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Application of satellite altimetry (ERS-2 and ENVISAT) for studies of Austfonna ice cap (Svalbard)

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Ice caps and glaciers are one of the most sensitive natural objects for detecting global climate variability and will be among the first ones to manifest changes before the rest of the planet does. We have studied application of satellite altimetry for the largest ice cap in the Eurasian Arctic - the Austfonna on the Svalbard.

We present analysis of ERS-2 altimetry data that has been performed over the Austfonna for 1995 to 2003. We present changes of absolute height and height anomalies, as well as backscatter values (depending on the surface roughness, melting and refreezing processes) and the leading edge width (affected by the presence of snow dunes, small-scale ondulations, effects of radar penetration in the snow).

We also present results of the combined use of the Digital Elevation Model (DEM) of the Austfonna with ENVISAT and ERS-2 altimetry data. The DEM has been used to first simulate the radar return waveform. By comparing the simulated and measured waveform we then estimate the errors associated with the DEM inclination plane (related to the long-wavelength DEM errors) and correct them using the least square method. Then we again simulate the return waveform and by this iterative approach we assess the application of this particular technique to DEM improvement and to altimeter measurements interpretation.

Using the results obtained, we analyse influence of glacier slope, atmospheric refraction, tides and the state of glacier surface (fresh or wet snow, bare ice, roughness) on the accuracy of altimetry data and estimate necessary corrections. We discuss processing of crossover techniques for processing multi-pass altimetry data obtained over glacier surface and the assessment of expected accuracies.