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Spatial variability and temporal stability of soil moisture in an alpine catchment

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Soil moisture is a key state variable for understanding a large number of hydrological processes involved in a broad variety of natural processes (geomorphological, climatic, ecological) that act at different spatio-temporal scales. Characterization of soil water content may be especially difficult in mountainous landscapes due to highly variable water inputs, topography, soils and vegetation. However, individual sites exhibit similar dynamics, suggesting that it may be possible to describe spatial variability in terms of temporally stable relationships. Data from the Dolomites Hydrology Experiment (focused on distinct hillslopes located in an alpine headwater catchment - the 7 km^2 – wide Vizza experimental basin) are used to analyse spatial and temporal variability of surface soil moisture in a mountainous, snow-dominated headwater catchment.

Our objectives were to: (i) describe the spatial variability of surface soil moisture in an alpine basin; (ii) characterize such variability in terms of temporal stability; (iii) examine the relationship between spatially and temporally variation of soil water and triggering of subsurface flow, as measured by a network of piezometers. Soil moisture was measured at two depths at several site over three distinct hillslopes.

Soil moisture was generally normally distribute in space on all measurement dates. Spatial variability was high compared to other studies, reflecting catchment heterogeneity. The ranking of soil moisture values displayed temporal stability for all site locations. This stability was attributed to soil texture. Further temporal analysis indicated that estimates of catchment mean and standard deviation of soil moisture may be characterized with relatively few measurements. Finally, threshold soil moisture values identifying hillslope sensitivity to water input were analysed and identified.