Geophysical Research Abstracts,
Vol. 11, EGU2009-9596, 2009
EGU General Assembly 2009

Surface energy budget over snow and blue ice in Dronning Maud land, Antarctica, during two summer seasons.

T. Vihma, R. Pirazzini, and M. Johansson
Finnish Meteorological Institute, Helsinki, Finland (roberta.pirazzini@fmi.fi)

During two Finnish Antarctic expeditions (summers 2006/07 and 2007/08) radiation, turbulence, and snow properties were measured over a glacier in the vicinity of the Finnish Station Aboa (73˚03'S, 13˚24'W), in order to quantify the various component of the surface energy budget. The main measurement station, located at ∼230 a.s.l. in an area covered by a thick snow pack, was equipped with a weather mast that gave the vertical profile of temperature and wind speed up to 6.5 m, a 3-dimendional sonic anemometer from which the turbulent fluxes of heat and momentum, atmospheric stability parameter, drag coefficient and various statistics of turbulence were calculated, and a set of radiation sensors to measure the upwelling and downwelling longwave and shortwave radiation fluxes. A second measurement station was located at the distance of one kilometer from the main station, over a blue-ice area, and was equipped with a set of radiometers to measure the for components of the surface radiation budget (plus the downward diffuse shortwave radiation during the second campaign). A third measurement station was located on bare, rocky ground on the slope of a nunatak at 480 m a.s.l., at 3 km distance from the main measurement station on the glacier. The wind, air temperature, humidity, incoming solar radiation and, in 2007/2008, the turbulent fluxes of heat and momentum were measured.

Snow temperature and density vertical profiles (down to a depth of 0.5m) were measured twice a day (in the first campaign) and twice at each other day (in the second campaign). Occasionally, to quantify the spatial heterogeneity of the snow properties, snow temperature and density in the uppermost layers were measured along horizontal lines several meters long. Vertical profile of snow grain size was obtained from digital photos taken once or twice a day (in the first campaign) or at each other day (in the second campaign). Cloud cover classification was made every two hours except during night time.

The preliminary data analysis showed that near-neutral stratification dominated during both measurement campaigns, with some cases of strong surface-based temperature inversions over the glacier. Over the bare ground of the nunatak, the surface was strongly heated, which resulted in upward turbulent heat fluxes, convection and, occasionally during weak winds under clear skies, formation of convective Cumulus humilis clouds. Although the Sun was continuously above the horizon, the surface fluxes, atmospheric surface layer stratification, and the vertical profile of snow temperature had a pronounced diurnal cycle. Occasionally, much higher wind speed was observed at Aboa station compared to the glacier, due to the very stable stratification which prevented the vertical mixing of momentum over the glacier. Momentum flux and drag coefficient over the glacier were clearly affected by the sastrugi: high drag was observed when wind direction differed from the usual, i.e. wind blew perpendicular to the sastrugi. Surface albedo was identical at the snow and blue ice sites as long as snow was uniformly covering the blue ice area. When snow disappeared over the blue ice, the albedo significantly dropped, causing a sharp increase in net shortwave radiation absorbed at the surface. Daily maxima in upwelling longwave radiation were similar over snow and blue-ice, but over blue ice the nocturnal minima in upwelling radiation were much higher than over snow, due to the larger conductive heat flux from the ice/water beneath the surface. We also observed a large small-scale (< 1 m) horizontal variability in snow temperature and density, probably due to the presence of sastrugi and the non-uniform wind packing.