

Interactive comment on “The significance of soil properties to the estimation of soil moisture from C-band synthetic aperture radar” by John Beale et al.

Anonymous Referee #1

Received and published: 19 July 2019

The authors discuss based on literature the effect of soil properties on the C-band SAR observations and extrapolate this to the estimation of the soil moisture. They have chosen C-band because Sentinel-1, as the first operational space borne SAR system, provides C-band measurements. Yet, the authors do not analyse a single Sentinel-1 SAR image, while they are downloadable.

Although the manuscript is reasonably well written, the description of many elementary aspects of SAR remote sensing of soil moisture is incomplete, some examples are given under the detailed comments. Further, I do not really understand the prime focus on soil properties as a source of uncertainty affecting SAR-based soil moisture

C1

retrieval. The issues of radiometric accuracy of Sentinel-1, surface roughness parameter uncertainty and uncertain vegetation effects are much more pressing at field scale. The manuscript in its current form is a review paper that does not adequately describe the state of the art in the field and is without any original research of little added value to the community.

Detailed comments:

General: The abbreviation for soil moisture is not consistently used. Sometimes soil moisture is written out. Sometimes SM is used and on p3113 mv is used.

P2L17-33: The authors give an ambiguous description of the relationship between soil moisture and microwave (active/passive) observations, emission and backscattering. Soil moisture determines the dielectric constant and the dielectric constant is part of the refractive index that defines the specular reflection of microwave radiation, which is related to both the amount of microwave emission and backscattering.

P2L34: I agree with the authors that there are ‘many unknown factors’ that influence radar observations. In following sentence, however, the focus is on the soil properties, while from research it is well known vegetation, soil surface roughness and topography are much more important factors. In fact, much research (also cited later on in that manuscript) on how soil properties affect the relationship between soil moisture and the dielectric constant has been done.

P3L31: what do the authors mean by ‘take account of incidence angle’? Do they mean that the backscatter is also determined by incidence angle? or that the derivation of the backscatter requires correction for the local incidence angle? Both are actually the case.

P3L31: ‘validate’ from this sentence it is not clear that it concerns here soil moisture validation. The jump from SAR processing to validation of soil moisture retrievals is for me too big. soil moisture validation.

C2

P4L7: R2

P4L12: 'Vegetation . . .' this needs to be supported by a reference. Actually I think that surface roughness the most important factor and not vegetation.

P4L13: 'attenuating both the transmitted radar signal and the backscatter from the underlying soil'. Can the authors explain what the difference is between the 'transmitted radar signal' and 'the backscatter from the underlying soil'

P4L17: This statement is not correct, and also depends on the incidence angle and vegetation type, see for instance Joseph et al. RSE 2010 or Mattia et al. TGRS 2003. Often the vegetation – soil scattering terms are responsible for a significant amount of soil moisture sensitivity beyond a LAI 0.5 m² m⁻².

P4-5: Apart from the WaterCloud and MIMICS models, there are other models that are nowadays used more frequently by the community, e.g. the distorted born approximation by Lang and Sidhu (1983) was proposed by Kim et al. (TGRS 2013) for the SMAP radar product and the output of the Tor Vergata discrete scatterer model is used for SMOS soil moisture retrieval over forests.

P7L1: It would be better if the authors would state that the dielectric constant is defined as electric permittivity relative to the electric permittivity of free space.

P7: Figure 1 suggests that there different models to simulate the bare soil backscatter, but that there is only the water cloud model to account for the effects of vegetation. This is a bit out of balance.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2019-294>, 2019.