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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Chemical ozone loss in the Arctic winter 1991–1992" *by* S. Tilmes et al.

S. Tilmes et al.

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Respond to Referee 1:

General Comments: Based on this comment and on the comment of Referee 2, we added an additional analysis of ozone sonde data in the Arctic polar vortex in comparison with HALOE ozone profiles. This analysis shows a good agreement between HALOE observations and ozone sonde data and supports our statement that the influence of large aerosol loadings on HALOE measurements is small. We will include a more precise estimate of the uncertainty of calculated chemical ozone loss in the revised version of the manuscript. We add the following paragraph in the Discussion: "The comparison of different observations in the winter 1991–1992 results in a consistent picture of chemical ozone loss derived using tracer-tracer correlations. HALOE ozone agrees well with observed ozone sonde data in the Arctic polar vortex between January and March. The deviation between a monthly averaged ozone sonde profile and HALOE ozone is on average 0.3 ppmv at altitudes above 400 K potential temper-

ature. Below 400 K, altitudea which were most possible influenced by high aerosol loading after the eruption of Mt. Pinatubo, these data do not deviate by more than 0.2 ppmv." Please view the comment to Referee 2 for a detailed discussion.

Specific comments:

p. 10101, l20: we change the sentence to: "The relationship between ozone and a long-lived tracer will not change in absence of heterogeneous chemistry to cause chlorine activation, because of a sufficiently long life-time of the tracers in the lower stratosphere in winter."

p. 10103, l7, we change the sentence to: "In this study, we use satellite observations taken from the HALOE instrument (Russell et al, 1993), Version 19."

p. 10104, l8: modified sentences: "Owing to the strongly enhanced sulfate aerosol densities in the lower stratosphere, the threshold temperature for chlorine activation increased significantly (Katja Drdla, pers. communication). Temperatures during the first part of February and the first half of March 1992 below 450 K are below this threshold and a potential of chlorine activation exists during this period.

l 21: we add: "for altitudes between 380 and 550 K potential temperatues."

p 10106 l1. PVU are defined in terms of SI units and P = 29 PVU at 475 K . Changes will be implemented in the revised version of the manuscript.

p 10108, l 16: Quantification of the reliability of observations was performed in the revised version of the manuscript, please see general comments.

p 10111 l. 13 We thank the reviewer for pointing this out that the paragraph was confusion. We changed it in the revised version of the manuscript: "Here, we want to estimate the extent of chlorine activation that is still present in mid-March 1992. The abundance of inorganic chlorine Cly can be estimated by the observed sum of HCl and ClONO2 from the balloon-borne measurements. Grooss2002 reported a Cly_star\CH4 relation for deactivated conditions. Cly_star has been reduced by 12\% to account for

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the lower chlorine loading in 1992 than in 2000 (WMO2007). The increase in methane (2%) from 1992 to 2000 (Simpson2002) has only a minor effect but is also taken into account. The maximum Cly_star of about 3 ppb at the lowest CH4 mixing ratios is in very good agreement with Cly deduced independently from whole air sampler measurements for winter1991/92 (Schmidt1994).The comparison of the Cly_star/CH4 relationship with the observed relation between inorganic chlorine Cly/CH4 is shown in Figure 10. Clearly, for methane mixing ratios greater than ˜ 0.8 ppm the sum of ClONO2 and HCl is much lower than the estimated Cly. This indicates that chlorine is not yet completely deactivated at this time."

Generally speaking, broadband high spectral resolution spectroscopy as used with the LPMA and MIPAS-B instruments is less sensitive to errors due to aerosol continuum than the broadband / gas filter correlation radiometry applied in HALOE since in high spectral resolution broad band spectra the broadband aerosol features can be better separated from the absorption lines of gaseous components. Therefore, aerosol contributions in the spectra can well be accounted for in the retrieval. In the case of MIPAS-B, the aerosol extinction was retrieved from the spectra and residual errors were included in the error budget (cf. Clarmann et al., Oelhaf et al.). A separate paper (Echle et al., 1998) was even dedicated to this topic (Echle, G., T. von Clarmann, and H. Oelhaf, Optical and microphysical parameters of the Mt. Pinatubo aerosol determined from MIPAS-B mid-IR limb emission spectra, J. Geophys. Res., 103, 19193-19211, 1998.). In addition, it is important to note, that the pointing technique used with the limb emission sounder MIPAS-B is inherently independent of the aerosol amount, e.g. it does not rely on any suntracker data, which might be deteriorated by a large aerosol loading.

p. 10112, l 9: suggested changes are implemented

p. 19127/29 Figure 10 and 11 will be combined in a single Figure as suggested.

All technical corrections will be implemented in the revised version of the manuscript.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 10097, 2007.