

### **Author's response**

**We thank the reviewer for the additional suggestions in the revised version. The revisions are included and line numbers in the response corresponds to the 'track change' version of the manuscript.**

**Comment:** Though most of my comments are addressed properly, the comment that I raised on the variation of STIC-TI modelled fluxes with variation in MODIS sensor look angle has not been addressed completely. The authors have addressed it partially by mentioning that the flux estimates vary with the view angle of the sensor during daytime but not night time. Since the model needs day-night LST difference, both images could have been acquired with different sensor look angle. I asked the authors to check if the fluxes modelled by STIC-TI will be affected due to the sensor view angle changes between day and night observations.

**Reply:** Quantification of the modeled flux errors with respect to day-night view angle difference is done with additional analysis and is presented in Figure F in Appendix F. Relevant text is modified with new findings in section 4.4 between **line 582 to 594**.

**Comment:** Further, in the revised manuscript, Appendix-F is not really clear. What is meant by deviation? Instead of just presenting a histogram (which did not help at all), can the authors please quantify the errors in the modelled output with different look angles?

**Reply:** Quantification of the modeled flux errors with respect to day-night view angle difference is done with further analysis and is presented in Figure F in Appendix F. Relevant text is modified with new findings in section 4.4 between **line 582 to 594**.

**Comment:** It is assumed that MODIS aqua will collect data at 1:30 PM and 1:30 AM always. This may not be true always. This time can vary widely even by more than 30-45 minutes. I think this will affect the modelling of G through the mechanistic model. Can the authors please explain this more?

**Reply:** The standard deviations of MODIS Aqua day-night overpass time over study sites were found to be within 30-45 minutes. The possible impact of deviation of MODIS Aqua overpass time on LST and fluxes is explained in section 5.2 between **line 727 to 731**.

### **Minor comments:**

**Line 39: SEB is not expanded in the first place of usage. Please expand.**

**Reply:** Expanded in line 32 in the abstract. It reads as follows:

One of the major undetermined problems in evaporation (ET) retrieval using thermal infrared remote sensing is the lack of a physically based ground heat flux (G) model and its integration within the surface energy balance (SEB) equation.

**Line 46:** Replace 'was' with 'were'

**Reply:** Corrected

**Lines 48-49:** How overestimation of  $R_n$  will lead to over estimation of just LE? Overestimation of  $R_n$  need not only lead to over estimation of LE. It can also lead to over estimation of H. Can the authors explain this statement given in the manuscript?

**Reply:** In the manuscript we stated that the overestimation of LE was associated with the overestimation of net available energy (i.e.,  $R_{Ni} - G_i$ ) and use of unclosed surface energy balance measurements.

It has two aspects. Firstly, net available energy is an important component for estimating LE through the Penman-Monteith equation. If an overestimation of net available energy leads to overestimation of LE by STIC-TI, then H will be obviously underestimated according to the complementary form of the Penman-Monteith equation. Secondly, the widespread lack of surface energy balance closure is well known, which leads to LE (H) being undermeasured (overmeasured) in the eddy covariance system. Therefore, the validation of overestimated LE (due to  $R_{Ni} - G_i$ ) with undermeasured LE will lead to net overestimation in LE, and for H it will be vice-versa. However, to make it more clear, we corrected the sentence in the abstract (line 47 – 49) as follows:

Overestimation (underestimation) of  $LE_i$  ( $H_i$ ) was associated with the overestimation of net available energy ( $R_{Ni} - G_i$ ) and use of unclosed SEB flux measurements in  $LE_i$  ( $H_i$ ) validation.

**Line 56:** Will the TRISHNA mission provide both noon and night observations as needed by this model?

**Reply:** Yes, it will. It is also applicable for the LSTM (Land Surface Temperature Monitoring) and SBG (Surface Biology and Geology). We modified the last sentence of the abstract as follows:

Findings from this parameter-sparse coupled G-ET model can make a valuable contribution to mapping and monitoring the spatiotemporal variability of ecosystem

water stress and evaporation using noon-night thermal infrared observations from future Earth Observation satellite missions such as TRISHNA, LSTM, and SBG.

**Line 73: Change 'By contrast' to 'in contrast'**

**Reply:** Corrected

**Line 77: Change 'remained' to 'remains'**

**Reply:** Corrected

**Lines 143 and 144: How such a small number of sites will represent the entire northern and the southern hemispheres? Please modify this suitably.**

**Reply:** We deleted the term 'representing'.

**Line 176: delete the word 'were' (The remaining percentage of fluxes originated from...)**

**Reply:** Corrected

**Line 191: leave a space between 3 trees ha<sup>-1</sup>. Also, is it only 3 trees per hectare?**

**Reply:** Corrected as 3 trees per hectare.

**Line 192: US-var is a (leave space between 'is' and 'a').**

**Reply:** Corrected

**Equation 3: What is t'? In the next equation it is mentioned as t.**

**Reply:** It is a typo error. It is 't' instead of t'. We have corrected it in equation 3.

**Line 298: Is  $\Delta t$  a constant and held equal to 1.5? Then why is it necessary to calculate it as a function of  $f_c$ ?**

**Reply:** Murray and Verhoef (2007) initially proposed constant  $\Delta t$  which is equal to 1.5. However, Maltese et al (2013) later modified as a function of  $f_c$ . We have used  $\Delta t$  as a function of  $f_c$ . Text is modified accordingly in [line 295 to 299](#).

**Figure 2: I had asked the same query previously. I think only the observed curve is mentioned in the figure but not the theoretical trajectory.**

**Reply:** Theoretical trajectory is published in literatures earlier, which we have mentioned. However, the observed curve is more important for the study to develop G model. Therefore, we have shown the observed curve.

**Lines 402 and 403: What is PMEB? Please expand the abbreviations in the first place of usage.**

**Reply:** Expanded in [line 398 - 399](#).

**Line 497: 'slab' doesn't appear to be a right choice of word. You may use the word 'class'.**

**Reply:** Corrected.

**Lines 713 and 714: My same question regarding overestimation of H as raised in the abstract remains here too.**

**Reply:** Already explained above. To add better clarity, we added the [following in line 717 – 721](#).

Since available energy is an important component for estimating LE through the PMEB equation, an overestimation of net available energy leads to an overestimation of LE by STIC-TI. Sensible heat flux will be consequently underestimated due to the complementary nature of the PMEB equation.