Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2017-954-RC2, 2018

Atmospheric Chemistry and Physics Discussions

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

Anonymous Referee #2

Received and published: 15 February 2018

Review of "Maximizing ozone signals among chemical, meteorological, and climatological variability" by B. Brown-Steiner et al. (acp-2017-954)

General Comments ————————-

This manuscript describes an evaluation of the variability of surface ozone concentrations over the United States during summer. In particular, the authors analyze the effects of meteorological variability on ozone concentrations, and the dependence of this variability on temporal and spatial averaging scales. The goals is to use averaging to provide a more robust estimate of the uncertainty in the "true" ozone concentration, independent of the influence of meteorological "noise". The idea that spatial or tem-

poral averaging can reduce meteorological variability is not a new one, but this paper presents a useful and innovative framework for analyzing the choice of time and space scales, depending on the uncertainty threshold required for a particular application. This writing in this paper could be improved significantly to clarify the methods used and the basis for the recommendations being made. I list below some such suggestions for ways the manuscript can be improved. With revisions, this paper would be appropriate for publication in ACP, and would be a helpful contribution to the literature on detecting robust signals in ozone over a noisy background.

Specific Comments ————————

Abstract

line 41 – This 10-15 year time period pertains to detecting a robust estimate of mean ozone concentrations. What are the implications for detecting trends (e.g., driven by emission changes) in ozone? For instance, large robust trends in ozone were detected in observations as a result of emission reductions following the NOX SIP Call. This manuscript claims to provide information on estimating trends in ozone, but does not really provide specific information on trend detection methodologies.

lines 44-46 – For which other quantities might these results be applicable? What features of the spatiotemporal distribution dictate the choice of optimal spatial and temporal averaging periods.

1. Introduction

lines 93-95 – Mention also internal (unforced) variability.

lines 91-97 – There is not a clean distinction between running ensembles of model runs with different initial conditions versus "expand[ing] the temporal averaging window". In the case of "climatological" runs such as those done here with CAM-Chem, running more years in a single simulation is nearly identical in practice to running more years of a single simulation.

lines 123-125 – You mention here that the objective is to "limit the likelihood of overconfidence in an estimate of surface ozone". Presumably, the goal is more than that. Rather than just providing an improved (large) estimate of local variability, the averaging method suggested here also aims to reduce the underlying uncertainty due to meteorological variability.

lines 154-155 – Model resolution is not addressed in this study. How would varying model resolution compare with the other "parametric" changes in the model discussed here?

2.1 CAM-Chem

In this section and throughout the paper, the model name "MOZART" seems to be used interchangably with "CAM-chem", including in the names of the simulations. This is confusing, since MOZART and CAM-chem, although closely related, are distinct models. Please clarify throughout the paper.

line 200 – Here and elsewhere throughout the paper, clarify that you are only considering the effect of future *climate*, not actually fully simulating future conditions (e.g., future emissions).

2.3 Telescoping Regional Definitions

lines 230-232 – This sentence is repetitive of Intro.

3.1 Spatial and Temporal Comparisons

line 248 – Throughout the paper, the notation "DM8H" is used for the daily maximum 8-hour ozone concentration. Elsewhere in the literature, this seems to be referred to as "MDA8".

line 248 – "MOZART" –> "CAM-chem"

lines 255-259, Figure 2 – Show standard deviation and/or variability from the observations as well. If the standard deviation were similar between the model and observa-

tions, would the model ozone bias cause the (relative) variability to differ significantly?

line 283 – Add "(Figure 2, Table 1)" after "Here".

lines 283-285 – This sentence is repetitive of the first paragraph in this section.

line 289 – Add "from continental to a single NE U.S. grid box" after "telescoping regions".

line 290 – Add "albeit with lower overall variability" after "captures this trend".

3.2 Variability, Averaging Windows, and Thresholds

line 314 – Add "underlying variability at the" before "particular choice of spatial and temporal scale".

line 328 – Does "variability" here refer to standard deviation (as suggested by the ppbv thresholds) or as previously used, the relative variability (s.d./mean)? Confusing. Make sure to define the quantities being discussed.

line 329 – Clarify what is meant here by "This difference".

3.3 Selection of Temporal Averaging Scales

line 358-359 – Add "meteorological variability causing ozone anomalies" before "exceeding particular thresholds", if this is the intended meaning.

line 363 – "Increas[ing] the threshold" is not really a strategy for "filtering out the noise". It is more like accepting the higher level of noise.

lines 367 -370 – Confusing as written. Separate out the mention of Fig.S3 to a second sentence, e.g., "Similarly, in Supplemental Figure S3, one column (the 5-year averaging window) is selected."

line 369 – "Figure 6" –> "Figure 5"

line 369 – Add "compare with" before "equivalent plots".

line 370 – "Figures 7" –> "Figures 6".

4. Discussion

line 434 – Add "variability" after "surface ozone".

line 460 – Cut comment in parentheses about future simulations. It is not known whether the future simulations will/would exhibit biases.

5. Conclusions

line 502 – Add "and" after "configurations".

line 506 – Add "summertime" before "surface ozone". Clarify throughout conclusions that the analysis presented here is restricted to summer.

line 513 – Add "summertime" before "ozone variability".

line 523 – As mentioned earlier, the discussion of trend detection in the manuscript is very weak. Much more could (and should) be said about the application of the averaging methods presented here for trend detection. For instance, what are the implications of needing 10-15 year averaging windows for the length of timeseries needed to detect ozone trends (e.g., forced by climate change or emissions changes)?

lines 524-530 – Mention here the compounding of (meteorological) variability in the observations with changes caused by variability/trends in emissions.

Figure 2 – Add the standard deviations plotted here standard deviations of daily ozone concentrations? If so, then for comparison with Figure 5, it would be useful also to show the interannual standard deviation of seasonal mean ozone.

Figure 3 – Explain that the CAM-chem simulation has fixed year-2000 emissions and SST, but time-varying meteorology. Why are the CASTNET values for 2000 "detrended", instead of showing raw 2000 values? Change "MOZART" to "CAM-chem". In legend text in panel (a), also change "MOZART" to "CAM-chem".

Figure 4 – Define what is meant here by "variability". Is it the standard deviation, or the relative variability (s.d./mean)? Mention in caption that this plot shows summer ozone only. This is confusing from how the vertical axis is plotted.

Figure 8 – Change panel titles to the names of the regions. Keep the description of the regimes for filtering effectiveness in the text instead.

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