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Satellite soil moisture improves rainfall just where needed

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Soil moisture is a fundamental variable in the water and energy cycle and its knowledge in many applications is crucial. In the last decade, some authors have proposed the use of satellite soil moisture for estimating and improving rainfall, doing hydrology backward. From this research idea, several studies have been published and currently preoperational satellite rainfall products exploiting satellite soil moisture products have been made available.

The assessment of such products on a global scale has revealed an important result, i.e., the soil moisture based products perform better than state of the art products exactly over regions in which the data are needed: Africa and South America. However, over these areas the assessment against rain gauge observations is problematic and independent approaches are needed to assess the quality of such products and their potential benefit in hydrological applications. On this basis, the use of the satellite rainfall products as input into rainfall-runoff models, and their indirect assessment through river discharge observations is an alternative and valuable approach for evaluating their quality.

For this study, a newly developed large scale dataset of river discharge observations over 500+ basins throughout Africa has been exploited. Based on such unique dataset, a large scale assessment of multiple near real time satellite rainfall products has been performed: (1) the Early Run version of the Integrated Multi-Satellite Retrievals for GPM (Global Precipitation Measurement), IMERG Early Run, (2) SM2RAIN-ASCAT (https://doi.org/10.5281/zenodo.3405563), and (3) GPM+SM2RAIN (http://doi.org/10.5281/zenodo.3345323). Additionally, gauge-based and reanalysis rainfall products have been considered, i.e., (4) the Global Precipitation Climatology Centre (GPCC), and (5) the latest European Centre for Medium-Range Weather Forecasts reanalysis, ERA5. As rainfall-runoff model, the semi-distributed MISDc (Modello Idrologico Semi-Distribuito in continuo) model has been employed in the period 2007-2018 at daily temporal scale.

First results over a part of the dataset reveal the great value of satellite soil moisture products in improving satellite rainfall estimates for river flow prediction in Africa. Such results highlight the need to exploit such products for operational systems in Africa addressed to the mitigation of the flood risk and water resources management.