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Hydrology and Earth System Sciences Discussions

Interactive comment on "Physical based retrieval of crop characteristics for improved water use estimates" *by* K. Richter and W. J. Timmermans

K. Richter and W. J. Timmermans

katja.rich@gmail.com

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Dear Referee,

thank you very much for your fruitful comments to our study "Physically based retrieval of crop characteristics for improved water use estimates".

We will try to answer your specific comments as clear as possible.

Comment 1 ("I find the range in ALA rather small. Could you explain why such a narrow range was chosen"):

When performing model inversion, the well known ill-posed problem occurs, meaning a strong correlation between some parameters. For the PROSPECT+SAILH model,

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for instance, the spectral signature can be very similar for a planophile canopy (low ALA) with low LAI and an erectophile canopy (high ALA) with high(er) LAI (problem discussed for instance in Combal et al., 2002 or Atzberger, 2004). One possibility to regulate this problem and to improve the parameter retrievals is the implementation of a priori information from on-site measurements. During the SPARC 2004 campaign, measurements of LAI using the LAI-2000 instrument have been carried out, measuring simultaneously the MTA (mean tilt angle) that corresponds to ALA. Due to a measured mean MTA of 50° with standard deviation of 11° (for the crops used for validation), the range of ALA was set from 40° to 60°.

Comment 2 ("Also, it would be more informative if for each LUT variable the number of steps was given"):

The LUT was established in a very simple way. All variables were randomly sampled within their bounds, for instance chlorophyll: Cab = 20 + rand(100000,1)*(70-20). In this way, all combinations of parameters were covered, but no adaptations to possible sensitivities of the parameters were implemented.

Comment 3: ("The discussion on the influence of soil moisture on NDVI is not very clear. . .")

A change in superficial soil water content or roughness (and therefore "brightness") influences the value of NDVI because the red and the visible wavelength regions do not react in the same magnitude to such brightness variations. This was shown by Bach & Verhoef (2003) and can be simulated with the PROSPECT+SAIL model. That means that for different bare soil pixels or spots with low vegetation coverage, differences in NDVI due to soil brightness variations – and not due to vegetation coverage - may occur. The value of NDVImin does not express sufficiently these variations within the imagery, leading therefore to uncertainties in the fCover estimations.

As the referee correctly remarks some vegetation indices, among which SAVI, have been developed that might perform better with respect to this issue. However, there

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are a few reasons why we choose not to consider these as an alternative:

A first reason is that we were trying to stick to the recent versions of TSEB used (French et al., 2003 and Li et al. 2005) that employ the approach as proposed by Choudhury et al. (1994). A second, and possibly more important reason, is that we wanted to address the question whether physically based approaches for retrieval of canopy characteristics would produce better results in energy balance estimates than commonly used empirical approaches. The approach used here, using a scaled NDVI, is what is (still) most commonly used in estimating fractional cover from vegetation indices: e.g. Campbell and Norman 1998; Carlson et al., 1995, 1997. Moreover, using a vegetation index like SAVI would introduce the estimation of the slope of the so-called soil-line, which is an additional subjective parameter to determine on top of the selection of the minimum and maximum values that represent the bare and fully covered cases. Undoubtedly there are methods, or parameter value settings that eventually might produce better results, possibly comparable to the physically based approach presented here, but still the subjective character typical for empirical approaches would remain. We tested however our validation data base using SAVI, which revealed a slight improvement for LAI and fCover estimations as compared to the NDVI approach. But, the physical approach achieved still a higher estimation accuracy for both the LAI and fCover.

Technical corrections will be included in the revised version!

References not cited in the manuscript:

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