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# Spatial-temporal variability of soil moisture: a strategy to optimize monitoring at the catchment scale with varying topography and land use

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Soil moisture is of paramount importance in many hydrological and climatic applications. Its knowledge is relevant in several fields which include rainfall-runoff partitioning (Koster et al., 2010), landslide forecasting (Brocca et al., 2012), drought monitoring and agricultural productivity (Champagne et al., 2012), to cite a few. Despite its importance, the knowledge of soil moisture with an acceptable spatial-temporal resolution is not an easy task, because various factors, i.e., soil heterogeneity, climatic regime, vegetation, geomorphology, influence how water distributes through the soil.

In this study, a sampling scheme to optimize soil moisture monitoring over large areas and for prolonged periods was investigated. To this end, by using a portable Time Domain Reflectometer, 23 measurement campaigns were carried out during a time span of 14 months at 20 sites located within the Upper Chiascio River Basin, a catchment with a drainage area of about 460 $km^2$ in the Umbria region territory (central Italy). On the basis of statistical and temporal stability analyses, it was investigated how factors such as climatic regime and geomorphology influence soil moisture behaviour.

As expected, the spatial variability of soil moisture is higher in dry periods with respect to humid periods. Indeed, the average value of the coefficient of variation calculated for each sampling day was found equal to 0.21 and 0.16 for the dry and wet periods, respectively. The temporal stability analysis showed that the soil moisture values observed during the wet period were more correlated with each other than those recorded during the dry period. Indeed, during the humid period, it was found that just one “optimal” measuring point could provide values of soil moisture representative of the catchment-mean behaviour. Differently, in the dry period, the number of “optimal” measuring point is equal to two. Results provided guidance to optimize soil moisture sampling by performing targeted measurements at a few selected points representative of the catchment-mean behaviour.

**References**

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