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Evapotranspiration measurement and modeling without fitting parameters in high-altitude grasslands

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Mountain grasslands are important, also because one sixth of the world population lives inside watershed dominated by snowmelt. Also, grasslands provide food to both domestic and selvatic animals.

The global warming will probably accelerate the hydrological cycle and increase the drought risk. The combination of measurements, modeling and remote sensing can furnish knowledge in such faraway areas (e.g.: Brocca et al., 2013). A better knowledge of water balance can also allow to optimize the irrigation (e.g.: Canone et al., 2015).

This work is meant to build a model of water balance in mountain grasslands, ranging between 1500 and 2300 meters asl. The main input is the Digital Terrain Model, which is more reliable in grasslands than both in the woods and in the built environment. It drives the spatial variability of shortwave solar radiation. The other atmospheric forcings are more problematic to estimate, namely air temperature, wind and longwave radiation. Ad hoc routines have been written, in order to interpolate in space the meteorological hourly time variability.

The soil hydraulic properties are less variable than in the plains, but the soil depth estimation is still an open issue. The soil vertical variability has been modeled taking into account the main processes: soil evaporation, root uptake, and fractured bedrock percolation.

The time variability latent heat flux and soil moisture results have been compared with the data measured in an eddy covariance station. The results are very good, given the fact that the model has no fitting parameters.

The space variability results have been compared with the results of a model based on Landsat 7 and 8 data, applied over an area of about 200 square kilometers. The spatial correlation is quite in agreement between the two models.

Brocca et al. (2013). “Soil moisture estimation in alpine catchments through modelling and satellite observations”. Vadose Zone Journal, 12(3), 10 pp.

Canone et al. (2015). “Field measurements based model for surface irrigation efficiency assessment”. Agric. Water Manag., 156(1) pp. 30–42