Deriving incoming shortwave and longwave radiations from temperature and remote sensing cloud cover data in mountainous areas

Modeling snowmelt often comes down to choose between two approaches, using degree-day snow models or energy balance models. Degree-day models use air temperature as a proxy for the energy balance. These models are simple to use, but less reliable than energy balance models. Energy balance models use incoming shortwave and longwave radiation, air temperature and air humidity as meteorological forcing variables to compute the energy balance. These model are computationally intensive and as radiative data are relatively sparse, atmospheric model outputs are commonly used for driving these models. This makes energy balance models difficult to use for operational hydrological forecasting.

We developed a method to derive incoming shortwave and longwave radiation by using only temperature, elevation and optionally MODIS cloud cover data. The rationale for this is that we wanted to create create a conceptual snow model which reproduces the processes of the energy balance using only air temperature data and without having to use downscaled atmospheric model outputs. This method consists of automaticaly calibrating a new shortwave parameterization with longwave and cloud cover parameterizations using point scale shortwave and longwave radiation measurements and MODIS data. The model was tested on 26 Swiss meteorological stations and we show that this method improves the simulation of shortwave and longwave incoming radiation for high elevation areas. This may have a potential impact for the improvement of snowmelt modeling for real-time hydrological forecasting.