Aircraft Remote Sensing of the Surface Roughness of Sea Ice

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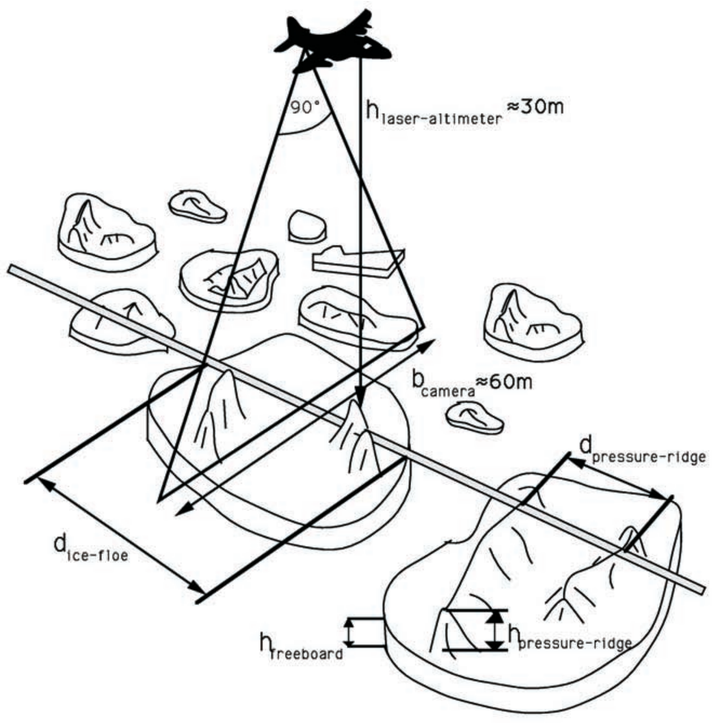
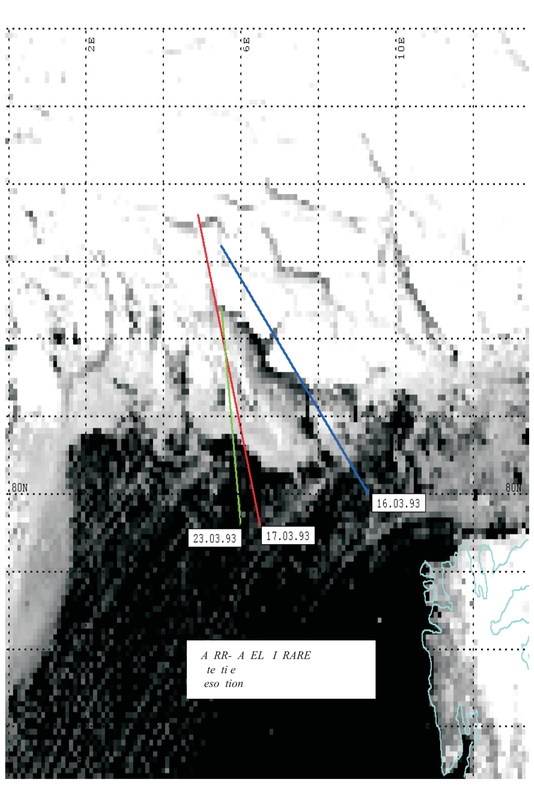
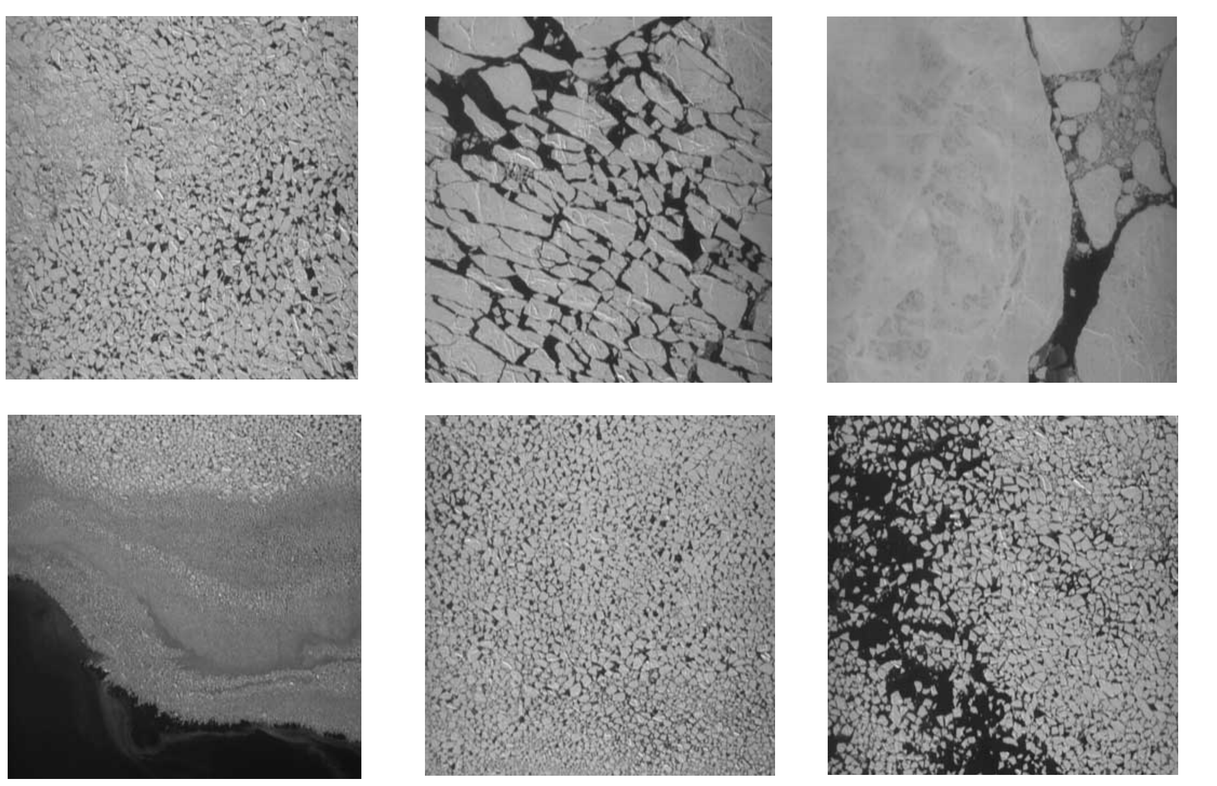
Numerical models of the atmosphere use drag coefficients to parameterise the roughness of the earth's surface. The dependence of the drag coefficients on the structure of sea ice is determined by measurements during Reflex II, Arktis 93.

- Aircraft Turbulence Probing System
  High precision flow measurements of the three components of the wind vector together with inertial and gps-based measurements of the movement and orientation of the aircraft Polar 2 enable the determination of the state of the turbulence.
- Laser Altimeter
  A laser altimeter, operating at a pulse frequency of 2000 Hz, recorded the surface topography. The laser altimeter has a resolution of 2 cm vertically, and 10 cm horizontally.
- Line Scan Camera
  A digital line scan camera was used to record a 2-dimensional image of the surface condition. The camera records at a rate of 50 Hz one line of 512 pixels. Each pixel has a grey-level on a scale of 0 - 255.
- Shipborne turbulence probing system
  The RV Polarstern provided ground truth data for the aircraft flux measurements. Momentum fluxes measured at the same time and position by Polarstern and Polar 2 agreed within 5 %.

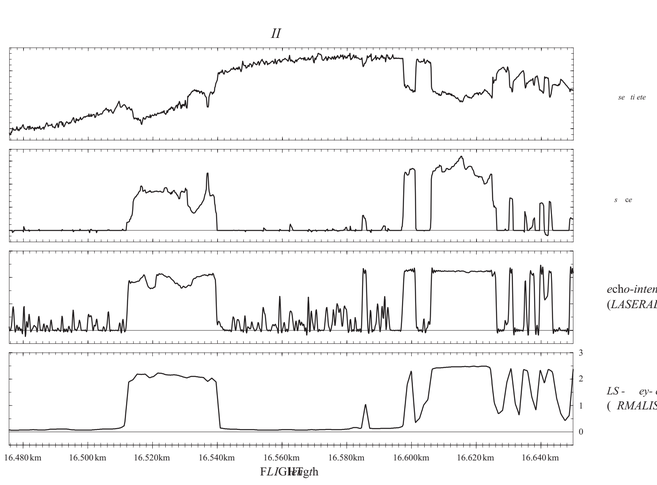


Aircraft based acquisition of sea-ice properties by laser-altimetry and digital camera survey.

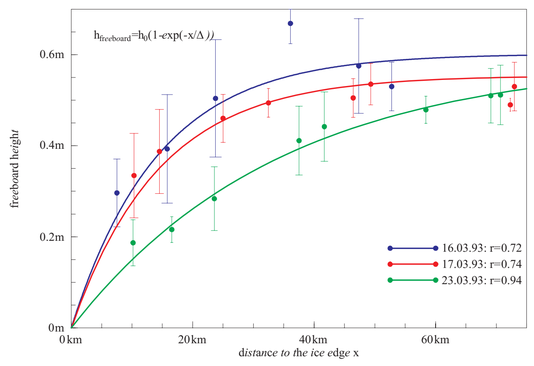




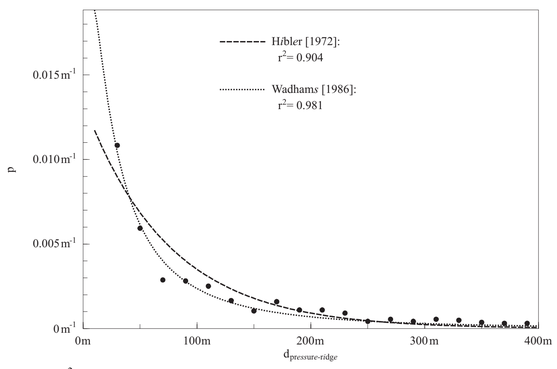
NOAA-satellite picture (left) of the experimental area of Reflex II showing closed sea ice in the upper part and open water with cloud street cover in the lower part. In the lower right corner parts of Svalbard are visible. Three flight tracks across the Marginal Ice Zone are marked by differently coloured lines. The images of the Line Scanner (right) indicated the change in ice concentration within the marginal ice zone.

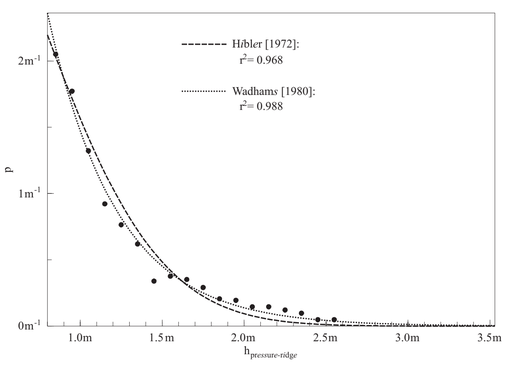


An example of time series of the laser altimeter and the line scan recording. The upper graph shows the distance between aircraft and local surface, including the vertical motion of the aircraft and the surface structure. The surface height (2nd graph from top) is computed from the distance subtracting aircraft height measured with the inertial navigation system of Polar 2. A high echo-intensity of the laser (3rd grph from top) indicates snow surface, a low one water.



Mean freeboard height as a function of distance from the ice edge for the three flight tracks marked on the NOAA image.





Distributions of pressure ridge parameters: ridge distance (left) and ridge height (right).

Comparison between aircraft data and model calculations of the drag coefficient of sea ice: The model combines the effects of pressure ridges (Arya, 1975) and floe edges (Hansen-Bauer and Gjessing, 1988) using statistics of floe and ridge parameters.