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The near-surface small-scale spatial and temporal variability of momentum, sensible and latent heat exchange in Arctic regions: a case study

G. Jocher (1), F. Karner (2), F. Obleitner (2), J. Reuder (3), Ch. Ritter (1), R. Neuber (1), K. Dethloff (1), and Th. Foken (4)

(1) AWI Potsdam, Climate Sciences and Atmospheric Circulations, Germany (georg.jocher@awi.de), (2) Innsbruck University, Institute of Meteorology and Geophysics, Austria, (3) University of Bergen, Geophysical Institute, Norway, (4) University of Bayreuth, Departement of Micrometeorology, Germany

The coupling behaviour of the Arctic atmospheric boundary layer with surface processes in different atmospheric situations is important for their parameterizations in numerical weather prediction and regional climate models. Ny-Ålesund is already known as a place where boundary layer measurements are challenged by local orographical effects. In this work we present data from two eddy covariance systems for determining the sensible heat flux, latent heat flux and the shear stress near the earth's surface, one close to the village (position: 78° 55.287' N, 011° 54.851' E), the other one located on Kongsvegen glacier (position: 78° 84.70' N, 012° 66.76' E) which was operated for a short period in April 2011 contemporary to the Polar Airborne Measurements and Arctic Regional Climate Model Simulation Project (PAMARCMiP) 2011. Two examples for small-scale variability are discussed: near surface external gravity waves associated with katabatic wind from the Broggerbreen glacier at the site Ny-Ålesund and an episode when the two eddy system at the two measurement sites captured very different conditions at the same time. In case of gravity wave motion the eddy covariance method results in fictitious positive fluxes due to the strong correlation between temperature and vertical wind, which had to be considered carefully.
The comparison between the two sites showed, that generally the exchange processes near Ny-Ålesund and the Kongsvegen glacier are different and local. But there are cases of synchronization due to synoptical influences, and then the same processes are visible at the two measurement sites.
Both examples show that the boundary layer in Ny-Ålesund is not only influenced from neighbouring glaciers, but also by other orographical characteristics, sometimes synoptical influences play the major role. It is clearly visible, that general statements about the Arctic boundary layer are mostly difficult with single measurements in space and time due to the high variability of the surface properties and meteorological conditions in Arctic regions.