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Interactive comment on "How waviness in the circulation changes surface ozone: a viewpoint using local finite-amplitude wave activity" *by* Wenxiu Sun et al.

Anonymous Referee #1

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This work by Sun et al. applies an advanced metric of wave activity to the study of air pollution. The relationships generated from observed and modeled ozone variations are used with projected changes in wave activity to quantify the impacts of climate change and also suggest the role of meteorological shortcomings in the persistent high bias in surface ozone. The manuscript is novel and will be of interest to a dedicated set of researchers studying this issue. I recommend publication after the authors address the following, mostly minor, comments.

General Comments

- I am somewhat familiar with LWA, but have always struggled to understand the

mapping from equivalent latitude back to the conventional geographic latitude. A brief discussion of this issue would be beneficial, especially for the unaccustomed reader.

- The ozone dataset is normalized to have unit variance. Is the local variance introduced back into the analysis of the projection value of the ozone influence from AWA?

- I understand the need to look at a broader time period to analyze the ozone-AWA relationship, but I do not follow the logic presented in equations 5 and 6. Can β be interpreted as the importance of the pattern contribution to the seasonal value? And then α is a sort of baseline amount? It seems to me that β will change with emissions and climate, and also be intricately linked to AWA. It is stated on Page 12 that β doesn't change, but shouldn't it? If more days are under larger AWA or the magnitude changes, I would expect the contribution to seasonal averages to change.

- Are the quantities in Figure 2 estimated from monthly mean geopotential heights or the average of daily AWA/LWA? Should there be a difference?

- Is AWA normalized to unit variance for the MCA analysis? It strikes me that the variables should have comparable variance in order to prevent one from dominating the results.

- I have to ask about the reliability of the projections given an ensemble of three and relatively short analysis record. There is some discussion, but I think a bit more is warranted.

- What impact does the spatial and temporal resolution of the geopotential height fields have on the estimate of AWA? I assume additional structure is available with higher spatial resolutions. The resolution used here in the reanalysis and

climate model output is rather course. Would a higher spatial resolution product improve the relationships?

Specific Comments

- Page 2, Lines 7, 11, 12 - There are some citation formatting issues here.

- Equation 2 - I am confused how both the cyclonic and anticyclonic LWA integrate inclusively to ϕ_e

- Page 5, Line 23 - Stating "scenario" and "pathway" is redundant.

- Table 1 - The SST/Sea Ice and Meteorology columns are unnecessary if they're all the same value (online)

- Page 5, Lines 32, 33, 34 - Subscript missing in CH_4 and CO_2.

- Equation 5 - Is $O_{3,i_0,j_0}(t)$ the seasonal (JJA) average of MDA8?

- Page 8, Line 29 - A period has gone astray.

- Page 9, Lines 1-7 - Does the interpretation of Shen et al. (2015) for their first two EOF modes match the physical explanation for the first two MCA patterns presented here?

- Page 9, Lines 1-3 - Is there any reason to prefer this method over the EOF analysis of 500hPa heights?

- Page 9, Line 19 - "less also" should probably be just "less"

- Page 9, Lines 18-19 - This is too be expected, right? The southeastern US flow from the Gulf is more mesoscale and likely poorly resolved transport in a global model at this resolution.

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