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Atmospheric Chemistry and Physics Discussions

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

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Discussion paper

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 < ∼10 nmole/mole, and that the end of an ODE features a return to levels of > ∼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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