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Rainfall estimation over-land using SMOS soil moisture observations: SM2RAIN, LMAA and SMART algorithms

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Recent advancements in the measurement of precipitation from space have provided estimates at scales that are commensurate with the needs of the hydrological and land-surface model communities. However, as demonstrated in a number of studies (Ebert et al. 2007, Tian et al. 2007, Stampoulis et al. 2012) satellite rainfall estimates are characterized by low accuracy in certain conditions and still suffer from a number of issues (e.g., bias) that may limit their utility in over-land applications (Serrat-Capdevila et al. 2014). In recent years many studies have demonstrated that soil moisture observations from ground and satellite sensors can be used for correcting satellite precipitation estimates (e.g. Crow et al., 2011; Pellarin et al., 2013), or directly estimating rainfall (SM2RAIN, Brocca et al., 2014).
In this study, we carried out a detailed scientific analysis in which these three different methods are used for: i) estimating rainfall through satellite soil moisture observations (SM2RAIN, Brocca et al., 2014); ii) correcting rainfall through a Land surface Model Assimilation Algorithm (LMAA) (an improvement of a previous work of Crow et al. 2011 and Pellarin et al. 2013) and through the Soil Moisture Analysis Rainfall Tool (SMART, Crow et al. 2011).
The analysis is carried within the ESA project "SMOS plus Rainfall" and involves 9 sites in Europe, Australia, Africa and USA containing high-quality hydrometeorological and soil moisture observations. Satellite soil moisture data from Soil Moisture and Ocean Salinity (SMOS) mission are employed for testing their potential in deriving a cumulated rainfall product at different temporal resolutions. The applicability and accuracy of the three algorithms is investigated also as a function of climatic and soil/land use conditions.
A particular attention is paid to assess the expected limitations soil moisture based rainfall estimates such as soil saturation, freezing/snow conditions, SMOS RFI, irrigated areas, contribution of surface runoff and evapotranspiration, vegetation coverage, temporal sampling, and the assimilation/modelling approach. The 9 selected sites gather such potential problems which are shown and discussed at the conference.

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