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A simple nudging scheme to assimilate ASCAT soil moisture data in the WRF model

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The present work shows results obtained in a numerical experiment using the WRF (Weather and Research Forecasting, www.wrf-model.org) model. A control run where soil moisture is constrained by GFS global analysis is compared with a test run where soil moisture analysis is obtained via a simple nudging scheme using ASCAT data. The basic idea of the assimilation scheme is to "nudge" the first level (0-10 cm below ground in NOAH model) of volumetric soil moisture of the first-guess (say $\theta_{(b,1)}$ derived from global model) towards the ASCAT derived value (say $\widehat{\theta}_A$). The soil moisture analysis $\theta_{(a,1)}$ is given by:

$$\theta_{(a,1)} = \begin{cases} \theta_{(b,l)} + K(\widehat{\theta}_A - \theta_{(b,l)}) & l = 1 \\ \theta_{(b,l)} & l > 1 \end{cases} \quad (1)$$

where l is the model soil level. K is a constant scalar value that is user specified and in this study it is equal to 0.2 (same value as in similar studies).

Soil moisture is critical for estimating latent and sensible heat fluxes as well as boundary layer structure. This parameter is, however, poorly assimilated in current global and regional numerical models since no extensive soil moisture observation network exists.
Remote sensing technologies offer a synoptic view of the dynamics and spatial distribution of soil moisture with a frequent temporal coverage and with a horizontal resolution similar to mesoscale NWP model. Several studies have shown that measurements of normalized backscatter (surface soil wetness) from the Advanced Scatterometer (ASCAT) operating at microwave frequencies and boarded on the meteorological operational (Metop) satellite, offer quality information about surface soil moisture.
Recently several studies deal with the implementation of simple assimilation procedures (nudging, Extended Kalman Filter, etc...) to integrate ASCAT data in NWP models. They found improvements in screen temperature predictions, particularly in areas such as North-America and in the Tropics, where it is strong the land-atmosphere coupling. The ECMWF (Newsletter No. 127) is currently implementing and testing an EKF for combining conventional observations and remote sensed soil moisture data in order to produce a more accurate analysis.

In the present work verification skills (RMSE, BIAS, correlation) of both control and test run are presented using observed data collected by International Soil Moisture Network. Moreover improvements in temperature predictions are evaluated.