Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2017-802-RC2, 2017

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Extraction of wind and temperature information from hybrid 4D-Var assimilation of stratospheric ozone using NAVGEM" *by* Douglas R. Allen et al.

T. Milewski (Referee)

thomas.milewski@mail.mcgill.ca

Received and published: 2 November 2017

This article addresses the potential of improving wind and temperature analyses in the stratosphere and mesosphere through the assimilation of ozone observations in a reduced-resolution NWP model. It follows up on previous studies that investigated this potential for a variety of data assimilation systems in a simpler model (e.g. global shallow water model), which pointed towards the quality of the Hybrid (covariances) 4D-VAR for this particular purpose. This study is a significant step forward in that it continues to investigate this outstanding question in a more realistic, closer to operational NWP DA setting.

Printer-friendly version

Discussion paper

Specifically, this study is an OSSE that focuses on the assimilation of stratospheric ozone observations and its potential added-value over more traditional radiance assimilation. The overall qualities of the study are the well-prepared experimental setup, with a clear progression between experiments, the tests in sensitivity to different parameters and the insights given about the impact of ozone assimilation on the other analyzed variables. However, in the reviewer's opinion, some aspects need to be improved for the article to be ready for final publishing.

Major comments:

The authors are making negative conclusions on the potential benefit of ozone assimilation from the diagnostics of a single case (Dec 1, the final date of a 14-day experiment). There is generally high quality in the experimental setup and the angle of analysis in this study, but it is difficult to objectively distinguish between the random noise in the results and an actual robust signal, in order to draw general conclusions. If the authors intend this article to be a case study, it needs to be firmly stated in the abstract/introduction/conclusions, a more detailed analysis of the current conditions and error patterns, and more caution in making conclusions are needed. Otherwise, the authors need to be more convincing on how this case is representative of more general conditions or, even better, extend the length of the experiments and provide time-averaged results, with statistical significance tests.

Minor comments:

Section 2.1, line 31: "low resolution of T47", please compare it to the operational resolution. This is important considering that this study is addressing the potential benefit of assimilating ozone in NWP systems. Also, How does the reduced resolution of the model might affect the results of radiance assimilation versus ozone assimilation ? In other words, could a higher resolution in the ensembles and/or the background fields help favor assimilation of ozone profiles versus assimilation of radiances ?

Section 2.2, line 18, "60 vertical levels": maybe specify the number of vertical levels

and approximate vertical resolution in the stratosphere and mesosphere.

Section 2.2, line 25, "with a prescribed estimate of the analysis error variance": how is it estimated in this context ?

Section 2.5, line 10, "the perturbation is performed ... different stratospheric analyses": but presumably valid at the same date ? Please specify.

Section 3.1: Did you look at the temporal evolution of sigma_ens, to make sure that the ensemble system has finished its spinup phase ?

Section 3.2: What motivated this choice of latitude and height ? You state that the PV charge analogy is particularly valid in regions "where strong ozone gradients and geostrophic balance occurs", but 28.6S is not a typical region for these two criteria.

Section 4.1: In comparing the ozone-assimilation experiments with perturbed and unperturbed initial conditions, you are also perturbing the troposphere, which can roughly be considered as a lower boundary condition in your experimental setup. The title of the section "dependence on initial conditions" might be a bit limited or ambiguous. The baseline experiment RMS errors are more representative of the dependence on initial conditions only.

P17, line 9: please correct "The mechanisms through which".

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2017-802, 2017.

Printer-friendly version

Discussion paper