

Author response to Referee Comment 1 on Burnett et al. (HESS-2020-186):

Referee Comment: This study produces a monthly basin-wide ET estimates for the Congo basin based on the water balance approach for the period April 2002 to December 2016 evaluated against previous literature estimates and six global ET products. Drivers were investigated for the seasonal and interannual variability. This study is very well structured and written, with a good flow and ease to read and understand the concepts being used. The author has been thorough in his review of existing studies, making good comparisons and analyses to their findings throughout the paper. I have a few minor comments as follows.

Author Response: We thank the referee for their positive view of the article.

Referee Comment: It would be interesting if you could discuss whether the use of this technique can be easily applied to other basins even without the use of a precipitation product being developed specifically for a particular basin under study? The findings are very interesting and can be useful for other larger basins in Africa such as the Niger basin with a large delta and the Nile basin.

Author Response: In the revised draft we will include text in discussion section 4.1 regarding this topic.

Referee Comment: You compare the ETwb with six available global ET products. As I see you have referenced Weerasingle et al., that also found that GLEAM and MOD16A2 were substantially underestimating ET at the long-term annual scale, whereas other products within that study had much lower biases. It would be interesting to see the same comparison with one or more of the products with lower biases in their study to see if those products capture the seasonal variations and bias better than the products being analysed in this study.

Author Response: This is a good idea. In the revised paper we will include SSEBop as a seventh global ET product comparison, as it is the global product recommended by Weerasinghe et al. with the lowest bias over the Congo Basin and the most use in the literature.

Referee Comment: P3L65 – you say that studies assume no change in water storage when applying the water balance equation and state ‘an assumption with little support’. Is this really true? In the study previously mentioned, Weerasinghe et al., they have looked at the largest contribution of the change in annual water storage from a study using GRACE data and found this to be 20mm yr⁻¹. They then applied this to several basins in Africa including the Congo basin and found there to be only a 2.3% representation of total long-term annual average ET. I believe this assumption has been made for large watersheds and for long-term averages and there is actually a lot of existing studies to support this. Be careful with this statement. Also, In all studies, if it is possible to use the change in storage, this should always give better results, although it may be negligible depending on the timescale and size of area and thus may not be the most important aspect of their studies if not looking at smaller temporal and spatial scales.

Author Response: This is a good point. We agree that the language in the previous version of our manuscript may be too strong, although we do maintain the importance of incorporating terrestrial water storage changes in water balance estimates of ET at monthly timescales. As the reviewer points out, many studies of long time periods and large watersheds use the assumption of constant TWS to simplify their methods, and in this context the assumption seems justifiable. However, Congo Basin GRACE data from our study (as well as Crowley et al. 2006 and Rodell et al. 2018) indicate that monthly dS/dt values can exceed 5 cm/month. Given ET values between 5 and 15 cm/mo, TWS is clearly worth incorporating for studies like ours which aim to quantify month-to-month variability in ET. We will revise the manuscript to clarify this point.

Technical Comments:

Referee Comment: P1L10 – ‘...second-largest river basin *in* the world...’

Author Response: Corrected in revised manuscript.

Referee Comment: Table 1 caption has ‘in’ twice consecutively.

Author Response: Corrected in revised manuscript.

Referee Comment: P14L355 – I would mention here the three variables you are considering in the text so the reader does not have to go to the figure before they know.

Author Response: The clarification on P14L355 has been added to the text. We thank the referee for their attentive reading.

References:

Crowley, J. W., Mitrovica, J. X., Bailey, R. C., Tamisiea, M. E. and Davis, J. L.: Land water storage within the Congo Basin inferred from GRACE satellite gravity data, *Geophys. Res. Lett.*, 33, L19402, <https://doi.org/10.1029/2006GL027070>, 2006.

Rodell, M., Famiglietti, J. S., Wiese, D. N., Reager, J. T., Beaulieu, H. K., Landerer, F. W. and Lo, M. H.: Emerging trends in global freshwater availability, *Nature*, 557, 651–659, <https://doi.org/10.1038/s41586-018-0123-1>, 2018.

Weerasinghe, I., Bastiaanssen, W., Mul, M., Jia, L. and van Griensven, A.: Can we trust remote sensing evapotranspiration products over Africa?, *Hydrol. Earth Syst. Sci.*, 24, 1565–1586, <https://doi.org/10.5194/hess-24-1565-2020>, 2020.