TURBULENCE STRUCTURES OF THE STABLE BOUNDARY LAYER OVER GREENLAND: AIRCRAFT MEASUREMENTS FROM "IGLOS"

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The exchange processes of energy and momentum at the atmosphere-snow interface of polar ice sheets play a key role in the polar climate system. The deficits in currently available SBL data sets and existing parameterizations demand for further studies of the SBL as well as of the overlying lower portion of the free atmosphere over snow surfaces.

In order to create a comprehensive dataset for validation and/or improvement of SBL parameterizations for numeric models, the experiment IGLOS (**I**nvestigation of the **G**reenland boundary **L**ayer **O**ver **S**ummit) was conducted in June and July 2002 in central Greenland. The aircraft based measurements are evaluated in comparison as well as in combination with other measurements made at Summit Camp, especially radiation fluxes and turbulent quantities measured on the 50 m tower operated by the ETH Zürich.

Six SBL flight missions cover a quite wide range of different synoptic framework conditions. In all cases, well developed stable boundary layers were found. The thicknesses of these SBLs were mostly below the values suggested from previous studies. Even in high wind conditions, the surface inversion thickness did not exceed roughly 100 m.

The low-level turbulence spectra show a double-peak structure. This structure is yielded by predominant wave motions (and aircraft movements across strong gradients) at longer wavelengths and small-scale turbulence at shorter wavelengths. The position of the spectral gap matches Brunt-Väisälä frequency estimations from measured vertical gradients.

The variances of temperature, humidity and vertical wind in the spectral range of small-scale turbulence are very small and represent only about 0.1 of the variances resulting from wave and cross-gradient aircraft motions. Although a vertical wind shear of up to 0.15 ms^{-1}/m was present, only very weak vertical mixing took place. Vertical transports on the turbulence scale were very small (mostly < 10 Wm^{-2}) and occurred only intermittently in areas of the order of few kilometers. The turbulent height of the SBL was found to be much smaller than the surface inversion thickness.