COLD: a mid-infrared quantum cascade laser spectrometer for in-situ airborne measurement of stratospheric trace gases

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The instrument COLD is a mid-infrared Quantum Cascade Laser spectrometer developed for in-situ measurements of trace gases in the upper troposphere and lower stratosphere. The analyzer was designed with the goal of realizing a portable and versatile spectrometer, suitable to be easily installed in different platforms, like stratospheric aircraft or balloons, without particular requirements of pressurization and without need of in-flight calibration procedures. Consequently the instrument features small size, light weight and low power consumption, but it is robust enough to guarantee unattended operation in harsh environment (with pressure variable between 1000 and 10 mbar, and an external temperature variable between 40 and -80 ^{0}C).

COLD was successfully employed on board the stratospheric aircraft Miyashichev M55 Geophysica in the frame of the StratoClim campaign (stratospheric and upper tropospheric processes for better climate predictions) carried out in Nepal, in July-August 2017, during the Asian summer monsoon season. During 8 scientific flights over Nepal, India and Bangladesh, the instrument provided carbon monoxide (CO) mixing ratios and for some flights also nitrous oxide (N_2O) mixing ratios, achieving an in-flight sensitivity of 1-2 ppb for CO and 10 ppb for N_2O, with a time resolution of 1 s.

The results collected during the campaign will be shown. In particular CO vertical profiles will be presented with emphasis on enhanced CO layers, that are often observed in upper troposphere, with respect to a CO mean vertical profile. The CO positive anomalies are analyzed jointly with cloud and ozone observations and with convective tracers from lagrangian models to identify convective influence and source regions of potential pollutants in the upper troposphere. Moreover a comparison with spaceborne remote-sensing CO from Microwave Limb Sounder (MLS) will be reported.