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Absolute and relative soil moisture spatial-temporal variability over large areas in Europe

Graziano Zucco (1), Luca Brocca (1), Tommaso Moramarco (1), Sonia Seneviratne (2), and Heidi Mittelbach (2)

(1) National Research Council, Research Institute for Geo-Hydrological Protection, Perugia, Italy (luca.brocca@irpi.cnr.it, 0039 075 5014420), (2) Institute for Atmospheric and Climate Science, ETH Zurich, Zurich, Switzerland

Knowledge about soil moisture spatial-temporal variability over large areas is fundamental for improving our understanding of land-atmosphere interaction and hydrological processes. The analysis of soil moisture spatial-temporal variability can be carried out considering the absolute (original) soil moisture values, usually expressed in volumetric terms (m^3/m^3), or relative values, such as the percent of saturation (dimensionless) or temporal anomalies with respect to a long-term mean value (in the same units as the absolute soil moisture values). Over large areas, soil moisture data measured at different sites can be characterized by large differences in their minimum, mean, and maximum (absolute) values, even though in relative terms their temporal patterns are very similar. Therefore, a large fraction of the spatial variability of soil moisture might be time invariant, i.e. only due to the differences in the range of variability between sites (Mittelbach and Seneviratne, 2012). In these cases, the analysis considering absolute and relative soil moisture values can provide very different results thus highlighting the requirement of a new perspective in the analysis of soil moisture variability. In fact, if soil moisture observations are used within modelling approaches (for hydrological, meteorological or climatic studies), the variability of relative soil moisture values is much of interest (Seneviratne et al., 2010; Brocca et al., 2012). By considering absolute soil moisture values only, misleading conclusions might be drawn with respect to climate-relevant spatiotemporal features of soil moisture.

In this study, in situ observations from different soil moisture networks in Italy, Spain, France and Germany are collected and analyzed to investigate the soil moisture variability over large areas (500-5000 km^2). Specifically, the statistical and temporal stability classical analyses of soil moisture have been carried out for both absolute and relative values. The comparison of the results with the different approaches highlights the relative contribution of time invariant and time varying components on soil moisture variability. Moreover, the effect of the variability of the soil texture, land use and climatic conditions of the analyzed soil moisture networks is discussed.

Overall, in accordance with a previous study (Mittelbach and Seneviratne, 2012), we obtained that the analysis of the spatial-temporal variability of absolute soil moisture does not apply to relative soil moisture values. Therefore, similar analysis should be carried out for past and present soil moisture data sets for better addressing their use within modelling studies.

References

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