

***Interactive comment on* “The impact of monthly variation of the Pacific-North America (PNA) teleconnection pattern on wintertime surface-layer aerosol concentrations in the United States” by J. Feng et al.**

Anonymous Referee #2

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Review of “The Impact of Monthly Variation of the Pacific-North America (PNA) teleconnection pattern on wintertime surface-layer aerosol concentrations in the United States” by Feng et al. (2015)

Overview

This study relates winter variability of particulate matter (PM) to changes in the Pacific-North America climate index. The authors use both observations and model simulations of PM. A statistically significant difference in PM is identified between the

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positive and negative phases of the PNA, particularly in the US Midwest. The authors provide some statistical evidence that changes in meteorology attributable to the PNA is the cause.

Overall the paper is generally clear. I think the research fits well within the scope of ACP and that the results would be well-received by the community. However, I have a number of concerns. I believe the authors can ease these concerns with additional work. I recommend the manuscript for major revision.

General Comments - I have some concern about the definition of the PNA index. It is not clear why the geopotential height in three grid boxes is sufficient. I recommend using a more standard index. For example, the NOAA Climate Prediction Center provides monthly values of the PNA index using the more common EOF loading approach. Also, just looking by eye, the NOAA CPC PNA data appears to differ from the PNAI presented here.

- Most of the analysis focuses on differences between the positive and negative phases of the PNA. It is generally most constructive to isolate the impacts of each phase from neutral conditions. If the authors have motivation to compare positive vs. negative phases, they should include those thoughts in the manuscript.

- The definition of the PNAI appears to have a significant flaw. I think this may just be a mistake in how the equation is written. By my calculation the denominator of $Z^*_{i,j}$ is always 0. The summation can be disturbed across the parentheses (since the terms are simply subtracted). The first term generates the average value of Z' (which should be 0 anyway, see below). Summing the second term is trivial since there is no dependence on i or j , so it is multiplied by $N \times 5$ and then divided by $N \times 5$. Thus both terms give the average value of Z' : $Z' - Z' = 0$.

The second term of the numerator, by my calculation, should also be 0. The summation of anomalies from a mean will always be equal to 0, if the period used for estimation of the mean and period of anomalies are the same.

This equation needs correction; it is clearly not the algorithm used to produce the data in Fig. 2. Perhaps this is an issue with notation. See additional comment about these equations below.

- There are significant trends in PM2.5 and aerosol composition over this time period (hints of this can be seen in Fig. 5c). The EPA AQS data should be detrended (in addition to removing seasonality) in order to best detect interannual variability. It needs to be shown that differences arise from true variability and not other factors (emission regulations). Indeed, just by eye, most of the positive phase months are in the early part of the period and negative at the end. This could introduce an artifact of emission regulations.

- How are regional averages performed? A US-scale average will generally be more heavily weighted by the East Coast since there are more sights in that region. Some of the regional average numbers presented (US, western US, eastern US) should be reassessed.

- The figures are very hard to view. I recommend breaking up some of them to allow larger maps. Figures 3, 5, and 6 are particularly hard to read. The data in the maps is useful and necessary.

Specific Comments - Page 33210, Line 6: “..Air Quality System of Environmental ...” should be “..Air Quality System of the Environmental ...”

- Page 33215, Line 4: It is unclear if 5 days of observations are required or 5

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observational periods. A single observational period could be 5 days long.

- Page 33217, Line 14: The notation here is confusing. The equation defining Z' should not have two references to i (i is listed as an input and the summation variable).
- Page 33218, Line 2: "PANI" should be "PNAI".
- Page 33218, Line 18: I do think contiguous Salt Lake is an identifiable location.
- Page 33219, Line 9: Why is 90th percentile used? 95th percentile is more standard.
- Figure 2: The difference between Figure 2a and 2b is not clear. The panels have slightly different labels, but the data and highlighted +/- points appear identical.
- Page 33222, Line 23: Again, you cannot use the variable i in the summation notation since its already used to denote the month of interest.
- Table 3 – The mass flux values seems a little low. I recommend double-checking the calculation.

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