

Helicopter-borne laser profiling of sea ice surface roughness

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Laser profiler measurements were performed during cruises of RV POLARSTERN. An Riegl 3100HS laser distance meter operating at a pulse wavelength of 905 nm was used with an accuracy of about ± 3 cm. The laser was mounted on a EM sea ice thickness sensor (EM-Bird) pointing vertically downwards to measure the altitude above the ice surface which nominally was 10 to 15 m. Depending on flight speed, the spatial sampling interval ranged between 0.02 and 0.15 m. Positioning of the profiles was performed by means of a Global Positioning System (GPS).

After eye inspection of the data and removal of outliers, the low frequency helicopter motion is eliminated from the data using a multiple filter procedure described by Hibler (1972), Dierking (1995), and Haas et al. (1999). It takes advantage of the fact that the helicopter height variations are only at low frequencies, whereas the surface roughness is a superimposed, high frequency signal. The resulting ice morphology is obtained relative to the surface of the surrounding level ice. Absolute freeboard, i.e. the height of the surface above the water level, cannot be obtained unless the helicopter height variations are independently determined by means of differential GPS and Inertial navigation systems. The resulting surface profiles can be used to identify pressure ridges, e.g. by a Rayleigh criterion. By this criterion only local maxima which are twice as high as the surrounding local minima are defined as pressure ridges.

References

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