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# Time series of $^{12}$CO and $^{13}$CO at northern mid-latitudes: determination of partial column and $\delta^{13}$C seasonal and interannual variations

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Carbon monoxide (CO) is an important reactive gas in the troposphere. It is emitted at the ground level by fossil fuel combustion and biomass burning. Biogenic sources and oceans as well as oxidation of methane and non-methane hydrocarbons complete the emissions budget. Large uncertainties still affect the relative contributions of the identified anthropogenic and natural sources. Destruction by the hydroxyl radical (OH) is the main removal process for CO in both the troposphere and the stratosphere. The resulting average tropospheric lifetime of CO varies from several weeks to a few months.

Two approaches have been developed and optimized to independently retrieve abundances of $^{12}$CO and $^{13}$CO from high-resolution ground-based infrared solar spectra, using sets of carefully selected lines and the SFIT-2 (v3.91) algorithm which implements the optimal estimation method. The corresponding products will be described and characterized in terms of error budget and information content. These strategies have allowed us to produce partial column time series of $^{12}$CO and $^{13}$CO, using spectra recorded on a regular basis at the Jungfraujoch station (46.5ºN, 8.0ºE, 3580 m asl, Swiss Alps), a site of the Network for the Detection of Atmospheric Composition Change (NDACC). The seasonal and interannual changes observed in the$^{12}$CO,$^{13}$CO and $\delta^{13}$C ($^{13}$C/$^{12}$C) data sets will be presented and discussed.

Complementary zonal mean time series derived from occultation measurements collected by the ACE-FTS instrument onboard the Canadian SCISAT-1 platform since 2004 will also be included and analyzed, focusing on the upper troposphere-lower stratosphere region of the atmosphere.

Finally, we will use GEOS-Chem 3-D chemistry transport model results to help in the interpretation of the short- and long-term variations characterizing the ground-based and satellite data sets, focusing on the factors influencing the partitioning between the two CO isotopologues.