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# Space-time soil moisture variability for two different land use types: analysis at the plot scale

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Understanding space-time soil moisture variability at various scales is a key issue in hydrological research. At the plot scale soil moisture variability is expected to be explained by physical factors such as soil hydraulic properties, local topography and vegetation cover. This study aims to: i) characterize the spatial and temporal variability of soil moisture at the plot scale at two soil depths and for two different types of land use (meadow and vineyard); ii) investigate the role of vegetation cover on the seasonal variability of soil moisture; iii) assess the capability of a dynamic model to explain soil moisture variability and the control exerted by land use.

The work is based on soil moisture data collected on a plot (about 200 $m^2$) in Grugliasco (Po River basin, Northern Italy) by means of Time Domain Reflectometry (TDR) measurements. The plot is divided into two subplots: one covered by grapevine plants, the other covered homogeneously by grass. The soil is sandy, the slope is about 1%, and there is a buffer grass area about 20 m wide around the measurement field. The characteristics of the site allow to isolate the contribution of soil hydraulic properties and land use to space-time soil moisture variability. We used the data of 40 probes distributed in the two subplots, vertically inserted into the soil at 0-30 cm and 0-60 cm depths. Precipitation and temperature are recorded continuously on site. Statistics were computed based on soil moisture measurements collected continuously at daily time step over three years (2006-2008).

Results show that soil moisture spatial patterns at the two sampling depths are highly correlated for both land uses. Higher values of mean soil moisture at 0-60 cm depth with respect to 0-30 cm for both types of land use likely reflect the evaporation processes affecting more the surface layer. Spatial mean soil moisture is always higher in the vineyard than in the meadow (especially at 0-30 cm depth), implying the influence of vegetation cover during the growing season. An exponential equation fits well the relationship between the spatial coefficient of variation and the mean soil moisture. An increasing variability of the coefficient of variation is observed during periods with high potential evapotranspiration rates (June-August). This is more evident for the grass site at 0-30 cm depth, highlighting again the important shading effect performed by the grapevine leaves. The application of a simple soil moisture dynamic model reveals a general good capability to capture soil moisture temporal dynamics at the plot scale. Moreover, the model reproduces consistently the observed relationships between soil moisture spatial mean and variability. Thus, the model provides a preliminary link between physical processes and statistical variability patterns.

Keywords: soil moisture, plot scale, space-time variability, land use.