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Hydrology and Earth System Sciences Discussions

Interactive comment on "On the derivation of soil surface roughness from multi parametric PolSAR data and its potential for hydrological modelling" *by* P. Marzahn and R. Ludwig

Anonymous Referee #1

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General Comments

This paper investigates the potential of using estimates of surface roughness, retrieved from polarimetric SAR data, for hydrological modelling. The work is interesting and suited for publication on the HESS Journal. Its main strength is the assessment of the performances of three previously proposed SAR estimators of surface roughness, based on a large and well-documented data set. However, the paper is presently lacking a clear interpretation of the results and this aspect should be improved before the final publication. In addition, it would be very useful for future studies to report in a

Table the multi-temporal roughness parameters measured in situ.

Specific comments

Section 2.1

The description of the test site (i.e. section 2.1) should be followed by the description of in situ measurements, including sections 2.3 and 3.1. Therefore, I would suggest swapping section 2.2 for sections 2.3 and 3.1.

Section 2.2

This section would benefit from a bit more detailed description of the physical meaning of the investigated radar features (insights can be found in Schuler et al., 2002). For instance, an important point to be clarified is that for a surface showing azimuthal symmetry (i.e. isotropic roughness and vegetation structure) the circular coherence is real (see eq. (24) and (25) and related comments in Schuler et al., 2002). Of course, this aspect has important implications in the analysis of the experimental data set.

Section 2.3

The photogrammetric method is explained with sufficient details. However, the issue of spatial scale should be more critically addressed. Indeed, previous papers (e.g. Davidson et al., 2000) have shown that roughness parameters often change with the length of the profile over which are estimated. This aspect may be particularly critical for spaceborne SAR sensors, usually characterized by spatial resolution cells of several meters, whereas the photogrammetric method can sample quite small areas (approx. 0.5 sqm). With a view to possible future use of the method, it would be useful to further elaborate the issue of the influence of spatial scale in roughness measurements.

Section 3.1

This section should be expanded. In particular, I think that the information presently shown in Table 1 is by far inadequate to support the interpretation of the paper results.

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An important asset of the adopted photogrammetric method is to allow a 2-dimentional characterization of the surface roughness. This means that it must be possible to estimate the roughness parameters (at least the RMS heights) along both parallel (prl) and perpendicular (prp) directions with respect to the field tillage pattern. As a result, the field roughness anisotropy could be estimated, per each field, by means of the ratio between prp and prl RMS heights. In my opinion, this information will significantly help in better understanding the behaviour of radar features, such as anisotropy and circular coherence, over each field. Therefore, I would ask the authors to carry out the directional analysis of surface roughness and report in one table the multi-temporal estimates of prl and prp RMS heights per each field. It is also worth mentioning that such a detailed description will probably be very useful for future studies concerning the same data set.

Section 3.2

In my opinion, the comparison between polarimetric radar features (i.e. anisotropy and circular coherence) and in situ roughness measurements should be carried out per each field. In other words, Table 2 should report the statistical parameters of the comparison per each field. This information, together with the one concerning the field anisotropy, would help in better understanding the limits and the potential of the method. For instance, for the fields sown with summer vegetation (i.e. maize and sugar beet), the effect of vegetation should be negligible (at least during the first part of the experiment), then the correlation between the measured roughness and the absolute or the real value of the circular coherence should be similar unless an important roughness anisotropy had been observed. In addition, the procedure adopted to transform the polarimetric radar features into roughness values should be better explained. I guess that the regression was applied to the whole data set. Please elaborate this point.

Section 3.3

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The multi-temporal analysis is very interesting, however, I think that it should be carried out bearing in mind the polarimetric response of different crops. For instance, sugar beet at a mature stage is characterised by almost the same values of HH and VV backscatter, which is also the case of a fairly rough bare surface. Therefore, the increase of roughness estimated for sugar beet fields in Fig. 10 (from May to July) is very likely due to vegetation. Conversely, the increase and then rapid decrease of roughness values, observed from April to May, is probably due to the agricultural practice (i.e. roughness increase) followed by rain events that determine a roughness smoothing. Of course, it would be interesting to compare the estimated roughness values with the in situ measurements to assess such an interpretation. In this respect, I would suggest to substitute Fig. 9 and 10 with similar plots showing, per each crop, the temporal evolution of estimated and measured surface roughness.

Section 4

This is an informative section (especially for scientists not familiar with hydrologic modelling), however the quantitative analysis is just confined to the correlation between the bulk density and the estimated roughness parameter. Then, I would suggest reducing the length of subsection 4.1 and focusing on section 4.2.

Minor corrections

Section 2.1, pag. 3387, line 2: - 18 sample points ..-; this sentence is not clear and should be reworded;

Section 2.1, pag. 3387, line 14, please add a reference for the Lee-Filter;

Section 2.2, pag. 3387, line 10, please add the spatial resolution of the employed images;

Section 2.2, pag. 3388, line 4, the complex circular coherence should not be indicated with its absolute value;

Section 3.2, pag. 3393, line 3, -..for areas with dominant surface scatter mechanisms..-

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Interactive Comment

; please give more details on the results of the mentioned analysis (i.e. which are the fields with dominant surface scatter meachanism?);

Section 3.3, pag. 3393, line 23, -It is obvious in both figures that roughness state is changing over time-; I think that this sentence should be reworded considering that the changes observed in the retrieved roughness values may be due to changes in the vegetation layer. It seems not straightforward to decouple the effect of vegetation from that of roughness on the polarimetric radar features;

Section 3.3, pag. 3394, line 26-28, since winter wheat and winter barley have a very similar canopy structure, the differences observed in the roughness evolution of winter wheat and winter barley fields are probably due to differences in the phenological stages of the plants.

References

Davidson, M.W.J.; Le Toan, T.; Mattia, F.; Satalino, G.; Manninen, T.; Borgeaud, M. On the characterization of agricultural soil roughness for radar remote sensing studies. IEEE Trans. Geosci. Remote Sens. 2000, 38, 630-640.

Schuler, D.L.; Lee, J-S.; Kasilingam, D.; Nesti, G.; Surface roughness and slope measurements using polarimetric SAR data. IEEE Trans. Geosci. Remote Sens. 2002, 40, 687-698.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 3383, 2008.