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A Derived Optimal Linear Interpolation approach for merging multiple satellite soil moisture-based rainfall products with IMERG early run

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As a natural feature of the Earth's weather system, rainfall is the main driver of the hydrological cycle. Rainfall plays an essential role in many applications including climate monitoring, extreme weather prediction and weather forecasting. On a global scale, ground-monitoring networks do not provide sufficient coverage and satellite rainfall products are often the only source of rainfall that guarantee a continuous temporal coverage. However, the indirect and the instantaneous nature of the measurement makes satellite rainfall products prone to errors (Kucera et al., 2013).

Thanks to the strong connection between soil moisture and precipitation, capable to track accumulated precipitation estimates (rather than instantaneous), soil moisture can be successfully used to enhance the quality of satellite rainfall observations (Crow et al., 2011; Pellarin et al., 2013; Brocca et al. 2014). The SMOS+rainfall project of the European Space Agency (ESA), started in 2015 and concluded in 2017, has demonstrated the capability of the SMOS soil moisture product to enhance satellite rainfall information over land and has raised many interesting research questions related to the potential improvement that can be obtained by a combination of different soil moisture sensors.

Here, we propose the use of a new near real time purely observational rainfall dataset derived from the combination of the Integrated Multi-Satellite Retrievals for GPM (IMERG early run) with multiple satellite rainfall products obtained from the inversion of the soil moisture retrievals derived from: 1) the Soil Moisture Active and Passive (SMAP) mission, 2) the Advanced Scatterometer (ASCAT) and 3) the Soil Moisture and Ocean Salinity (SMOS) mission via SM2RAIN (Brocca et al. 2014).

The weighting method (Hobeichi et al. 2018) is based on a technique that provides an analytically optimal linear combination of rainfall products and accounts for both the performance differences and error covariance between the participating products. We examine the performance of the weighting approach in India, United States, Australia and Europe showing that the simultaneous use of soil moisture products is able to increase the quality of IMERG early run product and its performance for hydrological applications.

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