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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Trans-Pacific transport and evolution of aerosols: Spatiotemporal characteristics and source contributions" *by* Zhiyuan Hu et al.

Anonymous Referee #1

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This manuscript reports a quite comprehensive analysis of trans-Pacific transport and evolution of aerosol and its contribution to aerosol over North America based on 5-year quasi-global WRF-Chem simulations. The analysis includes both aerosol mass and number concentration, total and composition, surface and profile/column, direct radiative forcing and air quality implication. This study highlights the importance of trans-Pacific aerosol in determining aerosol column mass loading, number concentration, and direct radiative forcing, which is generally consistent with results of previous observational and modeling studies. This modeling study also provides more insights into composition of aerosol. It adds useful contribution to the discussion of long-range transport of aerosol and its climate and air quality impacts. I recommend the paper be

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Discussion paper

published in ACP after the following concerns(mostly minor) are adequately addressed.

1. Section 3.1.2: Many numbers appear in this section but often it is not clear what these numbers represent. For example, page 7 1st line: "The EAS dust decrease rapidly (7.60 ug/m2) during transport...." It is hard to understand what this 7.60 ug/m2 represents. Please check throughout this section (even the paper) to clarify what those numbers represent.

2. Section 3.2: this section calculates aerosol fluxes and compares with some observational estimate. Discussion about significant model-observation differences could be more thorough from both measurement and modeling perspective. One point I don't quite agree is that they attribute observation-model difference to different time periods and claimed that the "discrepancies may be due to the increasing pollution over East Asia under fast economic development". But many studies have shown that the pollution aerosol has been reducing since 2007/2008. It is also necessary to present and discuss the transport efficiency (aerosol flux arriving in North America to that leaving East Asia) and its variations with season and composition (e.g., dust vs pollution aerosol).

3. Sections 3.3 & 3.4.2 - Aerosol direct radiative forcing. We know that aerosol direct radiative forcing can take place in both clear and cloudy sky, in solar/shortwave and thermal infrared spectra. It is necessary to state clearly what you are estimating. We all know that the aerosol direct radiative forcing is determined by aerosol optical depth (AOD), single-scattering albedo (SSA), and phase function. But the paper never shows these quantities. I would suggest that they at least show AOD and SSA from transported aerosol vs North American aerosol. Then readers may understand why the transported aerosol causes much larger direct radiative forcing than the North American aerosol does.

4. Check throughout the paper and make sure that any acronyms are spelled out when they first appear.

5. page 5, line 29-30: "....due to the offset by the westward transport..." what do you mean here? Also do emissions change from season to season? does such the seasonal variation of emissions contribute?

6. page 7, line 24-25: "Over the Pacific Ocean...., while over the western Pacific..... " it is confusing.

7. page 8, line 18-20: Do you want to point to any figure (e.g., Figure 6) that shows "the nitrate is mainly concentrated in the low level ...." ?

8. Figure 1 caption: explain what PM10 represents

9. Figure 2: averaged over what longitudes?

10. Figure 3: can you overlay the percentage contribution of each component in the map, probably as isopleth?

11. Figure 4 caption: state clearly what are shown in left panels vs right panels.

12. Figure 10: can you explain why sulfate causes a warming effect in the atmosphere if sulfate is purely scattering aerosol as many studies have suggested?

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