

Hydrol. Earth Syst. Sci. Discuss., referee comment RC3
<https://doi.org/10.5194/hess-2022-125-RC3>, 2022
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Comment on hess-2022-125

Anonymous Referee #3

Referee comment on "Accuracy of five ground heat flux empirical simulation methods in the surface energy balance-based remote sensing evapotranspiration models" by Zhaofei Liu, Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2022-125-RC3>, 2022

The main target of this paper is to test several empirical formulations of the ratio between the soil heat flux G and the net radiation R_n , which is a key issue for estimating evapotranspiration through surface energy budget models forced by instantaneous remote sensing surface temperature data.

Main issues with the paper are:

- The evaluation dataset is based on the sole estimate of G as a residual of the energy budget from flux tower measurements; G being usually small compared to the turbulent fluxes, the total uncertainty is high, and a more robust method would have been to do, as classically done, a correction of the subsurface soil heat flux plates measurements, with potentially a further correction with the residual G estimate, bearing in mind that turbulent fluxes are generally underestimated. Furthermore, the FLUXNET dataset is not representative of the agro-eco-types where remotely sensed ET estimates are required; especially, crops in Mediterranean and semi-arid climates are largely underrepresented. This limits the study's impact.
- The number of empirical equations under study is limited, esp. regarding previous works (Sun et al., 2013*, Bonsoms and Boulet 2022**)
- I am concerned with Figure 1a: H and R_n are equal ! Also, why are the flux values so low for half hourly flux estimates ? Some explanation is required here; if G is the residual, the energy budget is closed, the SEB average of all sites should also be closed for each half hourly value, i.e. $R_n - G = H + LE$. Also, G' seems to be an uncorrected G measurement at a few cm depth (please confirm, G' is actually not defined properly in the paper), the corrected G' at the surface should be shown and analysed for all sites compared to G , esp. since the normalized (G) and (G') looks similar (1e versus 1f).

Detailed comments:

- Line 7: what is the difference between “intra-day” and “diurnal” ?
- Line 9: add that G is required for RD ET models based on the SEB forced by radiative surface temperature (it is of no importance for other models).
- Line 9: add “empirical”, i.e. “G empirical estimation methods”
- Line 13: “the two methods ... ”: revise the sentence ; I find a bit contradictory that calibrated G/Rn based on NDVI and fractional cover have contrasted performances.
- L65 to 77: all models based on forcing SEB with land surface temperature need an estimate of G/Rn, no need to review them all, better provide an updated review of all G/Rn equations
- Line 140: we can’t use only calibrated parameters for operational applications (i.e. satellite products) so it is important to also test the default (published) parameter values (comment also made by other reviewers).
- Line 370: NO, Santanello and Friedl (2003) do NOT need LST
- Line 420: I don’t understand this sentence

* Sun, Z., Gebremichael, M., and Wang, Q.: Evaluation of Empirical Remote Sensing-Based Equations for Estimating Soil Heat Flux, *Journal of the Meteorological Society of Japan*, 91, 627-638, 10.2151/jmsj.2013-505, 2013.

** Bonsoms, J., and Boulet, G.: Ensemble Machine Learning Outperforms Empirical Equations for the Ground Heat Flux Estimation with Remote Sensing Data, *Remote Sensing*, 14, 1788, 10.3390/rs14081788, 2022.