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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Influence of synoptic patterns on surface ozone variability over the Eastern United States from 1980 to 2012" *by* L. Shen et al.

Anonymous Referee #2

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Overall summary. The authors examine specific synoptic meteorological conditions and their influence on surface ozone variability over the eastern United States over several decades. The work has implications for projecting future changes in surface ozone directly from general circulation models, and for more deeply understanding the mechanisms responsible for observed variability, and is thus a useful contribution. I share many of the concerns raised by Reviewer 1, and for example agree that the time scales involved in the analysis, and the resulting interpretations, should be more clearly explained. Perhaps the paper would be better organized if it were separated by daily variability versus inter-annual variations in the summer mean values. Below I outline

some specific points to address.

General Comments. Some of the language could be clarified. For instance, the phrase 'jet wind' is used frequently but from the context it seems this is referring to the location of the jet rather than speed. Similarly, the westward edge of the Bermuda High is said to shift northward, which reads a bit awkwardly. Would it be clearer to cast in terms of the 'northernmost extent of the west edge', or is something else intended? For the EOF analysis, it would help to clarify that expansion coefficients are also commonly called principal components (time series) as well as any other commonly used terminology.

Specific Comments

Abstract. Please define terms such as SD and polar jet frequency, and clarify why some of the analysis is only deseasonalized - and why de-seasonalization is necessary when only summer is considered - while other bits are detrended, and why a high SD identifies regions most influenced by weather variability rather than high emissions.

L9 While associated is used, there is a bit of an implication of causation here and so it would be good to right away clarify that the decrease is from emission reductions, as stated later in the abstract.

L17 What time periods are being considered here? Why use anything shorter than all available data? If the correlation is weaker on longer time periods, as shown in Table 1, might that suggest that other processes play a role in projecting responses to future climate regimes whereas this jet indicator is best on shorter time scales?

Introduction p. 13075 L9 seems appropriate to cite early work, e.g., Logan, 1989.

p. 13075 L26 Please check on Eder et al. spelling as it's mis-cited as Edger in a few places.

p. 13076 L11-18. Clarify if this study focused on inter-annual or decadal time scales.

p. 13077. Are the Li et al., 2012 and 2013 studies based on single or multiple models?

Clarify what else would contribute to observed variability in Question 1. In other words, what else would be playing a role? Or is the intent to delve into the specific synoptic meteorological conditions (i.e., different weather systems)?

Section 2. Are all sites falling within a 2x2.5 grid cell simply averaged or is something more sophisticated being done to account for uneven spatial sampling? This needs to be stated. Also, why are annual means being used here when the abstract implied it was summer means? What is the rationale for removing a seven-year average to detrend? It's unclear whether this would adequately remove emission trends as they have changed rapidly, with step changes in the early 2000s. Perhaps this could play a role in Table 1 as to why the correlations seem stronger on shorter periods? Somewhere it should be explained that natural emissions respond to meteorology and this is included in the variability attributed to meteorology.

P13079 L12-14. The spatial pattern looks more coherent for the relative SD; isn't that important? L15. What is the ratio? Either plot as a fraction or discuss as percent for consistency with the figure. L28 is incomplete.

Section 3. In addition to deseasonalizing, is the data also standardized (normalized by the individual variances) prior to the EOF analysis?

P13082 L25 This seems misleading as Fig S1 shows the correlation coefficient is very weakly positive in the Northeast in contrast to the Southeast

P13083 L 1-2. It would help to explain further how this is consistent with the anomalous high pressure over Louisiana which is the main feature evident in 3i.

P13084 L 3. Is this done for each year, or for the entire dataset? In other words, are trends still included?

P 13084 What are the trends in these metrics of jet activity?

P13086 L27. Is this the climatological spatial mean that is removed? Or the climatology in each grid cell? Are trends removed too? If it's a spatial mean, are the zonal means

subtracted to remove the climatological latitudinal gradients in height?

P13091 L25-28. Bloomer et al., 2010 (Atmospheric Environment) also show that temperature trends would have increased ozone whereas ozone has declined.

P13094 L25 It is unclear why the Zhang et al. 2014 paper fits here when the sentence is on the eastern U.S. and that paper focuses on the Intermountain west. There are numerous other papers over the past decade or so that discuss background ozone variability in the eastern U.S.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 13073, 2015.