Hydrol. Earth Syst. Sci. Discuss., 7, C4722–C4726, 2011
www.hydrol-earth-syst-sci-discuss.net/7/C4722/2011/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Remotely sensed latent heat fluxes for improving model predictions of soil moisture: a case study" *by* J. M. Schuurmans et al.

J. M. Schuurmans et al.

hanneke.schuurmans@dhv.com

Received and published: 16 January 2011

The paper deals with the use of thermal infrared remote sensing to improve a hydrological model. Surface temperature images were converted into ET map using the SEBAL algorithms. I have several major comments on the paper : 1) Normalisation in Equation 3 is really not understandable. If we develop it we arrive to the following correction term ETact/ETpots*(delta ETpotaverage). So the correction is the strongest when ETPots is the lowest. The term can be very important when ETpot is lower than the Delta.

This is not really justified. A single bias correction using theDelta value would be better justified. It is not clear in the text what means a 2.5 – 2.74 mm bias correction? AC: In the adjusted paper we will rephrase some sentences to explain the method. The fact is that the (by SEBAL processed) ASTER and MODIS images showed higher ET values than the model over the entire study area. This is due to the fact that the hydrological model and SEBAL use different methods. If we want to compare the reduction factor (ETact/ETpot), the values have to be in the same range.

2) Computation of the reference ET by Eq 4 needs more explanations? Is Feddes relationship suitable to be implemented in every layers? What are the assumptions on the root distribution? Why not using the soil water storage variation to estimate ET? There are much less hypothesis behind such calculation (the only one is to ignore the water flows at the bottom of the measured profile) whereas with the proposed error model error are cumulated and may be strong and very difficult to determine. AC: The ET in Eq 4 is not the reference ET but the actual ET. The hydrological model, as well as this method, assumes a uniform root distribution among the entire root depth. This means the Feddes relationship can be applied to each layer indeed. Determining the change in soil water storage would in theory be a good suggestion. As we only have VMC measurements (and no lysimeter) we think this method will involve even more assumptions.

3) In scen 2 the proposed approximation need more explanation. Can we really make extrapolation with erroneous value (i.e FRnew>1) to provide water potential in the wet domain (h>h3). The fact of having FRnew>1 reveal computation inconsistency in both ET et ETp. There is no reason to link such inconsistencies to the soil moisture. AC: In the hydrological model FR indeed can't be higher than 1, meaning the ETact equals ETpot. In this case it can be higher than 1 because the SEBAL image, despite the bias correction, can locally have higher values for ETact, new than ETpot of the model. So it is not computation inconsistency. We assume that the higher ETact, new the wetter the soil should be in reality. Stating that the soil moisture is at the reduction point (just wet

enough so ETact equals ETpot) leads probably to underestimation of the soil moisture content for those areas where ETact of SEBAL shows much higher values than ETact of the model.

4) In scen 3 and 4: I don't understand what was done. Why not applying Feddes curve with FR new or somewhere between Fr new and Frm (to take into account that both estimate are characterized with errors). AC: We understand the referees comment on this. It's indeed not clear what is done, we will explain this better in the revised paper.

5) The impact of the paper is very low since the evaluation of the RS data assimilation cannot be evaluated. However, an evaluation could be made at the measurement station level with at least the ASTER data considering their high resolution (25 m). Why this was not done instead of invoking problems in representativity (6191-8) AC: The "ASTER data" contains information of ETact and ETpot. We use an assimilation scheme that weighs the "ASTER data" and model data in order to hopefully get better information about the soil moisture content of the model. So first of all we need soil moisture information. Secondly, to make a sound evaluation one needs "objective"data. That means, data that is not used to determine the variables in the data assimilation scheme (standard error of the modeled ETact).

6) In discussion, the disagreement observed on the forest can be also a weakness of SEBAL. As a matter of fact SEBAL discriminate water stress conditions with the measurement of the surface temperature. Due to a strong roughness, the super temperature signature of forest water stress is very low and so, more difficult to detect. This explains why, water stress may not be observed with the SEBAL method. AC: The referee is right in his comment on this. We will incorporate this in our revised paper.

7) HOW Etpot is estimated by SEBAL? AC: By using a minimal stomatal resistance. We will explain this in the revised paper.

8) Figures are too small. AC: The referee is not specific in his/her comment. Does this apply to all figures? We have done our best to make the legend readable and we think

the spatial information is viewable. Perhaps Figure 5 (timeseries) is too small. In that case we suggest that one page is reserved for Figure 5 only.

9) I am not a native English speaking, but I found that English should be improved. Many editorial improvements should be made as well.

a. 6188 L24 what means VMC AC: Volumetric moisture content; is explained when used for the first time (in 6186 L9-10)

b. 6188 L16 is the unit being mm or mmd-1? I don't understand the meaning of such numbers AC: mm d-1 indeed. We don't know what the referee means with his/her comment 'don't understand the meaning of such numbers?'

c. 6189 L5-10 not clear AC: We added a sentence that hopefully makes it clear.

d. 6189 L21-22 not clear AC: we rephrased this and hope this is clear now.

e. 6191 : the notion of reduction is not clear (difference between dates or between method???). As we have no information of the water storage at both dates, all comments on temporal reduction are very difficult to follow. AC:

f. Fig 3 what means h3l and h3h AC: the referee means Fig 2, we will explain these values in the figure text.

g. Fig 4 . Units are missing for the ET AC: correct, we will change that (mm d-1)

h. Fig 5 what means left and right in the legend AC: The measurement were done in duplo for all depth. We will explain that in the figure text.

i. Fig 7 root zone storage of what? AC: We don't know what the referee means. It's the storage of the root zone (i.e. the zone where hypothetically grow roots that can take up water for evaporation).

For me the assimilation process is really the major weakness of the paper. In its present form, It should be clarified and improved. Scen 2 has no scientific meaning . The au-

thor must demonstrate that FRnew variations above 1 is related to soil moisture. Scen 3 and Scen 4 are really not clear. The paper cannot be published whithout justifying all hypothesis in the assimilation scheme. AC: the goal of our paper is to point out the value of SEBAL in the practice of hydrological modeling. This means that we didn't (want to) change the computational schemes of the hydrological model. However, we wanted to do more with the SEBAL data than just compare it with the hydrological model outcomes. We therefore described a method to assimilate SEBAL data within the hydrological model. Taking that in account, we had to deal with scenarios that have no scientific meaning as such. However, these scenarios point out the problems one faces when working with these kind of models. The Feddes scheme is an internationally applied method. Working with that scheme leads to some problems and therefore we think it is important to point out the several scenarios.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 6179, 2010.