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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.

H. Stephen et al.

sajjad.ahmad@unlv.edu

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We understand the reviewer's concern about the penetration depth of Ku-band microwaves and the depth of the soil layer for which the soil moisture is used. We note that ground measurements of soil moisture are only available at 5 cm depth in the Walnut Gulch Experimental Watershed in the Lower Colorado River basin. This scarcity of soil moisture measurements resulted in using simulated soil moisture data from a hydrological (VIC) model. Nevertheless, we would like to note that the surface soil moisture is a surrogate of its values at near surface depths (5–10cm). In order to make

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this point clear in the manuscript, following paragraph has been added (2^{nd} last paragraph of Results and Discussion section). **We note that the penetration depth of Ku-band microwaves is shallow and thus only top few millimeters (depends on the moisture) of soil layer soil moisture affects the backscatter measurements. Nevertheless, the surface moisture is linked to the soil moisture at near surface layers (5–10 cm). This is evident from the high correlation of derived soil moisture to VIC and gage soil moisture data.**

Indeed, the used Ku-band for soil moisture is uncommon and has not gained much attention. Limited literature is available mostly using high resolution radars (SAR). We have added a few references and following text is added in the introduction section of the paper. **Nevertheless, the potential of Ku-band microwave to measure soil moisture has been demonstrated in several studies (Ringelmann et al., 2004). European Remote Sensing SAR data over agriculture fields have been shown to retrieve leaf area index and soil moisture under lower vegetation conditions (Moran et al., 1998). A similar study compared soil moisture retrieval from agricultural fields using C- and multiangle Ku-band SAR data for different surface roughness conditions (Sano et al., 1998). In recent studies, Ku-band backscatter data measured by Seawinds scatterometer has been shown to be temporally consistent with the changes in measured soil moisture (Mladenova et al., 2008, Mladenova et al., 2009).**

The authors show in this paper that backscatter is related to the soil moisture vegetation through a simple model. Despite the issues of Ku-band waves ability to penetrate through the canopy (especially wet) and very small soil skin depth, the model is showing reasonably good results because the nature of the vegetation cover in the arid-regions. The shrubby vegetation has patches of bare soils exposed that directly influence the incoming Ku-band radiation. Thus changes in the soil moisture have larger contribution in the presence of vegetation.

Page 6427: The information about SMOS has been updated and reads as follows.

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Similar mission called Soil Moisture and Ocean Salinity (SMOS) has been successfully launched by European Space Agency in 2009 (Drinkwater and Kerr, 2009).

Page 6428, line 13: We have added the relevant reference for the indicated line, i.e., Tang and Piechota, 2009. In-situ soil moisture data is not widely available and is sparse for regional scale modeling.

Page 6429, line 16: We have rephrased the line to remove the repetitive sound. The new line reads. Section II provides details of the study area and data.

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