Answers to Referee#1's comments

Thanks a lot for your time and comments. Our point-to-point answers are listed below the comments in blue italic.

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

This manuscript examined anomalous precipitation changes around the Chinese Spring Festival (CSF) and associated temperature, humidity and circulation changes using extensive station data and the ERA-Interim reanalysis. The results showed that the precipitation tends to decrease during the CSF holiday, and pointed out that the change is mainly caused by the humidity decease associated with an anomalous cyclone circulation. The results are very interesting, especially given that the ERA-Interim data present similar changes in the surface precipitation. However, the authors tried to attribute all these changes to the aerosol decrease due to the economic slowdown without giving persuasive proofs. I cannot agree to this part. The cause-effect relationship between aerosol and precipitation changes cannot be concluded from current results. I suggest a major revision to Introduction and Section 4. Currently they could be misleading for readers.

[Answer] We agree with your opinions. We have modified Introduction and Discussion accordingly. In revision, we generally talked the human activities and the influence on weather and climate, and intentionally to avoid the cause-and-effect relationship between aerosol and weather relation in Introduction. In Discussion, we also only showed PM_{10} anomalies and its time-lag correlation with the atmospheric circulation. Although we have not analysed their cause-and-effect relationship, the diagnostics and correlation analysis should shed lights on the possible mechanism(s) for further studies.

1. Page 1, Line 19, 'lower water vapor' → decreased water vapor; Line 21, 'When the precipitation days exclude the mean…' this sentence is confusing.

[Answer] Modified. We changed the sentence 'When the precipitation days exclude the mean…' to 'When the precipitation days are excluded…'.

2. The authors emphasized aerosols too much throughout Introduction. Although the authors did not state it clearly, it still feels as if aerosol changes associated with human

activities could explain all changes presented in the main text. This is misleading. I suggest the authors emphasize human impacts on weather and climate at diverse spatial/temporal scales rather than aerosols in this section.

[Answer] Thank you for your suggestion. We modified Introduction, put attention on the diverse human influence on weather and climate. And have avoided to directly mention/attributing aerosols' impact/effect, instead, we simply presented the changes in meteorological variables and air pollution in the context of human activities. When talking the weekly cycles, we mainly introduce what happened in meteorological parameters, and the aerosol changes mentioned occasionally. But when talking the human intensive events, we remain most content of the aerosols/air pollutions, because the relevant studies on the accompanying meteorological changes are very limited.

3. While this manuscript focused on southern China, are there any changes in precipitation over northern China? Since Gong et al. 2014 showed the cooling during the CSF holiday spreaded over both northern and southern China. It will be better if the authors could give some information on this aspect in the discussion.

[Answer] As shown in Figure 1a, there are much less precipitation days over northern China than southern China in the winter. The Chinese Spring Festival (CSF) holiday repeatedly occurs every year in January-February across the whole country. During January-February, average precipitation days and amount are 12.8 days and 9.9 mm (means for 319 stations north of 33°N). For the 279 stations south of 33°N, the average precipitation days and amount are 26.5 days and 81.9 mm. Too small precipitation samples in northern China would be difficult to statistically yield a meaningful signal, if any. In Section 2.1 (paragraph 2) of the revision, we have added a sentence to indicate this.

In revision, it reads:" In addition, for 319 stations north of 33°N the average precipitation days and amount are 12.8 days and 9.9 mm. Too small precipitation frequency and amount in northern China would be difficult to statistically yield a meaningful signal."

4. Page 9, Line 6, what does 'higher' mean here?

[Answer] We have changed the sentence to 'The precipitation reduction could occur with a drier and upper atmosphere'.

5. Page 10, Line 5, and somewhere else in the manuscript, 'medium cloud' → middle

cloud

[Answer] All taken.

6. Page 11, Line 18, 'plotted Figure 6b' →plotted in Figure 6b

[Answer] Done.

7. Page 16, Line 11, 'The frequency of PM10 concentrations greater' →The frequency of PM10 concentrations greater than

[Answer] Taken.

8. As the aerosol loading is greatly increased over East Asia since 1980s, the aerosol loading after 2000 is much larger than that in 1980s. Then, are the aerosol changes shown in Figure 10 dominated by aerosol changes after 2000? Maybe you should normalize the PM10 data for each year before compositing the multi-year mean.

[Answer] Yes, the AOD data of MODIS are available from 2002 to 2012 and PM$_{10}$ concentrations are for the period of 2001-2012.

We used deviation standardization to normalize the PM$_{10}$ data (x_1, x_2, …, x_n) for each year. The normalized PM$_{10}$ data (y_i) are deduced by:

$$y_i = \frac{x_i - \min_{1 \le j \le n}\left\{x_j\right\}}{\max_{1 \le j \le n}\left\{x_j\right\} - \min_{1 \le j \le n}\left\{x_j\right\}} \qquad (1)$$

The normalized data range from 0 to 1. The normalized results are shown in Figure A1-1. It reveals the PM$_{10}$ decreases significantly during the holidays. The frequency of normalized PM$_{10}$ greater than 0.2 during days [-15, -11] is 44.1% while the frequency for the same bin during days [+1, +5] is 23.9%. In Figure A1-1(b), the mean value for days [-4, -1] is -0.023 to eastern China, which is 16% reduction to these four days' climate mean. The normalized results are consistent with the origin and the PM$_{10}$ concentration is more impressive. In the revised version, we added a couple of sentences in Section 4.1 (the last paragraph) to indicate this.

In revision, it reads:" Note the PM$_{10}$ composites might be biased by their trends and outliers. To address this question, we repeated the analysis based on yearly normalized data. Here all PM$_{10}$ data are rescaled according to maximum minus minimum range year by year. The normalized data show that the frequency of PM$_{10}$ greater than 0.2 during days [-15, -11] is 44.1% while the frequency for the same bin during days [+1, +5] is 23.9%. The mean value for days [-4, -1] is 16% lower than climate mean. This
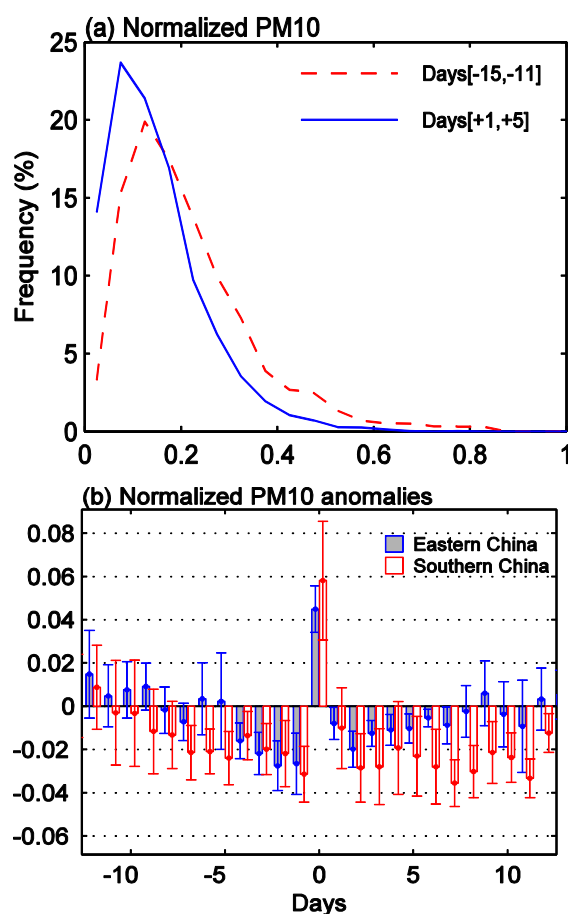
Figure A1-1. (a) Frequency distributions for normalized PM$_{10}$ concentration during days [-15, -11] (red dashed line) and days [+1, +5] (blue solid line) over southern China. (b) The temporal anomalies of normalized PM$_{10}$ concentration in eastern and southern China. Only years with more than 50% PM$_{10}$ station data available are employed for anomalous composites.

9. The authors examined the time-lag correlation between PM10 concentration and the anomalous cyclone, and found that the correlation is largest if the PM10 leads by -9 to -6 days. Is it possible that this correlation is due to the 1-2-weeks period of synoptic systems? In other words, the northerlies associated with a synoptic system could decrease the aerosol loading, and it may appear as if the aerosol decrease is correlated with northerlies associated with the next synoptic system that comes in 1-2 weeks. In Figure 11a, the curves rise for positive lead/lag days and may reach a similar height at +10 as that at -9.

[Answer] Yes, there is 1-2 weeks' variations in natural weather processes which could cause the time-lag correlation between temperature/aerosol concentration and the

atmospheric circulation. In our analysis, we think that the signal of natural synoptic processes should have been largely suppressed. Because the natural synoptic system occurrence and their phases of developing are randomly in time. Here we prepared the atmospheric correlation/temperatures time series according to the lunar calendar dates. If there is a natural cyclone around the New Year's Day, its random phase should be offset by other cyclones when put all years together. In other word, no evidence suggests there is a natural cyclone regularly occurs after lunar year's day. We slightly modified the text to mention this in revision (Section 4.2, paragraph 5).

In revision, it reads: "It should be pointed out that these time-lag correlations should not be explained by the natural 1-2 week processes. Because the natural synoptic system's occurrence and phases are randomly in time. Here we prepared the atmospheric correlation/temperatures time series according to the lunar calendar dates. If there is a natural cyclone around the New Year's Day, its random phase should be offset by other cyclones when put all years together."

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