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Antecedent Wetness Conditions based on ERS scatterometer data in support to rainfall-runoff modeling

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Despite of its small volume compared to other components of the hydrologic cycle, the soil moisture is of fundamental importance to many hydrological, meteorological, biological and biogeochemical processes. For storm rainfall-runoff modeling the estimation of the Antecedent Wetness Conditions (AWC) is one of the most important issues to determine the hydrological response.
In this context, this study investigates the potential of the scatterometer on board of the ERS satellites for the assessment of soil wetness conditions at two different scales. The satellite soil moisture data set, available from 1992, is downloaded from the ERS/METOP Soil Moisture archive located at http://www.ipf.tuwien.ac.at/radar/index.php?go=ascat. At the local scale, the scatterometer-derived soil wetness index (SWI) data (Wagner, W., Lemoine, G., and Rott, H., 1999. A Method for Estimating Soil Moisture from ERS Scatterometer and Soil Data. Remote Sensing of Environment, 70, 191-207) have been compared with two in-situ soil moisture data sets. At the catchment scale, the reliability of the SWI to estimate the AWC has been tested considering its relationship with the soil potential maximum retention parameter, S, of the Soil Conservation Service-Curve Number (SCS-CN) method for abstraction. The parameter S has been derived by considering several flood events occurred from 1992 to 2005 in different catchments of central Italy. The performance of two Antecedent Precipitation Indices (API) and one Base Flow Index (BFI), usually employed in the hydrological practice for the AWC assessment, have been compared with the SWI.
The obtained results show a high accuracy of the SWI for the estimation of wetness conditions both at the local and catchment scale despite of the complex orography of the investigated areas (Brocca, L., Melone, F., Moramarco, T., Morbidelli, R., 2009. Antecedent wetness conditions based on ERS scatterometer data. Journal of Hydrology, 364 (1-2), 73-87). At the local scale, the SWI has been found quite reliable in representing the soil moisture at layer depth of 15 cm with average correlation coefficient equal to 0.81 and a root mean square error of $\tilde{0}$.04 m3/m3. In terms of AWC assessment at the catchment scale, the SWI has been found highly correlated with the observed S parameter with correlation coefficient equal to -0.90. Besides, SWI outperformed both API indices, poorly representative of AWC, and BFI.
The methodology delineated in this study can be considered as a simple and entirely new approach to validate the remotely sensed soil moisture estimates at the catchment scale, mainly for coarse resolution sensors as scatterometers and radiometers. The obtained results indirectly reveal the usefulness of the SWI both for flood forecasting applications and for prediction in ungauged basins. Moreover, the correlation of in-situ soil moisture measurements with the SWI reveals the potential of scatterometer data, particularly considering the higher spatial resolution provided by the successor of ERS scatterometer, the Advanced Scatterometer, ASCAT, on board of the meteorological operational platforms, METOP.