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Error characterisation of global active and passive microwave soil moisture data sets

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Understanding the error structures of remotely sensed soil moisture observations is essential for correctly interpreting observed variations and trends in the data or assimilating them into hydrological or numerical weather prediction models. Nevertheless, a spatially coherent assessment of the quality of the various globally available datasets is often hampered by the limited availability over space and time of reliable in-situ measurements. As an alternative, this study explores the triple collocation error estimation technique for assessing the relative quality of several globally available soil moisture products from active (ASCAT) and passive (AMSR-E and SSM/I) microwave sensors. The triple collocation is a powerful statistical tool to estimate the root mean square error while simultaneously solving for systematic differences in the climatologies of a set of three linearly related data sources with independent error structures. Prerequisite for this technique is the availability of a sufficiently large number of timely corresponding observations. In addition to the active and passive satellite-based datasets, we used the ERA-Interim and GLDAS-NOAH reanalysis soil moisture datasets as a third, independent reference.
The prime objective is to reveal trends in uncertainty related to different observation principles an retrieval methods (passive versus active) and the use of different frequencies (C-, X-, and Ku-band) for passive microwave observations. The results suggest that the triple collocation method provides realistic error estimates. Observed spatial trends agree well with the existing theory and studies on the performance of different observation principles and frequencies with respect to land cover and vegetation density. In addition, triple collocation errors agree well with errors obtained using error propagation techniques and in situ validation. The results obtained in this study can help us in developing adequate strategies for the combined use of various scatterometer and radiometer-based soil moisture datasets, e.g. in hydrological modelling or for generating superior multi-mission long-term soil moisture datasets.
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