Hydrology and Earth System Sciences Discussions

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1
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# Comment on hess-2021-436

Anonymous Referee #1

Referee comment on "Testing a maximum evaporation theory over saturated land: implications for potential evaporation estimation" by Zhuoyi Tu et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-436-RC1, 2021

**General comments**

The authors have validated the maximum evaporation theory originally developed for oceans over global saturated land surfaces. I think this paper is a good extension of Yang et al. (2019) and is of great importance for land potential evaporation estimation.

**Specific comments**

1. In the last paragraph of introduction, the author intended to test their ocean research directly over saturated lands without any comparison between two different surfaces. I suggest to add some discussions on comparison (vegetation effect?) between ocean and land surface, which was mentioned in discussion. I think this kind of comparison can highlight the importance of this research and also can help authors to propose scientific hypothesis.

2. In introduction, the authors have pointed out the limitations of Penman and Priestley-Taylor model. So please simulating evaporation with this two models at select site-days, and then compare simulations to maximum evaporation method results. To see if maximum evaporation method show higher performance than the two classical models.

3. In section 2.1, the residual approach was used to force energy balance for EC flux data. The method will decrease Bowen ratio because latent heat flux usually increase after adjustment due to lack of energy balance for EC method, while sensible heat keep the same. The residual method not only changed latent heat flux, but also changed the Bowen ratio. And Bowen ratio is a very important variable in your research. I think the residual approach is not the optimal one here. You can try the method proposed by Twine et al. (2000). Twine method assumes that even though the EC latent and sensible heat fluxes are not measured accurately, the resulting Bowen ratio is accurate. Then turbulent fluxes are adjusted without changing the Bowen ratio.

*Twine, T.E., Kustas, W.P., Norman, J.M., Cook, D.R., Houser, P.R., Meyers, T.P.Prueger, J.H., Starks, P.J., Wesely, M.L., 2000. Correcting eddy-covariance fluxunderestimates over a grassland. Agric. Forest Meteorol. 103, 279–300.*

4. Equation (2). Please describe obtaining surface emissivity value with MOD11A1 products in more detail, such as time scale (different emissivity value for different day?), spatial scale (the matching between site location and MODIS pixel) and missing data problem (how to deal with conditions with no MOD11A1 for some site-day).

5. Around line 110. The data with negative sensible heat flux with advection (maybe caused by mesoscale circulation or synoptic system) were removed in the research. So maximum evaporation theory can be not used under advections. This is one of difference between relative homogeneous ocean surface and complicated land patches. Please add some discussions on this topic in your discussion part, especially the cautions of applying maximum evaporation theory (limitations?) over saturated land surface.

6. Around line 125. The calculation of $\tau$ here is same to clearness index. So atmospheric transmissivity here is identical to clearness index?

7. Around line 135. " the key processes governing the interactions between incoming and outgoing longwave radiations are essentially the same for ocean and land (mainly greenhouse gas effect)". Firstly, what is the interaction between incoming and outgoing

longwave radiation? Secondly, I think the longwave effect process caused by well-mixed GHGs is similar for ocean and land. But clouds and aerosols are different between ocean and land, both two have great effect on longwave radiation.

8. Equation (7). You indicated that latent heat of vaporization is a weak function of temperature, so please state this with words and show the calculation formula.

9. Around line 155. You explained why Bowen ratio over land is larger than ocean value in discussion section from stoma resistance. If stoma resistance is the main reason, Bowen ratio of sparse vegetated land should be close to ocean value, and dense vegetated land should be much higher than ocean value. Can this inference be reflected in Figure2? In addition, aerodynamic resistance for sensible and latent heat flux is thought to decrease with roughness (Zhao et al., 2014). So roughness difference between land and ocean can be used to explain the Bowen ratio difference? Please add some discussion on roughness effect.

*Zhao, L., Lee, X., Smith, R. B. & Oleson, K. Strong contributions of localbackground climate to urban heat islands. Nature 511, 216–219 (2014).*

10. “since $T_s$ is very sensitive to changes in LE (Figure 3)” I think it should be “LE is very sensitive to changes in $T_s$” here.

11. Around line 265. I think the maximum evaporation approach need both incoming solar radiation and reflected solar radiation. If so, using “incoming and reflected solar radiation” is more accurate than “ultimate external forcing”.

12. Symbols and lines are hard to be distinguished in Figure 2. Please improve it.

Please add the line of Priestley-Taylor model in Figure 2, which can give some implications for PT model applicability for different land surface.

**Technical corrections**

1. “Our results found this held over saturated lands but with considerable scatter (Figure 3)” It should be Figure 2 here.