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

Atmos. Chem. Phys., 7, 2357-2369, 2007
www.atmos-chem-phys.net/7/2357/2007/

Mid-latitude ozone changes: studies with a 3-D CTM forced by ERA-40 analyses

W. Feng[1], M. P. Chipperfield[1], M. Dorf[2], K. Pfeilsticker[2], and P. Ricaud[3]
[1]Institute for Atmospheric Science, School of Earth and Environment, University of Leeds, Leeds, UK
[2]Institute für Umweltphysik, University of Heidelberg, Heidelberg, Germany
[3]Laboratoire d'Aerologie, Observatoire Midi-Pyrenees, Toulouse, France

Abstract. We have used an off-line three-dimensional (3-D) chemical transport model (CTM) to study long-term changes in stratospheric O_3. The model was run from 1977–2004 and forced by ECMWF ERA-40 and operational analyses. Model runs were performed to examine the impact of increasing halogens and additional stratospheric bromine from short-lived source gases. The analyses capture much of the observed interannual variability in column ozone, but there are also unrealistic features. In particular the ERA-40 analyses cause a large positive anomaly in northern hemisphere (NH) column O_3 in the late 1980s. Also, the change from ERA-40 to operational winds at the start of 2002 introduces abrupt changes in some model fields (e.g. temperature, ozone) which affect analysis of trends. The model reproduces the observed column increase in NH mid-latitudes from the mid 1990s. Analysis of a run with fixed halogens shows that this increase is not due to a significant decrease in halogen-induced loss, i.e. is not an indication of recovery. The model predicts only a small decrease in halogen-induced loss after 1999. In the upper stratosphere, despite the modelled turnover of chlorine around 1999, O_3 does not increase because of the effects of increasing ECMWF temperatures, decreasing modelled CH_4 at this altitude, and abrupt changes in the SH temperatures at the end of the ERA-40 period. The impact of an additional 5 pptv stratospheric bromine from short-lived species decreases mid-latitude column O_3 by about 10 DU. However, the impact on the modelled relative O_3 anomaly is generally small except during periods of large volcanic loading.

Final Revised Paper (PDF, 1289 KB) Discussion Paper (ACPD)

Citation: Feng, W., Chipperfield, M. P., Dorf, M., Pfeilsticker, K., and Ricaud, P.: Mid-latitude ozone changes: studies with a 3-D CTM forced by ERA-40 analyses, Atmos. Chem. Phys., 7, 2357-2369, 2007. Bibtex EndNote Reference Manager