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Hydrology and Earth System Sciences Discussions

Interactive comment on "Application of satellite microwave remote sensed brightness temperature in the regional soil moisture simulation" *by* X. K. Shi et al.

Anonymous Referee #2

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General comments

In this paper, regional soil moisture (SM) is estimated from AMSR-E brightness temperature and then the estimated SM is assimilated into the Noah land surface model in the WRF (Weather Research and Forecasting) model through the four-dimensional Newtonian relaxation (NR) method. Undoubtedly, this is an advance compared with a pure remote sensing of soil moisture or a pure atmospheric modeling. In this sense, this work is worthy of publication. However, there are many uncertainties. For example, (1) the authors just used Yan's method but do not present any evidence on its reliability throughout the paper; (2) why the authors, without showing observed data, consider

SM values ranging over 0.06–0.08m3/m3 are reasonable in the deserts; (3) the comparison between in situ data and satellite remote sensing is not scale-match but the authors did not mention the possible effect of the heterogeneity of soil moisture on the comparison?

I suggest major revisions before its acceptance. Specific comments are below:

1. p1240: "Ta and Ts are the average physical temperatures of the uniform atmospheric layer and land surface, respectively". I do not understand the meaning of Ta. How to get its value or how to define the thickness of "the uniform atmospheric layer"?

2. p1240: "In general, 0<Q<0.5, Q=0.174 is taken in this investigation. (Njoku and Chan, 2006)". However, it is indeed important to determine Q and h. At least, the authors should discuss the sensitivity of such a choice or provide any evidence why they make this choice.

3. p1241: "The increasing of the SM boosts (RH+RV) much more than (RH−RV), therefore it yields a bigger radiation difference and MPDI value". Any mistake here?

4. p1241: "the R+(mv) can be derived from the current observation of MPDI, and then the mv can be found out by iteration". R+(mv) is a function of mv, Q, and h, uncertainty in Q and h would affect the derived mv. Please explain the sensitivity.

5. p1243: "w(x, y, 1, t) is the four dimensional assimilation weighting function." There is no detail on how to determine the weighting function.

6. p1242: "provide the monthly average SM for each grid point in the simulation area, we use the AMSR-E global monthly SM product (resolution 1 deg×1 deg) as the <mv>, and re-sampling it and the AMSR-E brightness temperature data to the 10 km resolution of the model grids for further processing." Is the monthly average of the derived soil moisture equal to AMSR-E global monthly SM product? How about their similarity in temporal variability? It would be desirable to show AMSR-E global monthly SM product in Figures 3 and 5.

7. p1244: “Figure 2a presents the regional distribution of the estimated SM which original spatial resolution is about 12 km”. As far as I know, the nominal spatial resolution is 25 Km or 54 km or so. Please explain why the resolution is 12 km.

8. p1244: “The estimated SM values in the desert areas are ranged 0.06–0.08m3/m3 and indicate a good correspondence to the distributions between the estimated SM and the land use classification”. The authors did not provide any observed data for the individual land use types. To show the reasoning, please provide observed data or relevant references for the observed data.

9. p1245: “The NCEP SM provides much higher values than the ground observations, while the SM estimated from AMSR-E yields lower values than the ground observations. Furthermore, the estimated SM has smaller relative error compared to the NCEP SM.” This description is confusing. “Furthermore” should be “However”?

10. p1245: “Gruhier (2008) pointed out that, the daily AMSR-E SM product is not able to capture absolute SM values at current stage, but it provides reliable information on land surface SM temporal variability, at seasonal and rainy event scale”. This conclusion might be specific rather than a general one. Contrast results are found by Choi and Jacobs (2008: Temporal Variability Corrections for Advanced Microwave Scanning Radiometer E (AMSR-E) Surface Soil Moisture: Case Study in Little River Region, Georgia, U.S. Sensors, 8, 2617-2627). Again, I suggest the authors to show AMSR-E global monthly SM product in Figures 3 and 5.

11. p1246: “Based on previous comparison, the estimated SM is smaller than the ground observations. A possible reason is that the monthly average SM resulted from the monthly AMSR-E SM product at July is not accurate enough though several other factors have been considered, such as the soil type, surface roughness and vegetation optical thickness”. I could not understand why soil moisture heterogeneity is completely neglected here. This would be a major factor to interpret their difference. At least, the authors should clarify the possible effect of such spatial heterogeneity of soil moisture

when interpreting the differences from observed one.

12. A review of recent progress in AMSR-E land data asssimilation techniques is expected.

13. Figure 5: After assimilation of estimated SM into Noah LSM in WRF, the authors only presented the results of soil moisture; however, what we do expect is its effect on the land-atmosphere interactions. Perhaps, the effect of soil moisture assimilation in WRF is not much different from the assimilation in the offline Noah LSM. I would like to see the comparison of surface air temperature and humidity or the fluxes at Tangla PBL site, as they are directly affected by soil moisture. Moreover, they have better spatial representativenss than in situ soil moisture.

14. p1247: “In assimilation test, the simulated desert SM values in Qaidam basin, which locates in the north Qinghai-Tibet Plateau, are ranged 0.1–0.15m3/m3 and have a better agreement with the distribution of desert area than the result in none assimilated test.” Again, there is no observed data to justify this statement.

15. In section 5.2, the authors should clarify that they are running WRF instead of the offline Noah LSM. In the text, this has never been clarified explicitly.

16. p1250: “The temporal variations of the estimated SM are in good agreement with ground daily precipitations”. Are you going to say “The temporal variations of the estimated SM are in good response to ground daily precipitations”

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