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Using Landsat land surface temperature to assess the spatial consistency of a distributed hydrological model in alpine environments

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Land Surface Temperature (LST) is a key boundary condition in many land surface schemes and its estimation is crucial for a correct quantification of the surface energy fluxes and, through evapotranspiration, of the water budget. In mountain areas, the modeling of LST is particularly challenging because of the complex interplay of topography, incoming radiation, atmospheric processes, soil moisture distribution and different land covers and vegetation types.
In this contribution, the LST spatial distribution of the Stubai Valley in the Austrian Alps is simulated by the eco-hydrological model GEOtop and compared with ground observations and with LST from a Landsat image, in order to assess the capability of the model to represent the land surface interactions in complex terrain and to evaluate the relative importance of the different environmental factors.
The model describes the energy and mass exchanges between soil, vegetation, and atmosphere, accounting for land cover, soil moisture, the effects of elevation on air temperature and of slope and aspect on solar radiation.
Model results and Landsat observations are compared and the influences of the different environmental factors controlling LST patterns (i.e. solar illumination, elevation, soil moisture, land cover) are evaluated separately through a set of numerical experiments, by spatially varying only one factor at a time.
Results show that for the humid climate considered in this study, the major factors controlling LST spatial distribution are incoming solar radiation and land cover variability. LST results weakly correlated with elevation, except along north facing slopes. For the humid conditions considered in this study, soil moisture distribution has a minor effect on LST along mountain ridges and south exposed steep slopes.
The presented approach shows how the use of remote sensing data in combination with numerical experiments can improve process representation in hydrological models.