Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2019-292-AC1, 2019
© Author(s) 2019. This work is distributed under
the Creative Commons Attribution 4.0 License.

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Global partitioning of runoff generation mechanisms using remote sensing data" *by* Joseph T. D. Lucey et al.

Joseph T. D. Lucey et al.

jlucey@ucla.edu

Received and published: 7 September 2019

Author responses are started with a "-" and placed below each comment.

P1 l16-18: This last line of the abstract is not a conclusion that I got from reading the paper. Now it seems that this is one of your main points, whereas in the text you find that most areas have mixed time lags and are driven by both precipitation and water storage.

- Line 16 – 18 will be changed to "Precipitation and total water storage equally control the majority of surface inundation developments across the globe. The model tends to underestimate and overestimate at locations with high interannual variability and with low inundation measurements, respectively" to properly state our conclusions.

P2 l56-58. Here you clearly state 3 research questions. These are not reflected well in the abstract. Also, I feel that the characterization of general behavior is limited.

Is there a typo on line 56? Is "too" supposed to be "to" for "We conduct such a study here too:. . .?"

- Lines 9 – 11 in the abstract touch on these research questions. I will update the sentence to "In this study, we examine the covariance of global satellite-based surface water inundation observations with two remotely sensed hydrological variables, precipitation, and terrestrial water storage, to better understand how apparent runoff generation responds to these two dominant forcing mechanisms in different regions of the world" in the final manuscript as it includes reference to our regional analysis.

P5 l87: you mention the common period amongst the 3 satellite products is April 2002-October 2015, but the previous paragraph mention that all satellite products are available until 2017 or present. So why October 2015?

- When I first accessed the data, GPCP was only available until Oct. 2015. While I was writing the manuscript, the extent of the data had been updated and we did not extend the analysis period.

P5 l 96: is each dataset's climatology based on the 2002-2015 period? Then I would not call it a climatology as it only spans 13 years, rather 'the 2002-2015 average'.

- The climatology of a region is defined as weather conditions averaged over a period of time. We feel this is a sufficient time frame to use for a climatology.

P5 l105-107: I don't understand the concept of the two time-lag thresholds. Do you check the cross-correlations for up to 5 months lag as well as up to 11? Also, if you are using a climatology (i.e. 12 months), going up to 11 months lag makes little sense to me to start with.

- Correct, we check the cross-correlations for up to 5 months lag as well as up to 11. We check up to 11 months to ensure there are no erroneous lags and no significant

statistical improvement in the results.

P5 l 114: please explain what coverage means. E.g. grid cells covered by SWAMPS? (I'm also not very familiar with GIS so the term polygon is also unfamiliar to me).

- Lines 114 – 116 will be changed to, "Pearson's R2, the root mean squared error (RMSE), and a ratio between R2 and coverage were used to determine each model's strength. Coverage is considered the number of SWAMPS grid cells with numerical values within the global coastline; for example, the analysis excluded Antarctica and Greenland because there is no SWAMPS data for these regions." to clarify our use of coverage.

P6 eq. 4-6: abbreviation LTA is not explained here. Also does 'slope' refer to m1, m2 in Equation 3? I thought those were determined using the climatologies, but then determining the standardized values (Eq 5) would not make sense, hence I'm confused at the methods here. Or are these equations only used for the four highly studied basins, i.e. Eq 5 shows the standardized value determined by the gridcells in the basins? Also, Eq 6 could be re-written to make it clearer that the control variable is determined by the slopes, e.g. slopegpcp - slopegrace.

- The "measured SWAMPS signal" (Line 129) will be changed to "measured SWAMPS long term average (LTA)". "Slope" in general refers to the m variables and m1 and m2 are specifically used to determine the control variable. Slopes at each grid cell are determined through the regressions which utilize our developed climatologies. We standardized the calculated slopes to determine the control variable. Since GRACE and GPCP function on different ranges and units, we can expect the slopes to reflect the spread and magnitude of their dataset. We remove the slopes' spread and magnitude by subtracting and dividing by the average and standard deviation of all the calculated slopes per variable. Therefore, when we use Equation 6 our inputs are fairly compared. Equation 6 will be rewritten as: Control Variable= |GPCP Slope|-|GRACE Slope|

P8 l150: "we no longer consider all 0-11 month models", yet it is shown in Fig 9.

- 0 – 11 month model results are provided to provide a thorough analysis. We felt readers would like to see the insignificant differences between the 0 – 5 and 0 – 11 month models for themselves.

P8 Fig4: just a small suggestion to make the figures easier to read, at least in my opinion. Maybe place a small text within the figures, rather than having the reader disentangle which figure represents which dataset and which lag threshold (also goes for other figures).

- The authors feel the figure captions sufficiently state which dataset and lag threshold are applied per (sub)figure.

P9 l 164: "we can see" . . . "we know". Actually I can't see or know because so far I've only seen the results of the multi-linear regression (Fig 5) and not the single regression models. The comparison for single and multi-linear regression only shows up in Fig 10 (without time lags). So I would rephrase or re-order, as you mention in this paragraph that a 'multi-linear regression model with a time lag correction between 0 and 5 months is the most rigorous for further analysis', so I was a bit surprised to see Fig 10 discussed later on.

- I am referencing the validation statistics provided in Table 1 in Line 164. I will add "(Table 1)" after "there isn't much improvement" to clarify this statement is a result of the validation results in Table 1.

P10 l 173: I assume you mean August 2007 rather than specifically August 15th 2007.

- Yes, thank you. This will be changed to "August 2007" in the final revision to prevent confusion.

P10 l 177-179: I got a bit confused which dataset has which limitations in which locations. SWAMPS data has limitations over desert and mountainous areas shown in Fig 1, but modeled SWAMPS (maybe better to call it modeled inundation rather than SWAMPS?) has limitations in areas with snow and ice or seasonal monsoon areas, so

that is related to limitations in either GPCP or GRACE?

- The limitations of SWAMPS are reflected in modeled SWAMPS. Areas heavy in snow and ice often report missing values or inconsistent measurements in SWAMPS (example in Figure 7e). We attribute the underestimations in areas affected by large interannual variability to the limited shared data period between the datasets and to utilizing climatologies which would reflect the average behavior.

P11 l198-199: related to the above, is the inadequate data related to GPCP or GRACE?

- Areas heavy in snow and ice often report missing values or inconsistent measurements in SWAMPS (example in Figure 7e).

P12 Fig 7: if there are no available measurements in winter, then the scatter plots reflect only the summer / fall months?

- These validation plots reflect the modeled versus measured inundation per month within the domain (163 months between April 2002 to October 2015). It is possible there were no measurements at a location for all winters, no measurements for only a single winter month (NaNs for Dec., values for Jan.), or no measurements during a specific year (NaNs for Winter 2007, values for Winter 2008). With this understanding, we expect the scatter plots in snow/ice dominated regions to reflect some winter trends, but not as thorough as locations that are not limited by snow/ice.

P13 l210-216: refer back to Eq 4-6 to help the reader remember how you determined your error.

- I will add text that references the equations in the final revision.

P14 l224: "white areas represent no values" this is repeatedly mentioned in the text but not in the captions. It would be OK to mention this clearly once (white areas are masked using SWAMPS quality map).

- White areas represent low values and/or no value depending on the figure and is stated whenever referenced for the reader. I would prefer to leave the text referencing the white as is to prevent possible confusion.

P16 l241: bracket goes before 'comparing' instead of 'Fig'.

- Thank you for catching this. We will remove "comparing" and the following comma in the final revision.

P16 l252-257: Regression coefficient refers to Eq 3 (m1, m2, called slope elsewhere)? Furthermore, you use a scale from -1 to 1 whereas in lines 99-107 you mention that negative regression coefficients should be impossible, and therefore you introduce time lags. So why are there still negative values in Figure 11? Should results for those grid cells not be trusted? The color scale is also a bit misleading, as grey values (towards -1) do not reflect small values (around 0), but the orange colors do.

- We hypothesized it should be generally impossible to have negative slopes because we wouldn't expect GRACE or GPCP to be inversely related to SWAMPS. However, we see this occur within the data before a time lag correction (Fig 11c and 11f) and after the correction (Fig. 11d and 11f). Some of the negative values are attributed to time lag and are reduced through the applied corrections. Other negative values tend to occur in regions with known limitations (areas of high elevation, snow dominated, and poor SWAMPS reliability) and are discussed in the manuscript. My apologies on the wording. The phrase will be changed to "Grey displays negative values" in the final submission.

- Figure 11c and 11e reflect slopes for the model in Figure 11a (multi-linear regression with no time lag). Figure 11d and 11f reflect slopes for the model in Figure 11b (multi-linear regression a time correction of 0 to 5 months). The caption was mislabeled and will be corrected.

Overall: I felt it was a bit confusing that the terms GRACE / TWSA / water storage,

GPCP / precipitation, SWAMPS / runoff generation / inundation are used interchangeably.

- These satellites and their respective measurements are core terminology within the literature.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2019-292, 2019.