Evaluation and intercomparison of SMOSL3, CCI, AMSR E-LPRM, SM-DAS-2, and ERA-Interim/Land soil moisture products

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Introduction

Soil moisture (SM) is considered to be one of the keys to our understanding of land-atmosphere interactions. Until now studies on this topic were mostly based on modelled data. With the recent advances in global SM retrievals from satellite in the past decade we are suddenly in the position to study these processes with observations. However, the uncertainty of these recently developed global satellite-based products is still to a large degree unknown.

Global SM datasets are being produced based on active and passive microwave satellite observations and simulations from Land Surface Models. These include, amongst others, three products based on remote sensing observations: 1) SMOS Level-3 SM products, 2) The Essential Climate Variable (ESA-CCI) Soil Moisture project and 3) AMSR-E LPRM, derived from the passive microwave AMSR-E sensor using the Land Parameter Retrieval Model (LPRM)) and two products based on the ECMWF land surface model: 1) SM-DAS-2: retrieved by ASCAT assimilation in the ECMWF Land Data Assimilation System and 2) ERA-Interim /land: an upgraded land surface for ECMWF ERA-Interim reanalysis. Due to the recentness of most of these global SM products, they have still not been sufficiently evaluated. In this context, we propose to evaluate the performance of recent SM products. First results of the comparison of these various products provide new insights into the performance of the various derived SM products

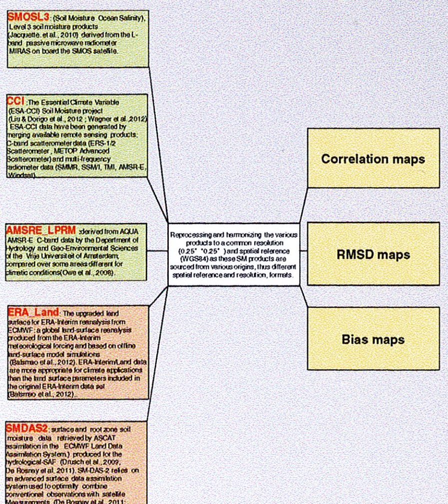
Objectives

A comprehensive comparison between five global SM products obtained from satellites and land surface models data have been carried out with the purpose to:

- ✓ Better understand the temporal relationships between the various products(i.e. explore possible correlations and/or discrepancies among them)
- ✓ Analyse their ability to capture the spatial and temporal variabilities under different land uses and soil types
- ✓ Investigate similarities and differences

Approach and data

- Data synthesis and preparation: five existing global derived SM products have been analysed:
- Evaluating the various SM products at global scale using classical statistic indicators: To provide correlation(R), bias, and RMSD maps (SMOSL3, SM-DAS-2, CCI, and ERA-land for the year 2010, SMOSL3 and SM-DAS-2 for the years 2011 and 2012). * Presented in this poster



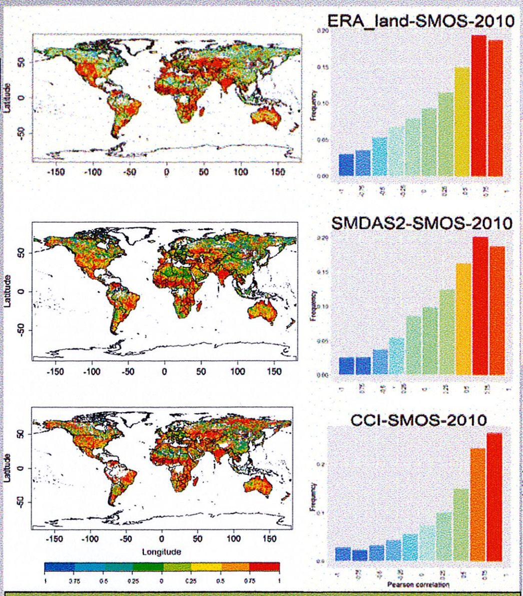


Figure 1 correlations of SMOSL3 vs. ERA_land, SMDAS2 ,and CCI for the year 2010

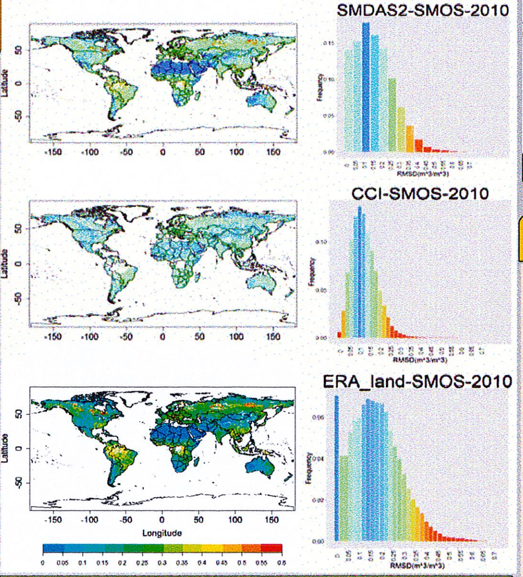


Figure 2 RMSD (SMDAS2, ERA_land, and CCI - SMOSL3 for the year 2010)

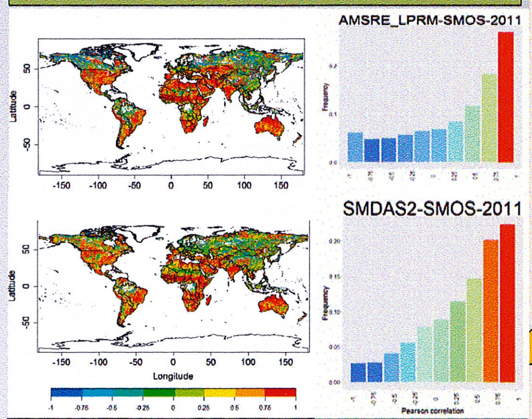


Figure 3 correlations of SMOS vs. AMSRE_LPRM and SMDAS2 for the year 2011

Results

We present here the absolute agreement results between the SMOS and the various derived SM products in terms of correlation coefficient(R) and RMSD during overlap periods.

Figure 1 shows correlation coefficients between SMOSL3 and CCI products compared with SM-DAS-2 and ERA-Land for the year 2010 over the globe.
Figure 2 shows correlation coefficients between SMOSL3 and CCI products compared with SM-DAS-2 and ERA-Land for the year 2010 over the globe.
Figure 3 and 4 present the correlation coefficients and RMSD results between SMOS , AMSR-E and compared with SM-DAS-2 for the year 2011 over the globe respectively.

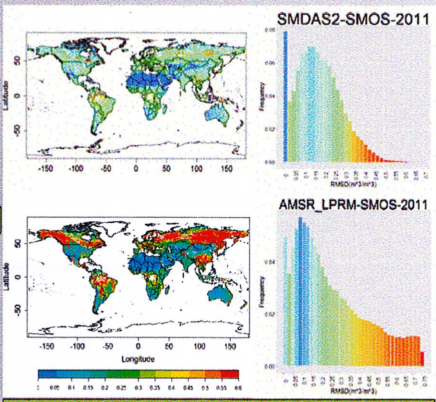


Figure 4 RMSD (SMDAS2,and AMSRE - SMOSL3 for the year 2011)

Summary & Conclusions

This study assessed the quality of several global derived SM products e.g. by comparing the satellite retrievals (SMOS_L3,CCI,and AMSER_LPRM) with modelled SM products(SMDAS2 and ERA-land). Correlations, bias ,and RMSD between remotely sensed and modelled SM products were used to evaluate global consistency in SM variability among the five products. This study is progress, conclusions so far include the following:

- In general, we found the best correlations between the global satellite and models datasets (R > 0.80) in the transition zones between wet and dry climates (e.g. Indian subcontinent, Great Plains of North America, the Sahel, and equatorial Africa), and also in the Western Europe, Eastern Australia, and the Southeast region of Brazil. This may be explained by the strong seasonal dynamics of SM in these regions and the strong coupling between SM and precipitation.
- Satellite and model datasets exhibit weak correlation (R < 0.40) in dry regions (e.g. Sahara, Arabian Peninsula, and central Australia) due to the low range of variation of SM in these regions which corresponds roughly to the sensor retrieval accuracy (~0.04 m3.m-3).
- RMSD and bias values were found to be markedly different between satellites and model products in tropical areas. We think that the presence of dense vegetation with complex canopy types limits the accurate detection of SM. In high latitude (boreal zone) , tundra(e.g. Northern Canada, Alaska north-eastern regions of Russia) significant differences between the satellites and model products were also found due to the influence of bound water and the constraint of frozen soil conditions on satellite signal retrievals.
- The analyses have pointed out the strong spatial correspondence between all products in India, the Sahel region, the Southeast region of Brazil, and Eastern Australia

Future work

Future work will be directed towards further :

- Avoiding seasonal effects
- Filter derived SM from satellites (e.g. exponential filter)
- Evaluate the various SM against in-situ measurements

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