Answers to Referee#2's comments

Thanks a lot for your time and helpful comments. Below your suggestions/questions are our point-by-point response which are shown in blue italic.

Interactive comment on "Anomalous holiday precipitation over southern China" by Jiahui Zhang et al.

General Comments:

This manuscript presents the anomalous holiday precipitation over southern China during the Chinese Spring Festival based on their analysis of the long-term station observations. The associated meteorological parameters are also analyzed to investigate the possible mechanisms of the reduced precipitation. The manuscript is scientifically sound, well organized, written, and concise. I recommend accepting it as minor revision as below.

Specific comments:

P3 L24 it is better to use southern China not China since the results are analyzed in southern China in this study.

[Answer] Modified.

P4 L8-9 What is your criterion to exclude the stations? likely if there is only one missing data do you exclude the site?

[Answer] Yes. Here we exclude the site if there is any missing data.

P4 L29 what is the step 0?

[Answer] The ERA-Interim data server surface archive has a mixture of analysis fields, forecast fields and fields available from both the analysis and forecast. If step 0 is chosen, then only analyzed fields, which are produced for 0000, 0600, 1200 and 1800 UTC, are available. (https://www.ecmwf.int/en/faq/what-are-steps-surface-daily-fields-era-interim)

P5 L10-18 The statements to calculate the precipitation frequencies are not clear. Actually how many days do you use, 7 days or 3 days? And it contradicts to the 9 days as found with the aerosol time-lag correlations.

[Answer] Here the calculation of the precipitation frequency anomalies is different from the continuous variables, like temperature. We counted the number of precipitation days (N) of a station in a specific day, like day 0, from 1979 to 2012. Thus, the precipitation frequency (F) is deduced by:

$$F = \frac{N}{34} \times 100\% \qquad (1)$$

To remove the randomness of precipitation, we used a 3-day window. For example, precipitation occurring on the previous day (day -1) and the day after (day +1) is considered to occur on day 0. Above method was also used to calculate the climatic values of F which are based on Gregorian calendar days. For a station from 1st January to 31st March, everyday has a precipitation frequency. Then to this sequence, we used a 7-day window filter to reserve the changes more than 7 days. For a station, in a specific day, like day 0, all precipitation frequencies whose lunar date is day 0 were found from the climatic means sequence and calculated the average. The departure of F from the average is the anomalous frequency (∆F). Final result is the average of all stations' anomalies. We slightly modified the text to make the statement clearer in revision (Section 2.2, paragraph 3).

In revision, it reads: "To remove the randomness of precipitation, we used a 3-day window. For example, precipitation occurring on the previous day (day -1) and the day after (day +1) is considered to occur on day 0. Above method was also used to calculate the climatic values of F which are based on Gregorian calendar days. For a station from 1st January to 31st March, everyday has a precipitation frequency. Then to this climatic sequence, we used a 7-day window filter to reserve the changes more than 7 days because the typical synoptic time scale is approximately 7 days. For a station, in a specific day, like day 0, all precipitation frequencies whose lunar date is day 0 were found from the climatic sequence and calculated the average. The departure of F from the average is the anomalous frequency (∆F). Final result is the average of all stations' anomalies."

We used a 7-day window filter here to remove monthly and sub monthly tendency/variation because February is always warmer than January and second half February is usually warmer than the first half February. Otherwise, the composite result would be biased. Here the rest represents the random synoptic signals within 7 days.

The 9-day time-lag correlation was calculated between year-to-year PM_{10} and circulation time series according to the lunar calendar dates. It doesn't mean there is a 9-day cycle. It reveals the correlation is the best when there is a 9-day time-lag

between PM_{10} and circulation during holidays. Such correlation between the year-to-year variation of circulation and PM_{10} reflects that year-to-year variation has a fixed time-lag of 9 days, not a relationship on the synoptic scale. We slightly modified the text to avoid misleading for readers in revision (Section 4.2, paragraph 4).

In revision, it reads: "It reveals the correlation is the best when there is a 9-day time-lag between PM_{10} and circulation during holidays. Such correlation between the year-to-year variation of circulation and PM_{10} reflects that year-to-year variation has a fixed time-lag of 9 days, not a relationship on the synoptic scale."

P6 L10-15 What do you mean of the specific day here?

[Answer] We have changed 'a specific day' to 'each lunar day'. Here we mean the lunar days, like day-1, day0 and day+1, etc.

P6 L30 It looks there are positive departures.

[Answer] Yes. It seems to be positive departures of precipitation amount before the Lunar New Year's Day (LNYD). However, they are not evident as they are in the range of 10-90th percentile. At the same time, they are not significant by the Monte-Carlo test. To avoid misunderstanding, we deleted this sentence "Unlike the precipitation frequency, the amount shows no evident departures before the LNYD."

P7 L16 section→ subsection

[Answer] Modified. Thanks.

P7 L29 could you also shown this sub-region in the Figure?

[Answer] The sub-region (108°E-115°E and 28°N-32°N) is shown in Figure A2-1. The description about the ΔF reduction center in the text is not very appropriate. To avoid misunderstanding, we slightly modified the text to "Most stations located in the north and east of study area have the significant ΔF reduction."

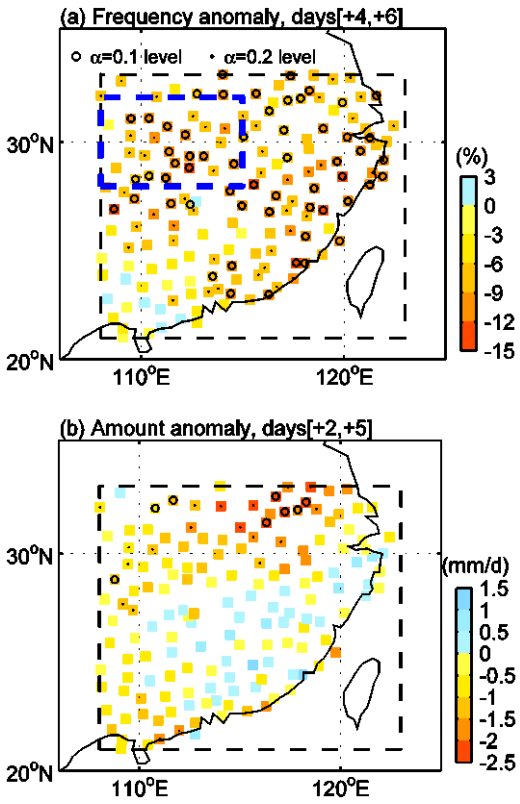

Figure A2-1. Anomalies of the precipitation frequency (a) and amount (b). The significances are estimated using a Monte-Carlo approach; stations with circles and dots denote that all days have values significant at the 0.1 and 0.2 levels, respectively. Sub-region (108°E-115°E and 28°N-32°N) is shown as blue dashed box.

P8 L10 factors-> factor

[Answer] Done.

P8 L25 Please give the sample numbers of no rain days

[Answer] During January to February from 1979 to 2012, for 155 stations, excluding the missing data, there are 152,616 samples for no rain days, 48.9% of that for all days. It can also be concluded from Figure 1a that all the precipitation days of January-February in the study area are about 30 days. In revision we added this information (Section 3.3, paragraph 2).

P10 L2-3 if total cloud cover shows no evident changes but low cloud covers experiences a significant decrease, does it indicate high cloud covers are increased?

[Answer] In fact, total cloud cover (TCC) also decreases and is similar to low cloud cover. It seems the reduction of total cloud cover is contributed by the decrease of low cloud

cover. As shown in Figure A2-2, middle cloud cover and high cloud cover both show no significant changes in southern China. We modified the text in revision (Section 3.3, paragraph 7).

In the revision, we changed the sentence to "The results show that both the total cloud cover and LCC reduces, especially the LCC experiences a significant decrease during the New Year's holiday. It seems the reduction of total cloud cover is contributed by the decrease of low cloud cover."

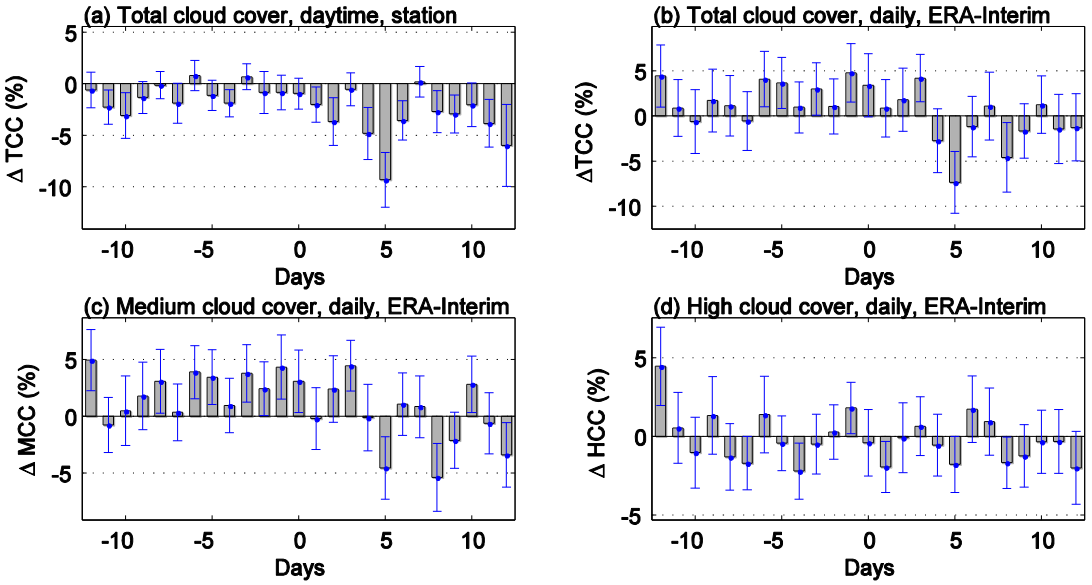

Figure A2-2. (a) Observational daytime total cloud cover anomalies from 1980 to 2012. Daily total cloud cover (b), middle cloud cover (c) and high cloud cover (d) of ERA-Interim from 1979 to 2012.

Figure 9 is it the horizontal wind or wind anomaly?

[Answer] Here is the wind anomaly both in Figure 9b and 9c. Modified.

P16 L1 why do you selected days [-15, -11]? Is it arbitrary?

[Answer] Yes, it is selected randomly. Traditionally, holidays begin a couple of days before the Lunar New Year. We chose the days [-15, -11] and [+1, +5] for comparison to reveal the aerosol reduction during Chinese Spring Festival. In the Figure A2-3, we selected days [-12, -8] and the holiday aerosol decrease is also evident. We modified the text in revision (Section 4.1, paragraph 3).

In revision, it reads: "We randomly selected days [-15, -11] to compute the

preholiday period AOD frequency distribution for comparison. We also tested other time period, like days [-12, -8], and the result is robust."

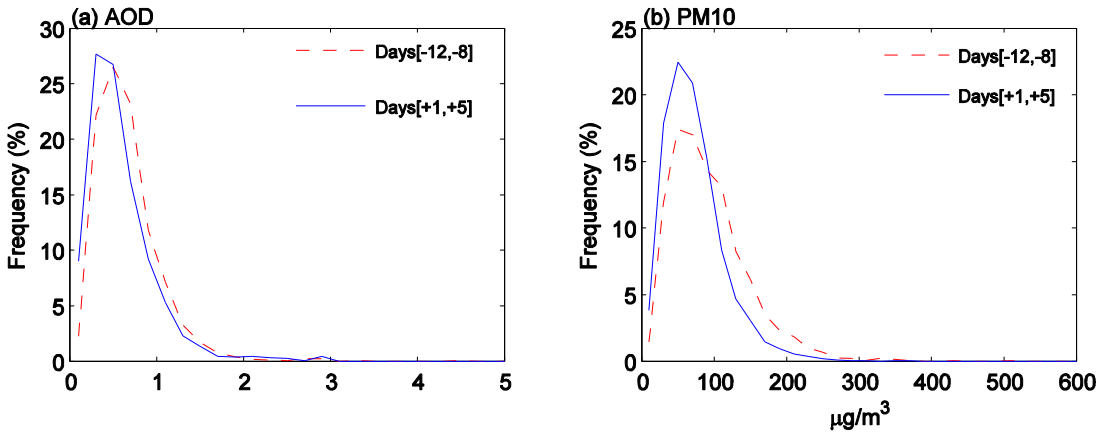

Figure A2-3. Frequency distributions for the AOD (a) and PM_{10} concentration (b) during days [-12, -8] (red dashed line) and days [+1, +5] (blue solid line) over southern China.

P18 L17 The maximum appears for a time-lag of -9, but aerosol lifetime is generally less than one week? Is there any other mechanism?

[Answer] The 9-day time-lag correlation was calculated between year-to-year PM_{10} and circulation time series according to the lunar calendar dates. It doesn't mean there is a 9-day cycle. It reveals the correlation is the best when there is a 9-day time-lag between PM_{10} and circulation during holidays. The strength of the cyclone every year during the holiday has a 9-day time-lag phase with the PM_{10}. Such correlation between the year-to-year variation of circulation and PM_{10} reflects that year-to-year variation has a fixed time-lag of 9 days, not a relationship on the synoptic scale.

Aerosol can impact the holiday precipitation/temperature through instant response of the radiation, short-term circulation response, and partly the response of the preceding emissions. It's likely human activity is the only explanation to the holiday precipitation/temperature anomaly.

We slightly modified the text to avoid misleading for readers in revision (Section 4.2, paragraph 4).

In revision, it reads: "It reveals the correlation is the best when there is a 9-day time-lag between PM_{10} and circulation during holidays. Such correlation between the year-to-year variation of circulation and PM_{10} reflects that year-to-year variation has a fixed time-lag of 9 days, not a relationship on the synoptic scale."

P20 L19 It is not accurate to use East Asia here.

[Answer] Modified. ‘East Asia’-> ‘eastern China’

-THE END-