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Simultaneous profiling of the Arctic Atmospheric Boundary Layer

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The structure of the Arctic atmospheric boundary layer (AABL) and the heat and moisture fluxes between relatively warm water and cold air above non-sea-ice-covered water (such as fjords, leads and polynyas) are of great importance for the sensitive Arctic climate system (e.g. Andreas and Cash, 1999). So far, such processes are not sufficiently resolved in numerical weather prediction (NWP) and climate models (e.g. Tjernström et al., 2005). Especially for regions with complex topography as the Svalbard mountains and fjords the state and diurnal evolution of the AABL is not well known yet.
Knowledge can be gained by novel and flexible measurement techniques such as the use of an unmanned aerial vehicle (UAV). An UAV can perform vertical profiles as well as horizontal surveys of the mean meteorological parameters: temperature, relative humidity, pressure and wind.
A corresponding UAV, called Small Unmanned Meteorological Observer (SUMO), has been developed at the Geophysical Institute at the University of Bergen in cooperation with Müller Engineering (www.pfump.org) and the Paparazzi Project (http://paparazzi.enac.fr).
SUMO has been used under Arctic conditions at Longyear airport, Spitsbergen in March/April 2009. Besides vertical profiles up to 1500 m and horizontal surveys at flight levels of 100 and 200 m, SUMO could measure vertical profiles for the first time simultaneously in a horizontal distance of 1 km; one over the ice and snow-covered land surface and the other one above the open water of Isfjorden. This has been the first step of future multiple UAV operations in so called “swarms” or “flocks”. With this, corresponding measurements of the diurnal evolution of the AABL can be achieved with minimum technical efforts and costs.
In addition, the Advanced Research Weather Forecasting model (AR-WRF version 3.1) has been run in high resolution (grid size: 1 km). First results of a sensitivity study where ABL schemes have been tested and compared with respect to the measured SUMO profiles are presented.