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Assimilation of L-band passive microwave brightness temperatures in the ECMWF land data assimilation system

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The Soil Moisture and Ocean Salinity (SMOS) mission is providing a unique and very valuable source of remote sensed information to accurately estimate the water content of soils. Accurate initialisation of soil moisture in Numerical Weather Prediction (NWP) models is crucial for the potential it has to improve weather forecasts. As NWP centre, the European Centre for Medium-Range Weather Forecasts (ECMWF) is assimilating SMOS data in their Land Data Assimilation System to adjust soil moisture estimates from land surface simulations.

This paper compares the results obtained from three assimilation experiments and its impact in surface and atmospheric variables:
a) In the first one, the control experiment, the same configuration as the operational system is used. This means that only 2 m temperature and 2 m relative humidity observations of the SYNOP network are assimilated to correct the model soil moisture estimates,
b) In the second one, only raw SMOS brightness temperatures are assimilated,
c) In the third one, both screen level variables and SMOS brightness temperatures are combined to correct soil moisture.

These experiments are run over a 4 month period, from May to end of August 2010 (when evaporation rates are higher), using the entire month of May as spin-off period to reach the hydric equilibrium, as strong gradients of soil moisture can occur when a new type of data is assimilated to adjust the soil moisture states. To increase the quality of the SMOS observations that are assimilated, only those localized in the alias free field of view of the satellite footprint are used. Several flags of the SMOS data product are also used to filter out Radio Frequency Interference. Only incidence angles at 30°, 40° and 50° and at pure XX or YY polarisations are assimilated.

The strategy used to evaluate the impact of SMOS data in the surface and atmospheric fields is the following; 1) the quality of the analysed soil moisture fields is evaluated through comparison with in-situ observations belonging to the International Soil Moisture Network (ISMN), and in particular, the dynamic of the analysed soil moisture field is compared to that of the in-situ observations, 2) the impact on the forecast of those atmospheric fields with stronger link to soil moisture, as air tem-perature and relative humidity, is evaluated through computation of meteorological statistical variables, such as the root mean square forecast error and the anomaly correlation. A special em-phasis will be put in those areas where the assimilation of SMOS data is most sensitive to variations of soil moisture.