Geophysical Research Abstracts
Vol. 12, EGU2010-8774, 2010
EGU General Assembly 2010

The Annual Surface Energy Budget of a High-Arctic Permafrost Site on Svalbard, Norway

Sebastian Westermann (1), Johannes Lüers (2), Moritz Langer (1), Konstanze Piel (1), and Julia Boike (1)
(1) Alfred-Wegener-Institute, Permafrost, Potsdam, Germany (swestermann@awi.de), (2) Department of Micrometeorology, University of Bayreuth, Germany

Energy balance models are highly capable tools to estimate the thermal conditions of permafrost. Their successful application depends on a detailed understanding of the different components of the surface energy budget and their seasonal variations, including snow cover effects. We present independent measurements of all components of the surface energy budget over a full seasonal cycle at a high-arctic permafrost site on Svalbard. The sensible and latent heat fluxes are hereby measured with an eddy covariance system. A detailed description of the effects of the snow cover is included in the study.
The short-wave radiation is the dominant energy source during the snow-free summer months, while well developed turbulent processes, the long-wave radiation and the heat flux in the ground are the balancing components of the surface energy budget. The Bowen ratio varies between 0.25 and 2, depending on water content of the uppermost soil layer. In the months of July and August, the seasonal thawing of the active layer consumes about 15% of the net radiation. During polar night conditions in winter, the net long-wave radiation is the principal energy loss for the snow surface, while strong sensible heat fluxes and the ground heat flux, which originates from the refreezing of the active layer, lead to a warming of the surface. During the first half of the polar day season from April to June, the surface energy budget resembles “winter-like” conditions, since the long-lasting snow cover with its high albedo effectively reflects the short wave radiation and thus reduces the energy input. The timing of the snow melt, with its associated albedo change is therefore crucial for the annual surface energy budget.
The strong positive sensible heat fluxes in July and August are compensated by negative fluxes during the rest of the year, so that the average annual sensible heat flux is negative with a value of -6.9Wm^{-2}. Strong evaporation is found during the snow melt period and particularly during the snow-free period in summer and fall. When the ground is covered by snow, latent heat fluxes through sublimation of snow occur regularly, but are on average negligible in the surface energy budget. With an annual average of 6.8Wm^{-2}, the latent heat flux more or less compensates the sensible heat flux.
For snow-free ground, an unstable to neutral near-surface atmospheric stratification is found, while stable to neutral conditions prevail for snow-covered ground. Long-lasting near-surface inversions in winter lead to an average temperature difference of approximately 3K between the air temperature at 10m height and the surface temperature of the snow.