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Characteristics of leads in sea ice and their impact on the atmospheric boundary layer measured during the aircraft campaign STABLE 2013

Amelie Tetzlaff (1), Christof Lüpkes (1), Jörg Hartmann (1), Gerit Birnbaum (1), Timo Vihma (2), and Tiina Nygård (2)

(1) Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven, Germany , (2) Finnish Meteorological Institute, Helsinki, Finland

Sea ice insulates the atmosphere from the underlying ocean. Leads are elongated channels in sea ice which allow for enhanced heat, moisture, and gas exchange between the polar ocean and atmosphere. Leads can refreeze within less than a day and are often covered by thin ice. Since most leads are sub-grid scale, their impact on atmospheric processes is not resolved in climate models. To improve the parametrization of lead effects in these models information about their general characteristics, such as lead width distribution and surface temperature, is required.

One goal of the campaign STABLE (Spring Time Arctic Boundary Layer Experiment) was to improve our understanding of the impact of leads on the atmospheric boundary layer. It was carried out by the Alfred Wegener Institute in March 2013 using the aircraft Polar 5 for meteorological measurements over the pack ice of the Northern Fram Strait.

We present lead characteristics derived from surface temperature measurements with different instrumentation, including an infrared scanner, and compare them to MODIS satellite data. The boundary layer modification over leads is studied using high resolution measurements of wind and air temperature, which allows the derivation of mean values as well as turbulent fluxes of heat and momentum. We show novel results of vertical profiles of turbulent fluxes derived from aircraft measurements. We present case studies of four individual leads differing by geometry, thin-ice cover, and atmospheric forcing conditions and discuss the difficulties related to these measurements.