Response to Review

Reviewer #2:

The authors introduced a new statistical post-processing method by incorporating large-scale circulation patterns with local spatiotemporal information, which is valuable for Hydrology and Earth System Sciences. However, it still has some questions and need a revision for publishing.

Thank you for the comprehensive and constructive review of our article. We are willing to address these comments and improve the quality of the manuscript in a revised version. Please find below some answers to your questions and explanations on how we would address your comments.

(1) Section 3 study area and datasets: The title is the same as section 2. Check the title carefully.

Thank you for your suggestion. We will replace "Study area and datasets" by "Methodology".

(2) Section 3.1 SOM model: Equation (1) may be incorrect, please check all equations to make sure all of them are correct.

Thank you for your suggestion. The other two reviewers also mentioned the same question. We will replace "$\langle Z\rangle = \frac{Z-Z_{mean}}{\sigma_Z}\cos$" by "$\langle Z\rangle = \frac{Z-Z_{mean}}{\sigma_Z}\cos\phi$".

(3) Section 3.1 SOM model: How to determine the larger domain (95–135°E, 12–53°N) for circulation classification? What is the impact of watershed in China on circulation classification?

Thank you for your questions! In this study, in order to capture the circulation patterns over the Huaihe River basin as much as possible, the boundary of the circulation classification is to expand around the Huaihe River basin, so we put the Huaihe River basin in the middle of the nine-grid (3*3, Figure 3). For the second question, the Huaihe River basin is located in the eastern part of China, using the entire Chinese basin for circulation classification may overly emphasize climatological structures over the region and fail to capture the regional variability. We prefer to use the area near the target watershed(95–135°E, 12–53°N) for circulation classification.

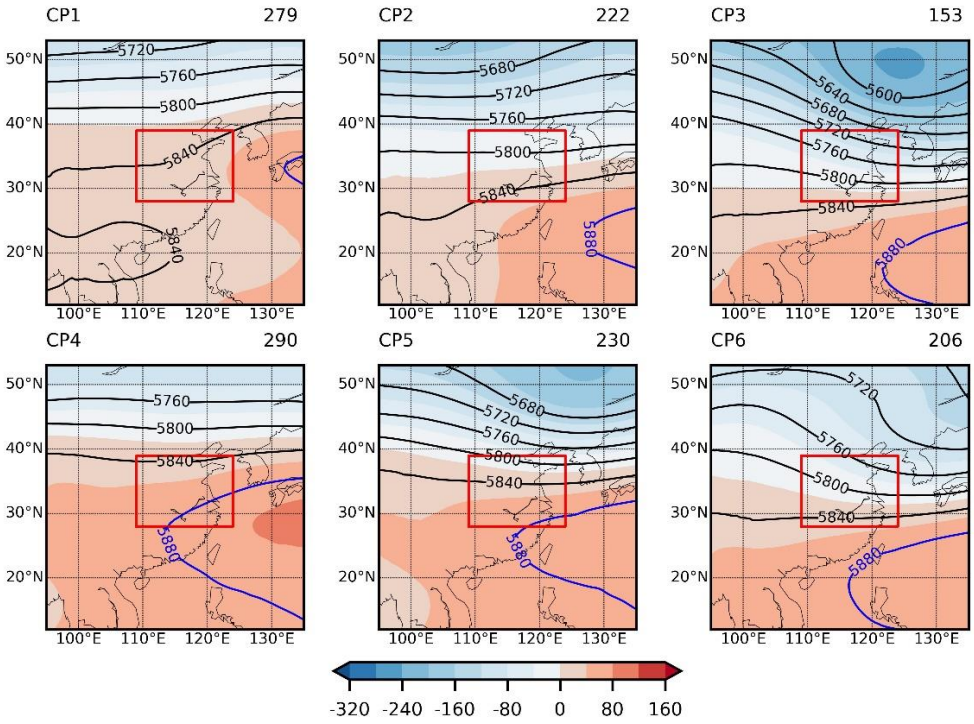

Figure 3 Circulation patterns at the lead time of 1 day in the summer of 2007-2021. The bold blue line (5880 gpm) is the characteristic position of WPSH; The red rectangle represents the scope of the Huaihe River basin; The colored shading stands for the geopotential height anomalies at 500 hPa; The numbers for each circulation pattern are shown in the upper right corner.

(4) Section 3.2 CNN-LSTM model: How to consider spatial information in the CNN model? It is not clear.

We are sorry for not explaining the point clearly. There are 508 grids in the basin and for each grid, a 5 × 5 sub-grids(about 125km×125km) centered on it is extracted to fully consider the spatial information(Figure 2A). Therefore, the CNN model includes input arrays with dimensions of 508×5×5. We will explain it in the resubmitted manuscript.

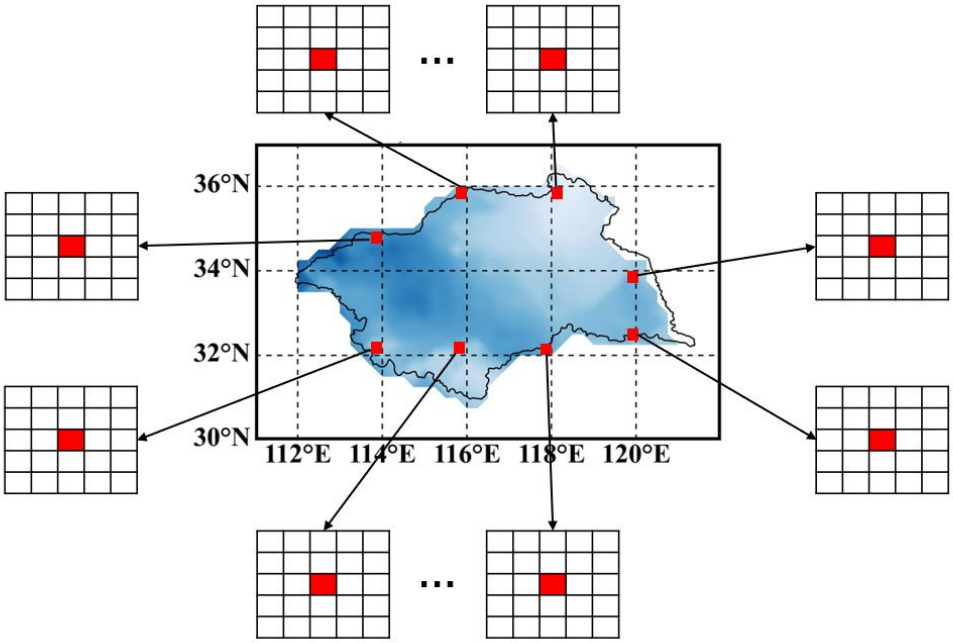

Figure 2A Diagram of CNN model sub-grid data extraction

(5) Section 3.2 CNN-LSTM model: In data preparation, the authors took summer precipitation as an example for explanation, so it might be better to add "Take summer precipitation as an example" before the sentence "First, each predictor is normalized…"

We fully agree. We will add it in the resubmitted manuscript.

(6) Section 3.2 CNN-LSTM model: The authors selected 14 predictors as the input of the CNN-LSTM model and were shown in Figure 2, but it may be better to add a table for 14 predictors with corresponding description.

Thank you for your suggestion. We will add a table for 14 predictors in the resubmitted manuscript.

Table 1 The predictors in this study

ID	Variable name	Abbreviation
1	Specific humidity(500hPa)	500-sh
2	Specific humidity(850hPa)	850-sh
3	Specific humidity(1000hPa)	1000-sh
4	U component of wind(500hPa)	500-u
5	U component of wind(850hPa)	850-u
6	U component of wind(1000hPa)	1000-u
7	V component of wind(500hPa)	500-v
8	V component of wind(850hPa)	850-v
9	V component of wind(1000hPa)	1000-v
10	10 metre U wind component	surface-u
11	10 metre V wind component	surface-v

12	Surface pressure	pressure
13	elevation	elevation
14	Total Precipitation	precipitation

(7) Section 5 discussion: The following references may be helpful to discuss the violent rain.

Chen G, Wang W C. Short-Term Precipitation Prediction for Contiguous United States Using Deep Learning[J]. Geophysical Research Letters, 2022, 49(8): e2022GL097904.

Li J, Sharma A, Evans J, et al. Addressing the mischaracterization of extreme rainfall in regional climate model simulations–A synoptic pattern based bias correction approach[J]. Journal of Hydrology, 2018, 556: 901-912.

Thank you for the suggested papers. The recommend papers are very helpful to improve the quality of our manuscript. We will add them to this section in the resubmitted manuscript.

(8) L218: “Once the four post-processing” should be “once the four post-processing”. Please check the manuscript to avoid similar errors.

We are very sorry for our incorrect writing. We will replace “Once the four post-processing” by “once the four post-processing”.

(9) L307 & L316: “SHAP” should be “WPSH”.

We are very sorry for our incorrect writing. We will replace “SHAP” by “WPSH”.

(10) L320: Is “can” more accurate than “could”?

Yes, we will replace “could” by “can”.

We appreciate for Reviewer’s warm work earnestly, and hope that the correction will meet with approval.

Once again, thank you very much for your comments and suggestions.