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Comment on angeo-2021-25

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Community comment on "Simulated seasonal impact on middle atmospheric ozone from high-energy electron precipitation related to pulsating aurorae" by Pekka T. Verronen et al., Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2021-25-CC2>, 2021

This manuscript analyzes the seasonal impacts of energetic precipitation from pulsating aurora by integrating realistic energy spectrums and spatial extents of precipitation into WACCM simulations including lower ionospheric chemistry. The results clearly show the descent of NO_x to lower altitudes in the winter, which causes a significant portion of the ozone loss. There are also clear differences between the southern and northern hemispheres, due to variations in the polar vortex. This study is a very nice example of the effect that energetic electrons from pulsating aurora can have on the atmosphere and furthers our understanding of this important topic. I have included some comments and suggestions below for consideration, which I hope can be addressed for the final submission.

Line 53: Add citation for "with a median duration of about 2–4 hours"

Line 56: Add citation for "PsA decays slower than the geomagnetic activity recovers"

Lines 192-195 & Figure 2: The difference between electron density in thermo-PsA and no-PsA compared to full-PsA and no-PsA is not clear in Figure 2. Essentially, these sentences are commenting on the clear difference between Figures 2e and 2i, but with the current color scale, that difference is not perceptible. There may be a slight bit of darker green in Figure 2e from 70-80 km (or up to 100 km in the winter) but it is certainly not clear and I had to really look several times and read this section closely to see there was a difference. Is it possible to change the color scale in just these two panels to a monochromatic one or else zoom in on this altitude range to get a better use of the rainbow scale to show the difference?

Figures 5 & 6: Is there a white trace in panels a and c on Figures 5 and 6? Either the white is not visible due to the mostly white background, or you did not perform the 30-day mean of the black line, which should be noted.

Figure 5: In panels a and c, the cyan line does not look like a 30-day running mean. Granted, we cannot see the full data for difference between thermo-PsA and no-PsA, but it does not look similar (as smooth) to Figs 4a, 4c, 6a, 6c. If there is a reason for this,

please comment on it in the text, or point to it if I missed it.

Overall comment: Is it reasonable to estimate a total % difference integrated over time or spatial region or both? I see the utility of showing a figure such as Figure 24, but it doesn't give an indication of over the entire winter, say, how much of a contribution is this input of PsA- EEP. Similarly for the entire NH or SH region. Perhaps an analysis of the difference in integrals of the time series shown in Figures 4, 5, 6. This may give a better overall context for the differences due to PsA-EEP over a season.

Grammar and spelling:

Line 29: "atmospheric ionization rates due **to** precipitation of solar protons,"

Line 167: "In wintertime, **the** largest concentrations..."

Line 194: "... removal **of** the ionization..."

Line 205: double "are" in "between the NH and SH are seen..."

Line 229: "In **the** NH, the peak increase..."

Line 245: remove "of" in "because of less variability in the polar vortex dynamics..."