

## ***Interactive comment on “The effect of water storage change in ET estimation in humid catchments based on Budyko framework and water balance models” by Tingting Wang et al.***

**Tingting Wang et al.**

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The writing of this paper needs a lot of improvement, and can benefit strongly from a native speaker rigorously rewriting it. I made a long list of suggestions for the first 50 sentences, but this list is not exhaustive (even not for this small part of the manuscript). In its current stage I cannot fully judge the scientific merit of the contribution because the I do not always understand the interpretation of generated results. The paper does not address anything sufficiently novel. The main conclusion that water storage changes can be significant at annual time-scales is already well known. In addition, some of the methods that the paper uses to estimate ET (Budyko and a water balance

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accounting) have been extensively reported to be only applicable at longer time-scales. Consequently, I do not see why the paper is relevant to HESS. The manuscript is not based on sound reasoning that can be easily followed. While this may be a linguistic issue, since the authors are (I assume) no native English speakers, it hinders me from properly judging the scientific merit of this work.

Thank you. 1. For the content, we have rewritten and re-organized our manuscript.

a) We have added the result about the effect of  $\Delta S$  on annual ET estimation based on Budyko framework in section 3.3. It shows that almost no improvement has been made in annual ET estimation based on the extended Budyko equation (Figure 6), which uses  $P-\Delta S$  as 'equivalent' precipitation at monthly timescale through high  $R^2$  achieved (Figures 5 and 6), which is due to the seasonal pattern within the year.

<Figure 5 here> <Figure 6 here>

b) The effect of  $\Delta S$  on annual ET validation based on water balance equation is shown in section 3.4. This section shows that much improvement has been made when comparing  $ET_{budyko} + \Delta S$  with  $ET_{wb}$ . And ignoring the variation of annual  $\Delta S$  increases the variability of real ET and leads to large deviation in modelled ET assessment in humid region. This provides an acceptable explanation for the poorly estimated annual ET and reveals the important role of annual  $\Delta S$  in ET estimation and validation in humid catchments.

c) We get the conclusion that the common practice of ignoring annual  $\Delta S$  in water balance, can lead to larger deviation in estimated ET assessment in humid catchments. Without reliable  $\Delta S$ , ET estimation in humid catchments remains a challenge in bridging our gap in our knowledge of the hydrologic cycle.

2. The conclusion from the previous version, we may have put more words on the conclusion that water storage changes can be significant at annual time-scales, which is already well known, as we have summarized in the introduction in the revised version.

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We meant to illustrate the effect of using ET<sub>wb</sub> to validate the modelled ET, large deviation would be achieved with small R<sup>2</sup> between ET<sub>budyko</sub> and ET<sub>wb</sub>. And attempts of improving modelled ET to meet annual ET<sub>wb</sub> would be inaccurate. Without reliable  $\Delta S$ , ET estimation in humid catchments remains an important scientific challenge.

3. We all aware that the Budyko hypothesis can be used in steady state. But commonly, we use the Budyko equation at annual timescale, especially in arid and semiarid region. The estimated ET are validated against ET<sub>wb</sub> ( $\Delta S \sim 0$ ) and satisfactory results can be achieved. In this study, we present the fact that, ignoring annual  $\Delta S$  can affect ET<sub>wb</sub> more in humid catchments than that in non-humid region, and the same approach cannot be used in humid region at annual timescale. And more importantly, attempts of improving modelled ET to meet annual ET<sub>wb</sub> would be inaccurate.

4. The language. We feel terribly sorry for all the inconvenience we made here. We have sought help from a native speaker, who is a postdoctor in hydrology, to revise the manuscript. Much improvement has been made in the revised version. Hoping that this version is readable and interesting to you.

The paper does not review previous work appropriately. Statements like “While in humid region, the quantity of research are limited (Tekleab et al., 2011; Zhang et al., 2012; Carmona et al., 2016)” do not represent the vast work that has been done in ET research. This also related to the previously addressed issue that the novelty of this paper is not sufficient.

Thank you for your invaluable suggestions! We have revised the manuscript accordingly. We mean that annual ET estimation in humid catchments is relatively limited on areas containing humid catchments only when compared with that in arid and semi-arid catchments. Vast intra-annual ET estimation has been done in areas containing both humid and non-humid catchments. I didn’t make this clear due to language issue. Sorry again. The revised version is in lines 64~98.

Detailed comments: Title: Avoid abbreviations in the title, and write evapotranspiration

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instead of ET Title: the title should include the time-scale(s) that the paper reports on (e.g. annual) Title: “for evapotranspiration estimations” instead of “in ET estimation” Title: “water balance models” is unclear. I suggest to use more commonly used wording. Title: “based on the Budyko framework” instead of “based on Budyko framework”

Done, we have revised our title as “The effect of water storage change on annual evapotranspiration estimation in humid catchments based on the Budyko framework”. Thank you.

Line 26: “water-energy budget research” is unclear. Line 26: “resources” instead of “resource” Line 26-27: “while it”, be explicit where “it” refers to. Line 26 – 28: this sentence needs to be reformulated. Line 28: include the timescale of ET estimates. Line 29: “located in” instead of “over” Line 28 – 32: “Here we : : : time scale”. This sentence should be completely rewritten. Consider to break down this information into two separate (shorter) sentences. Line 32: “and we” is not a way to start a sentence. Line 34: “works fine” is vague Line 34: replace “in” by “for” Line 35: be more specific than “well” Line 36: “of this poor” instead of “for this poorly” Line 37: “the neglecting of dS” should be replaced by something like “the assumption that storage changes are negligible” Line 37: “real” is redundant Line 37: “increases” instead of “enlarges” Line 37: specify if “it” refers to “neglecting storage changes” or “storage changes” Line 38: “Much improvement has been made” Line 47: replace “returns” for “equals” Line 49: “is captured by” is vague. Do you mean mean “controlled by” Line 50: replace “i.e.,” by “ as described by” Line 46: “over terrestrial surface” is redundant since terrestrial and land are repeated later in the sentence. Line 50: Why is there no citation to the original Budyko paper/book? Line 52: the limitation you refer to are explained in the original Budyko equation, there is no need to refer to other studies here as long as this original publication is cited. Line 51: “, and it” it is unclear what “it” refers to + you should start this as a new separate sentence.

Thank you. We have revised as suggested. Since the whole manuscript has been rewritten, and some of the changes are untraceable in the revised manuscript.

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Line 37-39: This sentence should be rigorously rewritten: “Much improvement has been made when comparing estimated ET +  $\Delta S$  with those ET<sub>wb</sub>, and the bigger the catchment area is, the better this improvement can be.” The message is clear, but it the sentence is not English.

Thank you for this comment. This sentence has been removed from the abstract and the results, since it is the major contribution of this article.

Line 39-40: what does “an acceptable explanation” mean? Because of the confused English I am unsure how “certain” this attribution is.

Thank you. We have removed this description and replaced with “This provides a possible explanation for the poorly estimated annual ET and reveals the important role of annual  $\Delta S$  in ET estimation and validation in humid catchments.”, in lines 39-41.

Line 41-43: “We highlight : : : humid catchments.” Or “Overall this highlights that storage changes affect evapotranspiration at the annual time-scale and should therefore be accounted for.”

Thank you for this comment. We have rewritten our highlights, “We highlight that the common practice of ignoring annual  $\Delta S$  in water balance, can lead to larger deviation in estimated ET assessment. Without reliable  $\Delta S$ , ET estimation in humid catchments remains a challenge in bridging our gap in our knowledge of the hydrologic cycle.”, to provided more clear highlight more readers.

Please also note the supplement to this comment:

<http://www.hydrol-earth-syst-sci-discuss.net/hess-2017-151/hess-2017-151-AC1-supplement.zip>

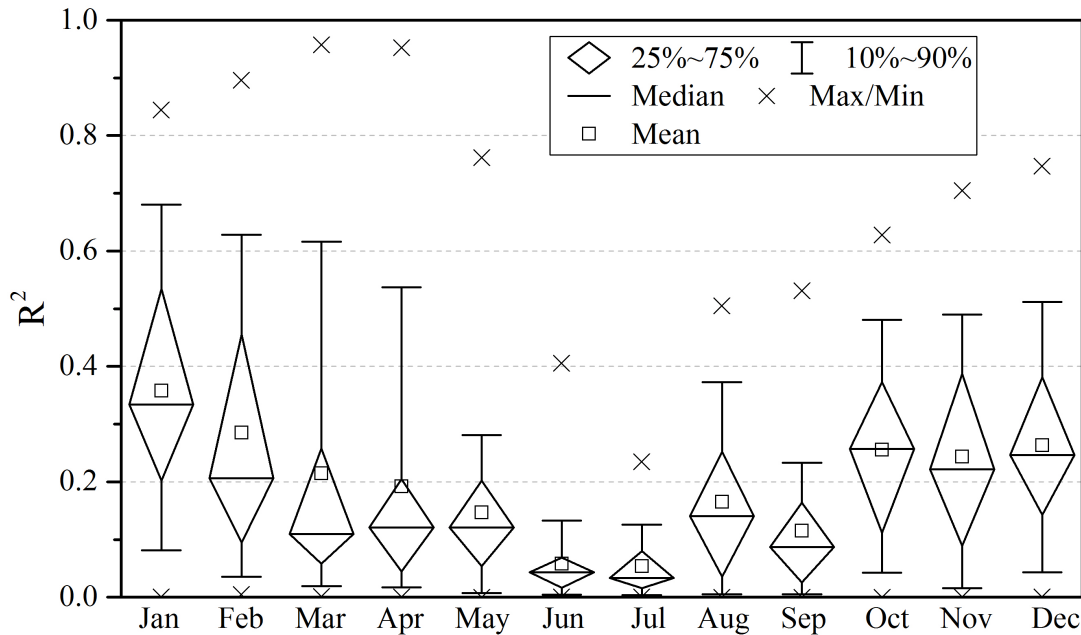
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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2017-151>, 2017.

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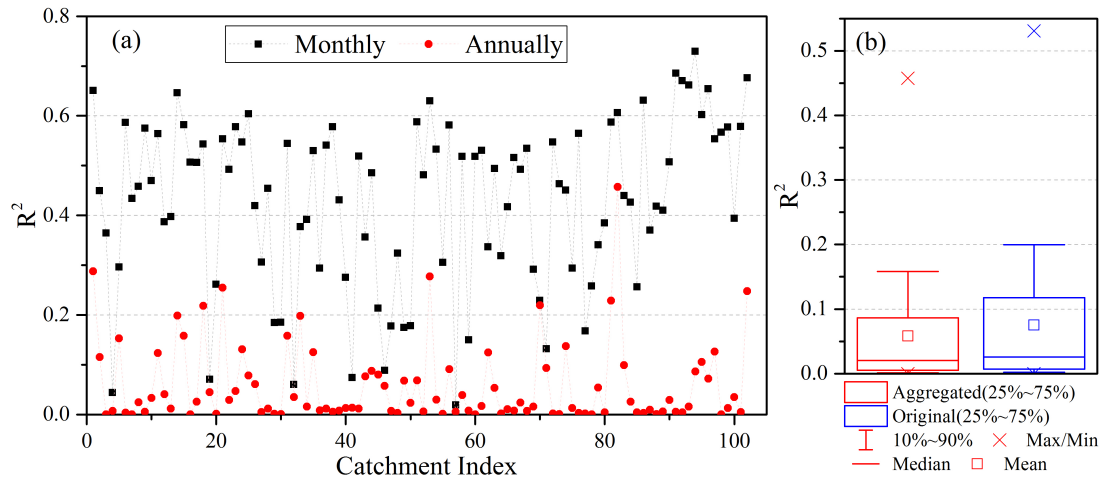


**Fig. 1.** Figure 5 The box plot of  $R^2$  between monthly  $ET_{wb}$  and  $ET_{budyko}$  using the extended Budyko equation, i.e.,  $P-\Delta S$  as equivalent  $P$ , and  $\Delta S$  is obtained from abcd model.

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**Fig. 2.** Figure 6 The  $R^2$  between ETwb and ETBudyko at monthly timescale and that aggregated to annual timescale in (a), and (b) the boxplot of  $R^2$  of this aggregated annual ETbudyko and the original  $R^2$  of annua