Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

AAS001-P21 Room: Convention Hall Time: May 27 17:15-18:45

Vertical profiles of O3, HCl and HF observed with Fourier transform spectrometer at Tukuba

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Vertical profiles of various species in the atmosphere have been observed with a Fourier transform infrared spectrometer (FTIR) at Tukuba. FTIR has advantages in its high resolution and the wide wavenumber range. Vertical profiles of some species can be derived from the high-resolution spectra. Chemical changes can be extracted from the correlations of species observed simultaneously. Purposes of this study are to establish the height retrieval from the spectra and to reveal O_3loss in mid-latitude regions in the winter/spring season due to transport of the polar airmass.
The vertical profiles of O_3, HCl and HF were retrieved from the solar spectra with SFIT2 that was developed by Rinsland et al. (1998). It needs to select an appropriate wavenumber region that has wide sensitive altitude range, small dependence on temperature and pressure profiles and initial profiles of the target species, and small absorption of interfering species. Optimization of fitting parameters such as a priori profile covariance matrix (Sa) and S/N is also needed.
First, we investigated the wavenumber region and parameters for O_3retrieval and validated the retrieved O_3profiles with ozonesonde data. There were 12 comparisons between FTIR and ozonesonde in 2006. Retrieved profiles using Sa=20% and S/N=200 from 3051.29 - 3051.90cm^{-1} are relatively suited to ozonesonde data in the altitude range of 20 - 30 km. The accuracy is about 3% - 10%.
Next, we investigated the wavenumber region and parameters for HCl retrieval and validated the retrieved HCl profiles with AURA/MLS data. There were 57 comparisons between FTIR and AURA/MLS during 2004 - 2007. Retrieved profiles using Sa=30% and S/N=300 from 2925.88 - 2 026.00$cm^{-1}$are relatively suited to AURA/MLS data in the altitude range of 20 - 30 km. The accuracy is about 10% - 25%.
Last, we investigated the wavenumber region and parameters for HF retrieval and validated the retrieved HF profiles with UARS/HALOE data. Since HF is a remakerbly stable species in the stratosphere, it is used as a dynamic tracer. There were 8 comparisons between FTIR and UARS/ HALOE during 2001 - 2005. Retrieved profiles using Sa=40% and S/N=400 from 4038.88 - 4039. 07$cm^{-1}$and 4109.88 - 4110.10$cm^{-1}$are the best conditions in the altitude range of 20 - 30 km. The accuracy is about 12% - 38%.
The export of airmass from the polar regions modulates the O_3abundance in the mid-latitude. The very high $O_3$and HF column values were observed once or twice a year among 2005 ? 2008. The correlation of O_3-HF mixing ratios showed chemical depletion of O_3. The origin of airmass were investigated using potential vorticity analysis and backward trajectory analysis. The variations of both O_3-HF correlation and HCl-HF correlation can be explained by the origin of the airmasses. This suggests that FTIR can detect ozone changes due to the influences of polar airmass.
The polar airmasses were observed on 11 days during 2005 - 2008. The O_3depleted airmasses were observed at all altitudes between 19 and 31km on March 16, 2005. The estimated amount of chemical ozone loss of total column from O_3-HF total column correlation was about 50 DU. On other 8 days, the polar airmasses observed only at 19km and chemical ozone loss were found. The estimated amount of chemical ozone loss at 19km from O_3-HF correlation was about 1ppm in most

case. Polar but no O_3depleted airmasses were observed only at 19km on the other two days. The chance to observe polar airmass was higher at 19km. In the second case, the chemical ozone loss could not be found from O_3-HF total column correlation except for one day on which the chemical ozone loss of 40DU was estimated. Profile retrieval enable us to detect the chemical ozone loss.