Geophysical Research Abstracts
Vol. 20, EGU2018-4517-1, 2018
EGU General Assembly 2018

Impact of Water Tracks on the Surface Energy Balance in the Antarctic McMurdo Dry Valleys

Tobias Linhardt (1), Joseph Levy (2), and Christoph Thomas (1)

(1) Micrometeorology Group, University of Bayreuth, Bayreuth, Germany, (2) Department of Geology, Colgate University, Hamilton, New York, USA

This study evaluated the hypotheses that water tracks significantly alter the surface energy balance in the non-ice covered antarctic McMurdo Dry Valleys and may serve as an important pathway of climate change response in this dry and cold environment. Water tracks are channel-shaped high moisture zones in the active layer of polar permafrost soils. The surface energy balance was measured at one water track and two non-water track reference locations in Taylor Valley during the antarctic summer in the 2012/ 2013 season. This experiment was the first application of the Eddy-Covariance Method in the Dry Valleys. The soil heat flux was analyzed separately for the upper active and the lower permafrost layer for all stations via computation of the heat storage change in the active layer. The results showed that both at the water track and reference stations over 50 % of the net radiation was transferred to the sensible heat flux, about 30 % to ground heat flux and the rest to latent heat flux. For the water track latent heat fluxes were increased by 200 % relative to the reference station, ground heat fluxes by 40 %, and net radiation by 10 %, while sensible heat fluxes were reduced by 30 %. For all stations the soil heat flux in the active layer did not act as a net energy sink, but the energy was directed toward thawing the ice table in the permafrost layer. At the water track station an elevated ground ice abundance compared to the reference station may explain the increased ground heat flux. Entertaining a simple, but realistic climate change scenario yielded that an increase in the land cover fraction of water tracks with the observed properties by 50 % would increase the evaporation of the lower Taylor Valley by more than 0.01 mm/d relative to the current evaporation of 0.29 mm/d. We conclude that water tracks have a strong impact on the surface energy balance in the cold Antarctic deserts. Water tracks are therefore hot spots of change and likely to respond faster to climate change signals than the dominant dry glacial till in the McMurdo Dry Valleys. They may therefore act as a sensitive indicator for change in permafrost-dominated cold landscapes.