Manuscript # acp-2021-166

Responses to Referee #2

As mentioned in the review of this article, many scholars have conducted the relevant studies on the impact of El Niño events on winter aerosol pollution over China. However, there are some uncertainties in those studies and thus it is necessary to continue to carry out In-depth research to reduce the uncertainty. The ingenuity of this research is that the classification method is distinguished according to the life cycle (i.e. SD and LD) method instead of the traditional El Niño such as intensity, CP or EP of the El Niño. So this study is very meaningful, but it can still be further improved in the following aspects.

We thank the reviewer for all the insightful comments. Below, please see our point-by-point response (in blue) to the specific comments and suggestions and the changes that have been made to the manuscript, in an effort to take into account all the comments raised here.

1. The author can try to discuss the relationship and difference between the SD and LD classification methods and the intensity classification in previous studies or the CP and EP classification.

The intensity classification focuses on the strength of an El Niño event. The East Pacific (EP) and Central Pacific (CP) types of El Niño are classified on the basis of the spatial location of sea surface temperature (SST) anomaly. The SD and LD classification is based on the duration of an El Niño event. These are briefly described in Section 1.

2. Although the authors focused on the analysis of events in different seasons throughout the year when distinguishing between the SD and LD types of El Niño, when studying the impact of different types of El Niño on aerosol pollution, DJF is selected as the researched season, so I recommend the title of this article should be revised to ***Intensified modulation of winter aerosol pollution in China by El Niño with short duration****.*

Thanks for the suggestion. We have revised the title of our manuscript to *Intensified modulation of winter aerosol pollution in China by El Niño with short duration.*

3. Previous study has shown (Sun et al., 2018) that GCM models have certain limitations to capture climate anomalies generated by El Niño, so there are usually some inconsistencies between the

simulation results and the observation results. It is recommended that the author face up to these problems and discuss the uncertainty of the study.

Reference:

Sun, J., Li, H., Zhang, W., Li, T., Zhao, W., Zuo, Z., Guo, S., Wu, D., and Fan, S.: Modulation of the ENSO on Winter Aerosol Pollution in the Eastern Region of China, J. Geophys. Res. Atmos.,123, 11,952-11, https://doi.org/10.1029/2018jd028534, 2018.

Thanks for your suggestion. We have added Fig. 7 in order to compare the observed with the simulated atmospheric circulation anomalies during SD and LD El Niño relative to the climatology. "To further verify the model simulations in capturing atmospheric circulation anomalies during SD and LD El Niño events, the wind fields are compared with those from ERA5 reanalysis data. The anomalous atmospheric circulation patterns in the latest SD El Niño event (2015/2016) and LD El Niño event (1986/1987) relative to the climatological mean (1950-2017) from the ERA5 are shown in Fig. 7. Overall, the SD and LD El Niño-induced anomalous atmospheric circulations over China simulated in E3SM are in consistent with the reanalysis data. Both of them show the anomalous northerly winds over central-eastern China at 850 hPa during SD El Niño compare to LD El Niño. In addition, obvious anomalous cyclone at 500 hPa over most of China can be seen in both E3SM and ERA5." We have added these descriptions in the revised manuscript.

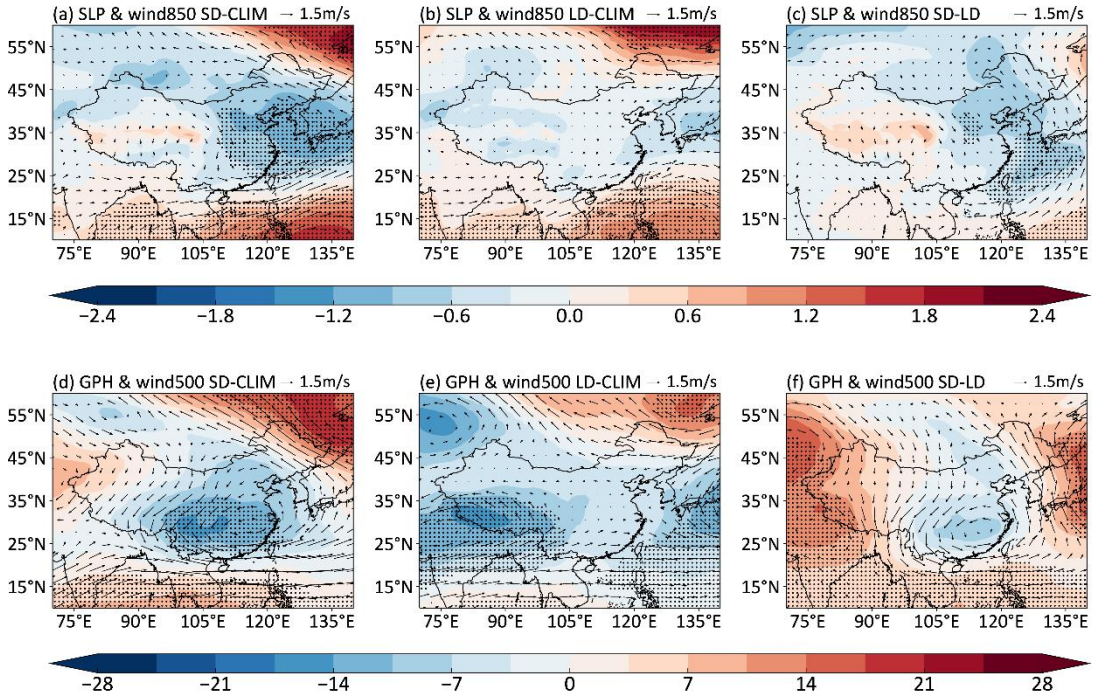

Figure 6. Composite differences in DJF mean sea level pressure (SLP, shaded; units: hPa) and wind at 850 hPa (WIND850, vector; units: m s-1) (top panels) and geopotential height at 500 hPa

(GPH500, shaded; units: m) and wind at 500 hPa (WIND500, vector; units: m s-1) (bottom panels) between SD and CLIM (a, d), LD and CLIM (b, e), and SD and LD (c, f). The stippled areas indicate statistical significance with 90% confidence from a two-tailed T-test.

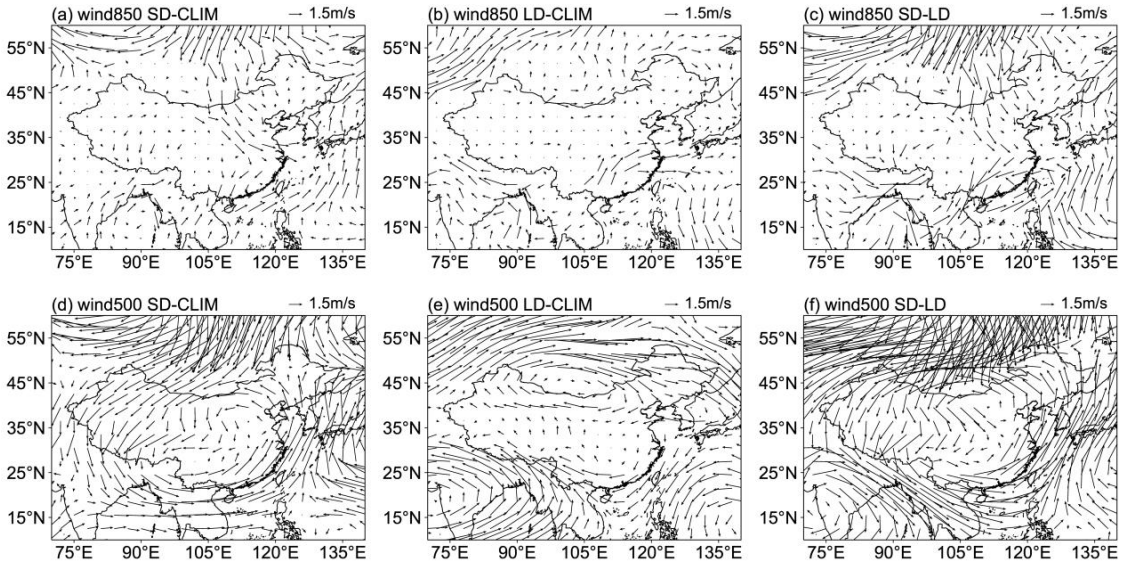

Figure 7. Composite differences in DJF mean winds at 850 hPa (m s^{-1}) (top panels) and 500 hPa (m s^{-1}) (bottom panels) between 2015/2016 SD El Niño and climatological mean (1950-2017) (a, d), 1986/1987 LD El Niño and climatological mean (b, e), and 2015/2016 SD El Niño and 1986/1987 LD El Niño (c, f) from the EAR5 reanalysis data. The data were detrended over 1950-2017.