HOW DOES THE SPATIAL SCALE AND THE SELECTION OF ANCILLARY DATA INFLUENCE THE EVALUATION OF EO SOIL MOISTURE PRODUCTS?

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1. INTRODUCTION

The key usage of soil moisture (SSM) products from Earth Observation (EO) is their assimilation into hydrological models. The data assimilation techniques require a well characterized error to be provided with the product. Understanding errors of EO surface SSM datasets is indispensible also for extractions of blended SSM products (Liu et al., 2011), as well as for their usage in evaluation of other SSM datasets.

The past dominant evaluation approaches for SSM datasets consisted of the computation of correlation coefficient (*R)* and the root mean square error (RMSE) between remotely sensed and in-situ data where the ground-based measurements were hold to be of higher accuracy (e.g. Ceballos et al., 2005; Gruhier et al., 2010; Wagner et al., 2007). Nevertheless, only the in-situ networks could not allow global evaluations given their limited spatial coverage. In the last decade, a large amount of remotely sensed soil moisture datasets have become available (Kerr et al., 2010; Njoku et al., 2003; Pathe et al., 2009; Wagner et al., 1999) that utilize independent algorithms and have an independent error structure. These products allowed for global evaluation activities in the soil moisture domain and initiated usage of new evaluation measures such as triple collocation (Dorigo et al., 2010; Scipal et al., 2008), or error propagation (EP) methods (Naeimi et al., 2009; Pathe et al., 2009).

Recently, another evaluation method, predicted RMSE, was introduced that evaluated the standard error of the Advanced Synthetic Aperture Radar (ASAR) Global Mode (GM) SSM using a soil moisture estimate from a hydrological model (Doubková et al., 2012) and enabled also the estimation of *R* between the two datasets if standard errors are known. The necessary prerequisite of the method was a good understanding of the standard errors of both datasets and their independency. Importantly, using the Australian Water Assessment System (AWRA-L) hydrological model the authors of the study concluded that RMSE is governed by the spatial distribution of the error of the ASAR GM dataset at 1 km scale.

The objective of this presentation is to study: a) if the conclusion introduced in the previous paper holds independent of spatial scale of the input datasets, b) if and how do the results of the absolute and relative evaluation measures change with spatial scale, and c) where do the differences between different relative and absolute evaluation measures stem from. To study the above listed questions the medium resolution ASAR GM SSM product is compared with hydrological models (either AWRA-L, GLDAS-NOAH, or ERA-Interim) acting at a diversity of scales ranging from 5 to 86 km as well as with in-situ data representing only several square meters.

2. RESULTS

The continental average absolute evaluation measures over Australia ranged between 2.65 % (for EP) and 8.44 % (for RMSE when computed with AWRA-L) of saturated soil moisture. The relative evaluation measures spanned from 0.39 (R_S when computed with AWRA-L SSM) to 0.57 (R_S when computed with GLDAS). Clearly, the resulting values vary between discrete relative and absolute evaluation measures and appear to be influenced by the selection of the ancillary dataset and its spatial resolution. The spatial patterns of R_S and R corresponded rather well and demonstrated significantly different spatial patterns to any of the absolute measures. Surprisingly large differences were encountered between different absolute evaluation measures. In particular, the spatial patterns of the EP significantly differed from RMSE (Figure 1) what is in contrary to the similar analyses performed at 1 km scale (Doubková et al., 2012). This finding suggests that the selection of spatial scale may change the absolute values of absolute evaluation measures as well as their spatial patterns.

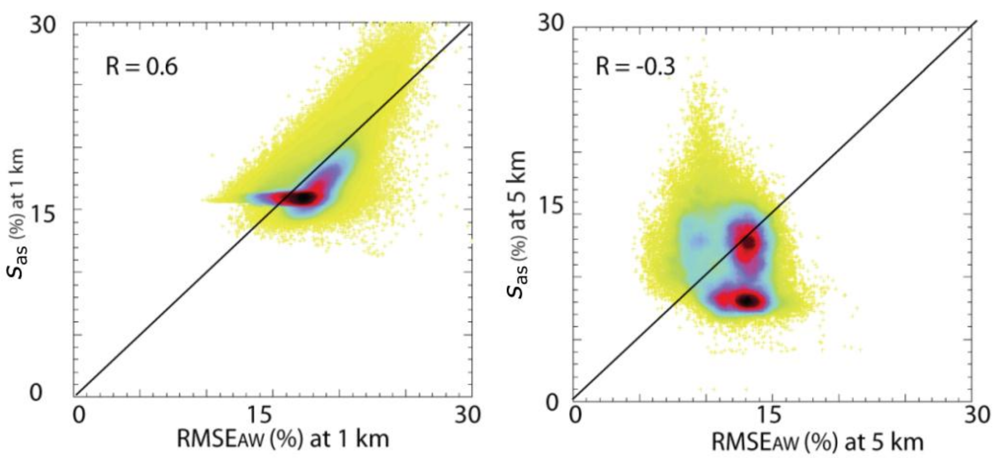

Figure 1 - Scatterplots between observed RMSE (computed between ASAR GM and AWRA-L SSM) and error propagation (EP) error (s_{as}) computed at the 1 km (left) and at the 5 km (right) spatial scale computed over the area of interest (700x700 km) in central Australia. The color represents the density of points ranging from high (black) to very low (yellow).

The findings and suggestions originating from the discussion are transferable to other EO soil moisture data. Of special interest is its transfer to data from the planned Sentinel-1 SAR sensor that shares similar technical characteristics but has an improved retrieval error comparable to the ASAR GM sensor. The operationally available medium resolution soil moisture from Sentinel-1 with a well-characterized error is likely to yield benefits for modelling and monitoring of land surface-atmosphere fluxes, crop growth and water balance applications.

3. REFERENCES

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