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Air-sea interaction in the inner Arctic: High-resolution simulations of the atmospheric boundary layer and comparisons with measurements during ABSIS-2003

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Non-hydrostatic simulations using two mesoscale atmospheric models have been performed for the inner Arctic during April 2003. Sea ice coverage was taken from sea ice retrievals from MODIS satellite data (1-2km resolution). Sea ice concentrations are high for the inner Arctic, but heat and moisture fluxes in the pack ice are strongly modulated by open water fractions associated with leads. Leads have a small width of a few kilometers, but can extend over more than hundred kilometers. During April 2003, the aircraft-based experiment ABSIS (Arctic Boundary Layer and Sea Ice Study) took place in the frame of the German ACSYS project, and a comprehensive data set was collected from a research aircraft, a helicopter-based turbulence probe, two ships with radiosondes and several surface-based measurements, allowing the comparison of boundary layer structures with model simulations. A number of shortcomings were identified when applying the operational model LM of the German Meteorological Service to Arctic conditions (with a resolution of 8km). In particular, excessive cloud formation is predicted by the cloud parameterization scheme. However, the air-sea exchange and the boundary-layer structures depend more on the correct representation of the fractional sea ice coverage and the surface temperature. A major improvement for the LM simulations of boundary layer structures was achieved by taking the actual surface temperature field from MODIS satellite retrievals. In order to resolve lead structures in the simulations, high-resolution simulations were performed using the model FOOT3DK (university of Köln) nested in LM. FOOT3DK is run with resolutions of 2km and 500m, and a dynamic-thermodynamic sea ice model can be coupled to the atmospheric model. Comparisons with the ABSIS data set show a good agreement for the boundary layer structures and near-surface quantities.