



The use of Spatially Distributed Soil Moisture Estimation for Hydrological Applications

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Soil moisture governs the partitioning of mass and energy fluxes between the land surface and the atmosphere, thus playing a fundamental role for many scientific and operational applications, including flood forecasting, climate modelling, landslide prediction, numerical weather prediction, irrigation scheduling, to cite a few. Nowadays, soil moisture estimates from satellite sensors are becoming more readily available with a spatial and temporal resolution that is suitable for hydrological applications. Moreover, the accuracy of the satellite-derived soil moisture retrievals is found to be satisfactorily in many countries worldwide and mainly in the Mediterranean region.

This study aims at showing the reliability of the satellite soil moisture product derived by the Advanced Scatterometer (ASCAT) over Europe and, mainly, to understand how these observations impact the modelling of extremes in the Mediterranean region by considering three different applications.

The first application addresses flood forecasting (Brocca et al., 2010; 2012a), by assimilating the ASCAT soil moisture into a multi-layer continuous and distributed rainfall-runoff model, named MISDc. The Ensemble Kalman filter is adopted to optimally incorporate the soil moisture data into MISDc. Several catchments located in different climatic regions over Europe are used as case studies. Results reveal that the ASCAT soil moisture product can be conveniently used to improve runoff prediction, mainly if the soil wetness conditions before a storm event are highly uncertain or unknown. However, reliability differs according to the climatic region, the soil/land use conditions and the size of the catchments under investigation. Therefore, the open issues that should be addressed in future studies are also given.

The second application investigates the use of the ASCAT soil moisture product for predicting the movement of a rock slope located in central Italy, the Torgiovannetto landslide (Brocca et al., 2012b). By using a statistical approach, the opening of the tension cracks, recorded by an extensometers network operating in the area, as a function of rainfall and soil moisture conditions prior the occurrence of rainfall, are predicted in the period 2007-2009. Results indicate that the regression performance (in terms of correlation coefficient) significantly increases if the ASCAT soil moisture product is included.

Finally, the third application aims at estimating rainfall starting from soil moisture observations (Brocca et al., 2012c). Specifically, by inverting the soil water balance equation, a simple analytical relationship for estimating rainfall accumulations from the knowledge of soil moisture time series is obtained. Satellite and soil moisture observations from three sites in Europe are used to test the developed approach that showed reasonable results thus opening new opportunities for rainfall estimation at catchment/global scale.

References

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