Author's Response to Anonymous Referee 2

Anonymous Referee #2:

Review comments for "Contrasting impacts of two types of El Niño events to winter haze days in China's Jing-Jin-Ji region" by Yu et al., (2020).

In this study, the authors tele-linked the El Niño events and wintertime haze pollution in Northern China. This study concludes that the occurrence of pollution is connected with El Niño modes. Generally speaking, the paper can be significantly improved with the inclusion of chemical research and discussion when dealing with the haze topic (e.g., the composition and response by each species). This study is more like a purely statistical analysis with insufficient mechanism explanations. Moreover, the overall structure of this paper is somewhat mixed up and the English of this study needs some improvements. I have the following concerns before the formal publication of this study.

Reply: Thank you very much for the thorough comments and suggestions. These comments and suggestions are very helpful to improve the quality of the manuscript. We have made revisions according to these comments. Please find the following point-point reply. In addition, the English of the manuscript has been improved by native speakers of English. For a certificate, please see: http://www.textcheck.com/certificate/fUwXLd

Specific concerns:

Q1: This study emphasized haze days, however, without specifying the source of haze. For example, the chemistry here should definitely be discussed. Is PM the one to blame? If so, what is the composition? Also, when conducting the correlation analyses, what are the correlation to individual particle types? Any size distribution biases?

Reply: Thanks a lot for these helpful comments. We agree with you that anomalous weather conditions may affect the chemistry of some aerosol types, such as sulfate and nitrate. However, the haze days defined by visibility and relative humidity is the only available long-term observation data that reflects air pollution levels in China. There are few long-term large-scale observations of aerosol composition, particle types, and size distribution in China for the correlation analyses. More detailed analyses need to be solved by gathering more observations and performing some sensitive simulations in future work. Alternatively, we added more analyses and discussions to further illustrate that the variations of WHDs in the JJJ region in response to EP and CP El Niño years are more attributed to the regional transport of aerosol pollutants caused by two types of El Niño. Please see the last paragraph of both section 3.2 and section 4 in the revised manuscript.

Q2: In this study, the Niño data used were provided by CMA. I am wondering what is the difference between the CMA Nino data and NOAA nino data? Authors should give more in-depth descriptions on the products they use.

Reply: The definitions of the Niño indices between CMA and NOAA are the same. Referring to the People's Republic China's National Standard (Ren et al., 2017), the Niño indices provided by CMA are calculated using the Hadley Centre Sea Ice and Sea Surface Temperature Data (HadISST) from March 1961 to December 1981 and the National Oceanic and Atmospheric Administration (NOAA) daily optimum interpolation (OI.v2) SST dataset from January 1982 to February 2013. We have supplemented these descriptions. Please see Lines 89-92 in the revised section 2.1.

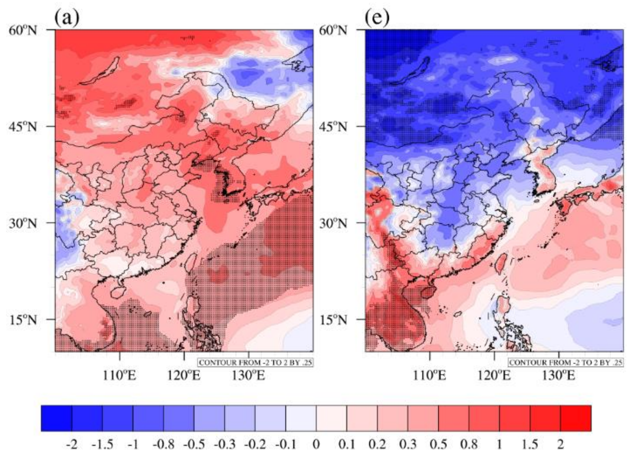
References:

Ren, H. L., Sun, C. H., Ren, F. M., Yuan, Y., Lu, B., Tian, B., Zuo, J. Q., Liu, Y., Cao, L, Han, R. Q., Jia, X. L. and Liu, C. Z.:

Identification method for El Niño/La Niña events. The People's Republic China's National Standard GB/T 33666-2017, May 2017. Beijing: Standards Press of China, 1-6, 2017.

Q3: The authors heavily relied on the ERA data for both ERA-40 and ERA-interim. Why not using the latest ERA5 data instead? I understand the ERA-40 is for older records but the ERA5 should be available for more recent years. Using state-of-art products boost the innovative part of this study.

Reply: Thanks a lot for this advice! We have reexamined our results using the latest ERA5 data and compared them with our original results. In the new results, the data from March 1961 to December 1978 are derived from the ERA-40 reanalysis data and that from January 1979 to February 2020 are derived from the ERA5 reanalysis data. As seen in Figures A1a and e, there are increases in surface air temperature (SAT) over northern China in the winters of EP El Niño years, but corresponding decreases in the winters of CP El Niño years, which are more obvious than our original results. Similar to Figures A1a and e, the opposite patterns of sea level pressure (SLP) anomalies over northern China in response to two types of El Niño years are shown in Figures A1b and f, although these anomalies are weaker than our original results. The patterns of geopotential height anomalies at 500 hPa corresponding to the EP and CP El Niño years are generally consistent with our original results. But the resulting changes in wind over northern China in the winter of both EP and CP El Niño years are weaker for the new data. For the changes in intraseasonal atmospheric circulation in each circulation type in response to two types of El Niño years, there are some differences between the new and original results (Figures A2, 3, and 4). However, the new results still capture the decreased SLP gradients, the southerly wind and positive SAT anomalies in most of circulation types in the winters of EP El Niño years over the JJJ region (Figures A2, A4a and e). Meanwhile, the opposite anomalies, such as increased SLP gradients, northerly wind, and negative SAT anomalies, corresponding to the CP El Niño years are shown in the new results (Figures A3, A4b and d). In brief, the new results also clearly show the differences of atmospheric circulations corresponding to two types of El Niño years at both interannual and interdecadal timescales. These are in line with our original analyses, so we didn't replace the data in this manuscript.



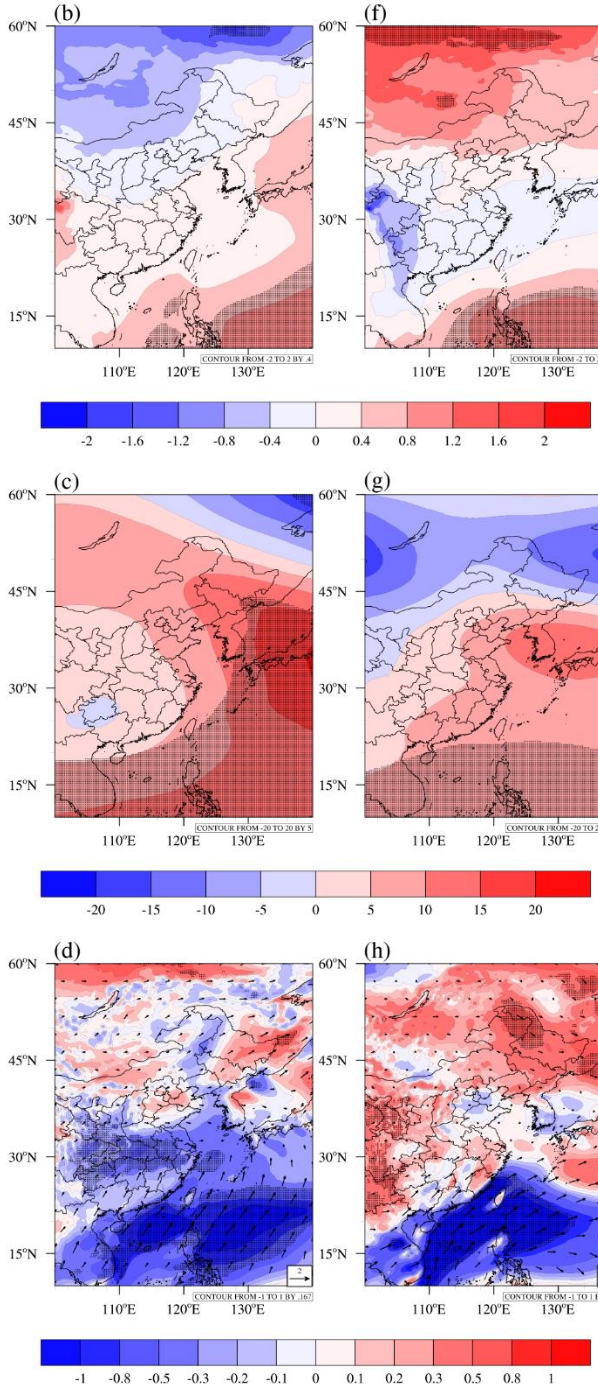


Figure A1: Winter mean changes in (a, e) air temperature at 2 meter (unit: K), (b, f) sea level pressure (unit: hPa), (c, g) geopotential height at 500 hPa (unit: gpm), and (d, h) wind averaged from 1000 hPa to 850 hPa (The arrows represent wind vectors and the contours represent wind velocities, unit: m s^{-1}) in responses to the two types of El Niño. The left (a-d) and right (e-h) panels represent the differences averaged in 11 EP El Niño and 7 CP El Niño years, respectively, relative to the 1961-2020 climatological means. The dots indicate significance at ≥ 90% confidence level from the t test.

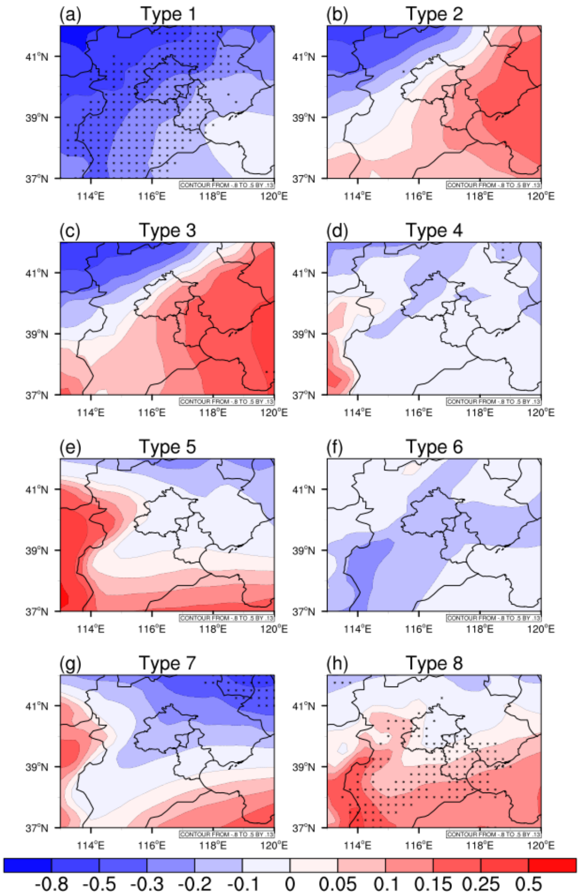


Figure A2: Same as Figure 5, but using the new data set.

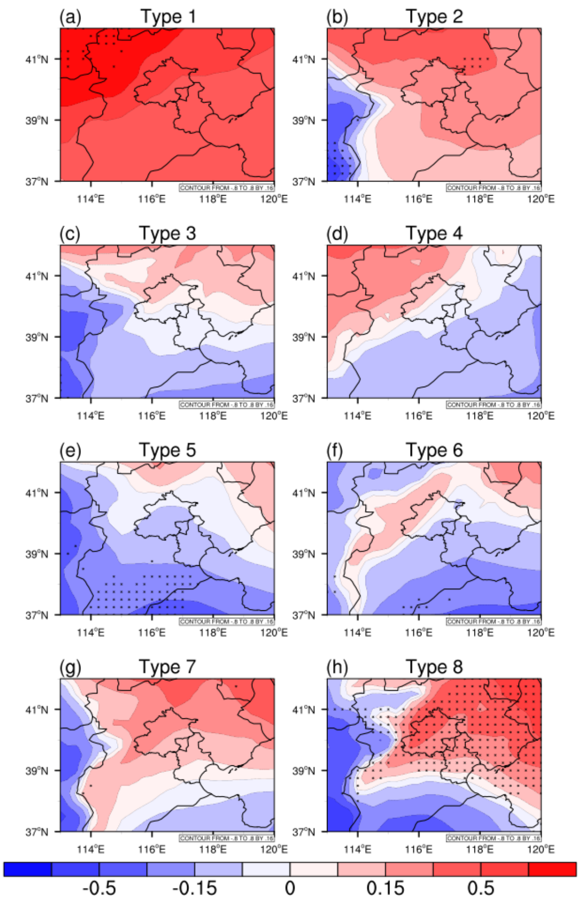


Figure A3: Same as Figure 6, but using the new data set.

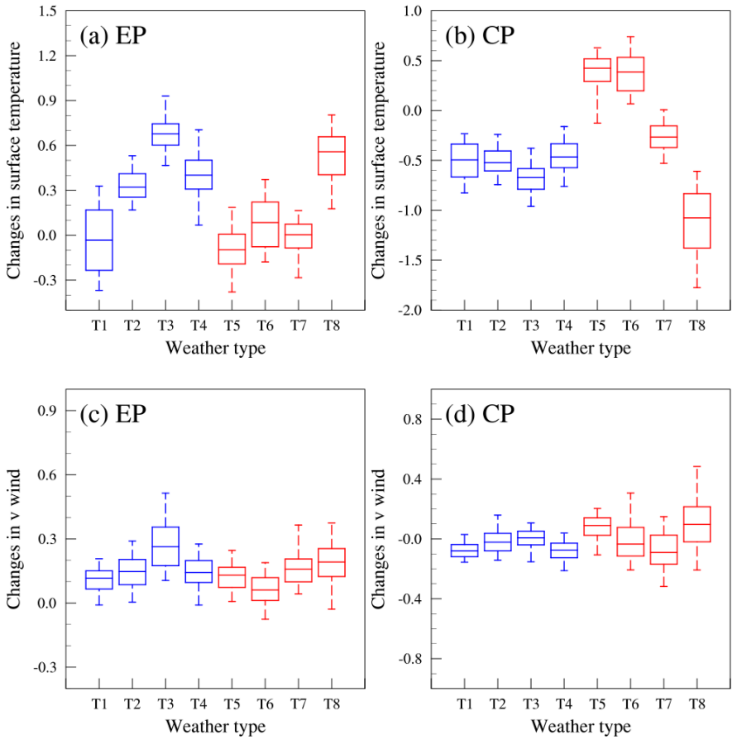


Figure A4: Same as Figure 7, but using the new data set.

Q4: The authors should expand section 2.3. The described method was very generic and details-lacking. It is very hard for readers to comprehend what has been done. Also, the first two paragraphs of 3.1 should be placed in the method section instead of the results.

Reply: Accepted. We have revised the section 2.3 to make sure that readers can clearly understand what has been done. In addition, we have moved the first paragraph of section 3.1 to section 2 as a separate section 2.4. The second paragraph of section 3.1 includes more results of correlation analysis, so we remain it in the original section. Please see the revised section 2.3, 2.4, and 3.1.

Q5: It is hard to tell whether the correlation results shown in Figure 1 are significant or not as the highest correlation is around 0.5 for both positive and negative correlations. Can authors please justify the significance of these correlation numbers?

Reply: All the correlation results shown in Figure 1 are significant at 90% confidence level. We have revised the figure caption. Please see the revised manuscript.

Q6: The caption of Figure 5 "The dots indicate that the differences between more than 60

Reply: We guess that the referee wants to know more details about the dots. We sampled daily data corresponding to each of synoptic-scale circulation types in 10 EP El Niño years, and then calculated the differences by subtracting the 1961-2013 climatological averaged result of each types from them. The dots indicate that more than 60% of all the differences have the same sign as the mean differences. This approach to some extent represents the statistics significance of the results.

Q7: Since this paper primarily focuses on the JJJ region, I would recommend authors to highlight the boundary of this region when making the plots, especially in zoomed-in cases (e.g., Figures 1, 2 and 5).

Reply: We agree entirely with the referee's view. We have highlighted our research domain of the JJJ region with the green boxes in Figures 1, 2 and S2. Note that the areas shown in Figures 5 and 6 are entirely consistent with our research domain.

Q8: Authors, please check the right panel of Figure 3 for CP_{year}. The lower whisky overlap with 25.

Reply: Thank you for your reminding. We have replaced the winter mean data with three monthly data sampled from each El Niño winter and replotted this figure. In addition, we have also replaced the extremums with the 5th and 95th percentile. Please see the revised manuscript.

Q9: This paper discusses the positive precipitation anomaly for the CP case. How about the precipitation for the EP case?

Reply: As seen in Figure 4e, the monthly precipitation is generally increased over southern China in the winters of EP El Niño years, with the maximum changes exceeding 10 mm. But there are slightly negative anomalies of precipitation over central and northeastern China. The area with positive precipitation anomalies over the JJJ region is smaller in EP El Niño years compared to that in CP El Niño years, although a comparable increase in precipitation over this region occurs with both types of El Niño years. We have increased the description of precipitation anomalies in response to EP El Niño years. Please see Lines 225-226 in the revised manuscript.

Q10: In Figure 1, I noticed one dot has distinctive signs between nino 3.4 and EP, shown below in square. Why is that case? I assume these two regions shall be pretty close.

Reply: Two stations with close distance may belong to urban and rural areas, respectively. This can lead to a distinct difference in their underlying surface and local emissions. In addition, two stations with close distance may differ greatly in altitude due to the complicated terrain. The above factors will complicate haze pollution and may be the reason for the distinctive difference in signs between two adjacent stations.