Geophysical Research Abstracts
Vol. 13, EGU2011-8531, 2011
EGU General Assembly 2011

Observed effects of soil moisture on surface fluxes and slope winds in an alpine valley

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Soil moisture affects flow in the atmospheric boundary layer through the relative partitioning of energy into the surface sensible and latent heat fluxes. While this effect has been well-studied over flat terrain through both field experiments and simulations, in complex terrain it has previously only been investigated through simulations. In the current study, we use observations to investigate effects of surface soil moisture on the strength and onset of buoyancy-driven slope winds following the diurnal cycle in an alpine valley. In the summers of 2009 and 2010, the Val Ferret catchment ($\sim$20 km^2) in southern Switzerland was instrumented with surface weather stations measuring wind speed and direction (2 m), soil moisture, surface skin temperature, air temperature (2 m), humidity (2 m), incoming solar radiation, and precipitation. Results indicate that on calm, cloudless days, increased soil moisture leads to weaker up-slope and up-valley winds. This is corroborated through the calculation of surface sensible and latent heat fluxes using Monin-Obukov similarity theory, which shows that increased soil moisture leads to increased latent heat fluxes and correspondingly decreased sensible heat fluxes at stations within the valley.