Author Response to Referee Comment 2 on Burnett et al. (HESS-2020-186):

Referee Comment: This article presents (1) the development of evapotranspiration estimate for the whole of the Congo Basin based on a water balance equation where components are either derived from up-to-date satellitate estimates (P, ds/dt) or in-situ measurements (Q, P), (2) a comparison with 6 existing products developed at global scale from different sources (model, reanalyses, satellites, in-situ) and (3) an analysis of the drivers of ET variations at the mean annual and interannual scale.

I find the article particularly well written and structured, with a carefull use of the multiple databases selected for analysis and interesting discussion sections regarding the drivers. A lot of the papers cited are also quite recent ones so that this paper itself is a nice review of the last findings for the CB. It is also particularly relevant as the functionning and inter-relationships of the hydrologic, biospheric and climatic components of the Congo Basin are far less well known and documented than those of Amazonia. An interesting finding is the potential role of the radiative forcing.

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

Referee Comment: L125 : amongst the quite recent and few attempts of rainfall estimates validation against in-situ measurements for CB you could also refer to Camberlin et al 2019 QJRMS

Author Response: Thank you for pointing us to this study; we will add it to the article.

Referee Comment: L247 : I would specify here « correlation at the interannual time-scale » (and not for the mean annual cycles)

Author Response: We will make this clarification in the revised article.

Referee Comment: Fig1 + all your figures : would be very helpful to readers if gridlines were provided so that we can better pick the peaks and lows, the lead-lags between variables etc

Author Response: While gridlines were omitted to preserve the clarity of the figures, we recognize that the subject matter of this paper will lead readers to search for specific minima and maxima in the many plots included, and as such gridlines would be useful in many figures. We are planning to add gridlines to several of our figures in the revised article, except where multiple vertical axes are present.

Referee Comment: L286 : part of the discussion about the shape of the mean annual cycle with a minima in JJA being driven by the southern pixels (which are dominant in the CB, e.g. L360) should appear as soon as this section

Author Response: We will add language to Results section 3.2 to introduce this point earlier.

Referee Comment: L289 : to me when reading the figure the fastest S decrease is between April and May …

Author Response: Note that Figure 2 plots *dS/dt* rather than *S*; we will edit the corresponding paragraph for clarity. Figure 4f shows the basin-wide *S* annual cycle.

Referee Comment: L308-311 : these differences in terms of dynamics, amplitude and ratio between MAM and SON are an important point that certainly plays then on the analysis of drivers … your ET estimate is singular from this point of view. you might provide these two statistics (amplitude, ratio) to support your discourse …

Author Response: Thanks for the suggestion. We will include these statistics in Table 3 to support comparison of the different ET products.

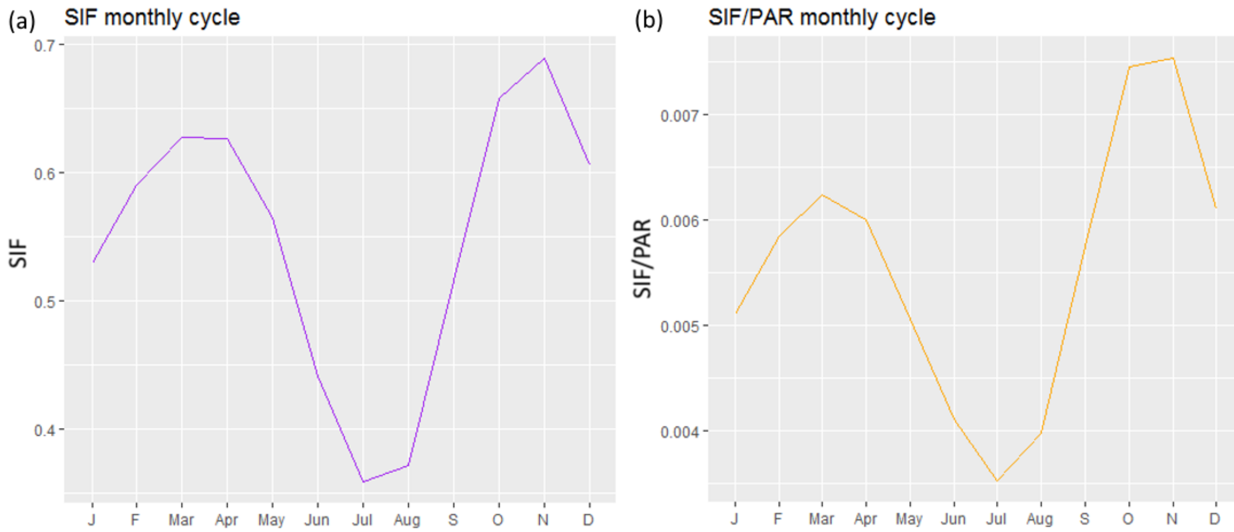
Referee Comment: Table 3 : why don't you provide the annual mean on 2002-2011 if you compute correlations etc on this period ??? You should also provide the significance level for the correlations …

Author Response: ET_{wb} data begin in April 2002, so 2002 was not included in the mean annual ET calculations, whereas all available months were used to generate the rest of the statistics in Table 3. We initially made this choice to avoid calculating an annual mean over a time period that did not represent an integer number of years. However, we recognize that this was confusing to readers. In the revised manuscript we are planning to incorporate (at the suggestion of Reviewer 1) a seventh global ET product (SSEBop) that is only available from 2003 onward, so consequently all statistics will be recalculated for 2003-2011.

Referee Comment: L346 : could you explain a bit the added value of normalising SIF by PAR

Author Response: Normalizing SIF by PAR is intended to isolate the contributions of climatic and ecophysiological factors to productivity while controlling for the influence of radiation on productivity (see Pagán et al. 2019 and Madani et al. 2017 in *Remote Sensing* for further explanation). This was designed to allow us to read clearer information about moisture availability, light use efficiency, and vegetation dynamics from the SIF data.

The relatively low variance of total PAR means that the SIF seasonal cycle and peak during October/November are similar with and without PAR normalization (see GOME2/CERES plots below, which we will add to the Supplement). We will add some text to the manuscript clarifying these points, and discussing the implications of our PAR-normalized SIF data for light use efficiency and the potential limiters of transpiration.



Referee Comment: L352 : I dont' think that the ratio is « significantly » greater in SON as compared to MAM as the greatest ratio is observed in May ; it seems quite comparable (and easy to check) so to my opinion this does not play ...

Author Response: You are right that in terms of seasonal means they are not much different. In the revised draft we will clarify that March and April have low diffuse PAR ratios that could cause the high ET observed in those months (in May, when diffuse PAR ratio peaks, ET decreases to nearly SON levels).

Referee Comment: L371 : the positive trend in radiation might not be a regional signal only as many studies have shown a brightening at global scale the past decade (as opposed to a dimming in the 90s)

Author Response: Dimming/brightening trends in central Africa over our study period are generally not well-constrained to our knowledge, and we had difficulty finding literature on global dimming/brightening for our study period (the recent studies we examined generally neglected Africa due to a lack of measurements). We will add a brief discussion of changing irradiance in central Africa with references to recent literature, including a 2020 assessment of global dimming/brightening trends (Hatzianastassiou et al., 2020), in Section 4.4.

Referee Comment: L400 : the scale of your study is far larger than the ones by Betbeder et al and Philippon et al which focus on very specific forests growing on particular soils, therefore I would not be so affirmative about a unique and consistant peak of EVI in SON across the whole central Africa forests even if these authors have not used the last state of the art EVI product...

Author Response: This is a good point—we will add text to this section noting the smaller extent of the Betbeder and Philippon studies as a likely cause of the different EVI cycles, and to clarify that the different EVI algorithms used are merely an additional factor on top of the spatial differences.

Referee Comment: 4.2.4 water storage : Your discussion is valid for southern pixels but not the northern ones … while the wettest rainy season is SON over the whole CB, the driest rainy season is DJF to the north and JJA to the south so this changes the dynamics of water storage and available water for trees at the beginnign of each rainy season ...

Author Response: This is true—we will add text to section 4.2.4 to clarify that much of the discussion pertains to the southern portion of the basin, but that the hydrologic characteristics of the southern region dominate the basin-wide hydrologic cycles and are therefore still relevant to the study.

Referee Comment: L540 : I would also add, amongst the reasons why you do not capture the negative trend in rainfall, that this trend mainly affects the northern part of the CB and your index is mainly « driven » by southern pixels

Author Response: Good point. We will add text mentioning this to Section 4.4.

Referee Comment: Fig.2S : would be good that the CB be contextualised ie by presenting a larger map of Central Africa with countries borders ....

Author Response: We will add such a map as a new panel in Figure S2.

Referee Comment: Lastly I would have liked seeing in this paper a short « perspective » section on the further analyses these results call for and the study limits (unfortunately ET at the monthly and CB scale that does not allow documenting spatial variations in the drivers of ET that might be significant nor fine temporal - daily or infra-daily – variations which might be key to understand differences between the two wet or the two dry periods)

Author Response: We will add a brief section to the end of the Discussion outlining some further analyses that would be useful, including more in-situ observational studies and meteorological stations, continuation of this study using data from the GRACE-FO mission, examination of ET in sub-regions of the Congo Basin, etc.

References:

Hatzianastassiou, N., Ioannidis, E., Korras-Carraca, M. B., Gavrouzou, M., Papadimas, C. D., Matsoukas, C., Benas, N., Fotiadi, A., Wild, M., & Vardavas, I.: Global dimming and brightening features during the first decade of the 21st century. Atmosphere-Basel, 11, 308, https://doi.org/10.3390/atmos11030308, 2020.

Madani, N., Kimball, J. S., Jones, L. A., Parazoo, N. C., and Guan, K.: Global analysis of bioclimatic controls on ecosystem productivity using satellite observations of solar-induced chlorophyll fluorescence, Remote Sens., 9, 530, https://doi.org/10.3390/rs9060530, 2017.

Pagán, B. R., Maes, W. H., Gentine, P., Martens, B., and Miralles, D. G.: Exploring the potential of satellite solar-induced fluorescence to constrain global transpiration estimates, Remote Sens., 11, 413, https://doi.org/10.3390/rs11040413, 2019.