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Discussions

Interactive comment on "The importance of radiation for semi-empirical water-use efficiency models" *by* Sven Boese et al.

Sven Boese et al.

sboese@bgc-jena.mpg.de

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We thank Referee #2 for the positive and constructive appraisal of our article! Below, we respond to the general and specific points of the review.

TROPICAL CLIMATES AND ECOSYSTEMS "But, what is author opinion, is it possible to apply suggested WUE model to large tropical areas and especially to tropical rain and monsoon forests? Or not?" For all its extensive coverage of northern latitudes, the FLUXNET is limited regarding a representation of tropical sites. This exarcerbated by our choice of sites with a "Fair and Free Use" data policy. The only tropical site in our pool was the Australian site AU-How. However, we surmise that the observed effects are not restricted to extra-tropical regions, as the potential factors driving them are likely of physical nature and not due to specific processes limited to certain plant

types or ecosystems. Yet one potential limitation for tropical areas with frequent precipitation events is the necessary filtering for successively rain-free periods. This would, of course, be less a problem for the mentioned monsoon climates with pronounced dry-seasons. The revised manuscript now alludes to how our inferences can only be cautiously extrapolated beyond the coverage of our subset of FLUXNET sites.

EFFECT OF VEGETATION STRUCTURE "Is there any difference in found transpiration - GPP relationships between forest and grassland sites?" Referee #2 raises an important question regarding potential differences between different kinds of vegetation structures, such as grasslands and forests. Following up on this suggestion, we partitioned all sites in two classes: Low vegetation for grasslands, crops and savannas and high vegetation for all other vegetation types. When stratifying the data set like this, we found that uWUE was not significantly different for either vegetation type (Fig. 1 of this response). However, we noted that grasslands and crops had a significantly higher mean value of r (Fig. 2 of this response). This is a relevant finding, as it supports our proposed explanation that the radiation effect could be a sign of equilibrium transpiration (Jarvis and McNaughton, 1986). In a preceding study, McNaughton and Jarvis (1983) report that grasslands had a higher decoupling parameter Ω, which quantifies the contribution of equilibrium evaporation. As Jarvis and McNaughton (1986) discuss, a stronger atmospheric decoupling (high Ω) implies a higher relative share of equilibrium transpiration. Therefore, we repeated the analysis of the fraction of radiation-associated transpiration (Fig. 3 of this response) and found that this metric, ET_frac, was significantly higher for the low vegetation PFTs grassland and crops (0.53, 95% CI: 0.48-0.58) compared to high vegetation (0.39, 95% CI: 0.34-0.44). We revised and adapted the manuscript accordingly!

DEWFALL "What is about dew formation and its evaporation? Is it ignored?" We in fact did not consider dewfall in the original article. The evaporation of dewfall would likely be very dependent on radiation, thereby violating our assumption that the observed latent heat flux represents transpiration and hence confounding our estimates of radiation sensitivity. To verify that our results were not biased by potentially including days with dewfall, we stratified the data set according to the relative humidity during night-time. As high relative humidity is a necessary, but not a sufficient criterion for dewfall, we consider this a conservative rule for which days are likely unaffected by any dewfall. We then estimated the term ET_res separately for all sites that had had observations for the respective RH intervals (Fig. 4 of this response), finding that the mean ETres for all sites was insensitive to this variable. We also found that excluding days with high relative humidity caused only very minor changes in the mean cross-validated model-efficiencies.

EFFECT OF LAI "Did you analyze the relationships between contributions of soil evaporation to ET and canopy LAI? LAI is an important factor for models of evapotranspiration. With the selection of rain-free periods, we assumed that both interception and bare-soil evaporation would be negligible in our analysis. To verify that our observed patterns are nevertheless merely the result of open canopies, we performed an analysis in which we filtered for successively higher LAI observations. In the corresponding figure (Fig. 5 of this response), we show the smoothed response of mean MEF over all sites for both the Zhou and the +Rg model. As the difference in performance actually *widens* for higher LAI values, we conclude that the observed patterns are unlikely the product of open vs. closed canopies. As we discuss in a preceding point, we have now better support for the explanation involving equilibrium transpiration.

In addition, all specific points referring to spelling, coherence and citations were considered and integrated in the revised manuscript.

Thank you again for your assistance in improving this paper!

Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2016-524, 2017.

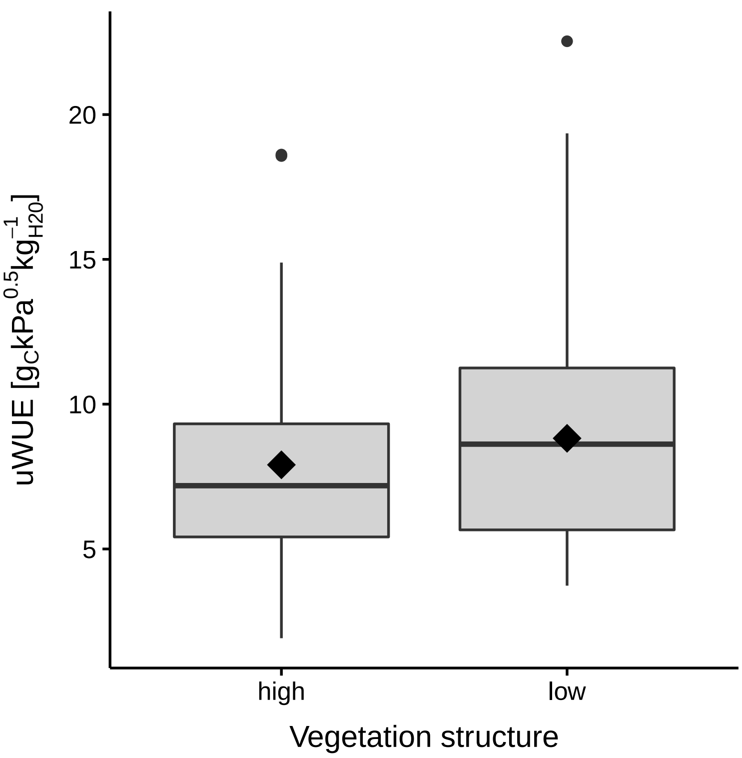

Fig. 1. Parameter distribution for sites separated by vegetation structure for the parameter uWUE.

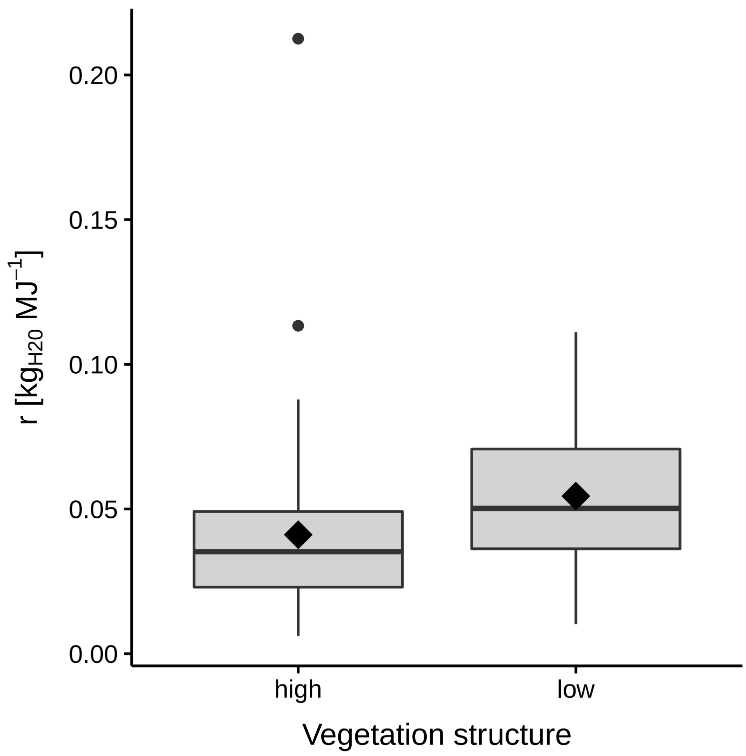

Fig. 2. Parameter distribution for sites separated by vegetation structure for the parameter r.

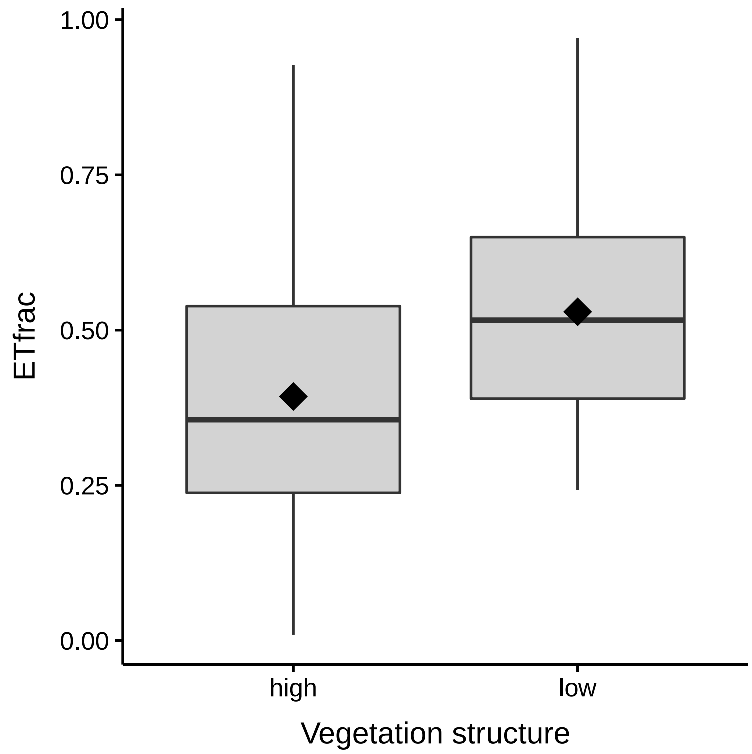

Fig. 3. Distribution of the fraction of ET associated with Rg separated by vegetation structure.

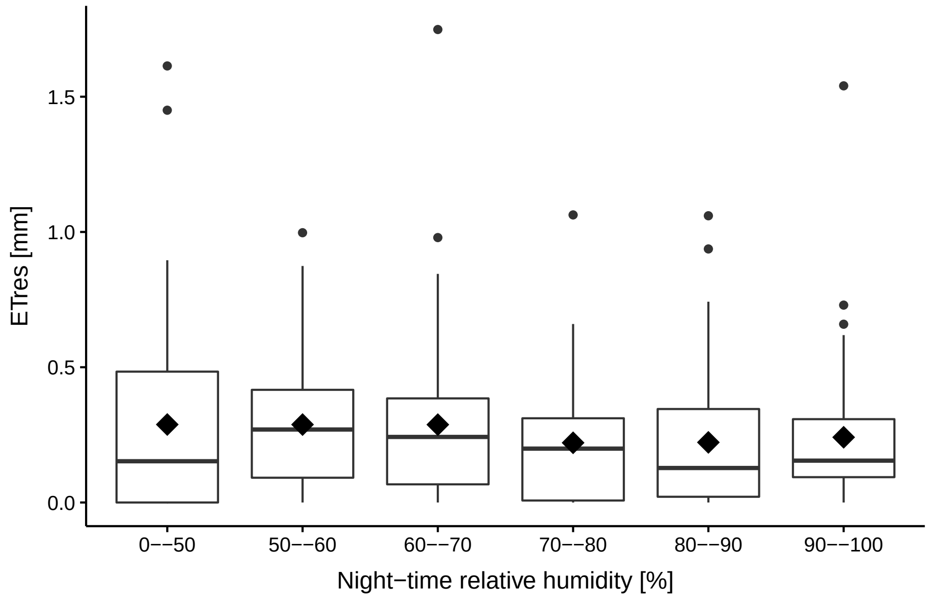

Fig. 4. Distribution of the ETres parameter stratified according to relative humidity during night-time.

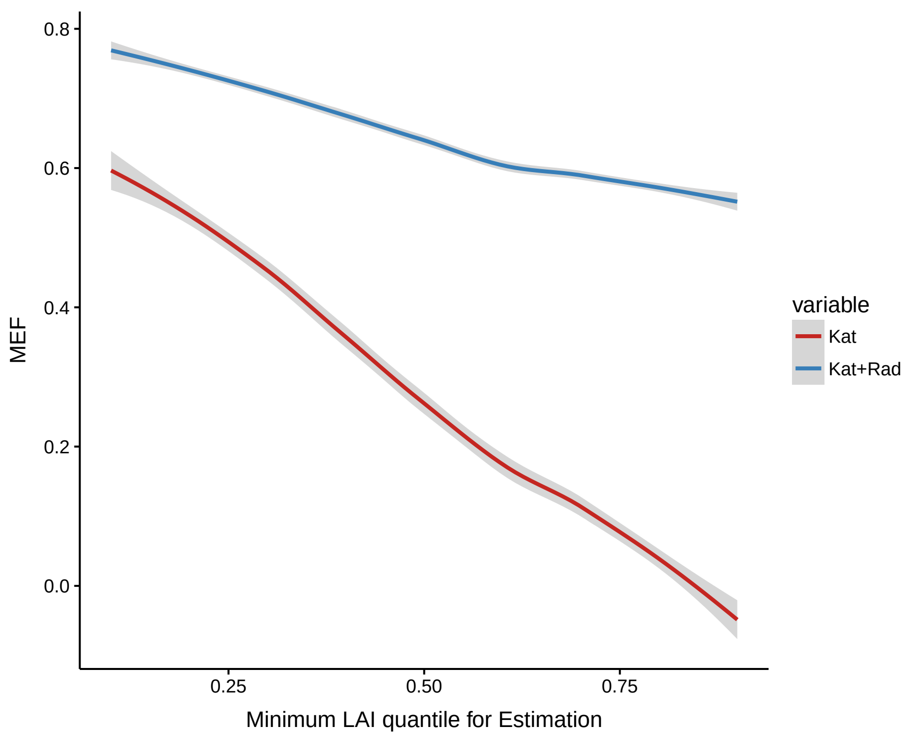

Fig. 5. Response of the model-efficiency for the Zhou (here referred to as Kat) and the +Rg (Here referred to as Kat+Rad) model variants to increasing filtering for higher LAI