

Dear reviewer,

Thank you for your reviewing our manuscript. Here is our reply to your comments.

Comment 1: I believe the title does not sufficiently highlight these two aspects, and it should be revised

Reply 1: Our manuscript mainly consists of these two parts, one is the spatial and temporal variation characteristics of rainfall, including the temporal variation of rainfall over a long period of time from 1987 to 2023 at Taihangshan Station, and the other is the spatial variation characteristics of rainfall in Yuanshi County corresponding to the four surface runoff generating processes from 2014 to 2023, and the second is the surface runoff generating processes from 2014 to 2023, and we are not aware of any inaccuracies.

Comment 2: for example rows 40-41: the statement that more intense and/or longer duration rainfall increases the runoff is acceptable, but the formation of the peak runoff also implies a dependence of the role of duration and intensity with respect to the scale of the basins, which requires an enrichment of the citations with papers that deal with this topic.

Reply 2: We just looked for relevant literature around our topic to back it up, and it's all publicly available. We are endorsing these conclusions. If the reviewer has a problem with those conclusions, I don't think that's something we need to address in this paper.

Comment 3: rows 45-47: the direct link between the emissions of greenhouse gases and the trigger or increase in the frequency of floods is debated and the results of the various analyses reported in the literature show different conclusions in different parts of the world (positive trends in some areas, no trend in others etc.). Therefore the authors' statements should be revised and accompanied by a more extensive literature analysis on the topic. furthermore, the cited paper by Yavuz talks about trend verification methods and shows an application to precipitation.

Reply 3: We address this only to say that climate change has some impact on hydrological processes and therefore raises concerns. Not to prove these theses. The fact that these conclusions are the results of other scholars who have already published them publicly shows that they are still partially recognized, and we won't question their correctness when we cite them. Of course, science is inherently dialectical, and perhaps this thesis will be debunked later.

Comment 4: rows 51-52: Please specify better what "more complicated" means. The statement is correct, but even in this case I suggest adding some other literature to support what has been stated

Reply 4: We will revise it.

Comment 5: row 85 and the following text where the term "runoff" is used: Generally in hydrology "runoff" indicates that part of rain that does not infiltrate and flows by gravity and feeds watercourses. In this paper, it is also used to indicate the discharge flow at the outlet of a small basin. I suggest immediately clarifying the sense in which the term is used in the paper.

Reply 5: The data we measured is the flow at the outlet of the small watershed, and we don't know what that should be if it's not surface runoff. According to a number of geographers and hydrologists in China to prepare a modern geography dictionary in the explanation, including Bingwei Huang and Changming Liu, etc., runoff varies with time, and the curve formed by connecting the runoff values at each moment becomes the runoff hydrograph, and runoff is generally expressed in terms of flow. In addition, we would like to say that the runoff formation process is the entire physical

process from the beginning of natural rainfall in the watershed to the amount of water flowing out of the river outlet. The whole runoff formation process is involved in atmospheric precipitation, soil infiltration, interflow, groundwater, evaporation, filling of depressions, slope flow, and slough streams, and not only refers to the part of rain that does not infiltrate and flows by gravity and feeds watercourses.

Comment 6: rows 107-108: from the description it would seem that the soil is made up only of gravel and it is not clear whether we are referring to the basin where the surface runoff is monitored or to the entire area. To understand the results relating to the comparison between runoff and precipitation, I suggest inserting a detailed description of the "surface runoff monitoring plot" (e.g. extent, location in the study area, local soil composition, whether it is hydrologically confined, at least as regards surface water, by surrounding areas, etc..)

Reply 6: In this paragraph we are describing the vegetation and soil conditions in the Taihang Mountains, where the Taihang Mountain station is located, and the small watershed is located, and we don't know how else to describe the natural conditions of the small watershed.

Comment 7: Figure 1 can be improved. First of all I suggest to enlarge the part concerning the runoff monitoring plot. I think it is also necessary to ensure that the position of the area monitored by the raingauges and that of the basin are clearly identifiable, indicating the position and extent in each map. Also information about the extent of the area monitored by raingauges can be useful

Reply 7: Rainfall and runoff are measured at the Taihangshan station, which has been made clear in the manuscript, to say that there is really a distance, almost 200 m. This is due to the deployment of meteorological stations have the relevant requirements and regulations, rainfall monitoring place belongs to an open and level place, runoff monitoring is set in the outflow of the small watershed. Unless we put the zoning map of Taihangshan Station on this map, we cannot see the location of the two at the present scale. And with this map, what we are trying to convey at this time is the location of the Taihangshan Station, both in Taihang Mountain, and also the location in Yuanshi County, and the location of the 21 rainfall gauges in Yuanshi County, as well as a physical map of the surface runoff observation facilities. This is because we believe that readers should be more concerned with the accuracy of the data measured.

Comment 8: rows 171-177: Mention is made of the spatialization of

precipitation. In the rest of the paper, it is not clear when talking about precipitation, whether it is values obtained from an average over the interpolation area, or values observed at a single rain gauge. This point should be clarified in the text

Reply 8: This is something we've already mentioned in the article, and in 2.1, we mentioned that “This study was carried out in the Taihang Mountain Ecological Experimental Station (TMS) of Chinese Academy of Sciences, China.” In 2.3, we mentioned that “A self-recording water level gauge (HOBO U20-001-04, Onset Computer Corporation, Bourne, MA, USA) was arranged in a triangular gauging weir plot of the small watershed of the TMS”. In 3.1, we mentioned that “As shown in Fig. 2, the annual variation in precipitation in the TMS from 1987 to 2023 was large.” To make this clearer, we added TMS in 2.2 as well.

Comment 9: For example, in formula (5), P_b is a cumulative value derived from what exactly?

Reply 9: According to Cheng et al. (2022) and Gao et al. (2017), $\sum P_b$ is just the definition of this letter in the double cumulative curve formula. Other letters can also be used.

Comment 10: row 202: I would suggest improving the title, clarifying better why these further analyses are done. In the following results paragraph, a significant part is dedicated to commenting on the results of these analyses.

Reply 10: We have revised it into statistical analysis.

Comment 11: row 262: you state that the precipitation distribution of the October 2021 event is "more obvious": could you specify what you mean?

Reply 11: Our original words were “Except for this runoff generating process from October 3 to 10, 2021, the rainfall spatial distribution of the remaining three runoff generating processes is more obvious.” This conclusion is based on two aspects, the first is that as can be seen from Figure 4, the spatial differences in rainfall are not significant in this case. Secondly, calculated and mentioned in the manuscript “The variance coefficient of the total rainfall at each rainfall gauges during October 3 to 10, 2021 is only 5.96%, while for other three rainfalls, the variance coefficient values are all greater than 30%.”

Comment 12: Figure 6: I suggest enlarging the figures to make them more readable. it would be also useful to use the same duration for the time

window on the x-axis to facilitate comparisons (e.g. of the duration of the falling limbs of the hydrographs)

Reply 12: The horizontal coordinate we now use is the time of measurement data, rather than the time interval, mainly to compare how rainfall and runoff change at the same moment, and to get how each change in surface runoff generation responds to rainfall. As for the comparisons between different surface runoff generation processes, we elaborated them in the textual description and analysis, including the time when the surface runoff generation started, the duration and the time when it ended.

Comment 13: paragraph 3.3: In the comments on the three runoff events, only for the July 2021 event does a duration of the falling limb of the hydrograph emerge that is significantly different from the other cases. I would also suggest a comparison with the rainfall preceding the event to verify the role of the latter on the duration of the falling limb

I suggest specifying which precipitation values were used: e.g. averages on the monitoring plot, observed from a nearby raingauge, etc.

Reply 13: This result we did not mention in the manuscript, and in this section we mainly wanted to analyze the variation of the surface runoff generation processes with time as well as rainfall. The data we mentioned

in 2.2 and 2.3 are very clear, in which the rainfall data were recorded at 1 h intervals, and the runoff data were also recorded at 1 h intervals, and both were measured at the same place and at the same time synchronously. So, our part is to graph and analyze the data of both at the same time. There is no problem of using average values and nearby rainfall gauge for rainfall data.

Comment 14: The spatial rainfall characteristics that matter for a catchment are mostly those inside the catchment itself. If the catchment is not hydrologically connected with the surrounding area, the spatial distribution of rainfall outside the catchment usually has little influence on runoff. Can you explain better why you link runoff measured in a very small catchment (2.6 ha) with the rainfall distribution in an area of the order of 1000 km² (according to fig. 1)?

Reply 14: We are not linking the two parts together. Both from the title and from the results listed later it is clear that this manuscript of ours is divided into two parts, the first one is the temporal and spatial variation characteristics of rainfall, where the temporal variation we analyzed the rainfall measurement data from 1987-2023 at Taihangshan station, which was used to analyze the temporal variation characteristics of long time series of rainfall at this station and to get the understanding of the frequency

of heavy rainfall events in the period of 2014-2023 . After that, we mentioned that since the small watershed surface runoff observation equipment we constructed at Taihangshan station in 2014, we only observed four surface runoff generation processes, and the rainfall corresponding to this generation was all heavy rainfall. Therefore, we analyzed the rainfall characteristics corresponding to these four surface runoff generation processes. Among them, the rainfall data of space is utilized in the county where the station is located (the data of 21 rainfall stations in Yuanzhi County), and we have never mentioned the area of 1000 km² in the manuscript, so we don't know how the reviewers we got this data. The second thing we did was to analyze the characteristics of the four surface runoff generation processes and the relationship with rainfall.

Comment 15: The authors declare that " data is contained in the paper", but it contains summary tables, figures and graphs. My opinion is that "available data" means making the original data available in digital format to possibly repeat the experiments or do others.

Reply 15: Our intended meaning is that our data are contained in tables and figures in the manuscript. All the data in the manuscript were obtained from years of field measurements with our monitoring equipment and instruments, and these are also part of the results that belong to us. To the best of our knowledge, there are no articles that put original data from field measurements directly in the manuscript, even if they are data papers. We

can guarantee the accuracy of the data analysis. If there is a question about the results of a certain part of the data, we can communicate through the journal and editor. Of course, the accessibility of the original data depends, in the end, on the data requirements of the journal in which our manuscript will be published.