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Hydrology and Earth System Sciences Discussions

Interactive comment on "Combined use of optical and radar satellite data for the monitoring of irrigation and soil moisture of wheat crops" *by* R. Fieuzal et al.

Anonymous Referee #2

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The main novel contribution of the paper lies in the assessment of the effectiveness of Envisat ASAR data for monitoring soil moisture conditions in agricultural areas. In particular, wheat crops are investigated for which estimates of biomass water content (BWC) are retrieved employing the SAFY model where values for the green leaf area index (GLA) input parameter are derived from Formosat-2 RSI NDVI values.

The proposed methodology and results obtained are rather interesting, especially in the light of upcoming ESA Sentinel-1 and Sentinel-2 missions, which will make possible to obtain (at no costs) long time series of SAR and optical data worldwide. In-

deed, the former will provide the same type of data currently available from Envisat ASAR at improved revisit frequency, whereas the latter will provide data in 13 spectral bands (guaranteeing enhanced continuity for Landsat and SPOT missions) at 10 and 20 meters resolution (plus three bands at 60 meters for atmospheric correction) with an average revisit time of 5 days.

The main limitation of the proposed work is that just a single dataset is taken into consideration under kind of ideal hypotheses (i.e., same topography, stable surface condition, common agricultural practices). In this framework, it is proved that a relationship can be established (with certain limitations) between the soil moisture estimated from radar backscattering and that retrieved with in situ measurements. Nevertheless in a standard operational case, different sources of disturbance contribute to making the problem more complex and challenging. If it is not possible to perform additional experiments on a different area, the authors should add some considerations about an effective strategy for dealing with them.

Specific Comments:

In Section 2.3.3 some details about how large geographical units (used for averaging the backscattering coefficients) have been identified should be provided. Such an approach let remove the radar speckle noise. Nevertheless, this choice does not appear to be optimal. Indeed, several advanced techniques have been presented in the literature for reducing the speckle (e.g., Gamma filter, Lee filter) while preserving geometry at the edges between different regions. The authors might properly justify their choice.

In Section 3.2 the authors should clearly point out which is the formula used for approximating the Formosat-2 NDVI response to GLA and how they obtained it. Indeed, such a relationship is particularly important in the framework of the proposed work. However, it is worth noting that, despite still considered reasonable, the accuracy is about 25%. Here, I would expect that the use of advanced non-parametric regression techniques such as for instance the Support Vector Regression (SVR) approach might

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definitely help in improving the performances (they do not allow obtaining an explicit relationship between the NDVI and GLA quantities, but would act similarly to a black box where, once provided the NDVI value, the corresponding estimated GLA value is given).

Details should be given on the number of parameters that needs to be set in the SAFY model and how the research of the most suitable value for each of them has been carried out during the optimization phase. Did the authors consider a grid search strategy? How long did this training phase last?

By analysing Figure 8, I would suggest considering the possibility that there exists a kind of bias in the simulated soil moisture (for instance due to an imprecise retrieval of Hmin). In particular, it should be properly investigated whether the lowermost samples (i.e., those where the simulated soil moisture is lower than 10%) can be considered as outliers. Under such hypothesis, it seems that the above-mentioned bias could be estimated of the order of 7-8% and, if removed, the overall agreement (independent from the vegetative period) would be definitely higher. However, the reason for a rather low agreement when samples referring to different growing phases are considered at a time might be also due to the very simple linear relationship considered between estimated soil moisture and backscattering coefficient.

The authors should provide some details about the way they used for determining wet and dry lines depicted in Figure 7. It is important to know which samples they took into consideration, since the final value of H depends on this choice.

It is worth noting that at present the proposed method could not be employed for estimating soil moisture values when no in situ information is available (due to the lack of minimal and maximal topsoil moisture values observed at field. As gathering reliable in situ information is often not possible or even feasible, some ideas should be pointed out to solve this issue.

Technical Comments:

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In Section 2.3.3 it could be useful to recall all the 6 different viewing angles of the ASAR sensor.

As also pointed out by Reviewer 1, equations (1) and (2) are general for processing ASAR data. Authors should provide values used for setting specific parameters. Furthermore, it should be clarified what does the number of pixels per independent pixel represent.

Possibly, I would suggest to insert a Figure related to one of the ASAR images used in the study. This would give a clear idea of the type of data used in the analysis.

At the bottom of page 6217, the authors should explicitly point out the reasons for which differences in the incidence angles between the three images considered might affect the reduction of backscattering coefficient.

As they are not acronym, it is more appropriate to write both “Formosat-2” and “Envisat” in lower case font.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 6207, 2010.