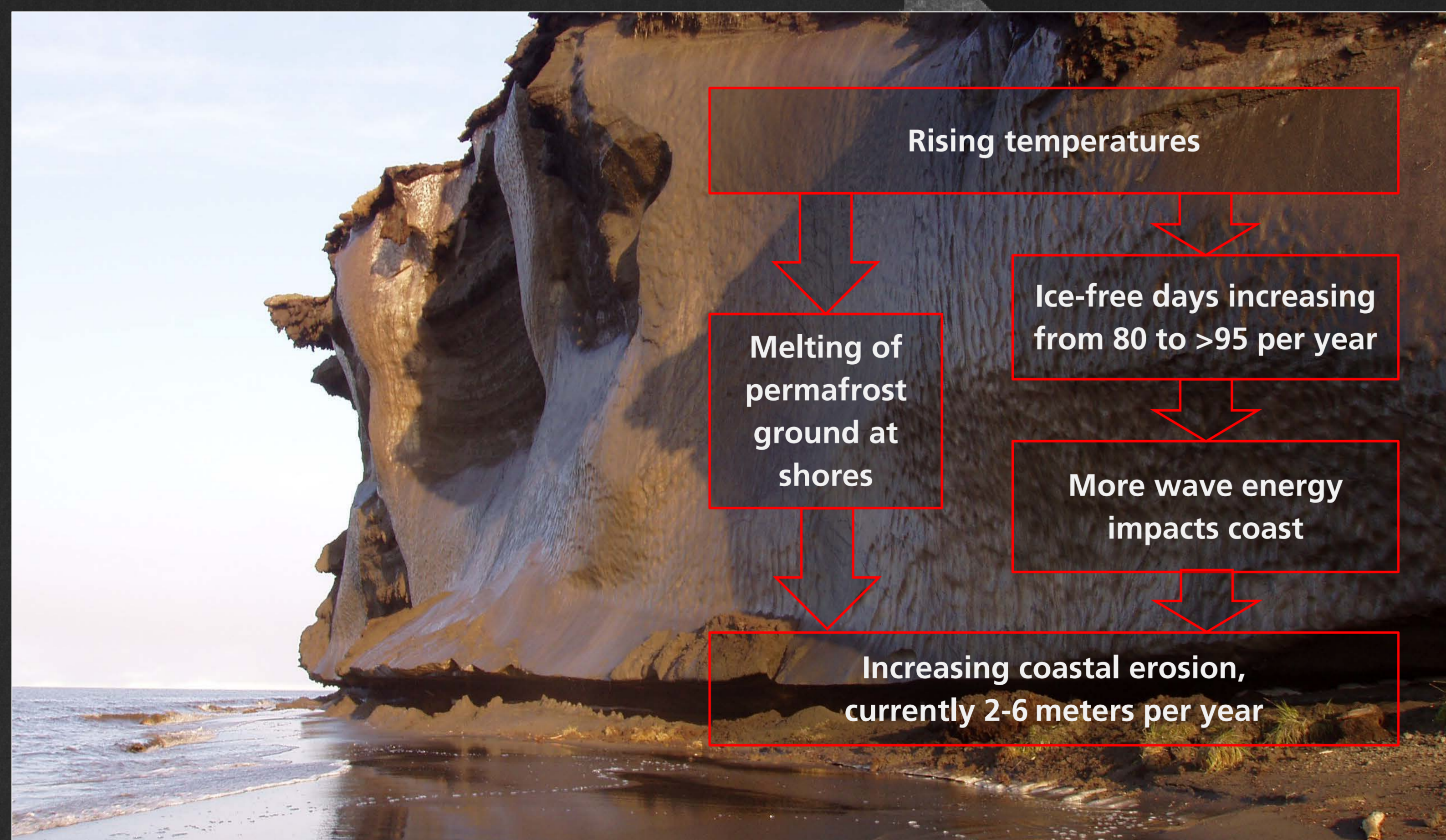
The Sentinel-1 SAR satellite (Image: ESA)

Remote Sensing opportunities

- Polar latitude means almost daily coverage by many Earth Observation satellites
- Synthetic Aperture Radar (SAR)
 - Active sensing technology
 - Penetrates clouds
 - Independent from illumination, important during polar night
- Sentinel-1 mission
 - 10 m pixel spacing
 - 250 km swath width
 - Frequent, regular acquisitions
 - Free data access
- TerraSAR-X mission
 - Resolutions down to <1 m
 - Monitoring of areas of interest



Map of Laptev Sea and New Siberian Islands



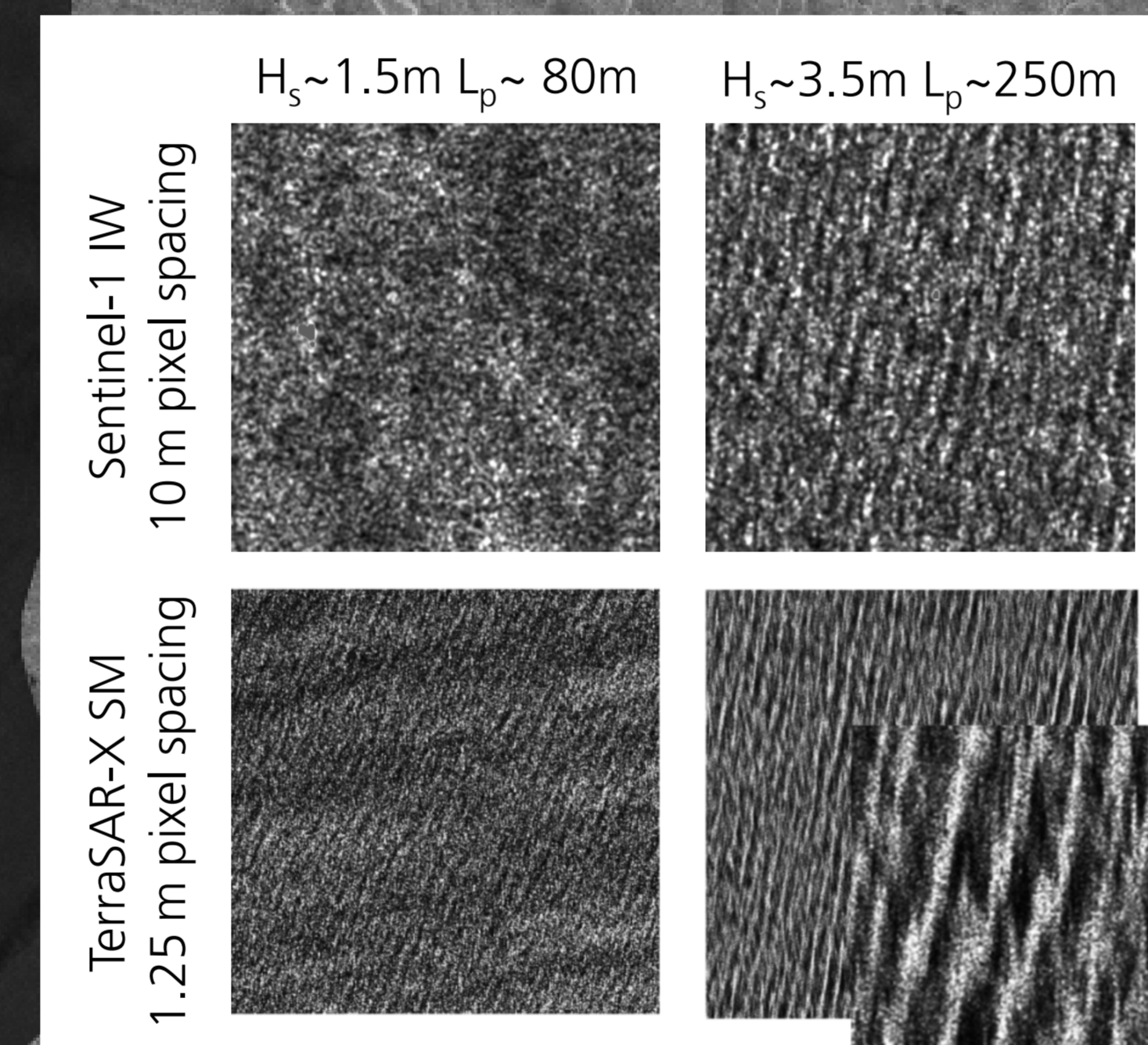
Permafrost soil at the Laptev Sea coast (Photo: Mikhail Grigoriev)

Coastline retrieval

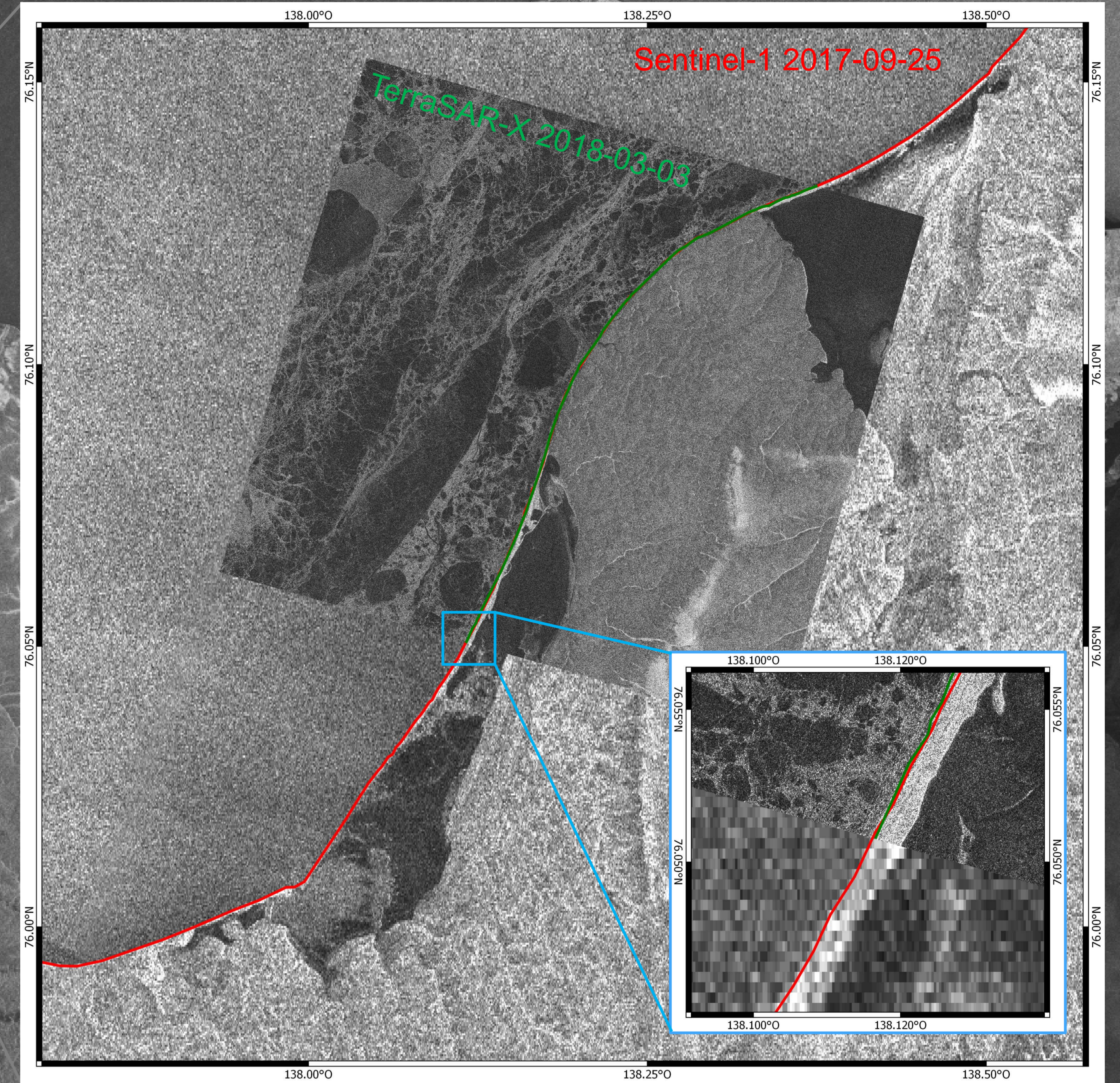
- Semi-automatic processor for SAR data
- Contrast-based detection of land-water-boundary
- Retrieves land-water-line under ice-free conditions
- Precision of about 2 image pixels

Sea state retrieval

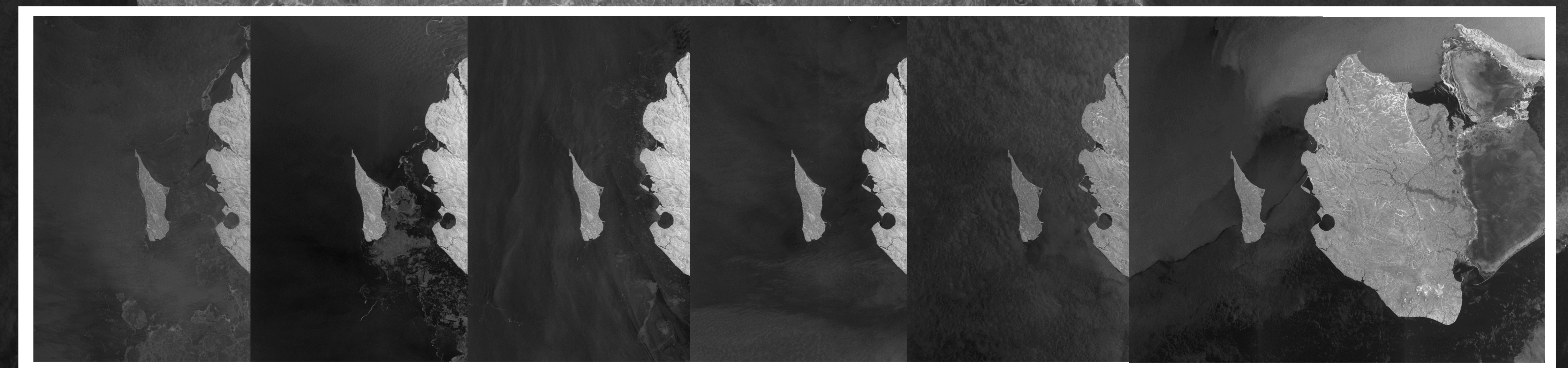
- Fully automated processor for Sentinel-1 IW mode and TerraSAR-X data
- Retrieves significant wave height H_s in ice-free areas
- Allows estimation of impacted wave energy to coast during ice-free season



Differences in sea state imaging between TerraSAR-X StripMap (SM) and Sentinel-1 Interferometric Wide Swath (IW) mode



Delineated coastlines from Sentinel-1 (2015, 10 m pixel spacing, 250 km swath width) and TerraSAR-X Spotlight (2018, 1.5 m pixel spacing, 10 km swath width). The TerraSAR-X scene from March shows the presence of ice; the Sentinel-1 scene from October is ice-free. Sea ice does not allow for automatic coastline detection and even makes manual delineation challenging due to lack of contrast at the coast. TerraSAR-X data © DLR 2018



Time series of 6 images of Sentinel-1 in IW mode, acquired every 12 days from July 27 to September 25, 2017 (left to right), where the Laptev Sea was mostly ice-free. More images are available for adjacent regions from different orbits or in the low-resolution EW acquisition mode