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Benefit of of coarse- and medium-scale satellite soil moisture products for flood modeling in small basins: temporal versus spatial resolution

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In runoff generation process, soil moisture plays an important role as it controls the magnitude of the flood event to precipitation inputs.
Hydrological models are the most viable way for obtaining soil moisture but the landscape diversity along with the rainfall spatial distribution and the inherent model simplifications make the estimation of the soil moisture very challenging. In this respect, earth observations derived from in situ and remote sensing represent a valid alternative to models.
Remote sensing is valuable source of soil moisture information. In the last decade two important satellite missions have been specifically launched for the measurement of soil moisture from space, namely, the Soil Moisture Ocean Salinity (SMOS) and the Soil Moisture Active and Passive (SMAP). Nevertheless, other active and passive sensors on board of operational and non-operational satellites have been and are still used to retrieve soil moisture. Notable examples are the Advanced Scatterometer (ASCAT) and the Advanced Microwave Scanning Radiometer for Earth observation science (AMSR-E) and its successor AMSRE-2.
Despite this, the small penetration depth (i.e. smaller than 5 cm) and the evident contrast between small scale applications and the coarse spatial and low temporal resolution of current products theoretically limit their use for flood forecasting in medium/small basins (<500 km sq).
Many attempts have been made to disaggregate and downsample coarse scale products to obtain products more suitable for small scale applications while at the same time new products derived from Synthetic Aperture Radar (SAR) satellites have been made available. For instance, the launch of Sentinel 1 (S1) satellites has provided new source of soil moisture information from SAR (Marschallinger et al. 2018a) opening interesting opportunities for disaggregating coarse scale measurements. For instance, Marschallinger et al. (2018b) developed a way to downscale ASCAT measurement with S1 observations providing a product with a resolution commensurable with small scale applications.
In this context different questions arise. Do the assimilation of medium to coarse scale products and their downsampled versions have a value for flood forecasting in small basins? How much the temporal resolution of the product is important?
Here we investigated the ability of three satellite soil moisture products to improve SWAT discharge simulations via their assimilation through the Ensemble Kalman Filter in two small (and hydrologically different) catchments in Central Italy. In particular, one passive downsampled soil moisture product (i.e. the SMAP L3 9 km), and two active products (i.e. the EUMETSAT H-SAF H113 ASCAT product and the SCATSAR product derived from the fusion of Soil Moisture ASCAT observations with those derived from S1 satellites). Results show the temporal resolution is one of the main important aspect for improving discharge simulations.

Bauer-Marschallinger et al. (2018a). Toward Global Soil Moisture Monitoring With Sentinel-1: Harnessing Assets and Overcoming Obstacles. IEEE Transactions on Geoscience and Remote Sensing, (99), 1-20.
Bauer-Marschallinger et al. (2018b). SCAT-SAR Soil Moisture: A Data Fusion Approach to Close the Spatial and Temporal Scale Gaps between MetOp-ASCAT and Sentinel-1 Observations." EGU General Assembly Conference Abstracts. Vol. 17. 2015.