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Hydrology and Earth System Sciences Discussions

Interactive comment on "Quantifying the uncertainty in estimates of surface- atmosphere fluxes through joint evaluation of the SEBS and SCOPE models" *by* J. Timmermans et al.

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Dear Reviewer, thank you very much for your comments on the manuscript. I have tried to adapt your comments to the paper.

Review on general comments Firstly in my overview of evapotranspiration models I focused in the original paper on energy balance models. However as you rightly stated there is a larger variety of ET estimating methods available. In order to show better background of the evapotranspiration modeling, I have added more publications about different methods for estimating evapotranspiration and recent ET products, from triangle methods to more complicated land data assimilation models. A detailed comparison between the different models however is not provided in this paper as the focus of the paper is uncertainty analysis. For such overviews/ comparison I have referred in the manuscript to overview papers, such as Kalma and Glenn.

Your main comment is that the energy balance approach cannot be used for regional applications and that less complicated models with less inputs provide a better solution for global evapotranspiration mapping. Indeed the triangle/trapezoid models that you have listed provide a good solution for large scale evapotranspiration mapping. The idea however to employ SEBS on a global scale is to provide a more physical approach to the plant-atmosphere interactions. As you stated yourself, "These two models cited In the paper are probably as good as most SVAT models in existence and can be used with good results in studying plant-atmosphere behavior for specific surface plots with accompanying ancillary surface data." The point that you make about the usefulness for operational use is therefore only limited to computer requirements (noted in the paper). However with the onset of grid-computing this can be solved. In any case the current paper does not focus on this, but identifying uncertainties and improving the parameterizations within the SEBS algorithm.

In your comments you also note that a triangle method produces better results as H or LE cannot stray beyond those limits, thereby avoiding nonsensical results, such as EF greater than 1.0. Within the SEBS algorithm both H and LE are also constrained. In contrast to other energy balance models, LE is not calculated as the residual, but through the use of EF. This EF is further constrained by converting from the relative evaporation that lies within 0.0 and 1.0, through the calculation of the 'theoretical' wet and dry limit. While noted in your comments as "The authors seem to be using this (triangle/trapezoid) approach as a sideline at the start of section 4.5, though I had trouble understanding what they were doing here with this equation" I have tried in the current manuscript to bring this better to light.

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Specific comments:

Comment 1: P2870 what do the authors mean by saying that the model can reproduce past, current and future data?

Answer: As the SCOPE model contains a detailed radiative transfer model, hyperspectral reflections can be simulated. Using a sensor simulator (and sensor characteristics from databases) any sensor performance from past to future can be identified. This is made clearer in the current text. "p6 The advantage of simulating band radiances enables simulation of remote sensing imagery during cloudy days when actual sensors only will measure clouds. This than leads to estimation of evapotranspiration for dates when there is no remote sensing observation and is therefore suitable for creating long time series. In addition the capability of simulating remote sensing data from arbitrary sensors can be used to investigate the effectiveness of future satellites, and reanalyze"

Comment 2: P2874. I wonder if my pages did not print properly. I have no equation 11.

Answer: I believe that the printing in your version went wrong. In the PDF version, and the printouts (from multiple prints) equation 11 was printed correctly.

Comment 3: If the EF swings up or down at the end or beginning of the day, the resultant error in assuming constancy of EF with time during the day would be minimal because the fluxes themselves would be much smaller at the beginning and end of the day.

Answer: Indeed, as the reviewer noted the variability of EF in morning and afternoon has little impact due to the low available energy for evapotranspiration.

Comment 4: P2880. Here I became confused on line 25, where the authors refer to an 'original parameterization' that uses a weighted average approach for H and LE. This would seem to be the two stream idea I just mentioned, though the previous discussion did not seem to indicate that such a two stream methodology was being applied. Please enlighten this reviewer on this point! Finally, if the authors have not already checked out the literature on the triangle method, they should look at the various papers by Jiang and Islam, Carlson, Petropoulos, and others (though my memory seems to be blocked at this point).

Answer: I did not fully understand this comment. In SEBS there is no weighted average approach to calculate H and LE. Only two weighting average approaches are in the original SEBS model. A weighted average approach was present in the original SEBS algorithm for the calculation of ground heat flux. This parameterization in this paper is changed to an exponential decay of radiation using LAI. The other weighted average approach was in the calculation of KB-1 (dividing between soil and vegetation). SEBS can indeed be run parallel if two runs are performed: one with fc=0 and the other with fc=1. This will than provide H and LE for both scenarios and pixel estimations can then be estimated using a weighted average approach. However if fc is in between 0.0 and 1.0 a mixed term should be present, as air rising from the surface is affected by the overlying (nonclosed) vegetation. The weighting between the two scenarios will than not only be a function of the fractional vegetation cover, but also on LAI. Instead SEBS calculates the effect of mixed vegetation and applies a single source approach.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 2861, 2011.