Hydrology and Earth System Sciences Discussions

Interactive comment on "A comparison of ASCAT and modelled soil moisture over South Africa, using TOPKAPI in land surface mode" *by* S. Sinclair and G. G. S. Pegram

Anonymous Referee #2

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The paper presents results from a comparison of soil moisture estimated by a hydrologic model (TOPKAPI) and derived from coarse resolution satellite data (from the AS-CAT sensor). Several studies were published in recent times presenting similar results, however only few used hydrologic model data. The study hence presents a unique and valuable contribution towards the use of satellite derived soil moisture products in hydrologic applications.

Of general interest is the positive evaluation of a simple infiltration model based on a temporal filter approach which was developed in earlier studies to translate the satellite

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derived surface estimates into soil moisture representative of deeper soil layers. The simplicity of the method and the positive results presented in this study suggest that the method can be applied successfully on a broader scale over data sparse regions, e.g. in other areas of the African continent. Of more specific interest is the spatial analysis of differences between the datasets. Interestingly the products compare better in wetter areas with higher vegetation cover whereas under dry conditions there is little agreement. Unfortunately the assessment of the differences between the datasets is inconclusive as it is difficult to attribute errors to either one of the datasets. Clearly more research is required in future to better understand the quality of each datasets.

At all, the study is carried out very carefully, the methods are scientifically sound and the discussion of the results is objective. I therefore recommend to publish the paper in HESS after minor corrections. My remarks are:

1) In the study many different data sets are used, including earth observation data, station data, model analysis fields and model forecasts. Currently it is a bit unclear which data is used when. Especially for the TOPKAPI model a flowchart illustrating which data is used when would help to better understand the quality of the model fields which are used later in the comparison. Also some quality indication of the input data would be useful.

2) Please exactly specify which ASCAT product you are working with. Did you use the product distributed by EUMETSAT or by TUWIEN. During the last two years the soil moisture processor has been changed and some bugs in the processor have been fixed. Some of the observed errors could be due to the use of old data. It should be confirmed with the data provider that the data version you use is using a correct version of the retrieval algorithm.

3) A table highlighting the basic characteristics of the data which is compared would be helpful. This should include layer depth, spatial resolution time of observation. Currently it is not fully clear to me if the data represents the same physical quantity. For

example in section 4.2 soil horizon A and B are introduced for the TOPKAPI model, but the actual depth is not provided. How are these horizons defined (provide range of soil depth)?

4) In section 2.1.2 it is stated that analysis and forecast fields are used. Why do you use the forecast fields. I assume that the analysis fields are more accurate.

5) Figure 4 shall illustrate the quality of the solar radiation data. The plot shows 5 days of data. I assume the good fit during day one and day two is due to clear sky conditions. The good fit under such conditions is not surprising. It is more interesting to see where the data does not fit. Hence I recommend to plot only the data for the third/fourth day but stretch the plot. Maybe also the coefficient of determination can be calculated for both cases (cloud-free and clear sky)

6) The authors highlight the fact that the Penman-Monteith equation was developed for well watered soils. How does this assumption impact the quality of the evapotranspiration estimates over the study region? Especially in the drier eastern parts, this assumption does not hold. Can this explain part of the low correlations between observed and modelled soil moisture in this region.

7) In the ET0 calculation grass is used as a reference surface type. How does this impact the model results?

8) According to section 2.2 the evapotranspiration calculation uses SAWS model and station data. How is the station data used? Is it used in a data assimilation framework?

9) A table with more information of the locations A-D which are used to illustrate the results of the comparison would be helpful, this should include landcover, annual precipitation. What are the criteria for selecting the locations? In Fig 10 the conditions for B and C look very similar.

10) Clarify the notation of the locations. Either use ids (such as in Fig 10 A, B, C, D) or names (as in Fig.11-15). Currently there is no link between Ids and names.

11) Beside the correlation also provide the RMSD. The low correlation in the drier western part of the study area could be due to a low variation in soil moisture. Under such conditions the correlation is determined by noise and becomes very low. Under such condition the RMSD is more informative.

12) The periodicity observed in the ASCAT time series of Western Cape could have several reasons: a. Azimuthal viewing effects (as described in Z. Bartalis, K. Scipal, W. Wagner (2006) Azimuthal anisotropy of scatterometer measurements over land, IEEE Transactions on Geoscience and Remote Sensing, Volume 44, Issue 8, August 2006, Pages 2083-2092.) This effect is observed over regions with spatially large scale organized roughness patterns (for example sand dunes in deserts). Under such conditions the measured signal depends on the viewing geometry, which varies from orbit to orbit but is exactly the same every 29 days (when the satellite repeats its cycle). In Bartalis et al. high resolution images (such as available in Google Earth) have been used to illustrate the surface conditions causing this effect, a similar approach could be used here to either confirm or reject this hypothesis. b. A calibration mismatch which has been identified recently. Currently ERS data is used to parameterize the ASCAT retrieval. An apparent mismatch in the calibration of the two sensors leads to an increase in the noise of the soil moisture estimates derived from ASCAT. This error is not considered in the error model used to calculate the error which is attached to the soil moisture product and for example displayed in Fig 21. This noise is more pronounced at high incidence angles. However currently it is assumed that this calibration mismatch only result in higher noise and not in a bias as observed in Fig. 14. The hypothesis could however easily be rejected/confirmed by plotting the difference (RMSD and bias) between model and ascat versus incidence angle. c. An error in the soil moisture computation. To reject/confirm this hypothesis you should check with the data provider.

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