

Dear referee #3

Thanks for your pertinent comment of our paper-“Extension of the Hapke bidirectional reflectance model to retrieve soil water content”.

(1) 1. Introduction: please refer also to the literature of microwave RS for soil moisture retrieval and justify the choice to use optical data instead. line 22-25 pg 3668, please rephrase it is not clear enough (which categories?)

Reply: We refer the literature of microwave RS for soil moisture retrieval as following :

‘The remote sensing of microwave can provide multi-configuration (multi-temporal, multifrequency, multi-angular, and multi-polarization) radar data that make it possible to address soil moisture estimation and monitoring issues in more effective ways (Baghdadi et al., 2009). Methods use either backscattering model-based retrieval algorithms or polarimetric information derived from target decomposition techniques (Joseph et al., 2009). However, for microwave sensors, which are anyway constrained by very low spatial resolutions and low temporal resolutions. Hence the proposal to use BRDF models on optical data to retrieve soil water content is interesting in this study.’

Baghdadi, N., Boyer, N., Todoroff, P., El Hajj, M., & Bégué, A. (2009). Potential of SAR sensors TerraSAR-X, ASAR/ENVISAT and PALSAR/ALOS for monitoring sugarcane crops on Reunion Island. *Remote Sensing of Environment*, 113(8), 1724-1738.

Joseph, A., Velde van der, R., O'Neill, P. E., Lang, R. H., & Gish, T. (2009). Soil moisture retrieval during a corn growth cycle using L-band (1.6 GHz) Radar observations. *IEEE Transactions on Geoscience and Remote Sensing*, 46(8), 2365-2374.

Line 22-25 pg 3668 were rephrased as follows:

‘Soil moisture as the key factor influences absorption, reflection and emission characteristics of landsurface, which can directly cause variations in soil energy and water budget (Verhoef & Hapke, 2007). The literatures describe the relationship between soil moisture and the soil reflectance including two main methods as follows: (a) only parameters related to soil moisture are retained, while other factors influencing soil spectra are either fixed or neglected.... (b) Principal component analysis is also used to model soil moisture parameters and reflectance spectra....’

2.1 Experimental area and data acquisition,: please give more details. For instance the spectral range of the Fieldspec is not reported; in my knowledge 8 is an optics and not a probe; the common reader may have no knowledge of what the principal plane is.

Reply: We supplement some information about the field experiment. The principal plane was labeled in Figure 1 .

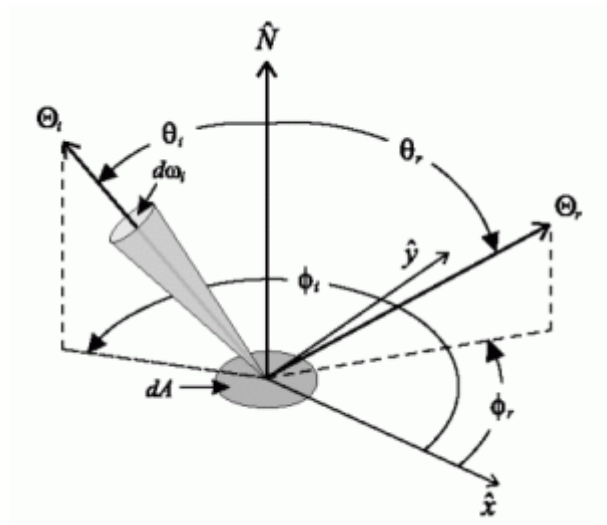
‘The ASD Fieldspec FR2500 spectrometer (350-2500 nm) and a simple multi-angle observation scaffold were adopted for the multi-angle spectral measurements (Figure 1). The field angle of the spectrometer probe was 25 °,...’

2.2 Soil BRDF

model and its extension: I think a sketch with the fundamental geometry of the radiation model could be of help for understanding, especially regarding quantities and angles as reported in equations. As regards equations: please check that every parameter is correctly reported and described in the text and specify that the radiometric quantities are also functions of the

wavelength. The shift from inherent to apparent optical properties could not be so usual for the common reader, please be more careful.

Reply: We have carefully checked all equations again. We think BRDF as the common knowledge for readers, it is not necessary for add a sketch to illustrate the geometry of the model.



The diagram of BRDF

3.1 Model parameter inversion: Why did you use single wavelength as sampled by the spectrometer and not an integration on a narrow spectral band (by example 10nm) to be more consistent with hyperspectral RS sensors?

Reply: In fact, all measured spectral were resampled into 10 nm interval again. We add a sentence in section 2.1: 'Total measured multi-angle spectral data were resampled into 10 nm intervals to be more consistent with hyperspectral sensors...'

Giving a code to the two experimental programs could increase clarity in the following text 3.1 Inversion results and 4 conclusions

Reply: We have given a code to the experimental programs as follows: Model parameters were retrieved from simulated data (Mode 1)... Model parameters were retrieved from in-situ measurements (Mode 2)....

An explanation for relationships among parameters exist in physical terms were listed in section 3.2 and 3.1.