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Comparison between SMOS brightness temperature observations and ECMWF ERA-Interim based brightness temperature

Patricia de Rosnay (1), Joaquín Muñoz Sabater (1), Clément Albergel (2), and Lars Isaksen (1)
(1) ECMWF, READING, United Kingdom (patricia.rosnay@ecmwf.int), (2) CNRS/Météo-France

We present radiative transfer modelling activities conducted at the European Centre for Medium-Range Weather Forecasts (ECMWF) to use Soil Moisture and Ocean Salinity (SMOS) brightness temperature observations for Numerical Weather Forecast (NWP) applications. The Community Microwave Emission Modelling Platform (CMEM) is used as the SMOS forward operator to simulate L-band brightness temperatures (TBs). In a first part simulated brightness temperature are compared to the observed SMOS near real time reprocessed brightness temperature (TB) product for 2010-2011 for several configurations, using different parameterisations, of CMEM. We show that simulated brightness temperatures are more sensitive to the choice of opacity and soil roughness models than to the dielectric model. Best configurations of CMEM are shown to be those using the so-called Wigneron vegetation opacity model with the simple empirical Wigneron soil roughness model. The Wang and Schmugge and the Mironov soil dielectric models perform similarly and lead to better agreement with SMOS observations than the Dobson dielectric model. Based on this intercomparison the configuration of CMEM retained for ECMWF forward modelling activities is the one based Wang and Schmugge, Wigneron simple and Wigneron for the dielectric, roughness and vegetation components, respectively. In a second part, this report presents the SMOS brightness temperature bias correction developed and used at ECMWF. It is a monthly Cumulative Distribution Function bias correction based on SMOS and ECMWF re-analysis-based brightness temperatures for the period from 1 January 2010 to 31 December 2013. Results show that it efficiently corrects for systematic differences between model and observations, with global root mean square differences and global mean bias for 2010-2013 for 30,40, 50incidence angles decreasing from 16.8 K and 2.08 K before bias correction to 7.91K and 0.0016 K after bias correction, respectively. The monthly bias correction allows to also correct for seasonal cycles systematic differences, with correlation values improved from 0.516 before bias correction and 0.621 after bias correction. Residual differences remaining after bias correction correspond to random differences between the model and observations which provide relevant information for monitoring and data assimilation purposes. Finally, time series and anomalies of SMOS TB and ECMWF re-analysis-based TB are compared for the 4-year period 2010-2013 at both polarisation and three incidence angles. RMSE, correlation and anomaly correlation statistics consistently show that SMOS and ECMWF TB agreement steadily improves between 2010 and 2013, indicating improvement of SMOS products quality.