

Atmos. Chem. Phys. Discuss., referee comment RC2  
<https://doi.org/10.5194/acp-2022-526-RC2>, 2022  
© Author(s) 2022. This work is distributed under  
the Creative Commons Attribution 4.0 License.

## Comment on acp-2022-526

Anonymous Referee #2

---

Referee comment on "Modulation of daily PM<sub>2.5</sub> concentrations over China in winter by large-scale circulation and climate change" by Zixuan Jia et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-526-RC2>, 2022

---

This study investigated the influence of large-scale circulation on daily PM<sub>2.5</sub> concentrations in China during winter using simulations with an Earth system model. Indexes based on circulation patterns corresponding to regional PM<sub>2.5</sub> levels were proposed by the authors to demonstrate the circulation impacts on PM<sub>2.5</sub> for both history and the future, especially for YRD. Sensitivities of regional pollution to emission reduction were also quantified. In general, the results reported in this study are interesting and have reasonable implications for effective PM<sub>2.5</sub> projections. However, some clarifications and major revisions are suggested before it can be considered for publication.

General comments:

- The authors published a highly relevant paper on ACP earlier this year, using the same model and a very similar analysis approach. However, the circulation-based indices defined in the two studies differ from one another, both in variable choices and key region detections. The authors claimed that the differences might be attributed to the different time spans. Does it mean that the index definition is sensitive to years and models? What do the uncertainties originate from, model instabilities or interannual-to-decadal variability of the relationship between PM<sub>2.5</sub> and circulations? What are the dominant variables (e.g. SLP, V850, Z500, etc.) in characterizing the day-to-day variability of PM<sub>2.5</sub> over different regions? Without a consistent definition of indices, the implication would be quite limited.
- The projections of the circulation-based indices in the future should be ensemble from more CMIP models to test the robustness of the trend. Besides, more SSP-RCP scenarios should be considered when evaluating the possible response of PM<sub>2.5</sub> both to circulations and emissions, since the authors consider exploring the daily pollution responses to climate change in the title.

Specific comments:

- Why is the correlation map shown in Figure 2 different from Figure 1 in Jia et al., 2022, especially for YRD? The PM<sub>2.5</sub> levels in YRD were closely connected with maritime airmasses in Jia et al., 2022, but correlated better with a broader region of inland in 1999-2018.
- I notice that the model failed to capture some heavily polluted episodes for the three regions, even for the year 2014. Since the indices and composite analysis are all based on the model simulations, would it significantly impact the results?
- In Line 20-23, Page 8, why are heavily polluted days impacted more strongly by emission reductions? In addition to the absolute levels change (from 3.1ug/m<sup>3</sup> to 8.5 ug/m<sup>3</sup> from local contribution for example), the relative values with respect to daily mean also increase (from 6.7% to 15.8% in this case). How to explain it?
- In section 4 the authors claimed that the index over YRD could “distinguish effectively between different levels of air pollution”, especially for heavily polluted and clean conditions. While in section 5, the PM<sub>2.5</sub> response to emission reductions in I<-1 days (Line 28, Page 8) shows similar values to the situation when considering winter daily mean PM<sub>2.5</sub> (Line 18, Page 8), but largely below the actual polluted conditions (Line 23, Page 8). How to address the contradiction?
- In Figure 9(b) and 9(f), why do reductions in emission over YRD lead to a PM<sub>2.5</sub> increase over coastal regions? The emission and compositions in PM<sub>2.5</sub> changes are suggested to be investigated since it shows large nonlinearity.
- Would it be possible to include the PM<sub>2.5</sub> projection in future scenarios in Figure 10 or an additional figure?