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Atmospheric controls of the energy balance of Haut Glacier d'Arolla, Swiss Alps

Francesca Pellicciotti (1), Marco Carenzo (1), Jakob Helbing (2), and Paolo Burlando (1)

(1) Swiss Federal Institute of Technology ETH, Institute of Environmental Engineering, Zurich, Switzerland (pellicciotti@ifu.baug.ethz.ch), (2) Swiss Federal Institute of Aquatic Science and Technology (Eawag), Switzerland

Mountain glaciers respond rapidly to changes in the climate system. As a result, a large number of studies have recently looked at the interaction between glacier surface and atmosphere across a range of latitudes and climates. Such studies are conducted at the point scale of Automatic Weather Station (AWS) sites, where direct measurements of the component of the energy balance allow to best understand and simulate the exchange of energy at the glacier surface. Most workers, however, have focused on glaciers in the Andes of South America, in Norway, Greenland and Antarctic locations and few studies have looked at the European Alps.

In this paper, we intend to contribute to the ongoing effort in process understanding by investigating the surface energy balance processes and resulting ablation at several AWS locations on the well monitored Haut Glacier d'Arolla, Switzerland, over several seasons.

The surface energy balance is studied with an energy balance model that includes different degrees of complexity and various parameterisations of the energy fluxes. Model outputs are validated using ablation records at ablation stakes and Ultrasonic Depth Gauges (UDG). The sub-daily and seasonal variability of the single components of the energy balance at the glacier-atmosphere is evaluated, together with the variability in space (comparison of different sites) and in time (comparison of different seasons). The importance of the inclusion of the subsurface heat conduction flux into the snowpack is evaluated, and a sensitivity analysis to both model parameters and input data is carried out.