Biogeosciences Discussions

Biogeosciences Discuss., referee comment RC2
https://doi.org/10.5194/bg-2021-356-RC2, 2022

Comment on bg-2021-356

Anonymous Referee #2

Referee comment on "A coupled ground heat flux–surface energy balance model of evaporation using thermal remote sensing observations" by Bimal K. Bhattacharya et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-356-RC2, 2022

Review on 'A Coupled Ground Heat Flux-Surface Energy Balance Model of Evaporation Using Thermal Remote Sensing Observations' by Desai et al.

The manuscript aims to couple a ground heat flux model with a surface energy balance (SEB) model to estimate G, LE and H together. The study reports that the combined model can estimate the surface energy fluxes with about 20 – 25% difference with respect to the in-situ observations. The manuscript is technically good and is suitable for the journal after a through revision, addressing the comments given below.

- The manuscript needs to be improved in terms of English language usage. I will highlight few sentences which I felt are not clear to understand in the following comments. However, a through revision in language usage is necessary. Also, I felt the manuscript to be little lengthy and I was forced to go back and forth to understand the details.
- It has been clearly mentioned that the manuscript is not intending to compare this coupled model with other existing SEB models. However, it will be good to have a comparison between a standalone STIC1.2 model and the coupled STIC-TI model. Also, please highlight and discuss if this coupling is improving the estimation of surface energy fluxes.
- The manuscript focusses on arid and semi-arid ecosystems where G can be a large component of the surface energy balance. Further, the authors have reported that the LE and G is sensitive to the LST observations. Over such arid or semi-arid ecosystems, it has been reported that the MYD21 LST (based on the Temperature Emissivity Separation algorithm) product might work better than the MYD11 product. May I suggest the authors to test if MYD21 product is better suited than the MYD 11 product for this coupled model?
- Among the different components of surface energy fluxes, the in-situ observations of G and soil temperature are indeed strictly point observations when compared with LE, H or even Rn. In Equation 12, I think the ground observed soil temperature amplitude and satellite LST are combined towards developing the regression relationship. Is this valid considering that there can be varying soil conditions that can affect the amplitude

of the soil temperature in a pixel?

- Further, satellite LST can represent soil temperature only over bare surface. Till what level of fraction vegetation cover, can we use LST to estimate the amplitude of soil temperature? Can the results in Section 4.1 be separated in terms of fc to see if there is any decrease in accuracy in estimating A with increasing vegetation cover?
- The STIC-TI model uses difference in LST between day and night. MODIS observations of LST can vary significantly in terms of viewing angle or increase in GIFOV due to the ground point being away from the nadir between day and night observations. Is this taken into consideration? Can the results be separated for LST observations made with similar viewing angles and different viewing angles during day and night?
- As mentioned clearly, the method by Bastiaanssen (1998) was able to retrieve G with accuracy closer to that of the STIC-TI model. Is this due to the fact that both the models use LST, NDVI and albedo as key inputs to the 'G' model? Also, what benefit does the STIC-TI brings over the model by Bastiaanssen? We can look at the diurnal variation of LST to get more information about the ecosystem processes than the soil temperature amplitude, I think.
- There can be a considerable difference between the diurnal behavior of soil temperature at the surface (skin temperature) and soil temperature at 10 cm depth. Further, for modelling G, the soil skin temperature is the actual boundary condition. Can the authors please explain the reason for using soil temperature measured over 10 cm depth as the boundary condition rather than the skin temperature? In addition, over two sites (Ind-Dha and AUS-Ade), soil temperature observations are done at or below 10 cm depth. How this has been used in the study in place of soil temperature up to 10 cm depth? When there are more than one soil temperature observations within 10 cm depth (AU-ASM, US-Ton and US-Var) were they averaged?

Other comments:

- Lines 103-104, Please mention the key conclusions of the studies that you are referring to and explain why this study is needed.
- Lines 181-182 The fetch ratio of …90% of fetch area: This sentence is not clear. Are the authors trying to say that the assumed fetch area around the towers accounted for 90% of the energy fluxes?
- Figure 1 caption can be shortened and made precise.
- Lines 237-238: Non-availability of G over Indian sites is an issue. The authors have explained about the this at the end of the discussions section. But any studies supporting the use of unclosed energy budget from EC observations and lack of G observations will be helpful here.
- Lines 268-269: The land surface emissivity was estimated from land cover types, atmospheric water vapour and …retrieval': I think MODIS emissivity is estimated from land cover type and anisotropy factor. The other variables mentioned here are used in the retrieval of LST with the split window algorithm. Please rewrite the sentence.
- Lines 271-272: How albedo was estimated from the white sky and black sky albedo available in the MCD43 product?
- Line 273-274: The line 'eight day compositing … (MYD11A2)' appears little confusing. Do you mean that the compositing dates were obtained from MYD11 product? Please rewrite clearly.
- Lines 295-296: Is point (4) a contribution of this study? I think that is the nature of the TI model selected for coupling. Also, what is meant by 'moisture constants'?
- Lines 303 – 304: Will the amplitude vary with each harmonic component? If yes, the A has to be replaced with A_n.

- Lines 310-312: How φ_n' can be taken as zero and k can be assumed to be one when noon-night data is considered? Please explain clearly.
- In equation (2), the first term in the inner bracket of sin term is 'nωt'. However, this becomes ωt' in eqn. (3). Are the symbols consistent here?
- Lines 331-332: It is mentioned that figure 2 contains theoretical and observed trajectories of soil temperature. However, only one curve is seen in the figure and I am not sure if it is theoretical or observed. Please check.
- Lines 339-340: How T_{STmin} can be assumed to be closer top deep soil temperature as well as minimum soil temperature of other layers? Any data/studies to show this?
- Lines 342-344: Have you used the OzFlux sites data to create Figure 2 or for the entire analysis?
- Line 438: 1.5 K repeats twice. Please check.
- Line 579: What is 'clothesline effect'?
- Figure 12: Expect the relationship between M and thermal inertia in the first plot, there seem to be no direct link between other variables in the other plots. What is the key take home message from this figure?
- Line 627: …'range of 2-3 K with a standard deviation of 0.009'. I think the 0.009 corresponds to the standard deviation in surface emissivity in MODIS product. Please check.