Reviewer #3 (Comments to Author (shown to authors):

I enjoyed reading this manuscript and believe the results presented here are very convincing – showing the dependence between soil moisture, rainfall, catchment area and flood magnitude. Although previous studies have attempted in parts to show this interplay (e.g. looking at trends), I feel this manuscript probably shows the most convincing and comprehensive results to date.

Reply: We appreciate the reviewer's comments, these insightful inputs have helped to improve the quality of this manuscript. We have made our efforts to address the concerns and made corresponding revisions.

Some general comments:
Line 178-187: I must admit I am having a bit of trouble with the S'/P' ratio. Maybe the wording could be changed a little bit; in line 181 it isn't the contribution of rainfall but really just the relative magnitude; in Line 186 it is not that one is more dominant than the other, it is just a relative measure. The demarcation on "1" is arbitrary and not helpful.

Reply: We agree with the reviewer that the S'/P' ratio is just the relative magnitude, and the demarcation on "1" could be arbitrary, we have rephrased this as: "When SPR is large, floods are more affected by the antecedent soil moisture; while a smaller SPR indicates relatively larger magnitude of rainfall comparing with antecedent soil moisture, that is, rainfall is more influential in flood generation." We hope the reviewer finds our revision appropriate now.

I am not convinced by Section 4.3 or Lines 411-423 for the flood warning because any SPR (low or high) could cause a flood because it is just a relative measure and has no measure of magnitude. You could have low rainfall and low soil moisture and get the same SPR as a high rainfall and high soil moisture. I don't think this can be used for forecasting.

Reply: We agree with the reviewer that SPR is just a relative measure, and given the diversity of flood generation, the SPR we derived at an average not event scale is not sufficient for flood early warning. This study is to present a framework to quantitatively evaluate the relative contribution of rainfall and antecedent soil moisture at mean annual scale, the potential application on flood early warning would need more detialed analysis at event scale. We have removed the discussion about early warning now. Hopefully the reviewer finds our revision appropriate now.

Also, I would concur with the other reviewer on the colour choice

Reply: Thank you for the suggestion, we have replaced the red dots with cyan dots now.

Line by line comments:
Line 42: "frequency and intensity"?

Reply: Yes, extreme rainfall events are becoming more frequent and intense. We have included "intensity" in the sentence. Thank you!

Line 43: And hence understanding the drivers of change becomes more and more important
Villarini, G., Wasko, C., 2021. Humans, climate and streamflow. Nat. Clim. Chang. 11, 725–726. https://doi.org/10.1038/s41558-021-01137-z

Reply: We have included this citation in the manuscript: "which requires better understanding of the underlying mechanism of flood generation as well as the drivers of change (Villarini & Wasko 2021)." Thank you so much for your input.

Line 61: remove "except Yang et al 2019" because in the next paragraph you demonstrate there are more studies than just this one.

Reply: Thank you for pointing this out. We have rephrased this sentence as: "Such researches were just conducted in China recently, though still limited (Yang et al 2019; Yang et al 2020)."

Line 76: I think there is an opportunity here to state what has been performed in terms of understanding the balance between soil moisture and rainfall as flood drivers (e.g. dependence on magnitude, catchment size, region etc). I appreciate these papers are quite recent and may not have come to the authors attention when writing their manuscript. Examples include:
Brunner, M.I., Swain, D.L., Wood, R.R. et al. An extremeness threshold determines the regional response of floods to changes in rainfall extremes. Commun Earth Environ 2, 173 (2021). https://doi.org/10.1038/s43247-021-00248-x
Wasko, C., Nathan, R., Stein, L., O'Shea, D., 2021. Evidence of shorter more extreme rainfalls and increased flood variability under climate change. J. Hydrol. 603, 126994. https://doi.org/10.1016/j.jhydrol.2021.126994
Bennett, B., Leonard, M., Deng, Y., Westra, S., 2018. An empirical investigation into the effect of antecedent precipitation on flood volume. J. Hydrol. 567, 435–445. https://doi.org/10.1016/j.jhydrol.2018.10.025
Bertola, M., Viglione, A., Vorogushyn, S., Lun, D., Merz, B., Blöschl, G., 2021. Do small and large floods have the same drivers of change? A regional attribution analysis in Europe. Hydrol. Earth Syst. Sci. 25, 1347–1364. https://doi.org/10.5194/hess-25-1347-2021

Reply: Thank you very much for your recommendation. These studies about the threshold effect, the the elasticity of flow to antecedent precipitation relative to flood-producing precipitation are inspiring for our work. We have included these citation in the manuscript and rephrased this sentence to: "Recently, studies started to examines the relative importance of rainfall and antecedent soil moisture in flood generation (Brunner et al., 2021; Wasko et al., 2021; Bennett et al., 2018; Bertola et al., 2021). A quantitative evaluation of the relative contribution of rainfall and antecedent soil moisture and its change across watersheds is still limited and currently unavailable in China (Liu et al., 2021; Wu et al., 2015)." Hopefully the reviewer finds our revision satisfactory.

Line 93: “The Yangtze River”

Reply: We have made the suggested change, thank you!

Line 106: The ‘s’ is a typo.

Reply: Sorry about the typo, we have deleted it now, thank you.

Section 2: I am not sure Figure 1 was referenced anywhere? The caption says: “climate stations and hydrological”, the legend “hydrological and precipitation stations” and the text in Section 2.2 “meteorological and streamflow”. As a result, I am not actually sure what stations have what data.

Reply: Thank you for pointing this out. We have referred Figure 1 in Section 2.2, and changed it to “hydrological stations and meteorogical stations” in the manuscript, figure caption as well as on the figure. Sorry about the confusion.

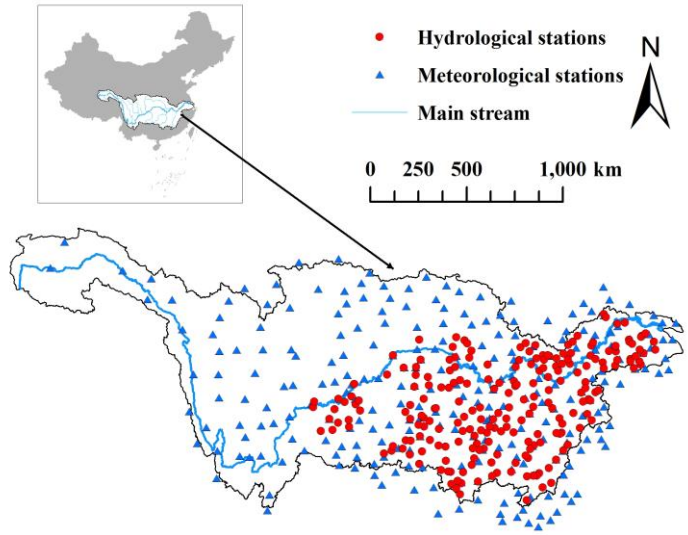


Figure 3 caption: Rather than saying “the green ones” you could say “the green circles” or “the green dots”

Reply: We have changed “the green ones” to “the green dots”, and “the red ones” to “the red dots” now. Thank you.

Line 231: “Dominant driver” – again, this is subjective and I would remove this sentence altogether.

Reply: We have deleted this sentence as the reviewer suggested, thank you.

Figure 4 y-axis: please label with normalized precipitation like you did in Figure 3.

Reply: Since we have replaced the normalized values with percentile values following reviewer #2's comment, we have changed the y-axis label to "Percentile of Precipitation" in Figure 4.

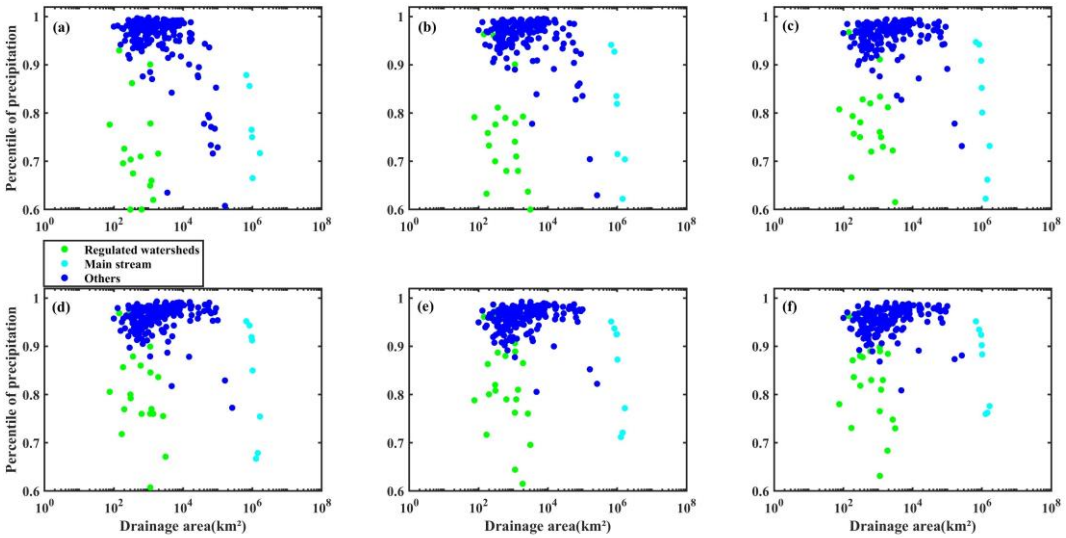
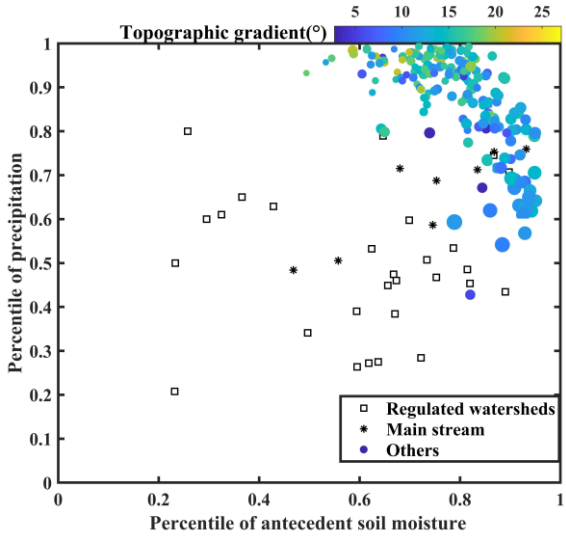


Figure 5: What are the slope units? The size of the dots needs a scale too. Figure 5 needs more explanation in the text to justify its place in the paper.

Reply: The unit of slope is (°). We have added it in Figure 5 and rescaled the size of dots to make it more distinct (following the comment of reviewer #2, we have also replaced the normalized soil moisture and rainfall with percentile values). We have also removed the dash lines as Reviewer #2 suggested. This figure is used for an illustration that we may divided the watersheds into three groups: the relative large and flat catchments on the bottom right that are more dominated by soil moisture, the relative small and steep catchments on the upper left that are more rainfall dependent, and the rest of the catchments having floods with heavy rainfall on near saturated soil. This could then lead to the derivation of TWI in Figure 6. We have included this discussion of Figure 5 and focused more on the declining trend between the percential of rainfall and percentile of antecedent soil moisture in the manuscript now. We hope the reviewer finds our revision and explanation sufficient now.

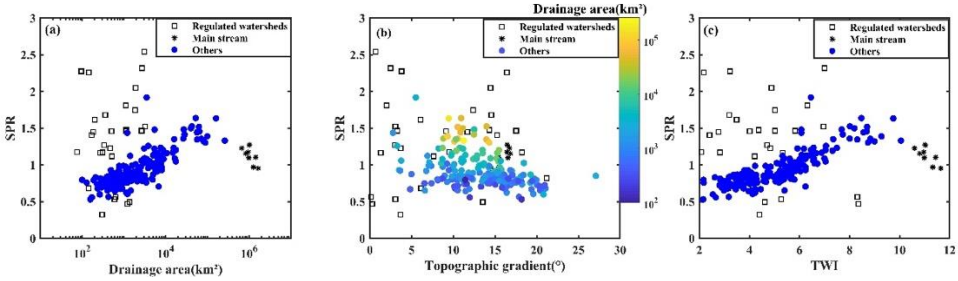


Line 275: Remove "the influential factors of"

Reply: We have removed "the influential factors of" as the reviewer suggested, thank you.

Figure 6: Units of drainage area?

Reply: The unit of drainage area is (km²), we have added it in Figure 6 now. We have also replaced the SPR calculated from normalized values with percentile values following reviewer #2's comments.



Line 286: What is the practical implication of the TWI? Is it just dominated by the area? Not sure about the value or physical interpretation of Figure 6c. Okay – this comes in the discussion – but I think more should be mentioned in the results to point to this.

Reply: TWI is the ratio betwene drainage area and topographic gradient, it is influenced by both factors. Its correlation with SPR is similar with Figure 6a, but less scatter. That is, the inclusion of topographic gradient could help improve the prediction of SPR. TWI represents the propensity of subsurface flow accumulation and frequency of saturated conditions, and thus can be used to predict relative surface wetness and hydrological responses (Meles et al 2020). It is widely used to quantify topographic impact on hydrological processes: i.e. spatial scle effects, hydrological flowpath, etc. It has also been used in land surface modelings for hydrological, biogeochemical as well as ecological processes (Sørensen et al 2006). Thus, the correlation between SPR and TWI is consistent with the physical representation of TWI, the relative surface wetness (TWI) could be used as indicator of the flood generation SPR. We have

added brief discription of TWI in Section 2.3 and this brief discussion in Section 3.4 as well. Hopefull the reviewer finds our addition sufficient now.

Sørensen, R., Zinko, U., and Seibert, J.: On the calculation of the topographic wetness index: evaluation of different methods based on field observations, Hydrology and Earth System Sciences, 10, 101–112, 2006.

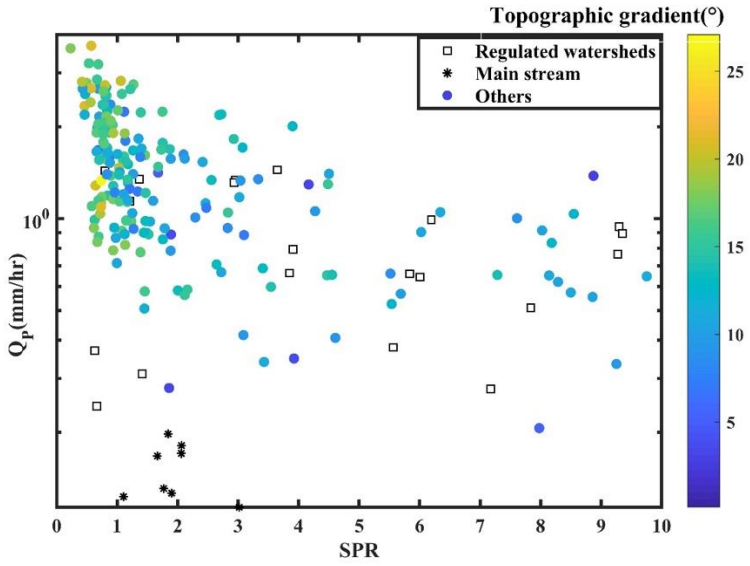
Meles, M.B., Younger, S.E., Jackson, C.R., Du, E., Drover, D.: Wetness index based on landscape position and topography (WILT): Modifying TWI to reflect landscape position, Journal of Environmental Management 255, 109863, 2020.

Figure 7: Again, more discussion is needed in the text, the authors may consider a log scale for the y-axis.

Reply: We agree with the reviewer that more discussion is needed for Figure 7. Following the other reviewer's comment, we have toned down the discussion on the event scale application and focused more on the discussion of mean annual scale. We have added the following discussion about Figure 7 in the discussion section (Section 4.2):

"Meanwhile, the SPR also present a negative correlation with the magnitude of AMFs (Figure 7). That is, we could infer the average AMFs based on SPR for each watershed. Since the characteristic SPR could be estimated from TWI, we could derive qualitative estimation of the mean AMFs from topographic characteristics that are easy to measure. This would be helpful for flood control management in ungauged watersheds, especially the mountainous watersheds with small SPR and flush floods. Similar correlation was also found in the observations from our experimental watershed, a headwater of Yangtze River (Liu et al 2021). The ratio of observed antecedent soil moisture and event precipitation also presents similar decline trend with total discharge at event scale. However, the correlation between SPR and discharge at event scale is preliminary and more observation data with higher resolution are needed for validation. For this study, we present the framework of flood generation SPR that could be derived from topographic characteristics and used to provide information of mean AMFs."

We tried a log scale for the y-axis, as shown following, it feels like the linear scale suits better, we think it may be better to keep the linear scale for the y-axis.



Line 375: Remove “for sure”

Reply: We have removed “for sure” now, thank you.

Line 377: “be used”

Reply: We have changed “used” to “be used” now, thank you.