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

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The Arctic experiences a significant impact of ongoing climate change resulting in an increase of air and water temperature, sea-ice loss and changes in the ocean and atmospheric circulation, temperature and wind distribution. These lead to changes in factors driving seabed and coastal erosion, likely to its acceleration in the shallow Arctic regions such as the Laptev Sea and East Siberian Sea. In the context of a changing sea ice and wave climate, the build-up of ocean waves in ice-free parts of the Arctic seas and their impact on both the coastline and marginal ice zone gains growing attention. In these regions, the coastline consists to a large extent of permafrost. The increase of the erosion rate of the coastline will increase the release of organic and inorganic matter from permafrost.

Automatic methods were developed to distinguish land from water and retrieve the coastline at the time of acquisition based on contrast and brightness of space borne SAR (Synthetic Aperture Radar) images. Due to their high resolution, daylight and weather independency, and global coverage, space borne SAR is particularly suitable for coastal regions in the Arctic. The Copernicus Sentinel-1 A/B SAR satellites cover these latitudes with acquisition strips extending thousand kilometres with $\sim$10m resolution in the Interferometric Wide Swath Mode (IW), each image with an approximate size of 200km$\times$250km. All acquisitions are accessible through the Sentinel data archive; this allows monitoring coastal processes retroactively in most areas of the world. Also, a new algorithm and processor for meteo-marine parameter estimation from Sentinel-1 (S1) imagery were developed. Surface wind speed, sea state parameters, and coastline can be estimated simultaneously from the same IW SAR image and used, e.g., for validation of numerical simulations.

This study is focused on coastline dynamics with connection to sea state conditions and ice situation both from satellite data and numerical model results. Sentinel-1 acquisitions with processed coastlines of the New Siberian Islands in the Laptev Sea for different seasons are presented.