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CH4, H_2O, and CO spectroscopy for the Sentinel-5 Precursor mission: an assessment with TCCON spectra

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The TROPOspheric Monitoring Instrument (TROPOMI) will be part of ESA's Sentinel-5 Precursor (S5P) satellite platform scheduled for launch in 2014. Two of TROPOMI's goals are to monitor methane and carbon monoxide concentrations in the Earth's atmosphere by measuring spectra of backscattered sunlight in the short-wave infrared.

S5P will be the first satellite mission to rely uniquely on the spectral window at 4190 – 4340 cm^{-1} to retrieve CH_4 and CO. In this study, we investigated if the absorption features of the three relevant molecules CH_4, CO, and H_2O are adequately known. To this end, we retrieved total columns of CH4 and CO from absorption spectra measured by two ground-based Fourier transform spectrometers that are part of the Total Carbon Column Observing Network (TCCON). The retrieval results from the 4190 – 4340 cm^{-1} range at TROPOMI resolution (0.45 cm^{-1}) were then compared to the results obtained from the 6000 cm^{-1} (for CH_4) and the 4190 – 4340 cm^{-1} (for CO) spectral ranges at high resolution (0.02 cm^{-1}).

For TROPOMI-like settings, the current spectroscopy databases allowed to reproduce the CH_4 columns to an accuracy of 0.3%. The CO retrieval accuracy was, through interference, more strongly affected by the shortcomings of the CH_4 and H_2O spectroscopy. Contrary to CH_4, the CO column error also varied significantly with atmospheric H_2O content. This would introduce seasonal and latitudinal biases to the CO columns retrieved from TROPOMI measurements. We therefore recommend further effort from the spectroscopic community to be directed at the H_2O and CH_4 spectroscopy at 4190 – 4340 cm^{-1}.