ASSIMILATION OF THE ASCAT SOIL MOISTURE PRODUCT FOR FLOOD PREDICTION AND FORECASTING

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ABSTRACT

Nowadays, the more and more availability of soil moisture estimates from satellite sensors offer a great chances to improve real time flood forecasting and to reduce uncertainties in hydrological modelling. In fact, a real time flood forecasting system based on a rainfall-runoff model strictly requires an accurate estimation of the initial state of the catchment wetness to achieve reliable flood predictions. Overall, soil moisture information retrieved from satellite sensors can be conveniently used: (1) to improve real-time flood forecasting through the assimilation of these data set and (2) to test the capability of rainfall-runoff models of reproducing the internal states of the system (e.g. the soil moisture storage). However, the incorporation of these different sources of data in rainfall-runoff models is not straightforward due to the different spatial and temporal scales of observations and modelled quantities.

In this study, the soil moisture product derived from the Advanced Scatterometer (ASCAT) on-board of the Meteorological Operational satellite was employed to assess the effects of assimilating satellite-derived soil moisture estimates into a continuous and distributed rainfall-runoff model, named MISDc. This topic is relevant not only for scientific purposes but also for operational applications. In fact, the MISDc model is currently operative at the Umbria Region Functional Centre for real time flood forecasting in the Upper Tiber River (~5300 km^2).

By using a simple data assimilation technique, both the surface and the profile ASCAT soil moisture products were assimilated into MISDc and the model performance on flood estimation, with and without assimilation, was analyzed. To get profile soil moisture estimates, an exponential filter is applied to the time series of the ASCAT surface soil moisture obtaining the so-called Soil Wetness Index (SWI). Therefore, for the assimilation of the surface soil moisture product the structure of the MISDc model was slightly modified by incorporating a thin surface soil layer of ~3 cm capable of simulating the penetration depth of the ASCAT sensor.

Results reveal that the ASCAT soil moisture estimates can be conveniently used to improve runoff prediction in the study area. These products become essential when the soil wetness conditions before a storm event are highly uncertain or unknown. These encouraging results reinforce the idea of assimilating the ASCAT soil moisture product to improve flood forecasting in the study region, also by using more detailed data assimilation approaches (e.g. the Ensemble Kalman Filter or the Particle Filter).