Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 3, 1833-1847, 2003
www.atmos-chem-phys.net/3/1833/2003/

The impact of model grid zooming on tracer transport in the 1999/2000 Arctic polar vortex

M. M. P. van den Broek[1], M. K. van Aalst[2], A. Bregman[3], M. Krol[2], J. Lelieveld[4], G. C. Toon[5], S. Garcelon[6], G. M. Hansford[6], R. L. Jones[6], and T. D. Gardiner[7]

[1]Space Research Organization of the Netherlands (SRON), Utrecht, The Netherlands
[2]Institute for Marine and Atmospheric Research (IMAU), Utrecht, The Netherlands
[3]Royal Netherlands Meteorological Institute (KNMI), De Bilt, The Netherlands
[4]Max-Planck-Institut für Chemie (MPI), Mainz, Germany
[5]Jet Propulsion Laboratory (JPL), Pasadena, USA
[6]Cambridge University, Cambridge, UK
[7]National Physical Laboratory (NPL), Teddington, UK

Abstract. We have used a 3D chemistry transport model to evaluate the transport of HF and CH_4 in the stratosphere during the Arctic winter of 1999/2000. Several model experiments were carried out with the use of a zoom algorithm to investigate the effect of different horizontal resolutions. Balloon-borne and satellite-borne observations of HF and CH_4 were used to test the model. In addition, air mass descent rates within the polar vortex were calculated and compared to observations.

Outside the vortex the model results agree well with the observations, but inside the vortex the model underestimates the observed vertical gradient in HF and CH_4, even when the highest available resolution (1° x 1°) is applied. The calculated diabatic descent rates agree with observations above potential temperature levels of 450 K. These model results suggest that too strong mixing through the vortex edge could be a plausible cause for the model discrepancies, associated with the calculated mass fluxes, although other reasons are also discussed.

Based on our model experiments we conclude that a global 6° x 9° resolution is too coarse to represent the polar vortex, whereas the higher resolutions, 3° x 2° and 1° x 1°, yield similar results, even with a 6° x 9° resolution in the tropical region.

Final Revised Paper (PDF, 2361 KB) Discussion Paper (ACPD)

Citation: van den Broek, M. M. P., van Aalst, M. K., Bregman, A., Krol, M., Lelieveld, J., Toon, G. C., Garcelon, S., Hansford, G. M., Jones, R. L., and Gardiner, T. D.: The impact of model grid zooming on tracer transport in the 1999/2000 Arctic polar vortex, Atmos. Chem. Phys., 3, 1833-1847, 2003. Bibtex EndNote Reference Manager