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Improved calibration of XCO_2, XCH_4, and XCO measurements from European TCCON sites

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The Total Carbon Column Observing Network (TCCON) provides column-averaged mole fraction measurements for climate-relevant trace gases like CO_2, CH_4, CO and others at high precision. At each of the global TCCON sites, a Fourier-Transform Spectrometer (FTS) observes the sun at high spectral resolution from the near infrared to the visible. The column-averaged mole fraction of a species (referred to as Xspecies) is then derived from the observed solar spectra.

The goal for the TCCON measurements is high precision with small biases between individual stations. In order to also achieve high accuracy, TCCON has been calibrated against the World Meteorological Organization's Mole Fraction Scale for CO_2 and other greenhouse gases. This was achieved by sampling the atmospheric column above several TCCON stations with airborne in-situ instruments. One of these aircraft campaigns was organized within the European Union infrastructure project IMECC in 2009. During the campaign, coincident aircraft in-situ and FTS total-column measurements were taken above six European TCCON sites [Messerschmidt et al., 2011; Geibel et al., 2012].

Prior to 2010, many TCCON instruments were affected by so-called "ghosts": spectral artifacts that resulted in small but significant station-dependent biases in the order of up to 1 ppm for CO_2. The cause of the ghosts was eliminated later by modifying the hardware of all TCCON FTSs. However, the ghosts remained in the spectra that had been measured before this upgrade.

Recent developments in the TCCON data analysis have made it possible to identify and remove the ghosts from the spectra. This also affects the in-situ calibration factors that were derived from pre-2010 aircraft calibration campaigns. This study discusses the effect that the ghost-removal has on the calibration factors obtained from the European IMECC campaign. A full analysis for the whole TCCON data series will follow.

References:

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