Interactive comment on “Modeling and Numerical Simulation of the Recurrence of Ozone Depletion Events in the Arctic Spring” by Maximilian Herrmann et al.

Anonymous Referee #2

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In this study Herrmann et al. present a 1D modeling study investigating the potential for chemical oscillations (or more generally "recurrences") of ozone depletion episodes (ODEs) in the polar troposphere. Regular recurrences might be expected due to imbalances in the ozone-BrOx equilibrium that is central to the ozone depletion chemistry. For this study the authors used an advanced model involving gas and liquid phase chemistry, gas-aerosol interactions and vertical diffusion between the layers of their model. With initial conditions largely commensurate with observed data during polar ODEs their simulations predict recurrence of ODEs with periods from several days to a month, and ozone recovery from less than 1 to about 10 nmole/mole before depletion restarts. They follow this up with a parameter study to determine the impact of selected
parameters in the model on the recurrence of ODEs. The paper is well written with a
detailed description of their model, and every simulation result is extensively discussed
in the context of the overall ODE mechanism. The main problem with this paper is that
by ignoring large scale meteorological effects the model is too simplistic to be relevant.
There are many definitions on what constitutes a full ODE, but consensus exists that
levels of ozone should be $< \sim 10$ nmole/mole, and that the end of an ODE features a re-
turn to levels of $> \sim 30$ nmole/mole. Measurements of the rate of ozone loss have been
reported that implied total depletion in less than an hour. Satellite data have shown the
occurrence of large systems containing enhanced levels of BrOx over the Arctic. All
combined this suggests that ODEs as observed are driven by the change of air masses
with high ozone/low BrOx and low ozone/high BrOx content, and that the ozone-BrOx
chemistry that is responsible for the actual ozone depletion is not what is observed as
ODE. Chemical oscillations may well occur during an ODE but are not what drives an
ODE: recurrence of ODEs is driven by meteorological variability. Overall, I think the
paper is publishable, although the scientific relevance is rather minor. The title should
be modified so as not to suggest that the recurrence of ODEs is simulated (maybe into
something along the lines of "simulation study of the oscillations in ozone levels during
ODEs"). And while at it I recommend rereading the text and see whether the model
description and discussion of simulation results can be made more succinct; the paper
is quite long for what it delivers.

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2019.