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Atmospheric Chemistry and Physics Discussions
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Interactive comment on "Role of oceanic ozone deposition in explaining short-term variability of Arctic surface ozone" *by* Johannes G. M. Barten et al.

Anonymous Referee #3

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1. Influence of land deposition?

Near-surface ozone is a fascinating chemical compound, influenced by many, sometimes offsetting, processes. Models may get right concentrations for some wrong reasons or get it wrong for the right reasons. This study focused on late summer (August to early September) when deposition over land vegetation can still play an important role in influencing surface ozone concentrations at observational sites in norther high-latitudes (e.g., sites in Norway, Sweden, and Finland). Throughout the results section in this paper, however, there are no discussion on the potential influence of land deposition processes. There are studies showing that changes in dry deposition schemes

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Discussion paper

over land can lead to as much as 10 ppbv differences in simulated mean surface ozone concentrations at northern high-latitude sites. Please see Figures 13 to 16 in Lin et al. (GBC 2019) and discussions therein. Although the present study focused on oceanic deposition, the potential influence of land deposition needs to be discussed.

Lin, Meiyun, Sergey Malyshev, Elena Shevliakova, Fabien Paulot, Larry W Horowitz, S Fares, T N Mikkelsen, and L Zhang: Sensitivity of ozone dry deposition to ecosystemâĂŘatmosphere interactions: A critical appraisal of observations and simulations. Global Biogeochemical Cycles, 33(10), DOI:10.1029/2018GB006157.

2. Chemical boundary conditions?

It is not clear from Section 2 whether the WRF-Chem simulations use chemical boundary conditions from a global model, which can potentially influence near-surface ozone concentrations at remote Arctic sites.

3. Fig.4d: Need to include comparisons of ozone frequency distributions with observations, at least at sites where measurements are available. Justification to compare with CAMS reanalysis product is not clear. CAMS products are NOT observations.

4. Fig.5 and Fig.6: The referee suggests removing results from the DEFAULT simulation without nudging when comparing hourly ozone with observations. We all know that the DEFAULT simulation without nudging is not expected to simulate the synoptic day-to-day variability of ozone in observations. Including DEFAULT makes the plots (e.g., Fig.6) messy and makes it difficult for readers to see the impact of interactive ocean deposition.

5. Label the site names shown in Fig.6 on the maps in Fig.4 to facilitate understanding. Separate analysis for coastal versus far-inland sites can be a way to illustrate the influence of oceanic versus land deposition.

6. Label correlations and mean biases for each model, directly in Fig.6 (not in table), to facilitate understanding.

7. References in Introduction need to be updated to include more recent findings. For example,

Line 35-40, Ozone sources and sinks:

Young, Paul J. et al., January 2018: Tropospheric Ozone Assessment Report: Assessment of global-scale model performance for global and regional ozone distributions, variability, and trends. Elementa: Science of the Anthropocene, 6(1), 10, DOI:10.1525/elementa.265.

Tarasick, D W., I Galbally, O Cooper, M G Schultz, G Ancellet, T Leblanc, T J Wallington, J R Ziemke, Xiong Liu, M Steinbacher, J Staehelin, C Vigouroux, J W Hannigan, O Garcia, G Foret, P Zanis, E C Weatherhead, I Petropavlovskikh, H Worden, M Osman, Jane Liu, Kai-Lan Chang, Audrey Gaudel, and Meiyun Lin, et al., October 2019: Tropospheric Ozone Assessment Report: Tropospheric ozone from 1877 to 2016, observed levels, trends and uncertainties. Elementa: Science of the Anthropocene, 7, 39, DOI:10.1525/elementa.376.

Line 42: The role of emission changes on mid-latitude ozone trends:

Lin, Meiyun, et al: US surface ozone trends and extremes from 1980 to 2014: quantifying the roles of rising Asian emissions, domestic controls, wildfires, and climate. Atmospheric Chemistry and Physics, 17(4), DOI:10.5194/acp-17-2943-2017.

Lines 47-50: Dry deposition processes over land and the importance of interactive ozone deposition on surface ozone variability:

Lin, Meiyun, Larry W Horowitz, Yuanyu Xie, Fabien Paulot, Sergey Malyshev, and Elena Shevliakova, et al.: Vegetation feedbacks during drought exacerbate ozone air pollution extremes in Europe. Nature Climate Change, 10(5), DOI:10.1038/s41558-020-0743-y.

Kavassalis, S. C. & Murphy, J. G. Understanding ozone–meteorology correlations: a role for dry deposition. Geophys. Res. Lett. 44, 2922–2931 (2017).

Lin, Meiyun, Sergey Malyshev, Elena Shevliakova, Fabien Paulot, Larry W Horowitz, S Fares, T N Mikkelsen, and L Zhang: Sensitivity of ozone dry deposition to ecosys-temâĂŘatmosphere interactions: A critical appraisal of observations and simulations. Global Biogeochemical Cycles, 33(10), DOI:10.1029/2018GB006157.

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