

Response to comments by Reviewer #2 on “Environmental controls on seasonal ecosystem evapotranspiration/potential evapotranspiration ratio as determined by the global eddy flux measurements” by Chunwei Liu et al.

We appreciate the reviewer’ insightful comments. We have addressed all of the comments and present our response below. The review comments are in regular typeface, while all responses are in italics and boldface.

General comments

The authors use flux data to calibrate a simple empirical model of the actual to potential evapotranspiration ratio that can be used to calculate AET for other parts of the world, which is a subject appropriate for HESS. I have, however, some doubts about some parts of the methodology and the authors don’t really show the potential of the model by applying it. Therefore, I think a major revision is needed.

AUTHOR RESPONSE: We have validated the multivariate linear model using 30 additional study sites. The results showed that the multiple models can be used for monthly Kc calculation, and can be used for monthly AET calculation for large spatial scale and homogeneous ecosystems (Fig.8). (Line 130-133, 216-221, 285-290)

I get the impression that crop methods (e.g. L 71) are applied to other ecosystems without proper consideration of how the different structure and other properties of those systems should affect the methods. Eq 2 is constructed for crop and I think it is fine to apply it to other ecosystems for a reference, but it is not correct to use the wind speed at 2 m height measured within closed forest canopies for that calculation. You need to in some way transform the wind data for those sites to open field wind speed or use another parameterization and wind speed at a higher level. As it is done now ET₀ is underestimated and K_c is overestimated for the forest sites. For the within land-cover type evaluation it might not make a big difference but in the comparison of K_c levels between ecosystem (e.g. L 166-167) it will matter.

AUTHOR RESPONSE: The PET (ET₀) is calculated using the measured wind speed without calibration to 2m height. The reason is that every site has different vegetation types and the height of the wind speed sensors is also different. Thus, we use the measured wind speed to calculate the PET. This treatment indeed is different from reference ET method, especially for forest land cover types. As the reviewer indicated, PET calculated in this study is larger than the reference ET for forests, so the K_c may be underestimated.

However, since future applications will be based on the AET/PET response to environment factors, the multi-variant models still could be used for calculating monthly AET in forest ecosystems as long as the PET is measured at the top of the canopy or using wind speed measured at the 2 m height at a standard weather station. In addition, in many application cases, PET is estimated without windspeed in lieu of FAO Reference ET, for example using temperature based method, so it is not an issue in regional applications. We provided more discussion on this issue in Line 142.

Specific comments

To call latitude an environmental factor (L 102) is questionable though it has a direct connection to

the variation of the day length and incoming radiation over the year. Other environmental variables like temperature have some relationship to latitude and it would be better to use those or at least acknowledge that latitude is a proxy for those. This is somewhat done in the discussion (L 231-232), but it should be more clear and stated earlier.

AUTHOR RESPONSE: Revised in Line 179-183.

You have some southern hemisphere sites but it seems that you have treated them such as they were expected to have the same monthly variation as the other sites, is that correct?

AUTHOR RESPONSE: Thanks for the suggestion. We have corrected it in Fig.1 and Line 130.

How were seasonal and yearly Kc calculated, (Sum of ET over months)/(Sum of ET0 over months) or average of monthly Kc values? In my opinion the first method is correct.

AUTHOR RESPONSE: The monthly Kc should be ratio of total monthly ET to total monthly ET0. We revised it in Line 146-150.

In the discussion it would be good to discuss lag effects. There is e.g. a lag between precipitation and soil moisture that can be up to some months. And low soil moisture can lead to a loss of LAI and the low LAI can sustain for a longer period. Precipitation and LAI is included in the environmental variables but not soil moisture but Kc is partly expected to be explained by soil moisture.

AUTHOR RESPONSE: Good points and suggestions. The lack of soil moisture do decrease AET, and there will be a time lag after the precipitation occurring. However, we found little improvement in the model using a lagged Preci. Since soil moisture is not measured in many applications we opt not using it. We included some discussion on this (Line 265-268).

It would really have helped the conclusions if the model of KC developed here was applied and verified for AET. The whole conclusion is based around AET estimates but it has not been done. Some year or sites could e.g. been excluded from the calibration and used for validation.

AUTHOR RESPONSE: We have validated the multivariate linear model using 30 other sites. The results showed that the multiple models can be used for monthly Kc calculation, and thus can be used for monthly AET calculation for large spatial scale and homogeneous ecosystems (Fig.8). (Line 130-133, 216-221, 285-290)

Technical corrections

Be careful to use the same format (italic, subscript) for all the letters in your abbreviations in text, equations, tables and figures. E.g. Kc in L 100, Eq 2 and Fig 2-7.

AUTHOR RESPONSE: We have modified it. (Line 102,117 Eq 2 and Fig 2-7,)

L 108. Should be “land-cover specific” not “land cover-specific”.

AUTHOR RESPONSE: Corrected (Line 110)

L 112. Why do you have an F in all forest abbreviations but not for DB?

AUTHOR RESPONSE: we have corrected it to DBF.

L 140. “is slope vapour pressure curve” please write proper English.

AUTHOR RESPONSE: we have corrected it (Line 145)

L 175. Zeros instead of circular degree symbols are used.

AUTHOR RESPONSE: we have corrected it (Line 190)

L 187-188. I suggest revising to something like “In addition to growing season, site latitude and monthly precipitation leaf area index affected the monthly Kc” if I understand what you want to say.

AUTHOR RESPONSE: we have corrected it (see Line 199)

L 190-191. I suggest “The LAI range was up to 6 in most land covers, while it only reached 3-4 in OS and CRO”.

AUTHOR RESPONSE: we have corrected it (Line 228)

L 193. “was” not “were”.

AUTHOR RESPONSE: we have corrected it (Line 231)

L 201-202. I would put the numbers within parenthesis in this sentence.

AUTHOR RESPONSE: we have corrected it (Line 240)

L 206. Delete the first “are”.

AUTHOR RESPONSE: we have corrected it (Line 244)

L 232. “increased” should be replaced by “will in most cases increase” (see specific comment above).

AUTHOR RESPONSE: we have corrected it (Line 274)

L 267 “for a” not “fora”

AUTHOR RESPONSE: we have corrected it (Line 314)

Fig 1. Maybe increase symbol size, especially ENF is hard to see.

AUTHOR RESPONSE: we have corrected it (Fig. 1)

Fig 2-4. Tell that you are showing mean and standard deviation.

AUTHOR RESPONSE: we have corrected it (Fig. 2-4)

Fig 3. You have not specified what months are included in the different seasons.

AUTHOR RESPONSE: we have corrected it (Fig.3)

Fig 5. Use proper degree sign.

Fig 5 legend. “Variation of annual Kc at : : :” might be better.

AUTHOR RESPONSE: we have corrected it (Fig.5)