

## ***Interactive comment on “Maximizing Ozone Signals Among Chemical, Meteorological, and Climatological Variability” by Benjamin Brown-Steiner et al.***

### **Anonymous Referee #1**

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#### General comments:

This paper discusses the use of different temporal and spatial averaging scales to detect trends in surface ozone over the United States. This is an interesting topic that is useful to the community, and the approach is novel. However, I have two general concerns that I would like to see addressed:

1. The relevance of the particular methods discussed for detection of air quality trends should be better clarified or caveated, since the averaging time-scales suggested (10-15 years) are comparable to the trends we seek to detect, and temporal and spatial averaging can blur localized signals of high ozone that are relevant to public health.

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2. Given the heavy dependence of the analysis on model simulations, I would like to see more rigorous evaluation of the model's ability to accurately predict the spatial and temporal variability of surface ozone and its response to changes in meteorology and emissions.

In addition, a number of other statistical techniques have been applied to the problem of separating emission effects from other drivers of variability (for example, Camalier et al., Atmos. Environ., 2007, and refs therein), with the potential advantage of detecting changes on shorter timescales. How do the results in this paper compare to other statistical methods? Perhaps this could be discussed in the discussion or conclusion sections.

#### Specific comments:

Line 28: How is the “chemical variability” that is not related to “meteorological variability” different from an air quality signal?

Line 41: The authors state on line 31 that part of the motivation for this study is to identify the impact of emission reduction policies on e.g. ozone. Here, however, they suggest averaging over 10-15 years. This seems pretty long compared to the timescale of air quality changes and compared to the available data records, which for many CASTNET sites is only on the order of 20 years.

Line 42: If you average over several hundred kilometers, do you risk missing policy or health-relevant ozone exceedences that occur at more local scales?

Line 66: For signal detection, see also Weatherhead et al., Physics & Chemistry of Earth, 2002; Strode and Pawson, JGR, 2013; Deser et al., Climate Dynamics, 2011

Lines 96-110: While it is true that the 4th highest MDA8 criteria includes some averaging, it is also aimed at capturing the high end of the distribution rather than just the long-term mean. Isn't this lost by simply averaging over longer periods?

Line 148: Since you are interested in different spatial scales, why not include urban air

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quality sites as well as CASTNET?

Line 205: Please highlight the key differences between this and the earlier model version.

Line 252: The assertion that the spatial variability is well-captured is not really evident in Figure 2. Maybe overplot the observations on top of the model map, or report the spatial correlation between the model and the observations.

Section 3.1 and Fig. 2: It would be helpful to show the temporal variability of the observations along side that of the model

Line 255: Clarify that it is the standard deviation in the model.

Line 272: What is the correlation between the modeled and observed timeseries? Figure 3e suggests a lot of mismatches between the observations and model. What does this mean in terms of the uncertainty in your model-based findings?

Section 3.2, first paragraph: Some of this could go in the methods section.

Lines 374-375: Can you explain why? Do these regions have higher variability?

Line 430: The relationship between chemical and meteorological variability also depends on emission levels (e.g. Bloomer et al., GRL, 2009), and these are unlikely to remain constant over a decadal averaging window. Thus the real situation will be more complicated than the constant-emission model-based analysis shown here. The model-based analysis is still useful, but should be more carefully caveated.

Technical:

Line 374: "Shorter" not "short"

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