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Aircraft observations of the maritime atmospheric boundary layer over sea ice in the Antarctic

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We present a field study of the maritime atmospheric boundary layer in the area of the Antarctic Peninsula over various sea ice conditions. In the Antarctic, sea ice plays an important role in the development of the maritime atmospheric boundary layer, due to its large impact on the energy and radiation budget. In turn, energy and radiation fluxes influence formation and decay of sea ice. However, little is known about the complex feedback mechanism between air, sea and ice in the Antarctic and their accurate parameterisation. In order to improve our understanding of air-sea-ice interaction and the maritime boundary layer structure within the sea ice zone an airborne field campaign was conducted by the British Antarctic Survey. We give a brief overview of the meteorological instrumentation which was newly installed on a Twin Otter research aircraft. The turbulent atmospheric fluxes of momentum and sensible heat, as well as air and surface temperature, humidity, wind and radiation are determined from measurements of low level flights over ice and water. Sea ice concentrations are estimated from the measurements of sea surface temperature and radiation in combination with a video camera. The most important links between air, sea and ice are radiation and turbulent fluxes. Therefore, in this study special emphasis is placed on the discussion of the temporal and spatial variability of these fluxes for various ice and atmospheric conditions. The analysis of the data clearly shows how sea ice leads to a drastic change in the ocean surface albedo and temperature. However, the spatial variability of the atmospheric turbulent fluxes depended not only on the sea ice conditions, such as sea ice concentration, but also on the synoptic situation. An analysis of the data with the joint frequency distribution technique showed how the ratio between rising thermals and downdrafts is determined by different sea ice conditions and by the stage of development of the boundary layer. Furthermore, we discuss in this study the roughness lengths for momentum and heat over various sea ice.