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Aircraft-based studies of katabatic winds and boundary layer structures over the NOW polynya near Greenland during summer

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During June 2010, the aircraft based experiment IKAPOS was performed in northwestern Greenland. The main goals were studies of the summertime katabatic wind system and of the atmospheric boundary layer (ABL) over the North Water Polynya (NOW). Katabatic winds play a key role in exchange processes of energy and momentum between the atmosphere and the underlying surface over the ice sheet of Greenland. During summer, cooling of the boundary layer and hence the katabatic forcing is much less than during winter, but strong winds can occur during appropriate synoptic forcing. On the other hand, the NOW represents one of the largest polynyas of the Arctic, and the air-sea interaction over the NOW has important consequences for ocean processes, ice formation, gas exchange and biology.

The present study is based on aicraft measurements in the ABL using the research aircraft POLAR 5 of Alfred-Wegner-Institute (AWI, Bremerhaven). In order to study the turbulence structure and 3D spatial structures of mean quantities POLAR 5 was instrumented with a turbulence measurement system collecting data on a nose boom sampling at a rate of 100 Hz, additional basic meteorological equipment, radiation and surface temperature sensors, laser altimeter, and photo and video cameras.

For different synoptic situations four flights over the NOW and one flight each over the Humboldt and the Steenstrup Glaciers were performed. Over the glaciers, katabatic winds with up to 16 m/s wind speed were found. Over the NOW, a stable, but fully turbulent ABL was present during conditions of strong and relatively warm synoptically induced northerly winds. Strong surface inversions were found in the lowest 100 m – 200 m agl. As a consequence of channeling effects at Smith Sound a well-pronounced low-level jet with wind speed maxima of more than 20 m/s was detected. Thus wind-induced sea-ice export from the Nares Strait is considerably increased.