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Biogeosciences Discussions

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

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We thank Referee #1 for the positive and constructive appraisal of our article! Below, we respond to the general and specific points of the review.

METRICS FOR MODEL EVALUATION "But MEF does not provide a quantitative measure of the increase in the amount of variance explained by the successive modiïňĄcations to the model. Table 2 could contain such an estimation, based i.e. on the (average) changes in the RMSE." We agree that the Nash-Sutcliffe Efficiency (MEF) captures only a part of the overall model performance. Specifically, the absolute magnitude of the errors is not reflected in this measure. We therefore added an complementing table for the cross-validated RMSE (Fig. 1 of this response) to the supplementary materials.

NEGATIVE INTERCEPTS "The only problem in the model deïňĄnition is that the intercept is left to be negative, which has no biological meaning [...]" We also think that negative intercepts are biologically implausible. A squared intercept caused problems in the optimization, but it was possible to use a constrained optimization that limits the intercept parameter range to positive values. As can be seen in the attached plot (Fig. 2 of this response), the differences in MEF between the original model +ETres and the bounded variant +ETres_bnd is miniscule. Because it precludes biologically implausible values, we revised all relevant plots for the manuscript to account for this.

NONLINEARITY "It remains unclear why the effect of the radiation was modelled as a linear" This is a valid point! We previously tested nonlinear models, but did not detect any notable effect on model performance. However, the decision to only address linear models can appear ad hoc. We now refer to the suggested "observed–predicted" (see below) plots to support our choice of a linear response to radiation. We also included a nonlinear model variant ("+Rg_nl") of the form ET = (GPP*VPDˆ0.5 / uWUE) + r*RGˆa, where a = 0.7 in Fig. 2. This could represent a possible, gradual saturation effect for higher radiation levels. However, including this nonlinear response yielded inferior results.

ILLUSTRATING THE IMPROVEMENT OF THE MODELS "Overall the manuscript has the tendency to not display the data and the relationships between them. Showing, for a couple of examples, the gain in having an intercept and incorporating radiation in the modelling would be great." We concur that the previous version of the manuscript did not sufficiently show the actual predictions but rather metrics reflecting the skill of the employed models. We selected two sites for which we detail how the different model formulations affect the predictions. We originally plotted this as time series. However, the difference between the models were hard to extract, as our selection of data points for the estimation yields a very sparse and irregularly sampled time series. Therefore, we propose to plot observed against predicted values with a one-to-one line indicating perfect model fit. Two such plots, with two subplots for +ETres and +Rad respectively

are attached to this reply (Fig. 3a,b of this response).

FRACTION OF SIGNIFICANT INTERCEPTS "How many times (or in percent) has the intercept ETres been found signiïňĄ-cant?" This is an important number that is now part of the revised manuscript. The estimated intercepts were significant at 86 sites, which is 78% of all 110 sites considered. We added this number in the appropriate place in the manuscript.

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

Thank you again for your assistance in improving this paper!

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model	Zhou	+ETres	+VPD	+Rg	+VPD+Rg
Zhou	NA	0.06	0.08	0.15	0.16
+ETres	-0.06	NA	0.02	0.09	0.1
+VPD	-0.08	-0.02	NA	0.07	0.08
+Rg	-0.15	-0.09	-0.07	NA	0.01
+VPD+Rg	-0.16	-0.1	-0.08	-0.01	NA

Fig. 1. Table of mean differences of cross-validated RMSEs across all 110 sites.

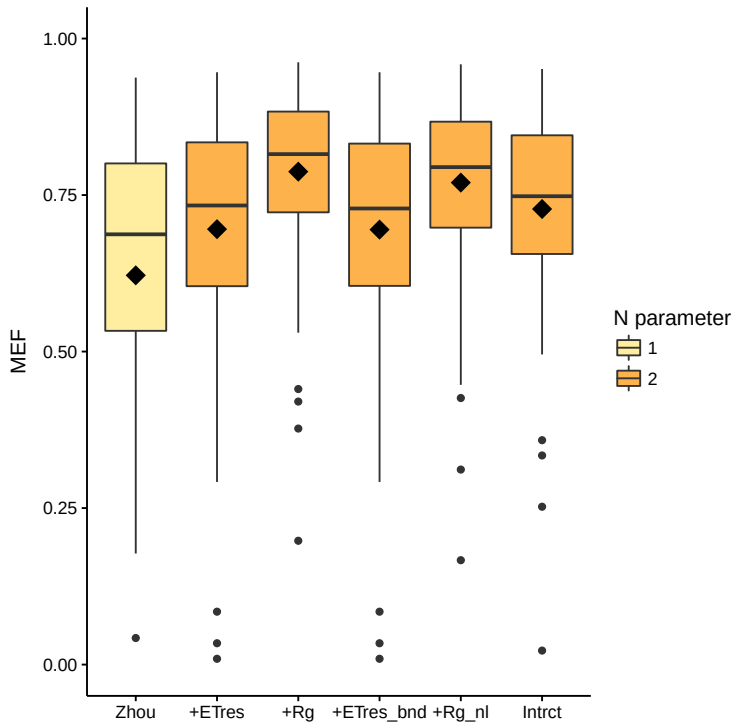

Fig. 2. Cross-validated model-efficiencies with three additional model variants: +ETres_bnd (pos. parameters), +Rg_n (nonlinear Rg) and Interaction variant (req. by Ref #3).

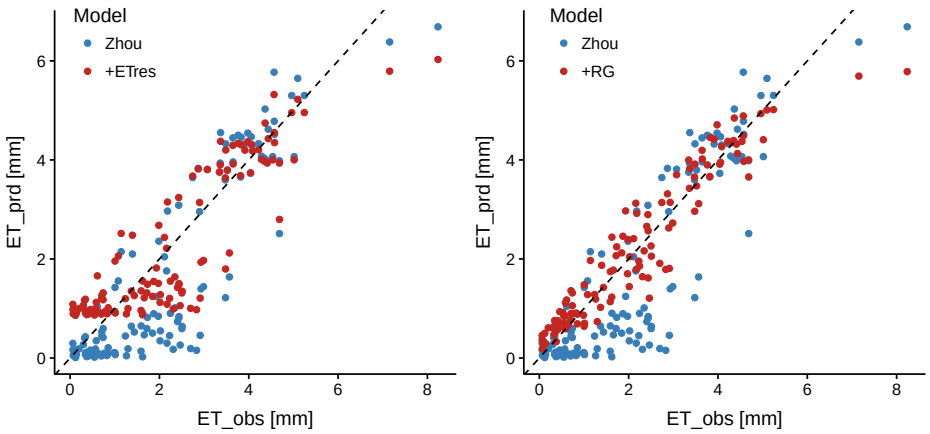

Fig. 3. Predicted vs. observed ET for the FLUXNET site BE-Lon for the +ETres and +Rg model variants, respectively.

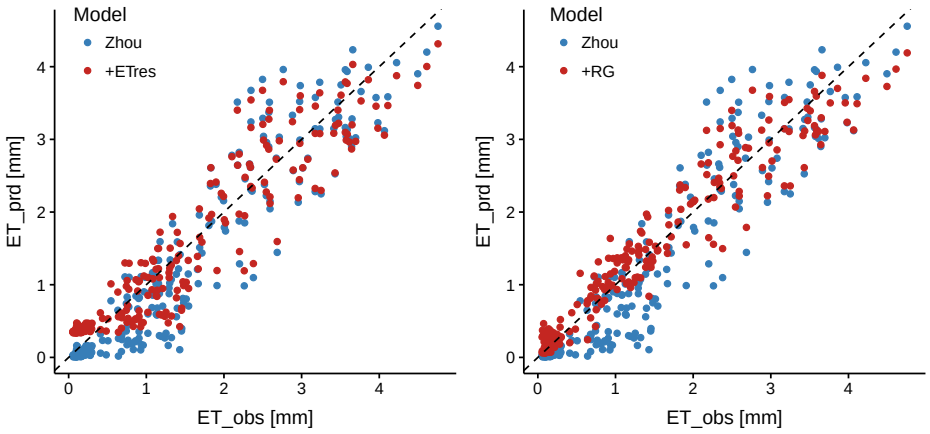

Fig. 4. Predicted vs. observed ET for the FLUXNET site HU-Bug for the +ETres and +Rg model variants, respectively.