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Merging bottom-up and top-down precipitation products using a stochastic error model

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Accurate quantitative precipitation estimation is of great importance for water resources management, agricultural planning, and forecasting and monitoring of natural hazards such as flash floods and landslides. In situ observations are limited around the Earth, especially in remote areas (e.g., complex terrain, dense vegetation), but currently available satellite precipitation products are able to provide global precipitation estimates with an accuracy that depends upon many factors (e.g., type of storms, temporal sampling, season etc. . .).
Recently, Brocca et al. (2014) have proposed an alternative approach (i.e. SM2RAIN) that allows to estimate rainfall from space by using satellite soil moisture observations. In contrast with classical satellite precipitation products which sense the cloud properties to retrieve the instantaneous precipitation, this new bottom-up approach makes use of two consecutive soil moisture measurements for obtaining an estimate of the fallen precipitation within the interval between two satellite passes. As a result, the nature of the measurement is different and complementary to the one of classical precipitation products and could provide a different valid perspective to improve current satellite rainfall estimates via appropriate integration between the products (i.e. SM2RAIN plus a classical satellite rainfall product). However, whether SM2RAIN is able or not to improve the performance of any state-of-the-art satellite rainfall product is much dependent upon an adequate quantification and characterization of the relative errors of the products.
In this study, the stochastic rainfall error model SREM2D (Hossain et al. 2006) is used for characterizing the retrieval error of both SM2RAIN and a state-of-the-art satellite precipitation product (i.e. 3B42RT). The error characterization serves for an optimal integration between SM2RAIN and 3B42RT for enhancing the capability of the resulting integrated product (i.e. SM2RAIN+3B42RT) in operational hydrology.
The study, conducted in Italy for a 5-yr period (2010-2014) using a dense network of raingauges (about 3000) as a benchmark, demonstrates that the integration is able to enhance the correlation and the root mean squared error of SM2RAIN+3B42RT with respect to the parent products. This suggests a potential benefit of merging SM2RAIN derived rainfall with state-of-the-art satellite precipitation estimates for creating a product characterized by higher accuracy and better performance when used in the contest of operational hydrology.

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