アラスカにおける対流圏 CO の高分解能 FTIR 吸収分光観測

Seasonal Variations of Carbon Monoxide over Poker Flat, Alaska by ground based infrared spectroscopy during 2000-2002

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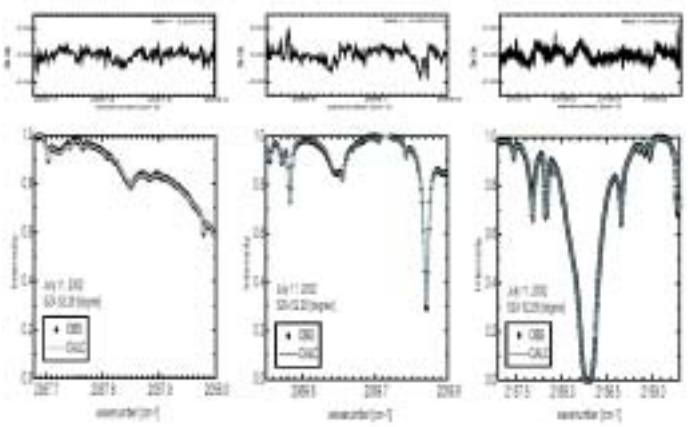
Carbon monoxide CO is one of the most important molecules in the troposphere. The reaction of CO with hydroxyl radicals OH is the primary sink for tropospheric OH, which controls the oxidizing capacity of trace gases in the troposphere [e.g. Logan et al, 1981]. CO plays a role in the cycle of catalytic ozone production and destruction. The distribution of CO holds an interest not only for it's role in tropospheric chemistry but also as a primary and secondary determinant of air quality via its use as an atmospheric tracer with a relatively long life-time, that is, as an indicator of how transport redistributes pollutants.

The purpose of this paper is to report and to interpret the seasonal variation of CO and its long-term trend by a time series of measurements derived from high-resolution infrared solar absorption spectra. The long-term trend fit suggests increase CO in tropospheric partial column over the observation period. These persistent seasonal variations and long term trend were detected for the first time over Poker Flat, Alaska (65N, 147W)

The Poker Flat FTS (Bruker 120HR: 0.0019cm^{-1} resolution), installed in September 1999, is equipped with a computer controlled solar tracker with a hatched weather-tight enclosure. The system only requires an operator to fill the detector dewars with liquid nitrogen once a day. The system monitors the weather conditions and records

Figure 1: An example of the retrieved results of CO. Top: The residual of the observation spectrum and the calculated spectrum using retrieved profile. The residual obtained is within 2 %. Top bottom: The observed spectrum and the calculated spectrum.



solar spectra when conditions are favorable. Under favorable conditions, the observations commence with a total of 10 measurements recorded in 6 spectral band pass filters. The spectra were recorded at unapodized resolutions of 0.0035 cm^{-1} with a liquid nitrogen cooled InSb detector and a KCl beam splitter. Observed spectrum data are automatically transported from the Poker Flat to CRL once a day.

Figure 1 illustrates an example of the retrieval results of a CO absorption spectrum observed on July 11, 2002. Altitude profiles and tropospheric partial column abundances of CO in 2000-2002 were retrieved from ground-based infrared solar absorption spectra observed over Poker Flat. These mixing ratio profiles were obtained from observations in 2000-2002. The vertical profiles of atmospheric constituents retrieved from infrared absorption spectra by use of the Rodger's optimal method (OEM) [Rodgers, 1967].

Figure 2 displays the time series of Poker Flat CO measurements during 2000 - 2002. The retrieval results indicate significant seasonal variation in the tropospheric content of the CO profile over Poker Flat with a maximum in winter-spring and minimum in summer. The long-term trend fit suggests increase CO in tropospheric partial column over the observation period. This indicates a trend of about 3% per year for the 3 years of data.

These persistent seasonal variations and long term trend were detected for the first time over Poker Flat. Abnormally enhanced CO profiles appear sometimes in spring and in summer. Good correlations between enhanced CO, HCN indicate that they had similar sources and underwent similar dilution processes.

Figure 2: Seasonal variation of tropospheric partial column of CO during 2000-2002