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Setting Up a Sentinel 1 Based Soil Moisture - Data Assimilation System for Flash Flood Risk Mitigation

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Several studies have shown that the assimilation of satellite-derived soil moisture products (SM-DA) within hydrological modelling is able to reduce the uncertainty of discharge predictions. This can be exploited for improving early warning systems (EWS) and it is thus particularly useful for flash flood risk mitigation (Cenci *et al.*, 2016a).

The objective of this research was to evaluate the potentialities of an advanced SM-DA system based on the assimilation of synthetic aperture radar (SAR) observations derived from Sentinel 1 (S1) acquisitions. A time-continuous, spatially-distributed, physically-based hydrological model was used: Continuum (Silvestro *et al.*, 2013). The latter is currently exploited for civil protection activities in Italy, both at national and at regional scale. Therefore, its adoption allows for a better understanding of the real potentialities of the aforementioned SM-DA system for improving EWS.

The novelty of this research consisted in the use of S1-derived SM products obtained by using a multitemporal retrieval algorithm (Cenci *et al.*, 2016b) in which the correction of the vegetation effect was obtained by means of both SAR (Cosmo-SkyMed) and optical (Landsat) images. The maps were characterised by a comparatively higher spatial/lower temporal resolution (respectively, 100 m and 12 days) w.r.t. maps obtained from commonly used microwave sensors for such applications (e.g. the Advanced SCATterometer, ASCAT). The experiment was carried out in the period October 2014 - February 2015 in an exemplifying Mediterranean catchment prone to flash floods: the Orba Basin (Italy). The Nudging assimilation scheme was chosen for its computational efficiency, particularly useful for operational applications. The impact of the assimilation was evaluated by comparing simulated and observed discharge values. In particular, it was analysed the impact of the assimilation on higher flows. Results were compared with those obtained by assimilating an ASCAT-derived SM product (H08) that can be considered at high spatial resolution (1 km) for hydrological applications and high temporal resolution (36 h) (Wagner *et al.*, 2013).

Findings revealed the potentialities of a S1-based SM-DA system for improving discharge predictions, especially of higher flows, and suggested the more appropriate pre-processing techniques to apply to S1 data before the assimilation. The comparison with H08 highlighted the importance of the temporal resolution of the observations. Results are promising but further research is needed before the actual implementation of the aforementioned S1-based SM-DA system for operational applications.

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