Geophysical Research Abstracts
Vol. 13, EGU2011-7498-1, 2011
EGU General Assembly 2011


# Stationary waves in middle atmospheric ozone and water vapour derived from observations and model simulations

Axel Gabriel (1), Deniz Demirhan Bari (1), Dieter H.W. Peters (1), Ingo Kirchner (2), Ines Hoeschel (2), and Hans-F. Graf (3)

(1) Leibniz-Institute for Atmospheric Physics at the University Rostock e.V., Kühlungsborn, Germany (gabriel@iap-kborn.de), (2) Meteorologisches Institut, Freie Universität Berlin, Berlin, Germany, (3) Centre for Atmospheric Science, University of Cambridge, Cambridge, UK

We present a comparative diagnosis of mean stationary wave patterns in middle atmospheric ozone and water vapour based on assimilated data (ERA-40, ERA-Interim), satellite data (SAGE, GOME, ODIN, AURA-MLS) and model simulations (MAECHAM5, HAMMONIA). The decadal mean distributions of both ozone and water vapour are characterized by pronounced wave one patterns which increase during autumn, maintain during winter and decay during spring, with maximum amplitudes up to about 20% of zonal mean values during winter. During Northern Winter, the wave one in stratospheric ozone shows a double-peak structure with enhanced amplitude in the lower and in the upper stratosphere, and with maximum over the North Pacific / Aleutians and minimum over the North Atlantic / Northern Europe. The wave one in water vapour extends from the lower stratosphere to the mesosphere with a westward phase shift with increasing height and including a phase jump at the upper stratosphere. In the Southern Hemisphere, similar wave one patterns occur during southern spring when the polar vortex breaks down. Based on a simplified tracer transport approach we can explain a large fraction of these wave patterns (ca. 50%) as a first-order result of zonal asymmetries in mean meridional transport due to zonal asymmetries in geostrophically balanced winds. Further influences which may contribute to the mean stationary wave patterns and their long-term changes, e.g. eddy mixing processes or temperature-dependent chemistry, are discussed. Based on the model simulations we show also that the radiation perturbations due to the wave one in stratospheric ozone and the 11-year cycle in solar irradiation can strongly influence the vertical propagation of planetary waves from the troposphere to the middle atmosphere. We find a significant feedback to the stationary wave one patterns in dynamics, transport and chemistry. The results suggest that a detailed diagnosis of stationary waves in ozone, water vapour and other important trace gases as well as their effects on atmospheric circulation may help validating and improving current general circulation and chemistry models.