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Improving satellite rainfall products using soil moisture measurements in west Africa

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This study describes a methodology to use passive microwave measurements provided by the AMSR-E sensor to improve satellite-based rainfall estimates over West Africa. Over low vegetated areas, typically the sahelian region, the AMSR-E measurements are strongly sensitive to the surface soil moisture. This information can be used to detect whether rain occurs or not at the ground level in a region where there is a strong re-evaporation of the rainfall under convective cells resulting in an overestimation of the number of events provided by satellite-based algorithms. Moreover, it is expected that the total accumulation of a rainfall event can be related to soil moisture time-series.

This study is based on three dense raingauge networks located in Mali, Niger and Benin. Three satellite rainfall products were used in this work: CMORPH, PERSIANN and TRMM-3B42. The proposed methodology consists of simulating soil moisture time-series and corresponding brightness temperatures and to modulate the rainfall accumulation in order to match simulated and observed brightness temperatures. The result is a modification of the rainfall products.

After testing the methodology at the local scale using ground-based soil moisture measurements, the methodology was tested using satellite-based soil moisture estimates at the local scale (25x25 km^2) and at the regional scale (sahelian band). Results show that the methodology improves both the rainfall accumulation and the number of rainfall events of the three satellite products over the Niger and the Mali sites but not on the Benin site where the vegetation cover decreases the accuracy of soil moisture estimates.