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Hydrology and Earth System Sciences Discussions

Interactive comment on "Relating surface backscatter response from TRMM Precipitation Radar to soil moisture: results over a semi-arid region" *by* H. Stephen et al.

Anonymous Referee #1

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This paper discusses the use of the TRMM Precipitation Radar for estimating soil moisture content in semi-arid regions. Due to the coarse scale of the product used, field data is insufficiently available and the soil moisture retrieval is validated against VIC model results. Although this paper has some interesting results, I have some major remarks, listed below:

- The radar onboard TRMM operates at Ku-band, for which it is known that the penetration depth into the soil is extremely limited (a few mm?). Yet, the authors compare their retrieved product with modelled soil moisture in a 10 cm top soil

layer. Due to the different thickness of the observed soil layer and the modelled one, results may be questionable.

- No literature review is done on soil moisture retrieval experiments using Ku-band radar, although several papers dealt already dealt on this.
- The vegetation considered seems quite dense (with respect to the Ku-band): the class DV is characterized by an NDVI of 0.5 to 0.7 which (I guess) corresponds more or less to an LAI of 0.5. It would be good to better characterize the different classes: maybe describe the type of vegetation and add the corresponding LAI range. In this description one could refer to literature upon the expected impact of the vegetation on the Ku-signal.
- With respect to these classes, figure 2 is developed which shows the backscatter incidence angle dependence for the different classes. Given the objective of the paper (i.e. to retrieve soil moisture), it would have been better to see the backscatter as function of the soil moisture content for the different vegetation classes, and different curves depending on the incidence angle may be plotted if necessary. Such plot would better demonstrate the sensitivity of the signal to soil moisture.
- The backscatter model, given in equation 1, is not well described. The reason for the different terms is given, but the statistics of the fit of the model lack (e.g. what is the RMSE on the models derived in table 1?). In equation 1: why also include μ_s and μ_{ndvi}? If you would't include it, then its value would be compensated for in the fitting parameters C, D, and N?
- The VIC model used is never validated + it is not clear why the model resolution differs from the σ^0 resolution (i.e. 12 km x 12 km and 4.4 km x 4.4 km, respectively).

- Why should the model be calibrated for each pixel (see p. 6437, line 14)? In that case, what do the values given in Table 1 correspond to (one specific pixel?)? If the model has to be calibrated per pixel, then what is the worth of such model? You cannot extrapolate to regions where no calibration data is available. Definitely the paper should be extended with a paragraph on how to apply this retrieval technique to an alternative site.

Some minor comments *((x,y) corresponds to page x, line y)*

(6428,6) add some references to papers that developed backscatter models for vegetation (there are several, papers by Pampaloni, Ferrazzoli, Lang or Karam, ... are definitely useful)

(6429,3) add references

(6430,18-19): the statement that the normalization with respect to incidence angle can be done using a linear relationship between backscatter and incidence angle only holds for a small region where the dependency is nearly linear, but it may not be applied to a wide range of incidence angles! This should be made clear. Page 6434, line 20-22, puts this correctly.

(6432,3) explain how σ_0 is cleaned.

(6434,2-5) add some references (e.g. Wagner et al., Nordic Hydrology, 38(1), 1–20, 2007

(6434,18-20): add reference to the fact that the slope reflects the impact of the vegetation cover

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 6425, 2009.