
Responses to reviewers' comments

In this response file, the text in black shows the comments from reviewers and editor, while the text in blue is our replies.

The authors employed the relative vorticity method to track Jianghuai cyclones and subsequently investigated their climatological characteristics, including frequency, intensity, and radius, in relation to Meiyu precipitation. This study holds significant value and serves as a crucial foundation for further research on the dynamics of Jianghuai cyclones and their impact on both mean and extreme precipitation. However, the current study requires substantial revisions. The key strength of this research lies in the association between Jianghuai cyclones and Meiyu precipitation; however, the analysis in this aspect is relatively limited. Therefore, I recommend that the authors devote more attention to this particular area. For instance, they could explore the differences in circulation patterns and underlying mechanisms between cyclone precipitation days and non-cyclone precipitation days, or investigate the connection with extreme precipitation events.

Response:

We would like to express our sincere gratitude for your help and supports. The most of your suggestions have been accepted and the manuscript is revised accordingly. Our responses to the comments are listed in a one-by-one manner as follows.

Detailed Comments:

Line 116: CN05.1 data need a citation.

Response:

We are very sorry that we forgotten the data reference, and we've added citations to the references in Line 131."The precipitation data are from the CN05.1 grid point observation dataset compiled by the National Meteorological Information Center of China Meteorological Administration with a resolution of 0.25°×0.25° (Wu et al., 2013; Xu et al., 2009). "

Section 2.2 Methods:

I would suggest the authors giving a briefly introduction of the rationale of the vorticity tracking method proposed by Hodges firstly, and then the details would be more readable. Besides, the method (Hodges, 1994, 1995) introduction still left too much attention to detail and seems tedious. And the advantages of the method used in this study over other methods should be stressed. That is, the last two paragraphs in this section could be rewritten to improve readability.

Response:

We appreciate your suggestion, and we have rewritten the last two paragraphs. In the revised manuscript, specifically in lines 147-169, we describe the adjustments we've implemented: "Scholars have proposed a number of methods to identify extratropical cyclones. The objective identification and tracking method for cyclones used in this paper is the vorticity tracking method proposed by Hodges (1994, 1995). This method mainly uses the relative vorticity field at the 850

hPa to determine the feature points of the cyclone. Feature points are used to correspond to the position of the cyclone and to match the cyclone track within a given time span. In addition to the relative vorticity method of tracking proposed by Hodges, different methods of cyclone identification have also been proposed by other scholars. Lu (2017) improved the extratropical cyclone identification and tracking method involving the nine-point pressure minimum. Jiang et al. (2020) proposed an algorithm for identifying extratropical cyclones on the basis of gridded data. This algorithm is named the eight-section slope detection method.

Among them, the most commonly used cyclone tracking methods are the mean sea level pressure method (SLP) and 850 hPa relative vorticity method. Mailier et.al (2006) and Zhang et.al (2012) studied the tracks of individual cyclones in these two methods. Both of them found 850 hPa relative vorticity method can identify and detect cyclone center earlier than the SLP method (Mailier et al., 2006). The reason for this result is that SLP is easily affected by topography and large-scale background circulation shear vorticity (Hodges, 1994). So based on this advantage of the relative vorticity method, we select the 850 hPa relative vorticity tracking method. The relative vorticity tracking method can detect low vortex systems earlier and track cyclones for a longer period of time with better stability. When the closed pressure levels are not visible on the satellite map, the vorticity tracking method can still continue to track the cyclone, improving the accuracy of cyclone track data."

Line 155-156: "genesis location" is the repetition of "the first occurrence". I would suggest changing to be: The brown dots represent the genesis locations, i.e., the first place meeting the criterion, of the Jianghuai cyclone.

Response:

Thank you for your valuable suggestion. We have changed the the description of "the first occurrence" to "The brown dots represent the genesis locations, the first place meeting the criterion, of the Jianghuai cyclone." In the Line 178-179.

Lines 157-161: The authors have pointed out that the tracks of the cyclone can be categorized into two group, the easterly and the northeasterly. However, since there are no further discussions for the two groups respectively. Indeed, both the easterly or northeasterly paths are related to the locations of the WPSH.

Response:

We appreciate your suggestion. We have revised the relevant description in line 180-182: "As shown in the figure, most of the cyclones develop in the Jianghan Plain and southern Anhui Province, then move eastward to the Yellow Sea coast. Some cyclones move northward through Shandong Province and reach the Bohai Sea."

Line 165-166: Two centers with high values, i.e., southwestern Hubei and eastern Hubei. The original sentences is puzzling, and I suggest the authors revising it.

Response:

Thank you for your valuable suggestion. Our revised content is as follows in line 189-191: "The frequency of occurrence refers to the total number of cyclones during the Meiyu period from 1961 to 2020 is higher in the region of the Western Hubei Province and Eastern Hubei Province."

1: “(The brown dots represent the genesis locations. The yellow lines indicate the tracks).” The bracket is no need.

Response:

We appreciate your suggestion, and we have deleted the bracket in the article.

Line 176: “. The larger the relative vorticity intensity is, the stronger the cyclone intensity is.” seems redundant.

Response:

Thank you for your valuable suggestion. We have removed relevant redundant descriptions such as these from the original text.

Line 178: It is confusing to see a “0×10-5 s -1” in the relative vorticity for the Jianghuai cyclone.

Response:

We appreciate your suggestion. We have revised the relevant description in line 200-201: “Figure 3a shows that among the 202 selected cyclones, the intensity of the cyclone center mainly ranges from 1.5×10-5 s-1 to 7.3×10-5 s-1.”

Line 186: “radii” to “radius”?

Response:

Thank you very much for your question. “radii” is the plural form of “radius”.

Line 187: “time” to “time span”? This is different from the caption of Fig. 2, in which the “time” is the “lifetime”? Which is right? The description in the main text or the figure caption of Fig. 2?

Response:

We appreciate your suggestion, and we’re sorry we didn't specify it clearly here. After the revision, we added an explanation about “lifetime” in line 199. “The lifetime is defined as the time of cyclones affecting precipitation on land.”

Lines 193-197: Several places in the manuscript are repetitive. I suggest the authors revised them carefully. Below is an example. “Figure 3a shows a positive correlation between the maximum intensity and the maximum radius of cyclone development. The stronger the intensity of a cyclone is, the larger its radius. Therefore, the horizontal scale of most strong cyclones is larger than that of weak cyclones, the precipitation is greater, and the precipitation range is larger.”

Response:

We appreciate your suggestion, and More tautology has been removed. The revised statement as follows in Line 201: “Figure 3a shows that among the 202 selected cyclones, the intensity of the cyclone center mainly ranges from 1.5×10-5 s-1 to 7.3×10-5 s-1. The number of cyclones in the range of 2×10-5 s-1 to 3×10-5 s-1 has the largest proportion, accounting for 36% of the total number of cyclones. A total of 180 cyclones are in the range of 1.5×10-5 s-1 to 5×10-5 s-1 in intensity, accounting for 89%. Figure 3b shows the relationship between the radius of cyclones and the number of cyclones. Most of the cyclones have an average radius between 300 and 800 km, accounting for 96% of the total number. The number of cyclones with radii between 500 and 600 km is the largest, accounting for 35%. Figure 3c shows the relationship between the time of cyclones affecting precipitation on land and the number of cyclones. Most of the cyclones affect precipitation

on land for 1-3 days, and only one cyclone affects precipitation on land for more than 3 days. The number of cyclones' lifetime that affected precipitation on land within 2 days was 186, accounting for 92% of the total number."

Line215: "Figure 4a shows a positive correlation between the maximum intensity and the maximum radius of cyclone development. Therefore, the horizontal scale of most strong cyclones is larger than that of weak cyclones, the precipitation is greater, and the precipitation range is larger."

Line 215: Indian Ocean dipole (IOP) to "Indian Ocean Dipole (IOD)"?

Response:

We are very sorry about this mistake, and we have revised it in line 236-244. "This quasiperiodic variation component is mainly influenced by the out-of-ocean forcing of the Indian Ocean dipole (IOD), which changes from the ENSO in the previous winter to late spring and early summer with seasonal changes (Liang et al., 2018). During the positive phase of the IOD, the strong warming of the Indian Ocean triggers a strong Indian monsoon. This leads to a strengthening of the WPSH and an increase in precipitation in southern China. The southwesterly low-level jet, which are enhanced by the positive IOD, also provide sufficient water vapor and warm advection to generate favorable conditions for the development of the Jianghuai cyclone."

Line 219: "Southwestern rapids" to "Southwesterly low-level jet"?

Response:

We are very sorry that there were some lexical errors and we have corrected them in lin242-243: "The southwesterly low-level jet, which are enhanced by the positive IOD, also provide sufficient water vapor and warm advection to generate favorable conditions for the development of the Jianghuai cyclone."

Lines 228-230: The alternatively increase and decrease of the numbers of Jianghuai cyclones is indeed the "decadal variation of Jianghuai cylone", with positive anomaly in 1965-1970, 1990-2000, and 2000-after, and negative anomaly in 1970-1990 and 2000-2010.

Response:

We appreciate your suggestion. We have revised the relevant description in line 252-254: "In the long term, the frequency of cyclone activity in the middle and lower reaches of the Yangtze River with positive anomaly in 1965-1970, 1990-2000, and 2000-after, and negative anomaly in 1970-1990 and 2000-2010."

Line 230-232: I would suggest the authors illustrating the relationship between the decadal variation of Jianghuai cyclone and that of Meiyu precipitation.

Response:

Thank you for your valuable suggestion. We have revised the relevant description in line 2566-258: "The decadal variation of precipitation during the Meiyu period with positive anomaly in 1965-1970, 1995-2000 and 2010-after, and negative anomaly in 1970-1980, 1985-1995 and 2000-2010."

Line 242: I would suggest removing "gales" since there is no further discussion.

Response:

We appreciate your suggestion, and we have removed "gales" in line 268: "They form rainstorms in the middle and lower reaches of the Yangtze River and the coastal areas."

Line 245: “Meiyu intensity index” should be defined explicitly.

Response:

Thank you for your valuable suggestion. We have defined “Meiyu intensity index” in line 133-146. “We used the Meiyu intensity index to characterize the strength of Meiyu, and data is from the National Climate Center of China. The area for which the Meiyu intensity index is calculated is defined in the article (GB/T 33671-2017). Meiyu intensity index is defined as:

$$M = \frac{L}{L_0} + \frac{0.5(R/L)}{R_0/L_0} + \frac{R}{R_0} - 2.5$$

M is the Meiyu intensity index. L is the length of the Meiyu in a given year (unit: day) and L_0 means the average length of the Meiyu over the years (units: day). R is the total precipitation of Jianghuai River basin during Meiyu in a given year, and R_0 is the average total precipitation of Jianghuai River basin during Meiyu over the years. Where M between -0.375 and 0.375, China Meteorological Administration defines this year as the normal. Where M between 0.375 and1.25, this year is defined as a little strong. Where M greater than or equal to 1.25, this year is defined as strong. Where M between -1.25 and -0.375, this year is defined as a little weak. Where M less than or equal to -1.25, this year is defined as weak.”

Lines 250 and Lines 252: “0.769” and “0.760” to be “0.77” and “0.76”.

Response:

We appreciate your suggestion, and we have revised the relevant description in line 277-281: “We found that the number of cyclones has a positive correlation coefficient of 0.77 with precipitation in the Meiyu period passing the 99% confidence interval according to the student’s t-test. The number of cyclones was also positively correlated with the Meiyu intensity index, with a correlation index of 0.76 passing the 99% confidence interval according to the student’s t-test.”

Line 259: “annual average” to “annual total”?

Response:

We are very sorry that there were some lexical errors and we have corrected them in line 2285-286: “Figure 8a shows the spatial distribution of mean annual total precipitation during the Meiyu period from 1961 to 2020.”

Line 267-269: The definition of non-cyclone precipitation days should be explicitly stated.

Response:

We are very sorry that the explanation here gives rise to a misunderstanding. We have removed this definition.

Lin 387: The colored region passed the 95% confidence interval according to a test. Student’s t-test?

Response:

We appreciate your suggestion, and we have changed all “T test” to “Student’s t-test”. The revised text will not be shown here.