Hydrology and Earth System Sciences Discussions

Hydrol. Earth Syst. Sci. Discuss., referee comment RC2
https://doi.org/10.5194/hess-2021-531-RC2, 2022

Comment on hess-2021-531

Anonymous Referee #2

Referee comment on "The relative importance of antecedent soil moisture and precipitation in flood generation in the middle and lower Yangtze River basin" by Sheng Ye et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-531-RC2, 2022

The authors analyse the relative importance of soil moisture and precipitation for the generation of the average annual flood in the Yangtze river basin. This is achieved by comparing the ratios of precipitation and soil moisture before the flood event with recorded maximum of the respective variable. The relative ratio of both variables shows a positive correlation with topographic wetness index and a negative correlation with magnitude.

Overall, I think the authors present a very thoughtful analysis which addresses some important drawbacks in our current approach to flood generating processes. Instead of annually averaged results I would have liked some more event-based results. Other recommended improvements are detailed below. I encourage the authors to take them into account for a great and improved article.

Soil moisture estimation

The authors quote two sources upon which the soil moisture routine is based on: Berghuijs et al, (2016) and Deb et al (2019). Deb et al (2019) use a water balance equation, however they did not use it to calculate soil moisture. I do not see any relevance of this reference at this point. I would recommend following the simple bucket model by Berghuijs et al (2016) to calculate soil moisture, the update version in Stein et al (2020) or to consider a modelled soil moisture product, such as ERA5. They are less prone to water balance errors.

Normalizing precipitation/soil moisture

Precipitation has more of an extreme tail than soil moisture. This is due to the fact that soil moisture has an upper limit, e.g. when the soil is completely saturated. Although this is not currently reflected in the equation used for soil storage calculation, this difference should still be taken into account. Another problem with the current normalisation approach is that some catchments in the study period will have experienced more extreme precipitation events than others, simply due to the small time period. If catchment A has experienced a 100-year precipitation event in the observed time period, but catchment B has not, then the values of catchment B will generally be higher than in catchment A. An approach to reduce this uncertainty is to use percentile values as a form of normalisation instead which is more robust (though still not perfect) to this error.

Section 4.3.

Being able to predict average annual flood magnitude for ungauged catchments would be a valuable discovery. This should certainly be explored further in another study. However, since all results are presented at an average and not event scale, I am not convinced that these approaches would work for flood early warning. For that the diversity of flood generating processes (Stein et al, 2020) is too high and the interplay between soil moisture and precipitation too diverse (e.g. Figure 5b, Saffapour et al, 2016). Just because a catchment is dominated by soil moisture, does not mean that an extreme precipitation event will not cause a flood. I would therefore recommend removing the discussion around early warning system and focus on predicting mean annual flood for ungauged catchments.

Minor comments

L61: Yang et al, 2020 presented an analysis on flood generating mechanisms in China.

L132: "with at least 20 years records from 1970 to 1990 and from 2007 to 2016 were selected". Unclear. Does that mean that some of the stations only have data between 1970 and 1990, while others only have data between 2007 and 2016? These time periods have likely different climatic conditions and the older ones might have since had dams added to their catchment. Please clarify if my understanding is correct. If yes, please discuss the implications for your analysis and add a Figure to the supplement indicating data ranges for the stations.

L190-193: Can be removed since it repeats information from the Introduction.

L200-203, 237-242, 256-266: Please ensure that you are not mixing results and discussion.

L220: There are no red dots on the colour scale in Figure 2. Please clarify.

L308: Can you explain why the fact that smaller watersheds more easily reach saturation supports that they are less soil moisture dominated? They way the results by Sharma et al (2018) are mentioned might confuse some readers otherwise.

L321-322: The correlation between TWI and SPR is much weaker in the regulated watershed. It will most likely not be sufficient for any form of prediction in those catchments.

L333-336: Where are the event scale results presented? It would be most interesting to see event scale results as well. Currently, I do not see any evidence that the results can easily be transferred to event scale.

Figures:

Please try to avoid the use of red and green together when they are the only distinguishing feature. People with colour vision deficiency will not be able to differentiate them. For alternatives, please check Stoelzle & Stein (2021).

Figure 5: The scaling of point size according to drainage area is barely visible. Since drainage area is covered in Figure 6b as well, I would suggest to remove this scaling.

Figure 5: It is unclear what the dashed lines indicate.

Figure 6b and 7: Since the text talks only about topographic gradient and not slope I would recommend using the same terminology in the Figures.

Saffarpour, S., Western, A. W., Adams, R., and McDonnell, J. J.: Multiple runoff processes and multiple thresholds control agricultural runoff generation, Hydrol. Earth Syst. Sci., 20, 4525–4545, https://doi.org/10.5194/hess-20-4525-2016, 2016.

Stein, L., Pianosi, F. and Woods, R., 2020. Event-based classification for global study of river flood generating processes. Hydrological Processes, 34(7), pp.1514-1529.

Stoelzle, M., & Stein, L. (2021). Rainbow color map distorts and misleads research in hydrology–guidance for better visualizations and science communication. Hydrology and Earth System Sciences, 25(8), 4549-4565.