Observation uncertainty of satellite soil moisture products determined with physically-based modelling

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Introduction

Accurate estimates of soil moisture as initial conditions to hydrological models is expected to greatly increase the accuracy of flood and drought predictions. As in-situ soil moisture observations are scarce, satellite-based estimates are a suitable alternative. The validation of remotely sensed soil moisture products is generally hampered by the different spatial support of in-situ observations and satellite footprints. Unsaturated zone modelling may serve as a valuable validation tool since it could bridge the gap of different spatial supports.

Material and methods

A stochastic, distributed unsaturated zone model (SWAP, Figure 1) was used in which the spatial support was matched to these of the satellite soil moisture retrievals. A comparison between point observations and the SWAP model (Figure 2) was performed to enhance understanding of the model and to assure that the SWAP model could be used with confidence for other locations in Spain. A timeseries analysis was performed to compare surface soil moisture from the SWAP model to surface soil moisture retrievals from three different microwave sensors, including AMSR-E, SMOS and ASCAT for Januari 2010 to July 2011 (Figures 3 and 4).

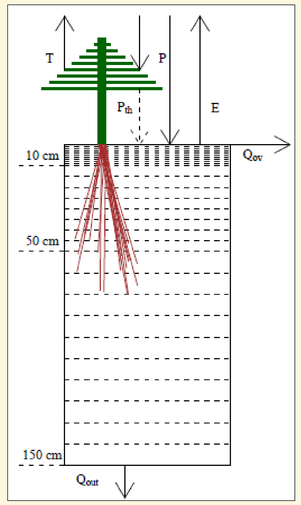

Figure 1: SWAP model setup

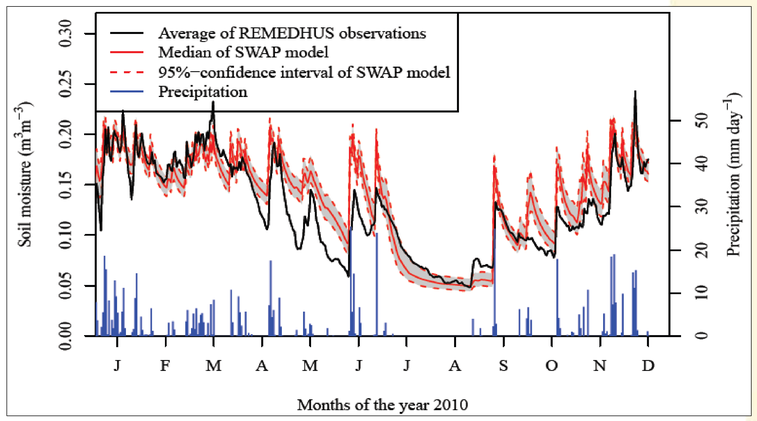

Figure 2: Comparison between SWAP model and observed soil moisture values at the REMEDHUS site

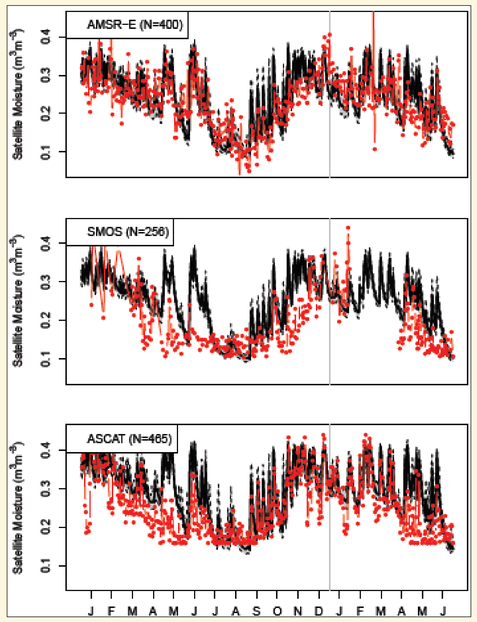

Figure 3: Example timeseries for a location in Nortwest Spain

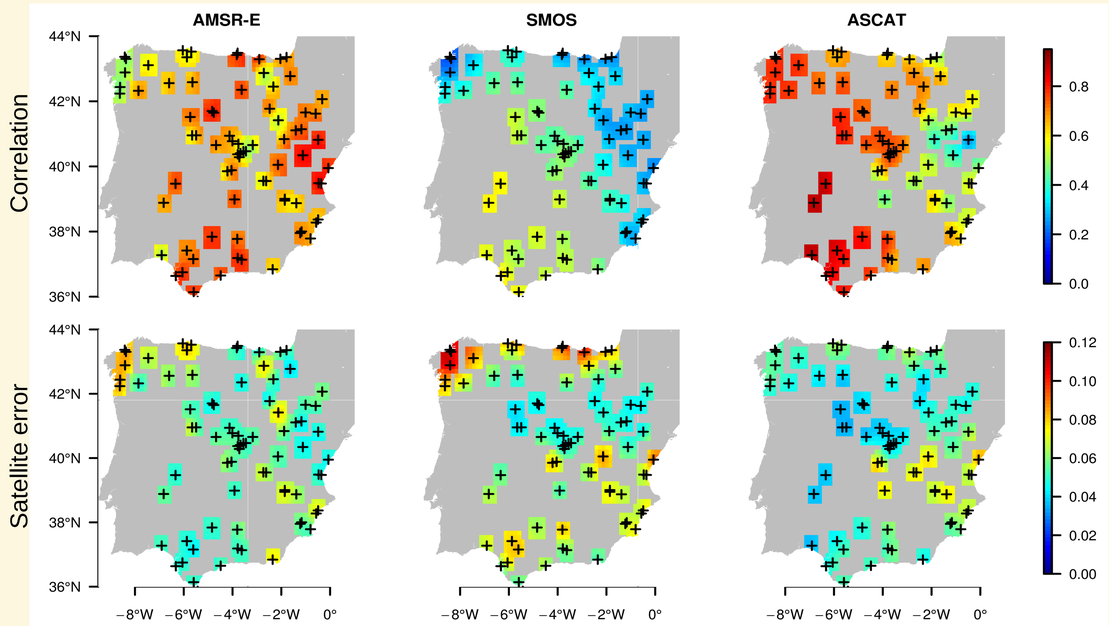

Figure 4: **Spatial distributions of correlation microwave and SWAP soil moisture (top) and satellite error (difference between microwave and SWAP soil moisture) (bottom) for three microwave sensors**

Table 1: Average correlation and satellite error for three microwave sensors over Spain

Average values	AMSR-E	SMOS	ASCAT
Correlation	0.682	0.420	0.713
Standard satellite error	0.049	0.057	0.051

Conclusions

- Temporal dynamics are best captured by AMSR-E and ASCAT
- Satellite error for the three sensors were found to similar (0.05 m^3m^{-3})
- The satellite uncertainty is spatially correlated and spatial patterns are found
- It is important to include model error in satellite validation

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