Home
Online Library ACP
- Recent Final Revised Papers
- Volumes and Issues
- Special Issues
- Library Search
- Title and Author Search

Online Library ACPD
Alerts & RSS Feeds
General Information
Submission
Review
Production
Subscription
Comment on a Paper

Volumes and Issues Contents of Issue 2

Atmos. Chem. Phys., 6, 349-374, 2006
www.atmos-chem-phys.net/6/349/2006/

Interannual variation patterns of total ozone and lower stratospheric temperature in observations and model simulations

W. Steinbrecht[1], B. Haßler[1], C. Brühl[2], M. Dameris[3], M. A. Giorgetta[4], V. Grewe[3], E. Manzini[5], S. Matthes[3], C. Schnadt[3,*], B. Steil[2], and P. Winkler[1]

[1]Meteorologisches Observatorium Hohenpeißenberg, Deutscher Wetterdienst, Hohenpeißenberg, Germany
[2]Chemie der Atmosphäre, Max Planck Institut für Chemie, Mainz, Germany
[3]Institut für Physik der Atmosphäre, Deutsches Zentrum für Luft und Raumfahrt, Oberpfaffenhofen, Germany
[4]Atmosphäre im Erdsystem, Max Planck Institut für Meteorologie, Hamburg, Germany
[5]Istituto Nazionale di Geofisica e Vulcanologia, Bologna, Italy
[*]now at: Institut für Atmosphäre und Klima, Eidgenössische Technische Hochschule, Zürich, Switzerland

Abstract. We report results from a multiple linear regression analysis of long-term total ozone observations (1979 to 2000, by TOMS/SBUV), of temperature reanalyses (1958 to 2000, NCEP), and of two chemistry-climate model simulations (1960 to 1999, by ECHAM4.L39(DLR)/CHEM (=E39/C), and MAECHAM4-CHEM). The model runs are transient experiments, where observed sea surface temperatures, increasing source gas concentrations (CO_2, *CFCs*, CH_4, N_2O, NO_x), 11-year solar cycle, volcanic aerosols and the quasi-biennial oscillation (QBO) are all accounted for. MAECHAM4-CHEM covers the atmosphere from the surface up to 0.01 hPa (≈80 km). For a proper representation of middle atmosphere (MA) dynamics, it includes a parametrization for momentum deposition by dissipating gravity wave spectra. E39/C, on the other hand, has its top layer centered at 10 hPa (≈30 km). It is targeted on processes near the tropopause, and has more levels in this region. Despite some problems, both models generally reproduce the observed amplitudes and much of the observed low-latitude patterns of the various modes of interannual variability in total ozone and lower stratospheric temperature. In most aspects MAECHAM4-CHEM performs slightly better than E39/C. MAECHAM4-CHEM overestimates the long-term decline of total ozone, whereas underestimates the decline over Antarctica and at northern mid-latitudes. The true long-term decline in winter and spring above the Arctic may be underestimated by a lack of TOMS/SBUV observations in winter, particularly in the cold 1990s. Main contributions to the observed interannual variations of total ozone and lower stratospheric temperature at 50 hPa come from a linear trend (up to -10 DU/decade at high northern latitudes, up to -40 DU/decade at high southern latitudes, and around -0.7 K/decade over much of the globe), from the intensity of the polar vortices (more than 40 DU, or 8 K peak to peak), the QBO (up to 20 DU, or 2 K peak to peak), and from tropospheric weather (up to 20 DU, or 2 K peak to peak). Smaller

Copernicus Publications
The Innovative Open Access Publisher

Search ACP
Library Search
Author Search

News
- Sister Journals AMT & GMD
- Financial Support for Authors
- Journal Impact Factor
- Public Relations & Background Information

Recent Papers
01 | ACP, 23 Dec 2008: Measurement of glyoxal using an incoherent broadband cavity enhanced absorption spectrometer

02 | ACPD, 23 Dec 2008: Single particle characterization using a light scattering module coupled to a time-of-flight aerosol mass spectrometer

03 | ACP, 23 Dec 2008: Corrigendum to "Modeling the effect of plume-rise on the transport of carbon monoxide over Africa with NCAR CAM" published in

variations are related to the 11-year solar cycle (generally less than 15 DU, or 1 K), or to ENSO (up to 10 DU, or 1 K). These observed variations are replicated well in the simulations. Volcanic eruptions have resulted in sporadic changes (up to -30 DU, or +3 K). At low latitudes, patterns are zonally symmetric. At higher latitudes, however, strong, zonally non-symmetric signals are found close to the Aleutian Islands or south of Australia. Such asymmetric features appear in the model runs as well, but often at different longitudes than in the observations. The results point to a key role of the zonally asymmetric Aleutian (or Australian) stratospheric anti-cyclones for interannual variations at high-latitudes, and for coupling between polar vortex strength, QBO, 11-year solar cycle and ENSO.

Final Revised Paper (PDF, 3366 KB)   Discussion Paper (ACPD)

Citation: Steinbrecht, W., Haßler, B., Brühl, C., Dameris, M., Giorgetta, M. A., Grewe, V., Manzini, E., Matthes, S., Schnadt, C., Steil, B., and Winkler, P.: Interannual variation patterns of total ozone and lower stratospheric temperature in observations and model simulations, Atmos. Chem. Phys., 6, 349-374, 2006.   Bibtex   EndNote   Reference Manager