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Round Robin evaluation of soil moisture retrieval models for the MetOp-A ASCAT Instrument

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Global soil moisture observations are crucial to understand hydrologic processes, earth-atmosphere interactions and climate variability. ESA's Climate Change Initiative (CCI) project aims to create a global consistent long-term soil moisture data set based on the merging of the best available active and passive satellite-based microwave sensors and retrieval algorithms. Within the CCI, a Round Robin evaluation of existing retrieval algorithms for both active and passive instruments was carried out. In this study we present the comparison of five different retrieval algorithms covering three different modelling principles applied to active MetOp-A ASCAT L1 backscatter data. These models include statistical models (Bayesian Regression and Support Vector Regression, provided by the Institute for Applied Remote Sensing, Eurac Research Viale Druso, Italy, and an Artificial Neural Network, provided by the Institute of Applied Physics, CNR-IFAC, Italy), a semi-empirical model (provided by the Finnish Meteorological Institute), and a change detection model (provided by the Vienna University of Technology). The algorithms were applied on L1 backscatter data within the period of 2007-2011, resampled to a 12.5 km grid. The evaluation was performed over 75 globally distributed, quality controlled in situ stations drawn from the International Soil Moisture Network (ISMN) using surface soil moisture data from the Global Land Data Assimilation System (GLDAS-) Noah land surface model as second independent reference. The temporal correlation between the data sets was analyzed and random errors of the the different algorithms were estimated using the triple collocation method. Absolute soil moisture values as well as soil moisture anomalies were considered including both long-term anomalies from the mean seasonal cycle and short-term anomalies from a five weeks moving average window. Results show a very high agreement between all five algorithms for most stations. A slight vegetation dependency of the errors and a spatial decorrelation of the performance patterns of the different algorithms was found. We conclude that future research should focus on understanding, combining and exploiting the advantages of all available modelling approaches rather than trying to optimize one approach to fit every possible condition.