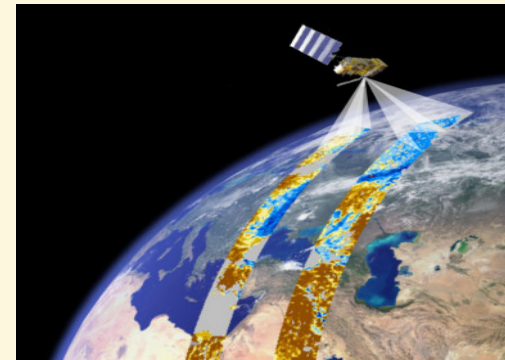
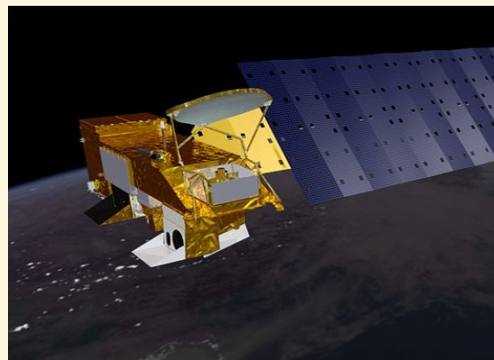


Observation uncertainty of satellite soil moisture products determined with physically-based modelling



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Universiteit Utrecht

25 April 2012 EGU General Assembly, Vienna

Objectives

- Provide a detailed assessment of the uncertainty of satellite derived soil moisture products
- Calculate the magnitude and spatial structure of uncertainties in remotely sensed soil moisture

Approach

- Accurate up-scaling of unsaturated zone model
- Include model and input uncertainty



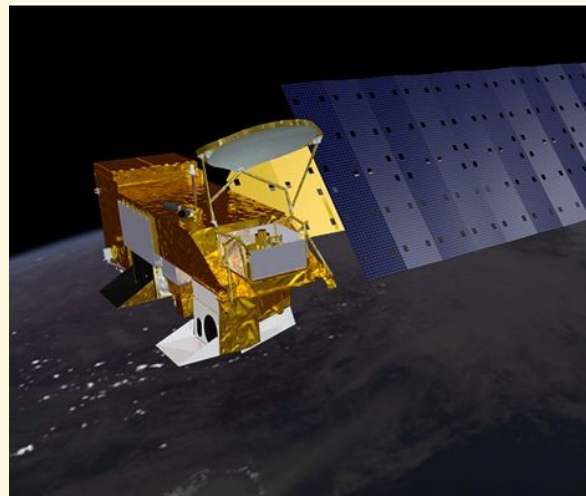
Satellite soil moisture

SMOS



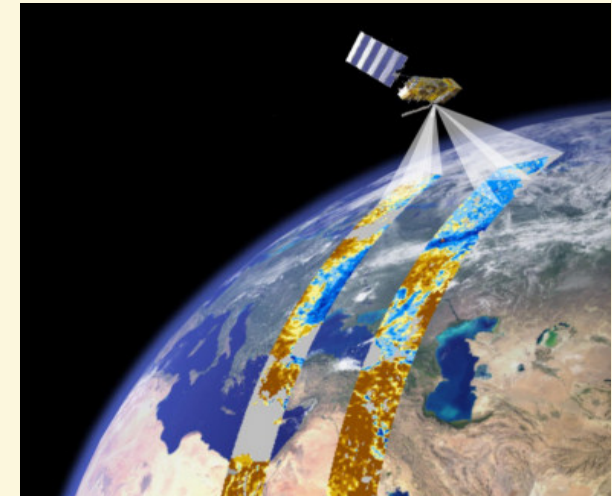
Passive L-band

AMSR-E



Passive C-band

ASCAT



Active C-band

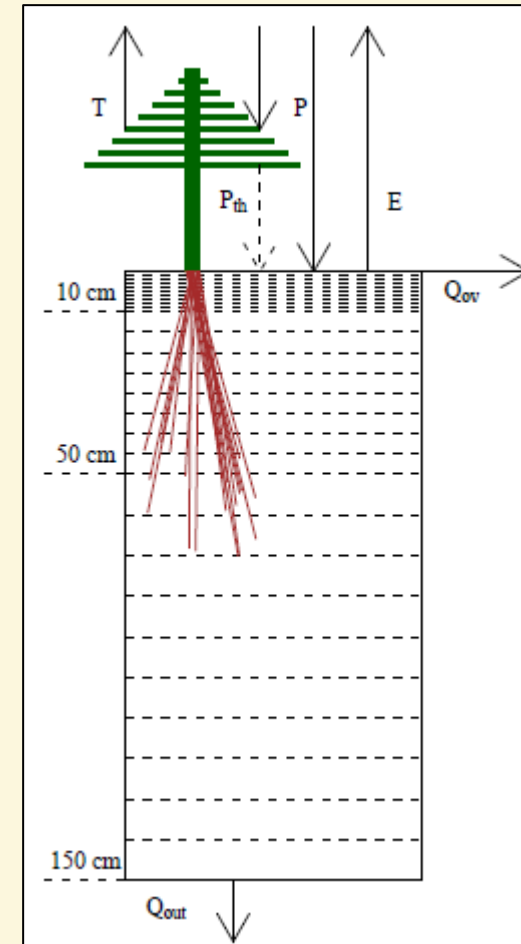


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Soil moisture modelling (SWAP)

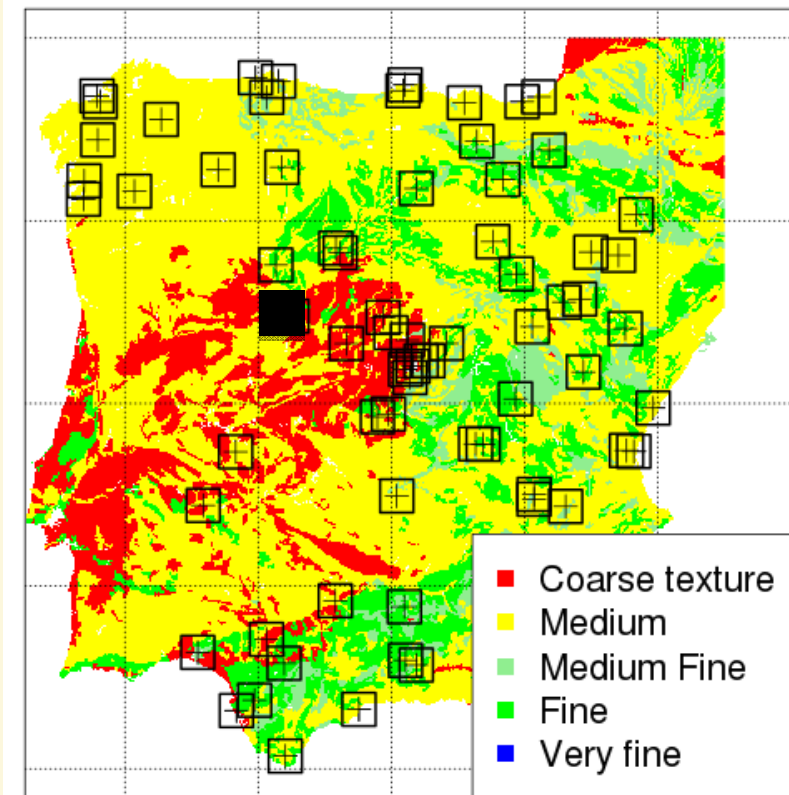
- Soil-Water-Atmosphere-Plant (SWAP)
 - Richards equation
 - Topsoil 10 layers of 1 cm
 - 1 km horizontal resolution
- January 2010 to July 2011
- Monte Carlo approach:
 - Input uncertainty (e.g P, E)
 - Model uncertainty (e.g K_{sat})



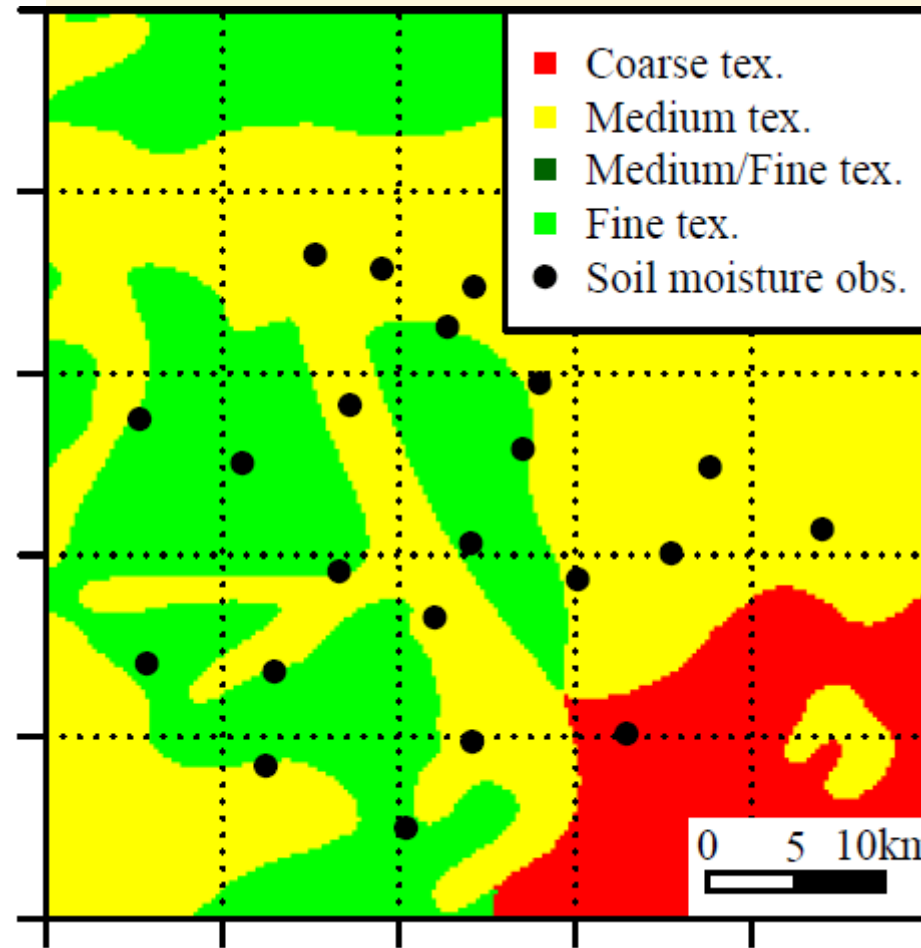
Soil moisture modelling (SWAP)

- Validation at REMEDHUS
 - Compare with observations
 - Assess model uncertainty
- 79 Locations in Spain
 - Meteorological stations
 - 50 by 50 km
 - Reduce input uncertainty
 - Linear rescaling
 - Determine satellite error

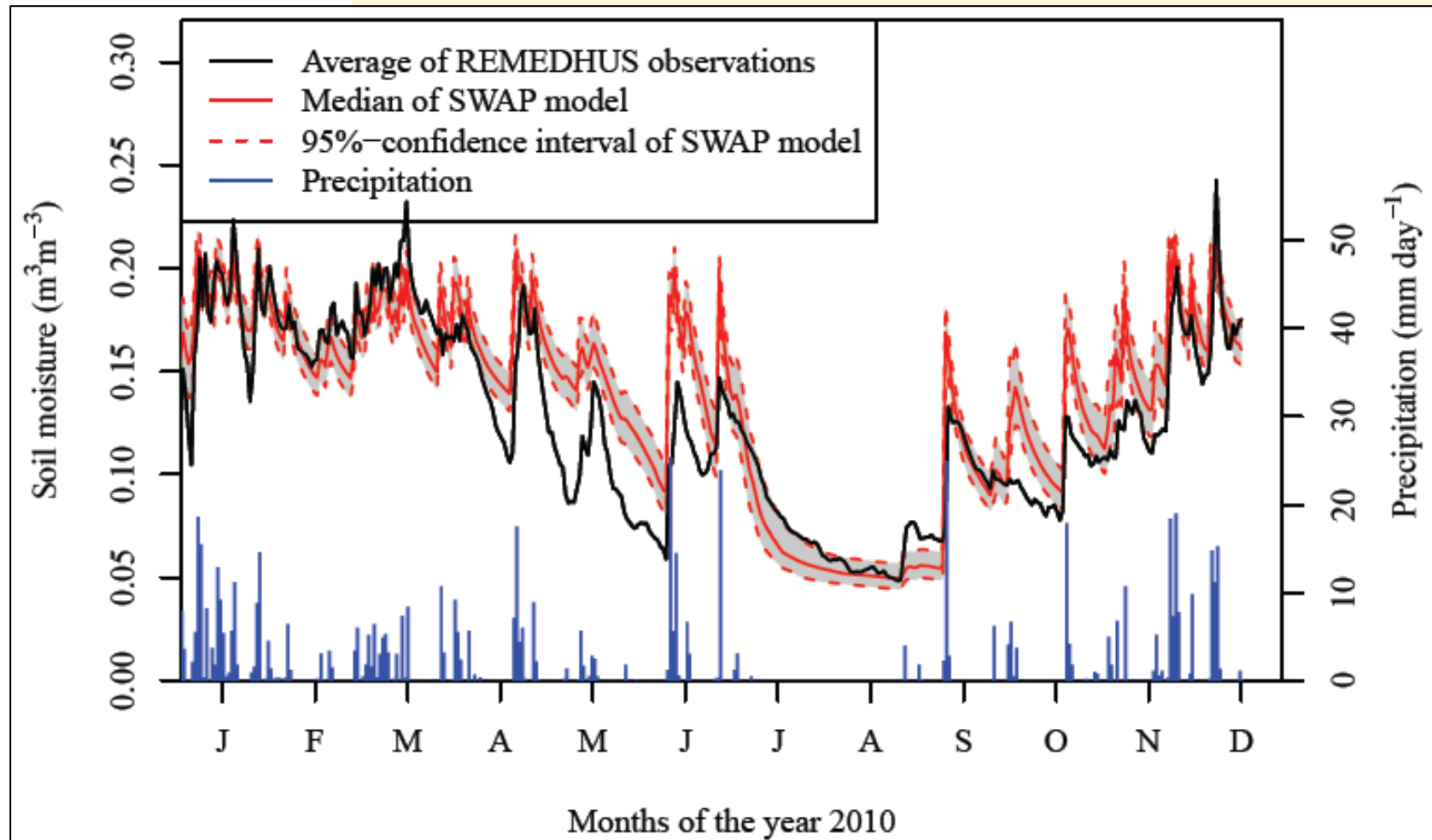
$$\varepsilon_s = \sqrt{\frac{\sum_{t=1}^N (\theta_s(t) - \theta_m(t) - bias)^2}{N} - \frac{\sum_{t=1}^N Var(mod)}{N}}$$



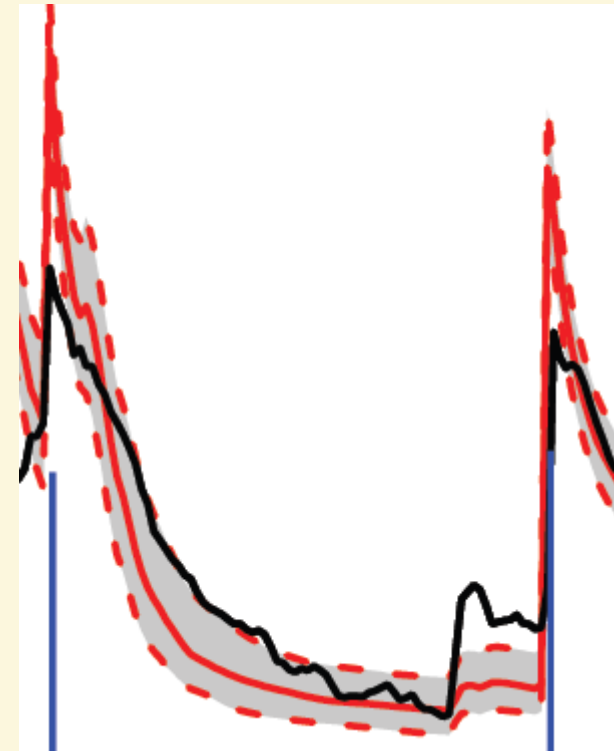
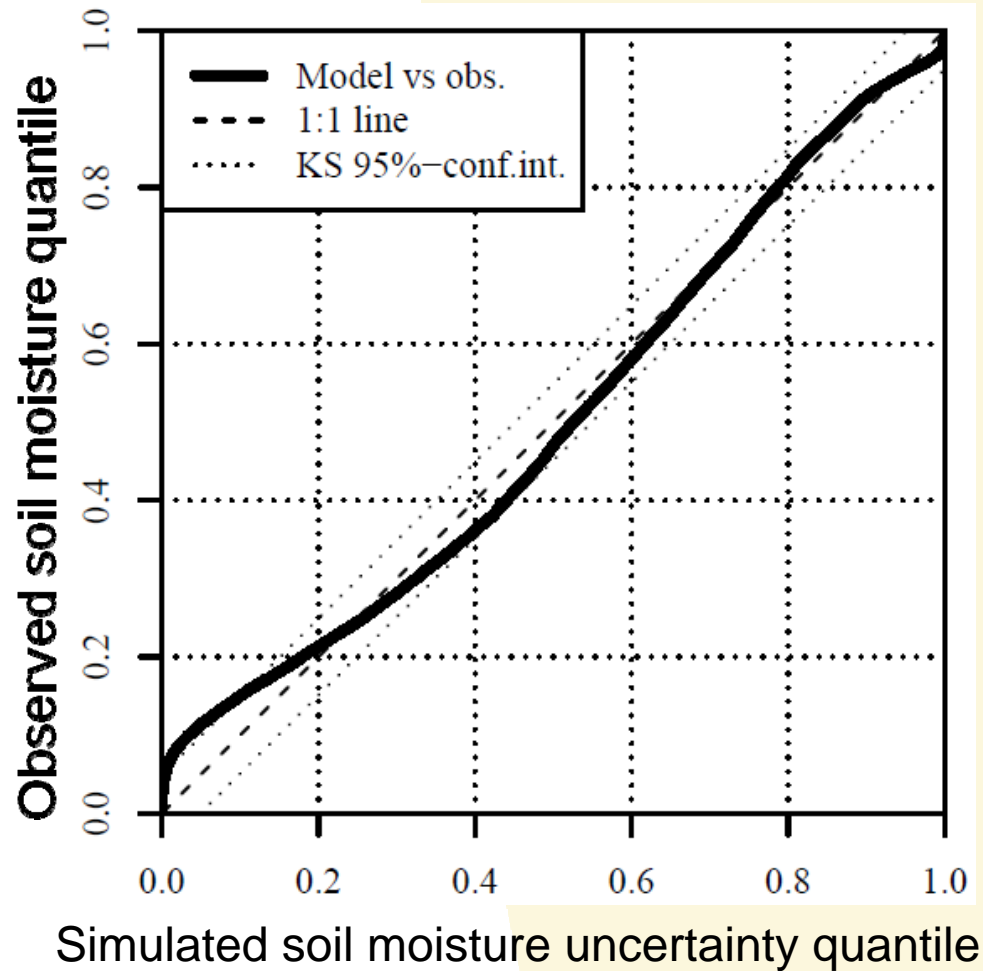
Model evaluation at REMEDHUS



Model evaluation at REMEDHUS

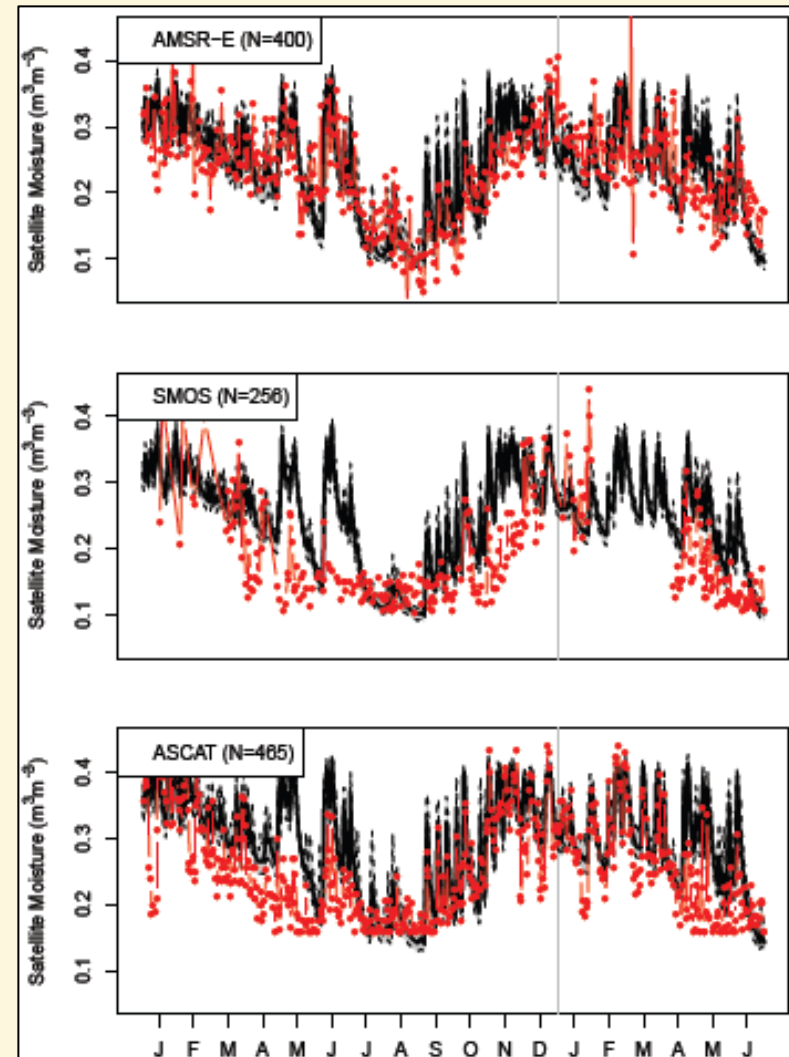


Model evaluation at REMEDHUS

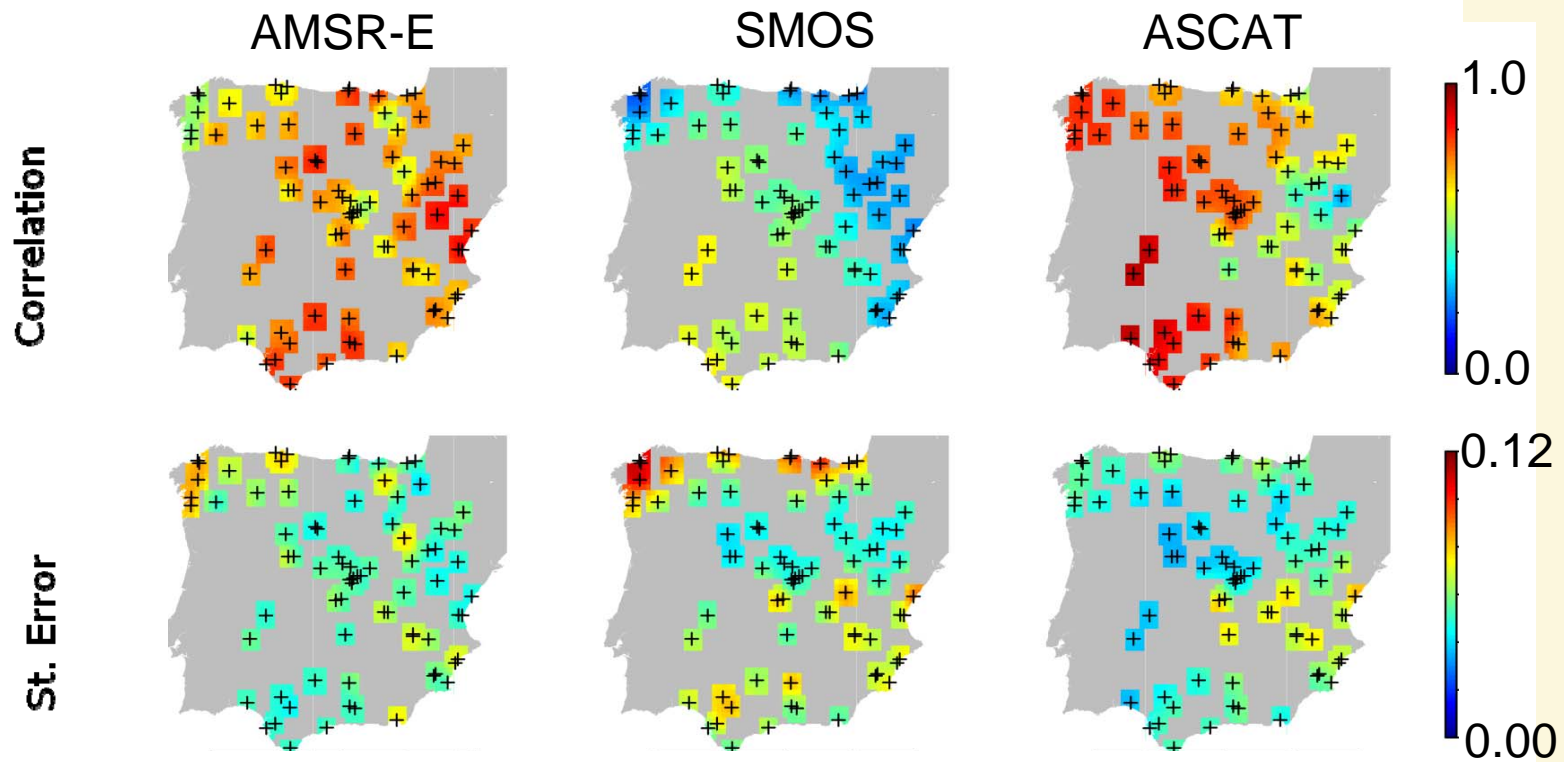


Example timeseries

- AMSR-E:
 - Captures rain events
 - Some strange outliers
- SMOS:
 - Problems with rain events
 - Yearly cycle captured
- ASCAT:
 - Captures rain events
 - Problems with spring rain



SWAP and satellite comparison



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

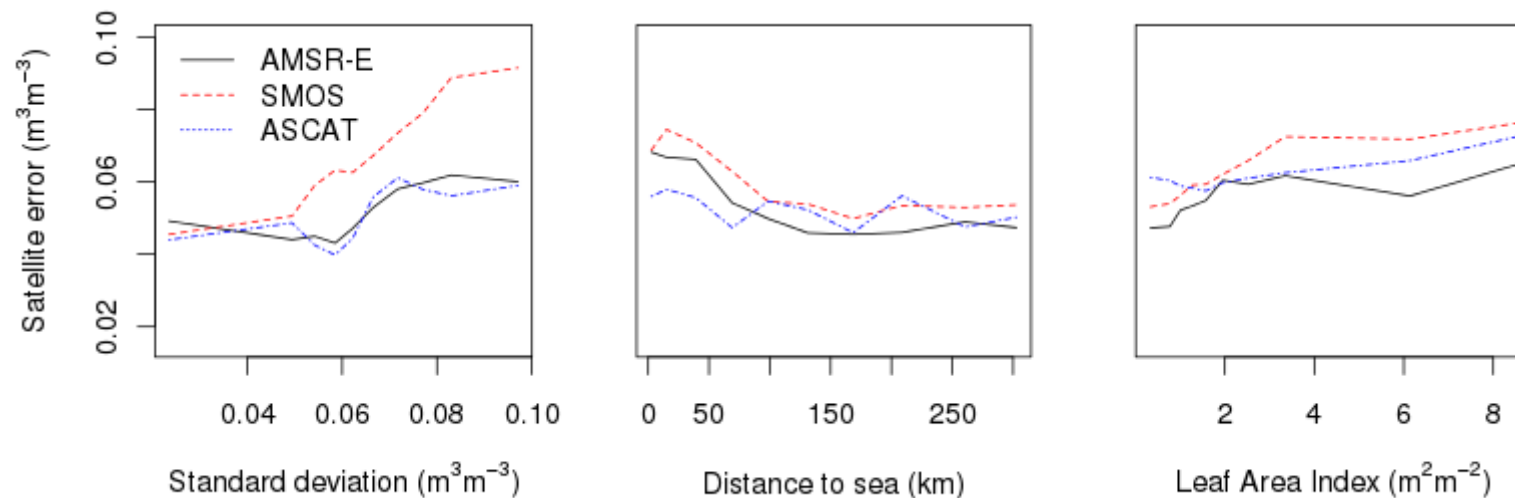


Error sources

- For SMOS satellite error increases with:
 - Enhanced soil moisture dynamics
- Satellite error increases with:
 - A decrease in distance from the sea
 - Higher vegetation density

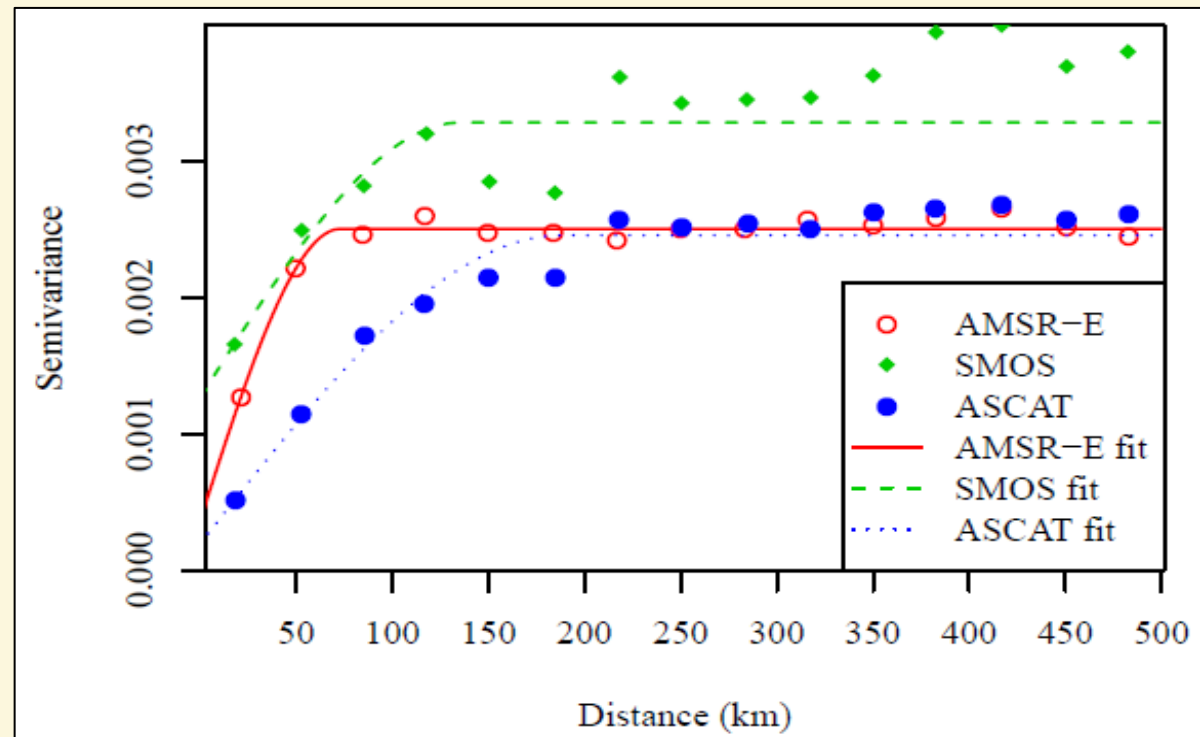


SMOS example



Spatial error structure

- Satellite errors are:
 - Spatially correlated
 - Up to ± 150 km



Conclusions

- Temporal dynamics are best captured by AMSR-E and ASCAT, SMOS only yearly cycle.
- Satellite standard errors for the three sensors were found to be very similar (0.05 m³m³).
- The satellite uncertainty is spatially correlated and distinct spatial patterns are found over Spain.
- Very important to include model error in satellite validation for proper error estimation

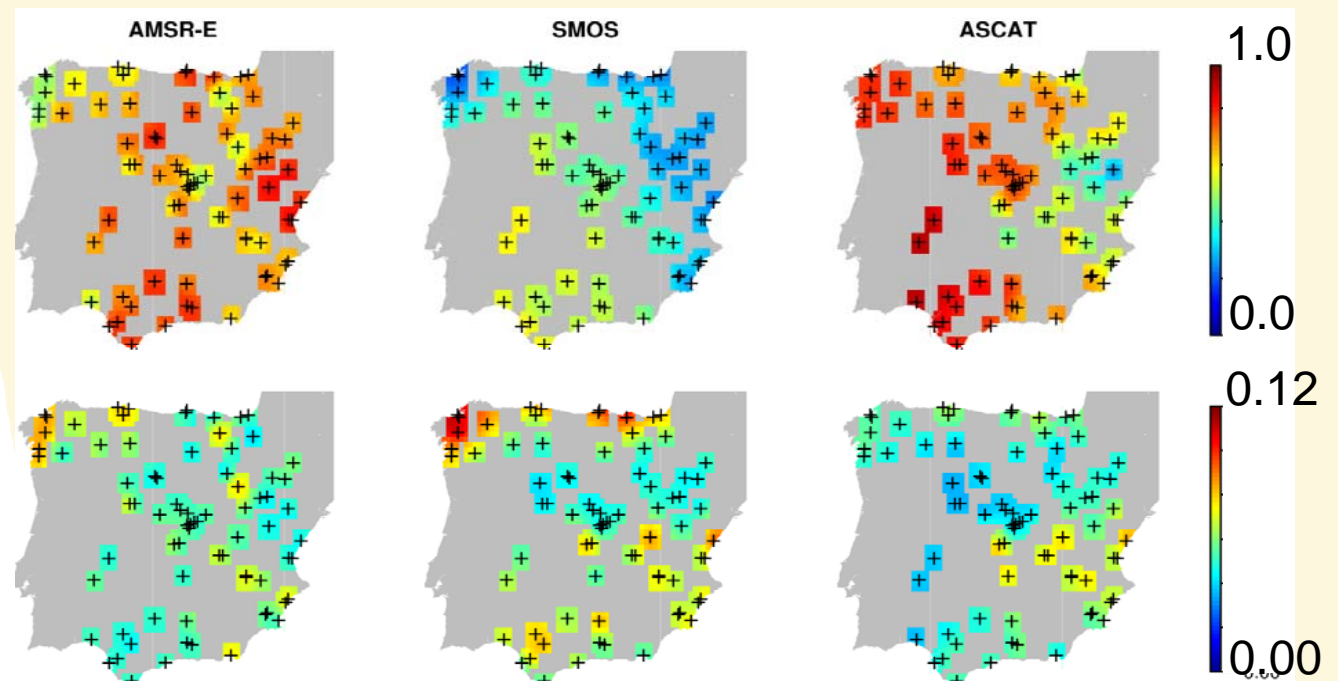


Thanks for your attention

Any questions, remarks or comments?

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Correlation between satellites

