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Assimilation of SMOS Brightness Temperatures at the Meteorological Service of Canada

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An Ensemble Kalman Filter (EnKF) to assimilate soil moisture brightness temperatures has been developed at the Meteorological Research Division of Environment Canada within the context of a new surface analysis and assimilation system. This study reports upon a set of EnKF assimilation experiments to examine the feasibility and issues involved in assimilating SMOS brightness temperatures in an operational Numerical Weather Prediction (NWP) context. For the summer period of 2009 over the eastern part of North America, the ISBA land-surface model is integrated to generate a series of land-surface states at 1-km resolution, so-called “nature run”. Synthetic SMOS L-band brightness temperatures are generated by running the Community Microwave Emission Model (CMEM) forward operator. These L-band brightness temperatures are then resampled onto a 40-km grid and are temporally and spatially located using a SMOS orbit simulator.

For the EnKF experiment the various ensemble members are subjected to atmospheric forcing variables derived from longer range forecasts of Environment Canada’s short-range NWP model. At Environment Canada the Canadian Precipitation Analysis (CaPA) is used to generate real-time precipitation products for the North American domain. An ensemble of precipitation analyses for the EnKF assimilation run are generated by perturbing both the precipitation first-guess fields and the surface gauge observations within the CaPA analysis. To account for surface condition uncertainties each ensemble member is subjected to perturbations in surface forcing variables. The impact of assimilating brightness temperatures is assessed by comparing the soil moisture from the EnKF run and an open loop simulation, where no brightness temperature information is assimilated, against the true soil moisture obtained from the 1-km “nature run”.