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Aircraft observations of the boundary layer in the Antarctic sea ice zone

A. I. Weiss, T. Lachlan-Cope, R. Ladkin, J. King
British Antarctic Survey, High Cross, Madingley Road, Cambridge, England

The sea ice zone in Antarctica is characterized by spatial heterogeneity over a wide range of scales. This heterogeneity affects the air-sea exchange of momentum and heat. An accurate specification and parameterization of the involved physical processes are vital for numerical model studies of the energy and radiation budget in the polar sea ice zone. In order to improve our understanding of the complex feedback mechanisms between air, sea and ice, aircraft observations of the maritime atmospheric boundary layer in the Antarctic were acquired by the British Antarctic Survey. Over sea ice, aircraft measurements are the only direct method to obtain spatially representative observations of the turbulent boundary layer structure. In this contribution, we give an overview of the meteorological instrumentation which was newly installed on a Twin Otter research aircraft. The instrumentation was tested and improved during two field campaigns in the austral summer months and turbulent fluxes of momentum and sensible heat, as well as air and surface temperature, humidity, wind and radiation are determined from low flight level observations. Sea ice concentrations are estimated from the measurements of sea surface temperature and radiation in combination with video footage. The observations show a large spatial and temporal variability of the turbulent fluxes, measured in the Weddell Sea and the Bellingshausen Sea area. Over Weddell Sea ice, for example, sensible heat fluxes between -20 W/m2 and +250 W/m2 were observed in February. In this study we place special emphasis on the discussion of the temporal and spatial variability of these fluxes for various ice and atmospheric conditions and discuss aspects of their parameterisation in numerical models.