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Geoscientific Model Development Discussions

Interactive comment on "The GEWEX LandFlux project: evaluation of model evaporation using tower-based and globally-gridded forcing data" *by* M. F. McCabe et al.

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This discussion paper evaluated the performance of four remote sensing-based ET models at 45 eddy-covariance sites across the globe. The authors found that there is not a single model consistently outperform any other models across biomes and climate zone, even they did find some models (i.e., PT-JPL and GLEAM) performs generally better than the other two. In addition, they concluded that all models show better performance when applied with observed meteorological variables at the site-level but perform worse using coarse gridded meteorological fields.

While I tend to agree this is an interesting and important study as we continue on the way of better global ET mapping, it has several issues. First of all, I do not think it is appropriate to compare ET estimates at the grid-cell scale (i.e., 0.5o in this case, or

$\sim$ 55 by 55 km) with flux-tower measurements (usually have a footprint of 1$\sim$2 km). The spatial heterogeneity in soil, vegetation and micro-climate can lead to large spatial variation in ET within one grid-box. This issue can be more strongly manifested if there were large variation in topography (leads to strong climate gradients) or vegetation type (the grid-box sits on the boundary of two biome types). Therefore, their conclusion regarding grid-box evaluation is no longer stand. In this sense, secondly, a big concern is what is the advancement of this study over a recently published paper in AFM (also conducted by the same group of authors, i.e., Ershadi et al., 2014, Multi-site evaluation of terrestrial evaporation models using FLUXNET data, AFM). In Ershadi et al. (2014), four models (three of them are used in this study, including PT-LPJ, SEBS, and PM-Mu) were evaluated at 20 flux sites, most of which (or all, I did not check) are also used in this study. What is the difference between using 20 and 45 sites, if they both intent to represent a "global situation". On to content there is not much difference between the two studies, given that the grid-box scale evaluation performed here is not valid. Moreover, these two studies even come to a similar conclusion that PT-JPL seems to perform generally better than the other models.

There are also some specific comments: 1. Page 6823-Line 1. Soil evaporation in PM-MU is not entirely based on the Penman-Monteith equation, although it uses PM to estimate potential ET over unsaturated surface. Then, the effects of soil moisture restriction on soil evaporation are reflected by meteorological forcing based on the complementary relationship. 2. Page 6824-Line 25. Ep is the annual potential evaporation. 3. The PM-Mu model was designed to run at a time scale longer than a day, and so the model parameters were calibrated at that time scale. If using the default parameter value at the instantaneous time scale, there can be some uncertainties. This issue needs to be mentioned and discussed. 4. Page 6826-Line6. Figure 4 should be Figure 3. 5. Page 6826-Line13-15. This is not supervising, because primary use of meteorological data does not allow PM-Mu to effectively capture the soil moisture restriction on ET on a physical basis. The consequences of that are a slower response of variations in energy and heat fluxes than the thermal remote sensing-based ET models

and unreasonable spatial ET patterns (because the spatial variation in soil moisture is usually much larger than that in climate variables and vegetation types). 6. Line 6827-Line 15. Why the aridity index varies between 0 to 1? P can be larger than Ep, for example, in Amazon. 7. Page 6835-Line 24. I am not sure if the performance of SEBS is that highly dependent on vegetation height. As shown in this study, SEBS also fails in estimating ET over shrubland, where vegetation height is generally low (shorter than 3 m). To me, the key issue here is single-source vs multi-source. SEBS is a single source model that does not allow partitioning between soil evaporation and plant transpiration. In shrubland ecosystems where vegetation cover is usually low and highly non-uniform, soil evaporation account for a large proportion of the total ET. In this case, I would expect that SEBS overestimates ET, as demonstrated by the authors. Similar conclusion was made in a comparison study by Choi et al. (2009), in which they found that multi-source models consistently outperform single-sources models, and the largest discrepancy was found in areas with LAI smaller than 2 (indicate low vegetation cover and possibly non-uniform cover). 8. Page6840-Line10 While I tend to agree that coarse resolution meteo files will reduce the model performance, I do not see this point is well supported by the analysis here. Again, this is due to inappropriate validation of 0.5 degree ET estimates by using 1$\sim$2 km2 flux-tower observation. This is wrong.

Ref: Choi et al. (2009). An intercomparison of three remote sensing-based surface energy balance algorithms over a corn and soybean production region (Iowa, U.S.) during SMACEX. Agr. Forest. Met., 149, 2082-2097.

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