RESPONSES TO COMMENTS FROM REFEREE #1

The manuscript has been much improved, but some of my comments and suggestions were not well addressed. I'd like to remind the authors that all responses should be incorporated into the main-body manuscript or supplementary file.

Responses: We thank this reviewer very much for the valuable comments and suggestions, which are believed to be very useful for us to improving the study. Now, we have revised this manuscript, and the detailed information could be found below and the revised version.

(1) Figure 1 is of poor quality should be improved in terms of its resolution and size of font.

Responses: Thanks for your comment. We have redrawn this figure (see below or the revised manuscript). In this redrawn figure, the size of font has been enlarged. We have checked the resolution of this figure, and it has a resolution of 600 dpi. Notably, when the word document was saved as a PDF format (all the files should be submitted according to the journal's requirements), the resolution may become lower.

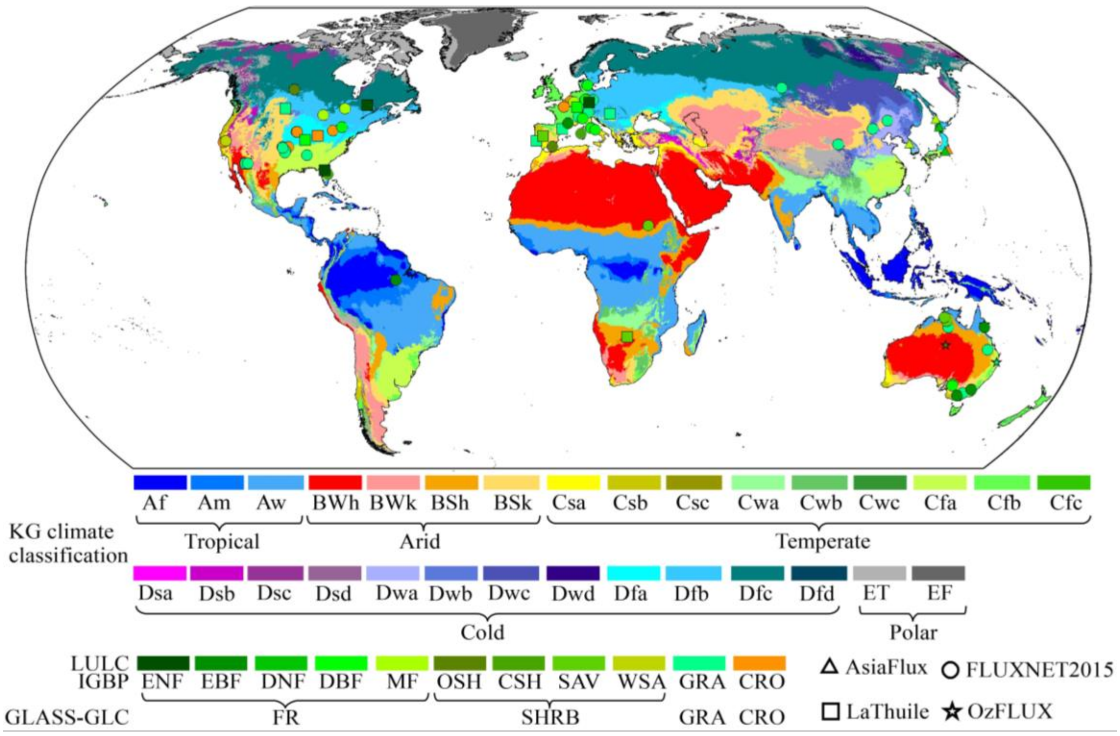


Figure 1: Locations of the used EC sites in this study over Köppen-Geiger (KG) climate regions (Beck et al., 2018). International Geosphere-Biosphere Programme (IGBP) classification system: CRO—cropland; GRA—grasslands; DBF—deciduous broadleaf forest; EBF—evergreen broadleaf forest; ENF—evergreen needleleaf forest; MF—mixed forest; CSH—closed shrubland; WSA—woody savannah; SAV—savannah; OSH–open shrubland. GLASS-GLC classification system: FR—ENF, EBF, DNF, DBF and MF; SHRB—SAV CSH, OSH and WSA; GRA; CRO.

(2) The responses to my last comment 5 are not satisfying. I cannot agree with the authors. If the physical full-factorial scheme of Jiang et al. is of low confidence in filling ET gaps, the gap-filled ET by the marginal distribution sampling method (a look-up table method) should be of much lower confidence and thus cannot be applied in the authors' study. The authors should make a more objective and positive appraisal of the physical full-factorial scheme of Jiang et al.

Responses: Thanks for your comment. We are sorry for that our responses and revision confused the referee. Originally, we would like to state that the gap-filled ET by the marginal distribution sampling method (***rather than the physical full-factorial scheme of Jiang et al.***) may introduce uncertainties into our study. Then, we re-calibrated and re-validated the SW model against the data points without gap-filling, and found that the gap-filled ET by the marginal distribution sampling method had limited impacts our study. We agree with the referee that the physical full-factorial scheme of Jiang et al. is better than the marginal distribution sampling method. Now, for removing the confusion, we have reorganized these sentences, such as "*In this study, for maximizing the use of data, the MSD method was employed to fill the gaps in the EC LE measurements. However, we should note that if the controlling thermodynamic and kinetic factors of the atmosphere and soil moisture conditions are different between the missing and retrieved moments, the gap-filled LE based on the MSD method may be of low confidence, especially when soil moisture has abrupt changes (Jiang et al., 2022). Recently, Jiang et al. (2022) developed a physics-based full-factorial scheme to fill gaps in ET from EC observations, and found that the gap-filled ET with this scheme showed higher confidence relative to the existing typical gap-filling methods. Therefore, to reduce the uncertainties from the MSD-based gap-filled LE, the physics-based full-factorial scheme could be a good candidate in the future to fill the ET gaps. Here, to quantify potential impacts of the MSD-based gap-filled values, the SW model was re-calibrated and re-validated against the data points without gap-filling. Relative to the SW model used in this study, the new* r_{smin} *and the validation metrics changed insignificantly (Figures S6, and S7), suggesting that the uncertainties induced by the gap-filled LE were limited.*" **(L575-585)**

(3) The Figs. R2 and R3 in the responses to my last comment 5 should be incorporated into the

main-body manuscript or supplementary file.

Responses: Thanks. The Figs. R2 and R3 (i.e., Figures S6 and S7 in the supplementary materials) has been added in the supplementary file. Please see the revised supplementary materials or below.

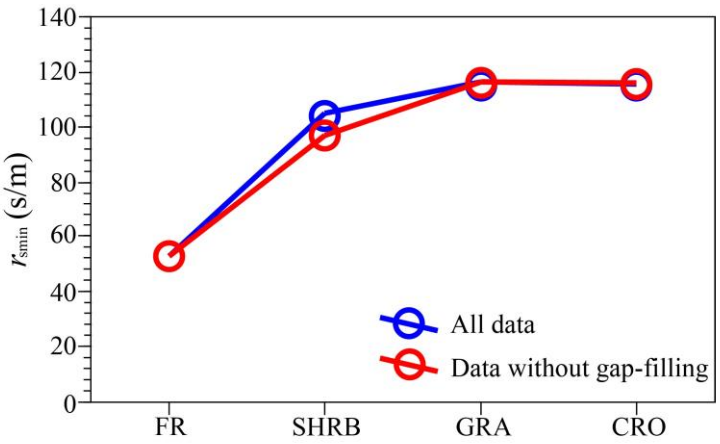


Figure S6: The calibrated r_{smin} based on all data and data without gap-filling.

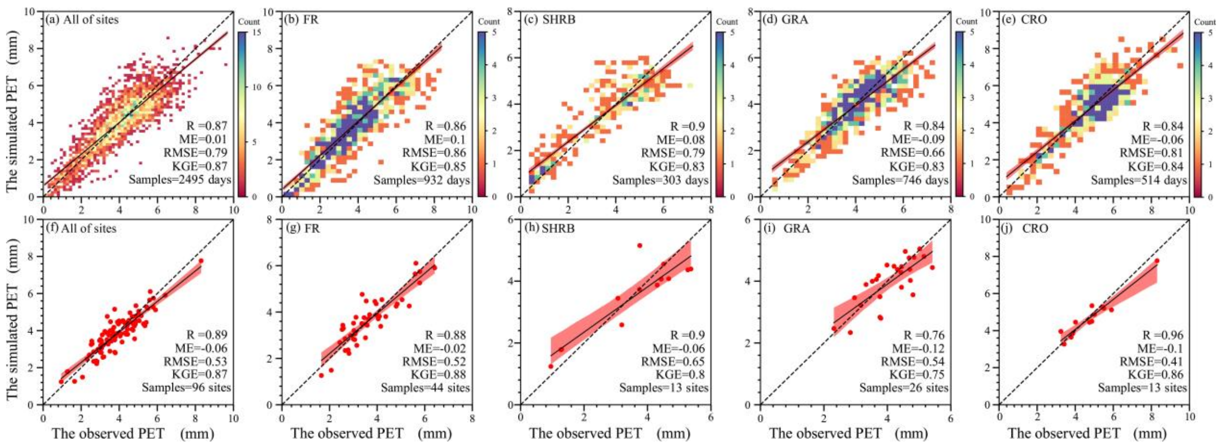


Figure S7: Validation results for the SW model calibrated using the data points without gap-filling. (a): Comparison for daily PET at all of 96 sites. (b-e): Comparison for daily PET for each LULC. (f): Comparison for site mean PET at all of 96 sites. (g-j): Comparison site mean PET for each LULC.

(4) Most (rather than a small fraction) of the responses to my last comment 6 should be incorporated into the main-body manuscript.

Responses: Thanks for your suggestion. We have added most of the responses to your last comment 6 into the revised manuscript, please see the revision or below, such as "*On average, the fraction of ETn accounts for approximately 6.3% of the total ET informed by the FLUXNET2015 dataset while 7.9% based on multiple global models (Padrón et al. (2020). This fraction may exceed to 15% in mountain forest with snowy and windy winter. Despite that, to accurately represent the ETn process is still difficult to date, mainly because the related controlling mechanisms are still not clear (Han et al., 2021). For example, Novick et al (2009) and Groh et al (2019) found that VPD and wind speed had a significant impact on ETn, while Groh et al. (2019) stated that the contributions of night dew could not be ignored. As an important component of ETn, the nighttime transpiration is not only related to the incomplete stomatal closure (Dawson et al., 2007; Duursma et al., 2019) but also the circular regulation of nighttime water uses by plants (De Dios et al, 2015). However, how the environmental factors alter nighttime transpiration is still disputed. Dawson et al. (2007) and Moore et al. (2008) reported a positive correlation between nighttime transpiration and VPD and soil moisture content, while Barbour and Buckley (2007), Phillips et al. (2010b) and De Dios et al. (2015) found no or negative correlation between nighttime transpiration and the two variables aforementioned. Moreover, the biological factors (e.g., plant species and ecosystem types) can also significantly influence nighttime transpiration (O'keefe and Nippert, 2018; Zeppel et al., 2014). Therefore, to establish a common model for estimating ETn across various ecosystems remains challenging. All in all, ignoring vegetation canopy interception and ETn may* *underestimate PET (Tourula and Heikinheimo, 1998; Lawrence et al., 2007; Mu et al., 2011; Padrón et al., 2020; Singer et al.; 2021). Subsequent research will be done to integrate these two processes in the SW model to further enhance the model's physical mechanism.*" **(L540-555)**

(5) The responses to my last comment 7 are not satisfying. A day in arid areas may not be identified to have no water limits even though its corresponding EF exceeded the 95th (or 98th) percentile EF threshold mainly because the soil moisture can hardly reach the field capacity or saturation due to the very limited precipitation. It is not relevant to the percentile!

Responses: Thanks for your comment. Now, we have revised the description according to your comment, please see the revised manuscript or below, such as "*Second, due to frequent water deficits in arid regions, the EF threshold may exceed the 95th percentile. What is more, there may be no unstressed days in extreme arid regions, mainly because the soil moisture can hardly reach the field capacity or saturation due to the very limited precipitation. Thus, the identified unstressed days using the energy balance-based criterion may actually include the stressed days in arid regions, and potentially biased the PET estimates.*" **(L567-570)**

(6) None of the responses to my last comment 12 was incorporated into the main-body manuscript!!! The authors should at least discuss the potential of the work of Peng et al. (2022) that developed for the first time a practical method for global estimates of 500 m daily aerodynamic roughness length in improving the ET and PET estimations.

Responses: Thanks for your comment. Now, we have revised the description, please see the revised manuscript or below, such as "*In recent, Peng et al. (2022) proposed a practical method for global estimates of 500 m daily aerodynamic roughness length with a combination of machine learning techniques, wind profile equation, observations from 273 sites and MODIS remote sensing data. Their results showed that the random forest model could well reproduce the magnitude and temporal variability of daily aerodynamic roughness length at most sites for all land cover types. We believed that the aerodynamic roughness length produced by this method has a potential to replace vegetation canopy height as an input to run the SW model, and thus reduce the vegetation canopy height-related uncertainties aforementioned and improve the accuracy of the PET estimates.*" **(L604-610)**

(7) Section 2.2.3 and Section 3. The root-mean-square-error (RMSE, besides or except the ubRMSE) should be introduced to measure the model performance.

Responses: Thanks for your suggestion. The ubRMSE has been replaced by the RMSE in this revision. Please see the revised manuscript.

A LIST OF ALL RELEVANT CHANGES MADE IN THE REVISION

1. "unbiased Root-Mean-Square-Error (RMSE)" in L295 has been changed as "Root-Mean-Square-Error (RMSE)".

2. The equation 4b in L299 has been changed as "$RMSE = \sqrt{\frac{\sum_{i=1}^{N}(S_i - O_i)^2}{N}}$".

3. "ubRMSE" in L335, L338, L346, L351, L365 and L366 has been changed as "RMSE".

4. "0.53" in L347 has changed as "0.54".

5. "2010" in L506 has been changed as "2010a".

6. "nighttime ET" in L546 has been changed as "nighttime ET (ET_n)".

7. "Padrón et al. (2020) …enhance the model's physical mechanism." in L550-566 has been changed as "On average, the fraction of ETn accounts for approximately 6.3% of the total ET informed by the FLUXNET2015 dataset while 7.9% based on multiple global models (Padrón et al., 2020). This fraction may exceed to 15% in mountain forest with snowy and windy winter. Despite that, to accurately represent the ET_n process is still difficult to date, mainly because the related controlling mechanisms are still not clear (Han et al., 2021). For example, Novick et al (2009) and Groh et al (2019) found that VPD and wind speed had a significant impact on ET_n, while Groh et al. (2019) stated that the contributions of night dew could not be ignored. As an important component of ETn, the nighttime transpiration is not only related to the incomplete stomatal closure (Dawson et al., 2007; Duursma et al., 2019) but also the circular regulation of nighttime water uses by plants (De Dios et al, 2015). However, how the environmental factors alter nighttime transpiration is still disputed. Dawson et al. (2007) and Moore et al. (2008) reported a positive correlation between nighttime transpiration and VPD and soil moisture content, while Barbour and Buckley (2007), Phillips et al. (2010b) and De Dios et al. (2015)

found no or negative correlation between nighttime transpiration and the two variables aforementioned. Moreover, the biological factors (e.g., plant species and ecosystem types) can also significantly influence nighttime transpiration (O'keefe and Nippert, 2018; Zeppel et al., 2014). Therefore, to establish a common model for estimating ETn across various ecosystems remains challenging. All in all, ignoring vegetation canopy interception and ETn may underestimate PET (Tourula and Heikinheimo, 1998; Lawrence et al., 2007; Mu et al., 2011; Padrón et al., 2020; Singer et al.; 2021). Subsequent research will be done to integrate these two processes in the SW model to further enhance the model's physical mechanism."

8. "marginal distribution sampling method" in L571 has been changed as "marginal distribution sampling method (MSD)".

9. "Second, due to … potentially biased the PET estimates." in L520-523 has been changed as "Second, due to frequent water deficits in arid regions, the EF threshold may exceed the 95th percentile. What is more, there may be no unstressed days in extreme arid regions, mainly because the soil moisture can hardly reach the field capacity or saturation due to the very limited precipitation. Thus, the identified unstressed days using the energy balance-based criterion may actually include the stressed days in arid regions, and potentially biased the PET estimates."

10. "In this study, … the uncertainties induced by the gap-filled LE were limited" in L628-639 has changed as "In this study, for maximizing the use of data, the MSD method was employed to fill the gaps in the EC LE measurements. However, we should note that if the controlling thermodynamic and kinetic factors of the atmosphere and soil moisture conditions are different between the missing and retrieved moments, the gap-filled LE based on the MSD method may be of low confidence, especially when soil moisture has abrupt changes (Jiang et al., 2022).

Recently, Jiang et al. (2022) developed a physics-based full-factorial scheme to fill gaps in ET from EC observations, and found that the gap-filled ET with this scheme showed higher confidence relative to the existing typical gap-filling methods. Therefore, to reduce the uncertainties from the MSD-based gap-filled LE, the physics-based full-factorial scheme could be a good candidate in the future to fill the ET gaps. Here, to quantify potential impacts of the MSD-based gap-filled values, the SW model was re-calibrated and re-validated against the data points without gap-filling. Relative to the SW model used in this study, the new rsmin and the validation metrics changed insignificantly (Figures S6, and S7), suggesting that the uncertainties induced by the gap-filled LE were limited."

11. "These limitations undermine the accuracy of the PET estimates." in L692 has changed as "These limitations undermine the accuracy of the PET estimates. In recent, Peng et al. (2022) proposed a practical method for global estimates of 500 m daily aerodynamic roughness length with a combination of machine learning techniques, wind profile equation, observations from 273 sites and MODIS remote sensing data. Their results showed that the random forest model could well reproduce the magnitude and temporal variability of daily aerodynamic roughness length at most sites for all land cover types. We believed that the aerodynamic roughness length produced by this method has a potential to replace vegetation canopy height as an input to run the SW model, and thus reduce the vegetation canopy height-related uncertainties aforementioned and improve the accuracy of the PET estimates."

12. "Dawson, T. E., Burgess, S. S., Tu, K. P., Oliveira, R. S., Santiago, L. S., Fisher, J. B., Simonin, K. A. and Ambrose A. R.: Nighttime transpiration in woody plants from contrasting ecosystems. Tree Physiology, 27, 561–575, 2007.

De Dios, V. R., Roy, J., Ferrio, J. P., Alday, J. G., Landais, D., Milcu, A. and Gessler, A.: Processes driving nocturnal transpiration and implications for estimating land evapotranspiration. Scientific Reports, 5(1), 10975, https://doi.org/10.1038/srep10975, 2015." have been added in L787.

13. "Duursma, R. A., Blackman, C. J., Lopéz, R., Martin-StPaul, K., Cochard, H. and Medlyn, B. E.: On the minimum leaf conductance: Its role in models of plant water use, and ecological and environmental controls. New Phytologist, 221(2), 693–705, 2019." have been added in L794.

14. "Groh, J., Pütz, T., Gerke, H., Vanderborght, J. and Vereecken, H.: Quantification and prediction of nighttime evapotranspiration for two distinct grassland ecosystems. Water Resources Research, 55(4), 2961–2975, 2019." have been added in L846.

15. "Han, Q, Wang, T., Wang, L., Smettem, K., Mai, M. and Chen X.: Comparison of nighttime with daytime evapotranspiration responses to environmental controls across temporal scales along a climate gradient. Water Resources Research, 57(7), https://doi.org/10.1029/2021WR029638, 2021." have been added in L850.

16. "Moore, G. W., Cleverly, J. and Owens, M. K.: Nocturnal transpiration in riparian Tamarix thickets authenticated by sap flux, eddy covariance and leaf gas exchange measurements. Tree Physiology, 28(4), 521–528, 2008." have been added in L1003.

17. "Novick, K. A., Oren, R., Stoy, P. C., Siqueira, M. and Katul, G. G.: Nocturnal evapotranspiration in eddy-covariance records from three co-located ecosystems in the Southeastern US: Implications for annual fluxes. Agricultural and Forest Meteorology, 149(9), 1491–1504, 2009." have been added in L1021.

18. “O'keefe, K. and Nippert, J. B.: Drivers of nocturnal water flux in a tallgrass prairie. Functional Ecology, 32(5), 1155–1167, 2018.” have been added in L1029.

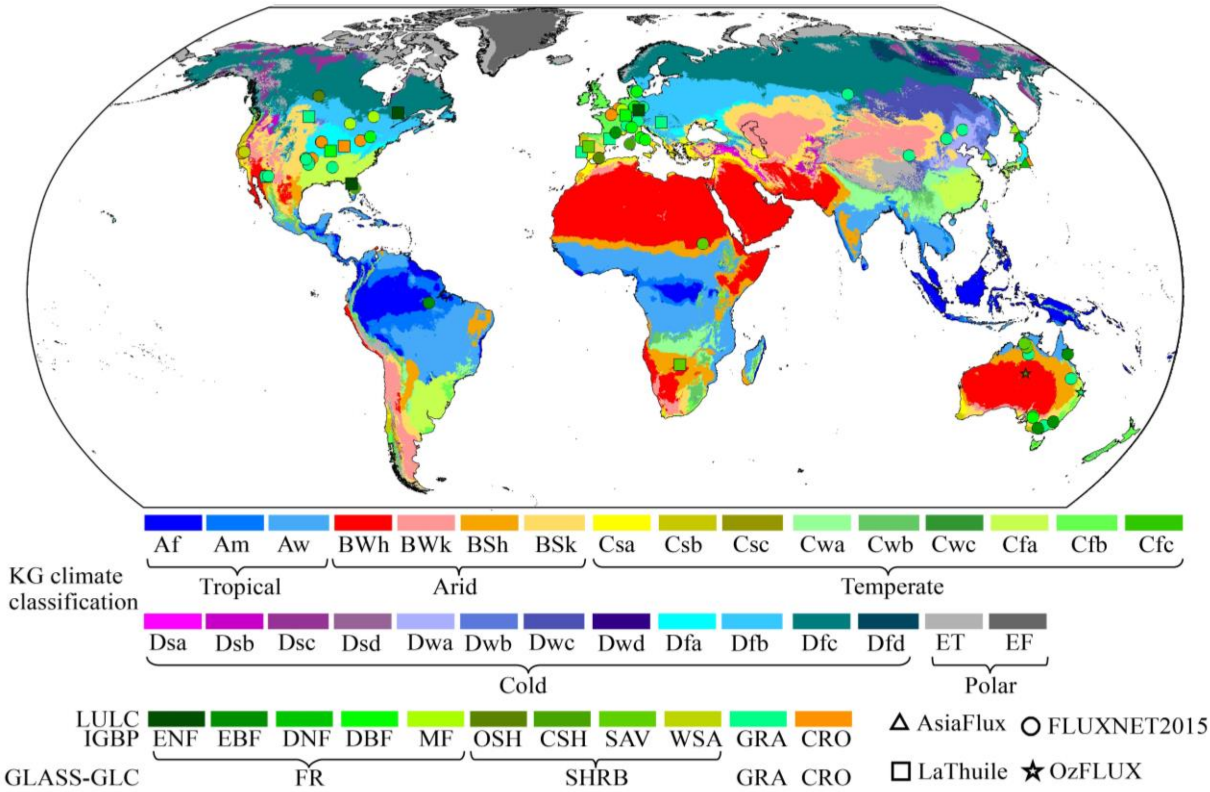
19. “Peng, Z., Tang, R., Jiang, Y., Liu, M. and Li, Z. L.: Global estimates of 500 m daily aerodynamic roughness length from MODIS data. ISPRS Journal of Photogrammetry and Remote Sensing, 183, 336–351, 2022.” have been added in L1035.

20. “2010” in L1042 has been changed as “2010a”.

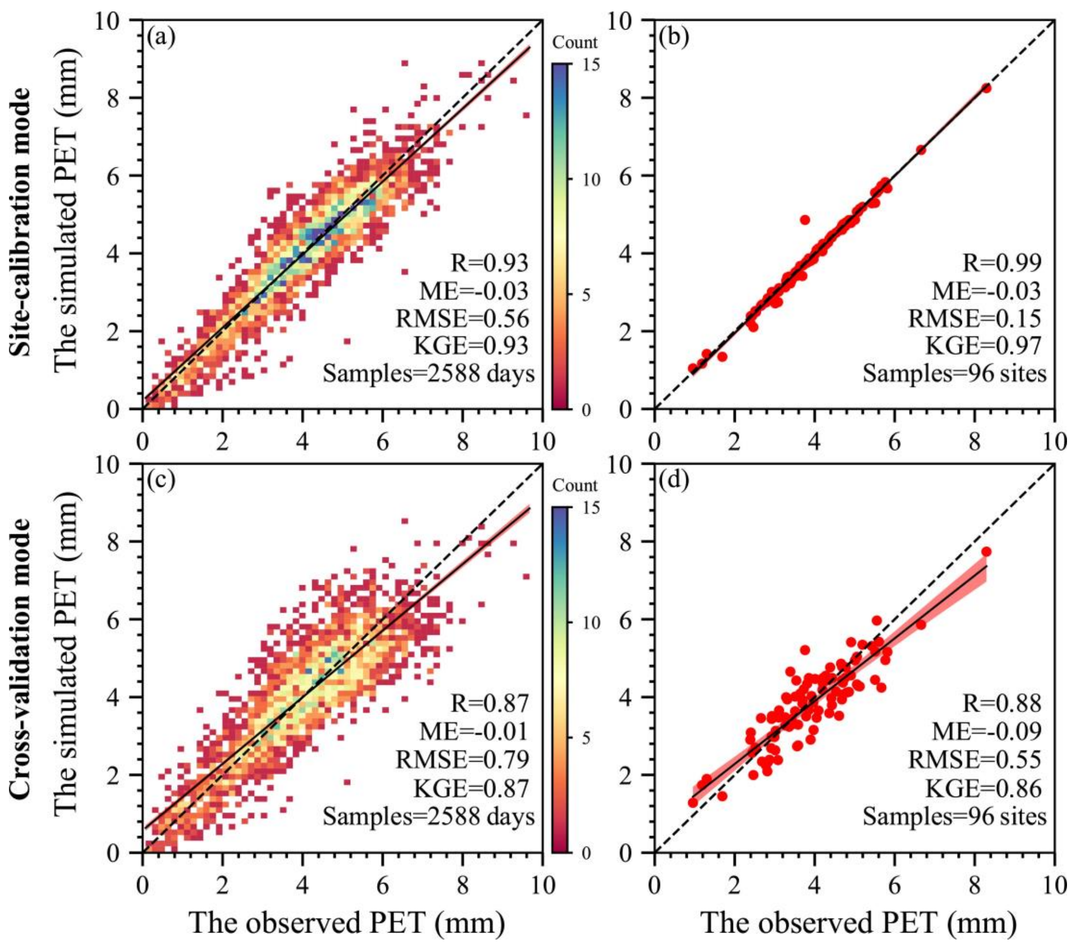
21. “Phillips, N. G., Lewis, J. D., Logan, B. A. and Tissue, D. T.: Inter- and intra-specific variation in nocturnal water transport in Eucalyptus. Tree Physiology, 30(5), 586–596, 2010b.” have been added in L1040.

22. “Zeppel, M. J. B., Lewis, J. D., Phillips, N. G. and Tissue, D. T.: Consequences of nocturnal water loss: A synthesis of regulating factors and implications for capacitance, embolism and use in models. Tree Physiology, 34(10), 1047–1055, 2014.” have been added in L1203.

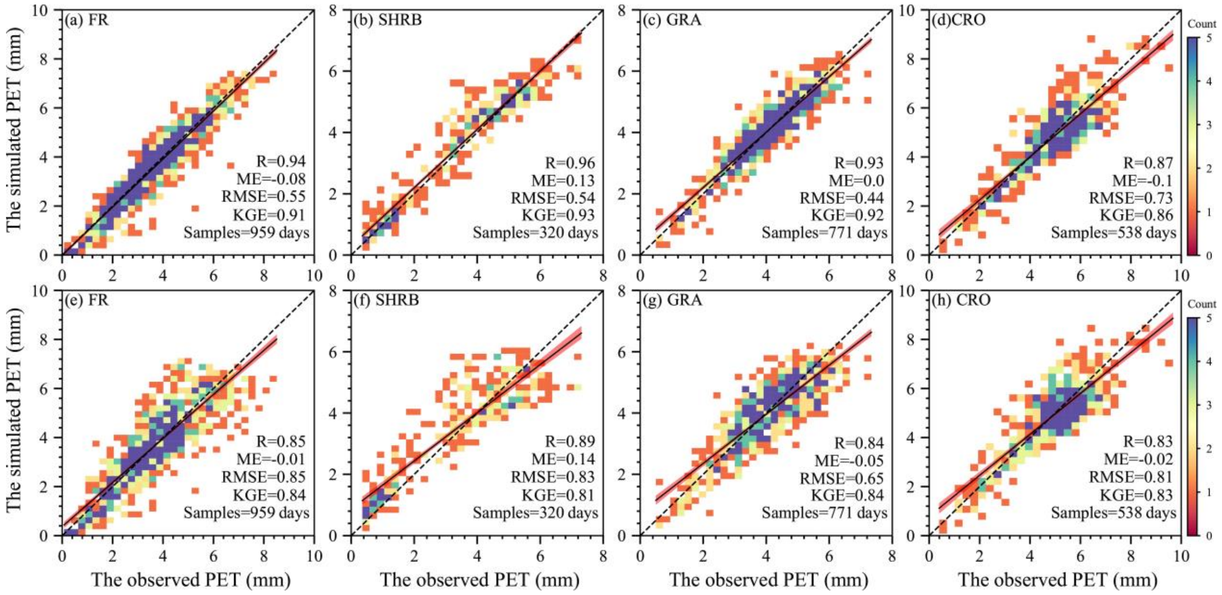
23. Figure 1 has been redrawn, such as



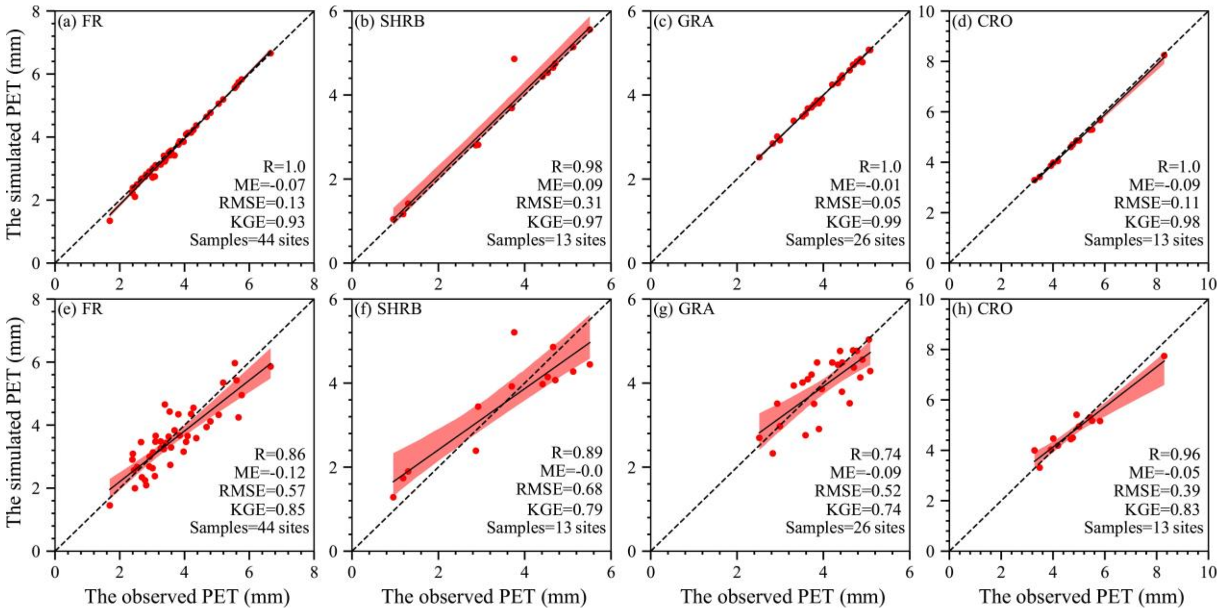
24. Figure 4 has been redrawn, such as



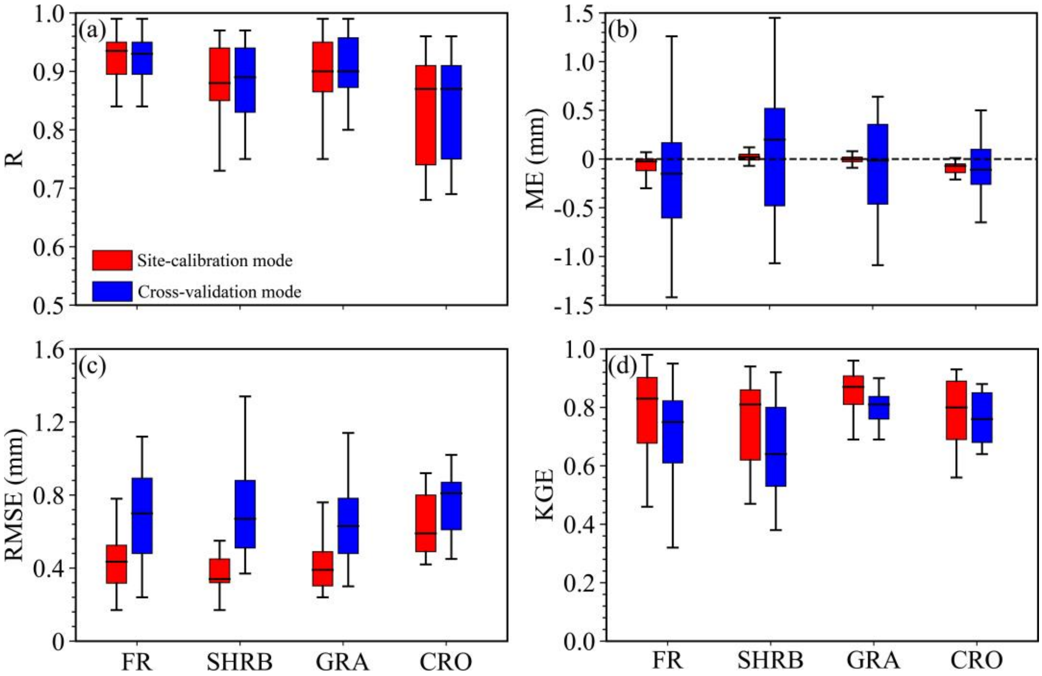
25. Figure 5 has been redrawn, such as



26. Figure 6 has been redrawn, such as



26. Figure 7 has been redrawn, such as


(a)
R
Site-calibration mode
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