Atmos. Chem. Phys. Discuss., 5, S983–S986, 2005
www.atmos-chem-phys.org/acpd/5/S983/
European Geosciences Union

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Midlatitude ClO during the maximum atmospheric chlorine burden: in situ balloon measurements and model simulations" *by* B. Vogel et al.

B. Vogel et al.

Received and published: 31 May 2005

Reply to the Reviewer 2 Comments

We thank the reviewer for his helpful review. Following his advice we discussed the low aerosol levels from 1996-1999.

Furthermore, we changed the initialization, so that the temporal development of the chemical trace species along each 24-hour backward trajectory are perpetually calculated using the results of the previous model simulation to initialize the following 24-hour simulation, whereas the species CH_4, HCl, H_2O, NO_x, and O_3 derived from measurements are reinitialized to measured values. The conservation of Br_y, Cl_y, and NO_y is warranted between the different cycles. In contrast to the first version of the manuscript, whereby all species was reinitialized to results of the previous model simulation, this yields a better agreement between measurements and simulations for the Aire flight. Further, for the Leon flight the most chemical species converge to a constant volume mixing ratio for a given time in the simulation after approximately 6 – 9 cycles depending on altitude similar to the Aire flight (shown in a new Figure) and in contrast to the previous version of the manuscript. Furthermore, model simulations using different initializations for the partioning between HNO_3 and N_2O_5 (cf. table 1) also converge to the same ClO mixing ratios after approximately 9 cycles as for the Aire flight. However, the measured ClO daylight profile is still underestimated at around 650 K potential temperature. Finally, model simulations with reduced NO_x or HCl values can reproduce measured ClO daylight profile, but simultaneously overestimate the measured night time values.

Major Revisions:

1. The authors neglect to discuss aerosol levels in the model or in the atmosphere at the time of these measurements. The low aerosol surface area is important for understanding ClO as it substantially alters the partitioning of NOx/NOy. This discussion impacts the section on NOx in particular.

For the model simulations, we adjusted the surface area of the background aerosol

ACPD
5, S983–S986, 2005

(SSA = stratospheric sulfuric aerosol) per unit volume A_{SSA} by varying the mixing ratio of H_2SO_4 in ppbv in gas-phase equivalent employing a stratospheric aerosol climatology from SAGE II and CLAES measurements by Bauman et al., 2003. Further, we performed sensitivity studies with A_{SSA} values significant higher and lower than reported by Bauman et al., 2003, however the sensitivity of ClO mixing ratios on the surface area of the background aerosol is not substantial for both flights. The results are shown in a new table (cf. Tab. 5, revised manuscript).

2. If I have correctly understood the model setup section, it seems that the ozone profile used in the model used to calculate pho- tolysis rates is derived from simulation with a 2-D model? I don't understand why the ozone profile is not setup from the ozone-sonde measurements pieced together with the appropriate HALOE observations above. Error in the ozone column could clearly lead to simulations errors of the type described in the paper. Error in the ozone column can also impact the discussion of the ozone budget (P-L).

We used as input data for the photolysis scheme an ozone profile that is derived from Observations of the Halogen Occultation Experiment (HALOE) on board the UARS satellite [Russellet al., 1993] and only below 15 km altitude model results of the Mainz 2-D model [Gidel et al., 1983; Grooss, 1996] are used. We agree that the impact of the used ozone profile for the photolysis scheme is very important for stratospheric chemistry, however in our study ClO measurements are shown between 15 – 35 km altitude and model simulations for altitude between 20 – 35 km altitudes are presented, so that in our model simulations the impact of the ozone profile used for the photolysis scheme below 15 km altitude is of no importance.

3. In general, my read of the figures and results is that they support the general conclusion that our understanding of stratospheric ClO is excellent. Perhaps this point

ACPD

5, S983–S986, 2005

should be better emphasized. There are a number of minor points of editing that I believe a careful check by the author and co-authors can address.

We revised the manuscript and emphasize more the excellent agreement between measurements and simulations (see revised manuscript).

ACPD

5, S983–S986, 2005