Atmos. Chem. Phys. Discuss., 13, C2259–C2261, 2013
www.atmos-chem-phys-discuss.net/13/C2259/2013/

Atmospheric Chemistry and Physics Discussions

ACPD
13, C2259–C2261, 2013

Interactive Comment

Interactive comment on "Stratospheric lifetimes of CFC-12, CCl_4, CH_4, CH_3Cl and N_2O from measurements made by the Atmospheric Chemistry Experiment-Fourier Transform Spectrometer (ACE-FTS)" *by* A. T. Brown et al.

A. T. Brown et al.

alex.brown@york.ac.uk

Received and published: 12 May 2013

The following section has been added to the paper:

"An analysis of the altitude dependent systematic errors in ACE-FTS retrievals has not been carried out at this time. However, ACE-FTS occultations have been compared to data from other instruments such as the MK-IV and FIRS-2 balloon borne spectrometers (e.g. Mahieu et al. 2008). Previous validation papers for N2O, CH4, CFC-11 and CFC-12 have not shown significant altitude dependent errors for the altitude range

used in this study (Mahieu et al. 2008; Velazco et al. 2011). In addition to these comparisons, the profiles of CFC-11 and CFC-12 were compared to those from the SLIMCAT 3-D Chemical Transform Model (Brown et al., 2011). The profiles used in this work showed that, whilst there were differences in the VMR from ACE-FTS and from SLIMCAT the overall shapes of the profiles were extremely similar. The differences between VMRs from ACE-FTS and other instruments (mentioned previously) can be used as a proxy for the systematic error, due to the fact that the full systematic errors associated with ACE-FTS retrievals are not known at this time. The methods described in this chapter have been repeated using ACE-FTS VMRs which have been modified by the differences calculated in previous validation work. The values used to modify the VMRs were + 10% for CFC-11 & CFC-12 from the validation work of Mahieu et al. (2008). Work by Velazco et al. (2011) also showed differences of + 10% for CH4 and N2O. The results of the reanalysis using these errors were combined with the statistical error. The final mean lifetimes were 113 +(-) 28 (21) for CFC-12, 123 +(-) 59 (39) for N2O and 195 +(-) 88 (62) for CH4.

The remaining species, CH3Cl and CCl4, are more problematic than the other species. Previous validations of these species have shown large differences between ACE-FTS retrievals and the retrievals from other species. For example comparisons between ACE-FTS and the MK-IV instrument (Velazco et al., 2011) found differences of 30% in the VMR retrievals of CH3Cl. The errors on ACE-FTS retrievals of CCl4 are estimated to be between 20 and 30% (Allen et al., 2009). The estimation of systematic errors for the CCl4 retrieval is complicated by the position of the spectral feature used to retrieve CCl4 VMR. There is an interfering Q-branch of CO2, the line mixing of which is not properly accounted for in the forward model. Similarly the Q-branch of CH3Cl suffers from line mixing which is not properly included in the forward model. The effects of line mixing on both of these retrievals are most serious in the troposphere, where the density of the atmosphere is at its greatest. In the stratosphere, where the density of the atmosphere is lower, line mixing becomes less of a problem within the retrieval. Quantifying the effects of line mixing on the retrieved VMR is a research project in and

ACPD
13, C2259–C2261, 2013

of itself. In this work we have approximated the systematic errors to be - 30% for CH3Cl (Velazco et al., 2011) and + 20% for CCl4 (Allen et al., 2009). Once more lifetimes were calculated using VMR which had been modified by the corresponding systematic error. The final mean lifetimes for these species were 35 +(-) 13 (10) for CCl4 and 69 +(-) 71 (37) for CH3Cl. These errors represent the best attempt to quantify the effect of systematic errors on the lifetimes of CCl4 and CH3Cl, however, due to the reasons outlined previously these errors may be different to those quoted here."

An additional couple of sentences have also been added to the conclusion:

"The altitude dependent systematic errors in ACE-FTS retrievals are not currently known at this time. An attempt has been made to estimate the effect of systematic errors on the calculated lifetimes. Lifetimes were recalculated using VMRs which had been modified to reflect differences between ACE-FTS retrieved VMRs and those from other instruments. The mean lifetimes were unaffected by these calculations, which affected the error ranges of these calculations. The results of these calculations were as follows: 113 +(-) 28 (21) for CFC-12, 123 +(-) 59 (39) for N2O, 195 +(-) 88 (62) for CH4, 35 +(-) 13 (10) for CCl4 and 69 +(-) 71 (37) for CH3Cl."

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 4221, 2013.