Geophysical Research Abstracts
Vol. 13, EGU2011-7629, 2011
EGU General Assembly 2011

Eight Years of Stratospheric BrO and NO_2 Profiles from SCIAMACHY Compared to ECHAM5/MESSy2 Atmospheric Chemistry (EMAC) Simulations

Steffen Dörner (1), Sven Kühl (1), Janis Pukite (1), Patrick Jöckel (2), Marcel Dorf (3), and Thomas Wagner (1)

(1) Max Planck Institute for Chemistry, Mainz, Germany (steffen.doerner@mpic.de), (2) Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institute for Atmospheric Physics, Oberpfaffenhofen, Germany, (3) Ruprecht-Karls-Universität, Institute of Environmental Physics, Heidelberg, Germany

Since 2002 the Scanning Imaging Absorption Spectrometer for Atmospheric Chromatography (SCIAMACHY) on the Environmental Satellite (ENVISAT) measures solar radiation that is transmitted, backscattered and reflected from the atmosphere. From these measurements stratospheric profiles of various trace gases can be retrieved. In this study, the data set of the MPI Chemistry Mainz for vertical profiles of NO_2, BrO and OClO is compared to the ECHAM5/MESSy2 atmospheric chemistry (EMAC) simulations for the lower to middle stratosphere (15 km to 35 km). This comparison is performed systematically on the global scale for the years between 2002 and 2009.

In order to collocate both data sets in time and space, the EMAC results have been sampled on-line (i.e., during the model run-time) along all possible orbits of the satellite measurements. Therefore, error sources like differences caused by the influence of the diurnal cycle are minimised. For the comparison we follow two different approaches: First, vertical profiles of NO_2 and BrO are averaged temporally and zonally to focus on the general global distribution. Second, the global distribution patterns in five-day averaged maps are compared for individual altitudes. While the first approach allows to quantify the systematic differences, the zonally and vertically resolved comparison reveals the impact of stratospheric transport processes on a smaller time scale by emphasising the longitudinal variation.

For both comparisons a generally good agreement is found for absolute values and distribution patterns. Differences within 20 % for NO_2 with systematically larger number densities for the EMAC simulations and 30 % for BrO with generally larger number densities for the satellite measurements are found. NO_2 and BrO for the polar regions and NO_2 for the tropics show larger deviations of up to 40 %. Considering the longitudinal variation, also different shapes of the distributions are revealed for certain regions and seasons.

While some of these differences may be explained by simplifications performed in the retrieval, the simulation of the stratospheric meteorology appears to be another reason for deviations. To investigate this point in more detail, stratospheric temperatures and potential vorticity from the EMAC simulations are compared to operational analyses data provided by the ECMWF. In general, a good agreement of both quantities is found. This is partially due to the weak nudging of the EMAC simulations towards the ECMWF analyses in the troposphere. However, large differences may develop for the polar vortex region especially during warm polar winter seasons in the northern hemisphere.

With our quantitative comparison of all three data sets problems in both SCIAMACHY measurements and EMAC simulations could be identified using also the information from balloon borne measurements. On the one hand the comparisons indicate an underestimation of NO_2 for tropics and a general overestimation of BrO by the satellite measurements. On the other hand possible problems with the simulation of the polar vortex meteorology and an overestimation of NO_2 number densities for the high latitudes by EMAC may be concluded.