

Summer- and wintertime characteristics of the atmospheric boundary layer at the Summit Greenland Observatory

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Year-round observations of the boundary layer structure and turbulent transfer at Summit, Greenland, were carried out from June 2001 to July 2002. The data provide evidence for: (i) The development of convective boundary layers during the summer season at times when the radiation balance of the surface is positive. The evolution of these boundary layers is analogous to the one observed in the mid latitudes and can be modeled accordingly. Non-dimensional wind and temperature gradients in the surface layer follow Monin-Obukhov similarity. (ii) The asymptotic behavior of the non-dimensional wind and temperature gradients under very stable conditions, pointing to a more or less constancy of the turbulent Prandtl number for values of the Richardson number up to at least 0.5. (iii) The dissimilarities concerning the vertical variations of the momentum and sensible heat flux in the moderately stable to very stable regimes. Detailed observations of the short- and longwave radiation fluxes covering most of the boundary layer depth indicate that vertical variations of the radiative fluxes must be taken into account for understanding the behavior of the heat flux under stable conditions. In summary, contrary to what one may expect for the dry snow zone of the Greenland ice sheet, the characteristics of the surface and planetary boundary layer in the Arctic regions are variegated, calling for extended parameterizations in weather-prediction and climate models.