

Interactive comment on “Insights from a joint analysis of Indian and Chinese monsoon rainfall data” by M. Zhou et al.

M. Zhou et al.

fq.tian@gmail.com

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Response to Referee 2:

We are grateful to Referee 2 for the careful review of the paper and many constructive suggestions. We have incorporated all of the criticisms, as described in the following response to Referee 2, which also lists the changes we are making to the paper.

1)**Comment:** The referee suggests to add discussions on relating principle components we obtained to physical mechanisms in each individual section, and to make the conclusion at the end of the paper more concise.

Response:We are making the following changes accordingly: (1) At the end of section C1959

3.1, we are adding the following discussions: In this section we did PCA on precipitation data in India and China respectively, and analyzed the correlation between PCs in India and China, and correlation between these data and monsoon indices including IMI and WNPMI. The PCs we obtain present main trends of rainfall in the studied areas. Hence the correlation between PCs in India and China suggests common factors affecting rainfall processes in these two areas. Moreover, the correlation between PCs in both areas and IMI/WNPMI suggests that India Monsoon and West-North Pacific Monsoon are two of these common factors. These findings are consistent with previous studies (Wang, et al., 2001). These possible common factors are studied in more details using joint-PCA in section 3.4. At the end of section 3.3, we are adding the following discussions: In this section we studied the teleconnection between PCAs in precipitation data in India and China and SST. The observed correlation between them suggests a physical mechanism affecting the rainfall can be represented by the SST. It has been seen previously that SST can in general affect rainfall through atmosphere circulation, especially moisture transportation processes (Chang, 2000; Hu, 2005). The detailed physical mechanism is studied in another work (Zhou, 2011). At the end of section 3.4, we are adding the following discussions: Using joint PCA two trends in rainfall data in India and China are revealed as distinct moisture transport processes coming from Indian Ocean and North Pacific Ocean respectively. This result provides new insight on the physical mechanism behind the rainfall processes in India and China and surrounding region.

2)**Comment:** The referee suggests to add comment on the strengths and weaknesses of the PCA approach in realistically representing climate driving mechanisms, and add pros and cons of PCA.

Response: At the end of section 3.2, we are adding: In section 3.1 and 3.2 the primary analysis method we use is PCA. The raw precipitation dataset we study in this paper is huge, and the data is affected by some large scale climate factors that we are interested in, as well as other minor local factors. Those major climate factors determine

the main trends in the raw data. PCA is capable of extracting the main trends from the raw data, and separating it from other minor fluctuations. Therefore it is a powerful method for our purpose. Besides PCA, there are other methods that can be used for similar purposes, including independent component analysis (ICA) and maximum value unfolding (MVU). ICA is a family of analyzing methods based on varied assumptions of statistical characteristics of the components in the raw data, while PCA uses a relatively simple assumption. Without any a priori knowledge of the climate factors we are looking for, PCA makes a good starting point for our study. Comparing to MVU, a nonlinear analyzing method, PCA has the weakness of being linear and cannot fully represent the nonlinear nature in climate processes. However, it is also more stable against noises in the data because of its linearity, and it is an acceptable approximation for our purposes.

3)**Comment:** The referee point out that in section 3.2, the method is not clearly described, and also the numbers in Table 2 need explanation.

Response: To address that, we are changing the lines 3 to 6 of section 3.2 into the following: Since the length of time series is far less than the number of stations, PCA's ability of minimizing noise is weakened. Furthermore, as the PCs of India and the PCs of China is well correlated, to get these common features (and to reduce noise), a joint PCA is performed with the following steps: first, we choose the first 2 leading PCs of India and China which we get in section 3.1; then we perform another PCA on the 4 PCs (India PC1, India PC2, China PC1, China PC2) and obtain 4 Joint PCs. Also, the title of Table 2 is wrong, the numbers are not correlation, but the coefficients of the joint PCA are right. However, since it did not contain important information, we delete Table 2.

4)**Comment:** The referee suggested that this paper needs to be more clearly spelt out as to what in this paper is just supportive of previous work and what is actually a new and significant contribution.

C1961

Response: Results we obtained in section 3.1 and 3.3 are mostly consistent with previous studies. On the other hand, to the authors' knowledge in section 3.2 the application of joint PCA to this problem and the results in section 3.4 are new. We are adding references in section 3.1 and 3.3, and discussions on the significance of our result in section 3.4. These changes are incorporated in the responses to comment 1).

5)**Comment:** The referee points out in section 2, the reason not discuss timing and during of monsoon should be mentioned.

Response: JJAS(June, July, August, September) was chosen as study time window, we are adding the following note at the end of section 2: We note that by choosing a fixed time window we are ignoring the variability in the timing and duration of the monsoon, which can be related to climate driving mechanisms we are investigating.

6)**Comment:** No mention is made as to what is a significant and what is a non-significant correlation

Response: In this paper, a significant correlation means 99

7)**Comment:** Some of the drivers beyond ENSO need to be considered and discussed to make true sense of the PCs relationships with SST.

Response: To address this question, we add the following discussion after the second paragraph of section 3.4: We checked PCs's correlation with PDO, IOD and other climate indices, and the result is much less significant comparing to SSTa, and below the significant level used in this study.

8)**Comment:** The referee point out that the final sentence "Hence there is predictability for Indian and Chinese monsoon rain- fall through PC1 and PC2" should be rewritten.

Response: We change the sentence as following: The study provide a possibility of predictability for Indian and Chinese monsoon rain- fall through PC1 and PC2, which will be mentioned in following paper(Miao Zhou et.al. unpublished). We update the reference accordingly.

C1962

9) We made the following changes addressing the MINOR COMMENTS made by the referee 2, RC stand for referee comment, AC stand for author comment:

RC: Abstract, 2nd line: "understanding its rule. . .". . .not sure what you mean by this?

AC: we change "understanding its rule" into "understanding the features of Indian and Chinese monsoon rainfall".

RC: Page 3169, intro, 4th line. . .upward and downward trend. . .over what time period were these trends based on?

AC: These trends based on the period between 1951 and 1998. We change the sentence into the following: "Yang and Lau (2004) also show that there is an upward trend in precipitation over southeastern China and downward trend in precipitation over northern China during their monsoon season from 1951 to 1998, ..."

RC: Also page 3169, intro, line 7-8. . ."primarily linked to variations over the warm pool and Indian ocean". . .where exactly (lat and long boundaries or specific locations would be helpful)

AC: We add a reference here and change "the warm pool" into "western tropical Pacific warm pool".

RC: Section 2, line 7: "the entire India". . .suggest change to "the whole of India" or similar.

AC: We change it to "the whole of India".

RC: Section 3.3, 1st line. . .ref to Fig 4 I think should be a ref to Fig 3.?

AC: We adapt the comment.

RC: Throughout Section 3.4 and in Table 3 there is ref to "lowest value years". What exactly does this mean?

C1963

AC: This means the years in which the PCs have lowest value. We change it to "years with lowest PCs values".

RC: Section 4, page 3175, line 22...ref to "warmer tropical SST"....where exactly in the tropics are you talking about? Or do you mean all along the equator? How far north and south?

AC: The tropics mean all along the equator, about 5 degree north and south.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 3167, 2011.

C1964