Reviewer #1 (Comments to Author (shown to authors):

The authors aimed to reveal the dominant factor controlling flood generation in the middle and lower Yangtze River basin by calculating the ratio of the relative importance of antecedent soil moisture and daily rainfall (SPR). And they further analyzed the relationship of SPR with topographic wetness index to understand the linkage between the dominant flood generation mechanism and watershed characteristics. It is a valuable study and within the scope of this journal. However, there are several aspects that need to be clarified and improved.

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.

Major concern:

1.In this manuscript, some conclusions were drawn based on correlation analysis but not casual analysis. For example, on the relationship of soil moisture with flood events in large catchments, due to long concentration time, it is possible that high soil moisture is the result of large rainfall, and at the same time the large rainfall leads to flood under the condition with low antecedent soil moisture. But when using correlation, the used soil moisture is not the soil moisture generating this flood but the one after rainfall. Therefore, I suggest that the authors add area information of the study catchments and calculate the concentration time. Based on the information, some further casual analysis should be taken.

Reply: It is possible that soil moisture at the day before the annual maximum flood (AMF) may not be the soil moisture before event in large catchments due to the long concentration time. We estimated the concentration time for 10 sites with largest drainage area (larger than 10^5km^2): the ones on the main stream and at the outlets of major tributaries following the USBR method (USBR 1973; Gericke & Smithers 2014). As we can see from Table A1, the concentration time is mostly within two days for main stream sites and is less than 24hr for sites at the outlets of major tributaries. Since these are the sites with largest drainage area, the rest of the sites are likely to have shorter concentration time. That is, for the sites we focused on, the concentration time is likely to be within one day. Thus, the soil moisture at the day before AMFs would contribute to the generation of AMFs.

We agree with the reviewer that, even for the soil moisture before AMFs, it could still be the results of rainfall. Since the AMFs in our study region all come during rainy season, when rainfall comes in most of the time. It could be difficult to separate individual rainfall events. Thus, we chose the daily scale instead of event scale to avoid the uncertianties. The goal of this study is to present a framework that examines the relative importance of soil moisture and single day rainfall in flood generation. Given the estimated concentration time for the largest watersheds, we believe the soil moisture of the day before the AMFs could represent the saturation ratio of soil before the occurring of AMFs. Besides, the seven days accumulated rainfall (Figure 4f) also represents similar correlation with drainage area, similar with Figure 3a. That is, the impact of antecedent soil moisture sustains with the consideration of concentration time.

It would be more rigorous to take the concentration time into consideration as the reviewer suggested, we are planning to do it with hourly data for further in-depth analysis. We have included these discussions in Section 4.4 Limitations. Hopefully the reviewer finds our explanation satisfactory.

Table A1: Estimated concentration time for sites on main stream (start with MS) and at the outlets of major tributaries (start with TR).

Site Name	Concentration Time (hr)	Drainage Area (km²)
TR-Hukou	17.9	161,979
TR-Chenglingji	18.8	261,986
MS-Zhutuo	32.7	668,661
MS-Cuntan	32.8	827,799
MS-Wanxian	37.6	948,524
MS-Yichang	41.5	982,948
MS-Jianli	45.2	1,014,690
MS-Luoshan	46.3	1,276,676
MS-Hankou	51.0	1,432,008
MS-Datong	54.3	1,657,604

Ockert J. Gericke & Jeff C. Smithers (2014) Review of methods used to estimate catchment response time for the purpose of peak discharge estimation, Hydrological Sciences Journal, 59:11, 1935-1971, DOI: 10.1080/02626667.2013.866712

USBR (United States Bureau of Reclamation), 1973. Design of small dams. 2nd ed. Washington, DC: Water Resources Technical Publications.

2. The analysis was based on the estimation of antecedent soil moisture, whose reliability was dependent on the water balance. However, there isn't enough description for the method to estimate soil moisture. (1) The authors simulated daily soil water storage using a water balance equation, in which there isn't the exchange of soil moisture with groundwater. It can lead to a large error in humid regions, such as Yangtze River basin.

Reply: We agree with the reviewer that there is exchange process between soil moisture and groundwater in our study region. Since the exchange with groundwater is more complicated and heterogenous: i.e., rivers could receive groundwater recharge in hilly area and recharge groundwater in lower land (Che et al 2021). According to Huang et al. (2021), the variation of groundwater level in the Yangtze River basin is relatively small, and the overall water resources will be in a balanced state. Thus, in this study, we estimated the soil moisture following Berhuijs et al. in 2019 with a simple water balance equation, and didn't consider the groundwater exchange. We agree that accurate estimation of soil moisture is important in our study, and we are using the reanalysis soil moisture for further analysis at event scale. We have included these discussions in Section 4.4 Limitations. Hopefully the reviewer finds our explanation satisfactory.

Che, Q., Su, X., Zheng, S., Li, Y.: Interaction between surface water and groundwater in the Alluvial Plain (anqing section) of the lower Yangtze River Basin: environmental isotope evidence. Journal of Radioanalytical and Nuclear Chemistry, 329, 1331–1343.

Huang, C., Zhou, Y., Zhang, S., Wang, J., Liu, F., Gong, C., Yi, C., Li, L., Zhou, H., Wei, L., Pan, X., Shao, C., Li, Y., Han, W., Yin, Z., and Li, X.: Groundwater resources in the Yangtze River Basin and its current development and utilization[J]. Geology of China, 2021, 48(4):979-1000.

(2) Equation 6 was used to estimate the change in soil water storage, but it isn't clear how to determine the initial value.

Reply: Since our simulation starts from January, the relatively dry period in the study region, the initial value of soil water storage was set to 0. Due to the long term of simulation, the change of initial value wouldn't significantly affect the results. We have clarified this in Section 2.3, we hope the reviewer finds it clear now.

(3) There is lack of necessary assessment on the estimated soil moisture.

Reply: We have to admit that the estimation of soil moisture are highly simplified, and may not always represent the actual condition at event scale. However, due to the lack of observation, it is difficult for soil moisture assessment: local measurements could not provide representative observation of soil moisture at catchment scale for our study region while remote sensing images can only provide soil moisture at the top 5cm (Babaeian et al 2019). While sophasticated models could be applied for the soil moisture estimation, there are also substantial uncertianties (Zaherpour et al., 2018). In this study, we used the mean annual values of the soil moisture which is considered as less impacted by the inaccurate representations at the event scale (Berghuijs et al 2019).

To further reduce the biases that may caused by this simplified estimation, we replaced the normalized soil moisture with percentile soil moisture following reviewer #2's comment. The percentile soil moisture represents the relative saturation, and would be less influenced by the inaccurate representations at the event scale (Berghuijs et al 2019). As we can see from Figure A1 – A5, all the trends sustain with the percentile presentation. More rigorous assessment would be necessary if we want to apply our findings to specific catchments. Indeed, we are planning to use reannalysis soil moisture data along with in-situ observations to further validate our results in experimental catchments at event scale, but it is beyond the scope of this study. We have included this discussion in Section 4.4 Limitations. Hopefully the reviewer finds our explanation satisfactory.

Babaeian, E., Sadeghi, M., Jones, S. B., Montzka, C., Vereecken, H., & Tuller, M. (2019). Ground, proximal, and satellite remote sensing of soil moisture. Reviews of Geophysics, 57, 530–616.

Zaherpour, J., Gosling, S. N., Mount, N., Schmied, H. M., Veldkamp, T. I., et al. (2018). Worldwide evaluation of mean and extreme runoff from six global - scale hydrological models that account for human impacts. Environmental Research Letters, 13(6), 065015.

Berghuijs, W. R., Harrigan, S., Molnar, P., Slater, L. J., & Kirchner, J. W. (2019). The relative importance of different flood - generating mechanisms across Europe. Water Resources Research, 55, 4582–4593.

Figure A1: Scatterplot between the drainage area and (a) the percentile of antecedent soil moisture of AMF events (the linear regression for blue dots: $R^2 = 0.46$, p-value<0.001); (b) the percentile of precipitation at the day of AMF events (the linear regression for blue dots: $R^2 = 0.61$, p-value<0.001). The green dots represent the regulated watershed, the cyan dots represent the sites on the main stream, and the rest sites are shown in blue.

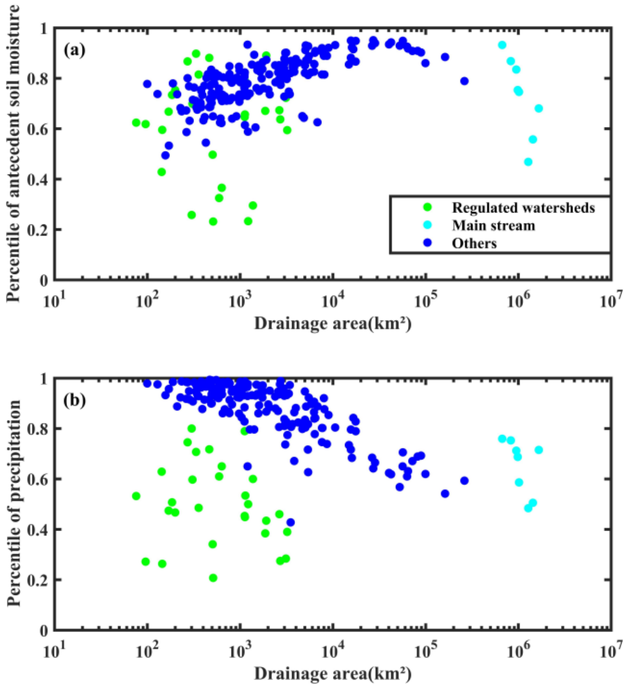


Figure A2: Scatterplot between the drainage area and the percentile of accumulated rainfall of (a) two days; (b) three days; (c) four days; (d) five days; (e) six days; and (f) seven days on AMF events.

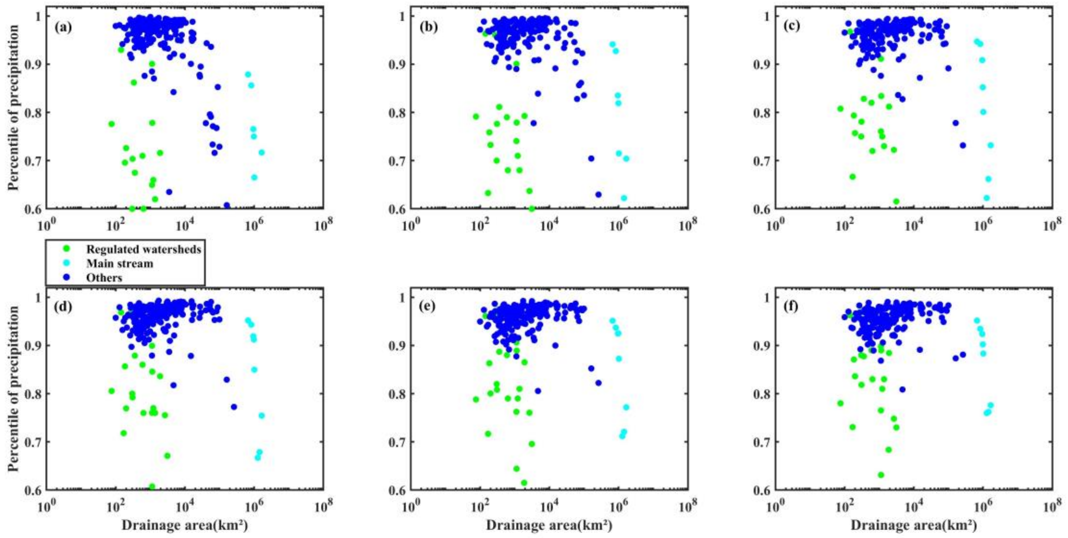


Figure A3: Scatterplot of the percentile of precipitation and antecedent soil moisture, the color represents topographic gradient and the size of circles is scaled by drainage area.

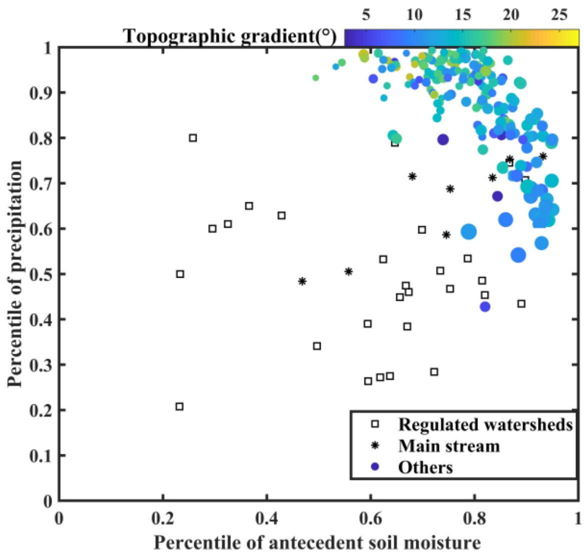


Figure A4: Scatterplots between the ratio of the percentile of antecedent soil moisture and precipitation (SPR) and (a) drainage area; (b) slope; and (c) topographic wetness index (TWI).

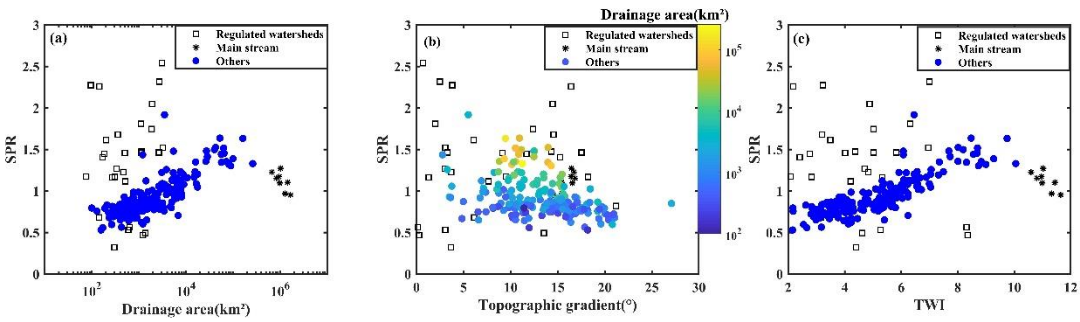
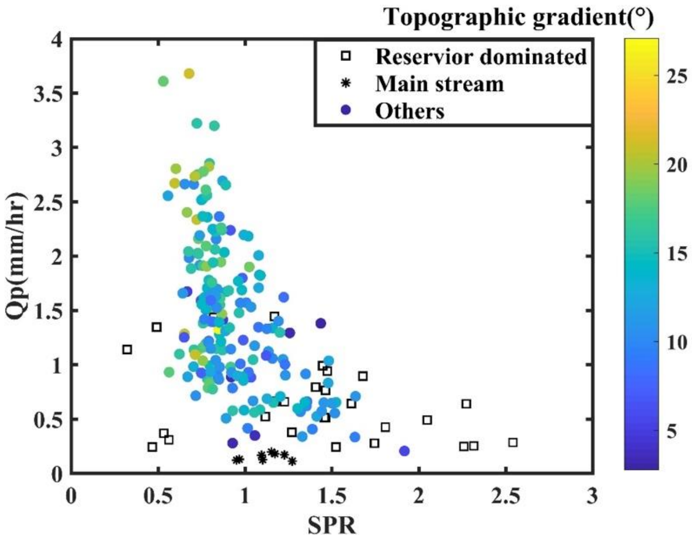


Figure A5: Scatterplot between the ratio of antecedent soil saturation rate and normalized precipitation (SPR) and area weighted annual maximum discharge (Q_P), the color represents topographic gradient.



(4) As an important element of water balance, ET was calculated according to Equation 7, which needs being re-considered. First, the dimension of ET0 and ET is mm/d, while that of S is mm. Second, why the upper limit of ET is 0.75*ET0?

Reply: ET was calculated following Berhuijs et al. (2019). S was used as the upper limit of daily ET to make sure that daily ET flux would not exceed the soil water storage. The ET was scaled as 0.75*ET_0 following Berhuijs et al. (2019) to make sure it is smaller than than the potential evaporation. This is a highly simplified estimation of ET, more sophasiticated method should be used in further analysis on specific catchments at event scale. For this study, we used this as an illustration for the framework that differentiate the contribution of precipitaiton and soil moisture in flood generation. We have included this discussed in Section 4.4 Limitations. Hopefully the reviewer finds our explanation satisfactory.

(5) It isn't clear whether the soil moisture has an upper limit.

Reply: Since we used the observed streamflow data for the water balance estimation, we didn't set an upper limit in the estimation of soil moisture. We calculated the Smax for our study catchments, they are mostly between 100mm and 300mm (Figure A6). According to the Harmonized World Soil Database (Nachtergaele, van Velthuizen, & Verelst, 2009), most of our study catchments belong to AWC (available water storage) class 1, that is 150mm/m (Figure A7). The soil depth usually vary between one and three meters, thus the total soil water storage would be between 150mm and 450mm. Our estimated Smax is within the range. To further reduce the bias in soil moisture estimation, we replaced the normalized soil moisture with percentile soil moisture following reviewer #2's comment (Figure A1-A5). The percentile soil moisture represents the relative saturation, and would be less influenced by the inaccurate representations at the event scale. Hopefully the reviewer finds our explanation satisfactory.

Figure A6: Histgram of Smax across the study watersheds

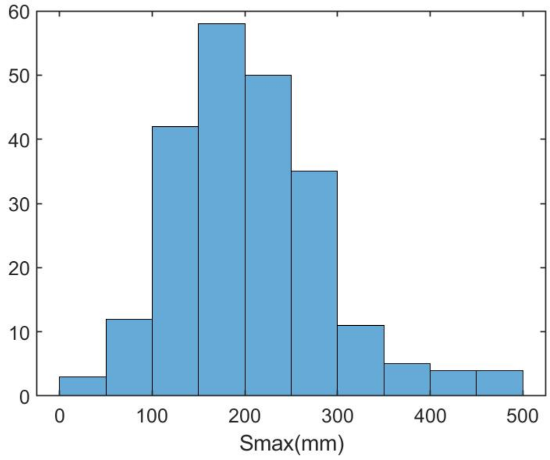
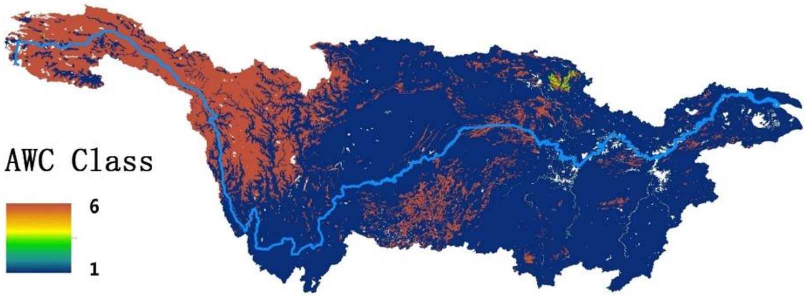


Figure A7: The available water capacity (AWC) class in the middle and lower Yangtze River basin.



Nachtergaele, F., van Velthuizen, H., & Verelst, L. (2009). Harmonized world soil database, Version 1.1. Rome: FAO/IIASA/ISRIC/ISSCAS/JRC.

3. The authors assumed that "When SPR is larger than 1, floods at those sites are more dominated by antecedent soil moisture; when SPR is less than 1, rainfall is the primary driver of floods." Why it is 1, not any other value? More explanations on its rationality are required.

Reply: SPR was calculated as the ratio between the saturation rate (*S'*) and the relative intensity (*P'*), both were normalized by the maximum values. In our revision, we have replaced the normalized soil moisture and daily rainfall with percentile soil moisture (*S'*) and percentile rainfall (*P'*) following reviewer #2's comment (Figure A1-A5). That is, both of them were ranks indicating how extreme they are. If *S'* is close to 1 and *P'* is small, then SPR would be larger than 1, that is, the soil moisture is close to the maximum while the rainfall is a relatively small rainfall comparing among the time series. Thus, the generation of runoff would be more dominated by soil saturation. Instead, if the soil is relatively dry (*S'* << 1) while *P'* is close to 1, then SPR would be smaller than 1. That is, the rainfall is close to the annual maximum rainfall while the soil moisture is relativley low. Thus, the generation of floods would be more dominated by extreme rainfall. That is, the larger the SPR is, the more dominant the soil moisture is in runoff generation, and vice versa. When SPR equals 1, the relative rank of soil moisture and rainfall are similar. Thus we use 1 as the divide.

We agree that this demarcation on 1 could be a bit arbitrary, we have included these explanation in the introduction of SPR in Section 2.4, and changed it to focus on the trend instead of the divide: '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.' Hopefully the reviewer finds our explanation clear now.

Detailed comment:

1. Line 60-61, it states that "Little work has been conducted on the flood generation mechanisms in China (except Yang et al., 2019)". It isn't correct. I notice that Yang et al. (2020) has been listed in the reference. In fact, based on casual analysis, Yang et al. (2020) explored the flood generation mechanism and the dominant factors (antecedent soil moisture, rainfall, snow melt and etc.) in the Eastern Monsoon Region of China, including most of the Yangtze River basin.

Reply: Thank you so much for pointing out this, we have now included Yang et al. 2020 and rephrased the sentence: 'Such researches were just conducted in China recently, though still limited (Yang et al 2019; Yang et al 2020)'. We hope the reviewer finds our revision appropriate now.

2. Line 76-77, a comment is similar to the above one.

Reply: Thank you for pointing this out. What we intended to say is that 'a quantitative evaluation of the relative contribution of rainfall and antecedent soil moisture and its change across watersheds is currently unavilable in China." We are sorry about the confusion and have rephrased this sentence, hopefully the reviewer finds our revision appropriate.

3. Line 171, maximum daily discharge?

Reply: Yes, it is maximum daily discharge, we have added daily in the sentence. Thank you.

4. Line 179, it isn't clear how to obtain Smax. Which data was used?

Reply: The Smax was obtained from the soil moisture estimated from Equation 6. Since we have replaced the normalized soil moisture with percentile soil moisture, we have removed Smax in the manuscript.

5. Line 181, it isn't clear how to define Pmax, the maximum in one year, or the maximum in all the years.

Reply: The Pmax is the maximum in each year and averaged for all the records to minimized the uncertainties. Again, since we have replaced the normalized rainfall with percentile rainfall, We have removed Pmax in the the manuscript.