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Interactive Comment

Interactive comment on "The WACMOS-ET project – Part 1: Tower-scale evaluation of four remote sensing-based evapotranspiration algorithms" *by* D. Michel et al.

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We appreciate this reviewer's good comments and address his/her comments as follows:

1. More references needed in introduction

Some state-of-art evapotranspiration studies have not been included, especially recently published in Scientific Reports and Environmental Research Letters.

Mao J, Fu W, Shi X et al. (2015) Disentangling climatic and anthropogenic con-

trols on global terrestrial evapotranspiration trends. Environmental Research Letters, 10, 094008.

Zhang K, Kimball JS, Nemani RR, Running SW, Hong Y, Gourley JJ, Yu Z (2015) Vegetation Greening and Climate Change Promote Multidecadal Rises of Global Land Evapotranspiration. Sci Rep, 5, 15956.

The articles above have been added to the introduction as follows:

"Based on the Mueller et al. (2013) methodology, Mao et al. (2015) synthesized a global ET time series for the period 1982-2010 based on a set of diagnostic ET products (including data sets produced with PT-JPL and GLEAM) to investigate the role of anthropogenic and climatic controls on ET trends. For the period 1982-2013 Zhang et al. (2015) produced a satellite-based global ET data set using remote sensing data and daily surface meteorology records for the investigation of multidecadal changes in ET, which was validated against precipitation and discharge records."

Zhang, Y. et al. Multi-decadal trends in global terrestrial evapotranspiration and its components. Sci. Rep. 5, 19124; doi: 10.1038/srep19124 (2015).

We couldn't find this article. Maybe it is currently in press. We are happy to include it once it is published.

2. Parameterisation There is no summary on parameterising the four selected ET models.

True. Being that all the models are well established within the ET research community we felt that just highlighting the main model particularities would be enough. But we are happy to add the following short paragraph at the beginning of section 2.1, summarizing how the models relate to each other:

“The four algorithms selected here estimate the fraction of the available energy at the surface used by the soil and canopy evaporation processes. Therefore, the available energy (i.e. the difference between the surface net radiation and the ground heat flux) is a key input for all algorithms. However, this evaporative fraction is parameterized differently by each model. SEBS is an energy balance model (Su, 2002) based on a detailed parameterization of the sensible heat flux at the surface, where ET is estimated as the residual of the surface energy balance once the sensible heat flux is calculated. Therefore, key inputs are the surface temperature and the temperature gradient between the surface and the air, and a key component of the model is the aerodynamic resistance to sensible heat transfer. PM-MOD (Mu et al., 2011) derives ET directly based on the Penman-Monteith equation (Monteith, 1965), which relates the latent heat flux to the vapor pressure deficit between the surface and the overlying air, and requires a resistance parameter to characterize the canopy transpiration. PT-JPL (Fisher et al., 2008) and GLEAM (Miralles et al., 2011a) are based on first determining the potential evaporation by applying the Priestley and Taylor equation (Priestley and Taylor, 1976), followed by reducing the potential evaporation to actual evaporation with a number of evaporative stress factors. The derivation of these stress factors is different between both models. PT-JPL requires the vapor pressure deficit, relative humidity and visible-infrared related vegetation indexes, while GLEAM combines microwave data of vegetation optical depth and soil moisture. A more detailed description of the input requirements for each model can be found in Table 1, while a more comprehensive description of each individual model is given in the following sections.”

The systematically overestimated or underestimated ET is mainly caused by the inappropriate parameters setup.

We are not sure we understand perfectly what the reviewer implies by "inappropriate parameters setup". We would argue that model performance is a combination of the model structural formulation, the actual value of the parameters used by the formulations, the choice of datasets selected to run the model from the available pool of existing observations for each required input, and even the quality of the metric used to evaluate the model performance. So even if a given model is carefully parameterized (as we imagine is the intention of all model developers), the choice of formulation and input data errors will have an impact on how the model performs. The problem is that disentangling the effect of each source of uncertainty is very challenging, even if careful experiments as the ones described in the paper are carried out. If it was all that simple, we would possibly not be reporting the large differences between the different ET estimates we currently see in most ET product inter-comparisons.

For example, the key variable surface conductance or surface resistance in the Penman-Monteith equation needs to be carefully parameterised. It requires at least one free parameter (the maximum stomatal conductance) in each biome.

The surface conductance of the Penman-Monteith model used in the study is based on a Biome Properties Look-Up Table where 9 parameters are calibrated for 11 different biomes (Table 1 in Mu et al., 2011, doi:10.1016/j.rse.2011.02.019). Certainly there can be ground for improvements as in any of the models we looked at, but as we discussed above the exercise of linking observed model performance with model deficiencies (in this case related to the surface conductance calibration) is not straightforward.

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It is not appropriate to draw a conclusion that x model outperforms y model without considering parameterisation schemes. At least, this issue should be discussed thoroughly.

The reviewer raises a very important issue here: how to attribute estimated ET differences to the differences produced by the choice of model forcing and parameterizations. Although we share his concerns, we disagree with the reviewer: we still think that publishing our findings contributes to the field, even if the current lack of understanding of how ET product difference relates to algorithm structural errors and/or input uncertainties clearly demands further research. Indeed, these publication findings are guiding an extension of the project, where studies more dedicated to relate product differences to the choice of models will be carried out in the framework of a merged multi-product dataset.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 10739, 2015.