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Calibration of column-averaged CH_4 over European TCCON sites

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In September/October 2009, six ground-based Fourier Transform Spectrometers (FTS) of the Total Carbon Column Observation Network (TCCON) in Europe were calibrated with aircraft in-situ measurements for the first time. The campaign was part of the Infrastructure for Measurement of the European Carbon Cycle (IMECC) project.

During this campaign aircraft in-situ profiles of CO_2, CH_4, CO and H_2O (from continuous measurements) as well as N_2O, H_2, and SF_6 (from flasks) were taken close to the FTS sites. The aircraft data had a vertical coverage ranging from approximately 300 to 13000 m, corresponding to $\sim$80 % of the total atmospheric column seen by the FTS.

This study summarizes the calibration results for CH_4. Using similar methods, the resulting calibration factor of 0.978 ± 0.002 ($\pm 1\sigma$) from the IMECC campaign agreed very well with the results that Wunch et al. (2010) had derived for TCCON instruments in North America, Australia, New Zealand, and Japan. By adding the data of the previous calibration of Wunch et al. (2010) the uncertainty of the calibration factor could be reduced by a factor of three.

A careful analysis of the calibration method used by Wunch et al. (2010) revealed that the incomplete vertical coverage of the aircraft profiles can lead to a bias in the calibration factor. This bias can be compensated with a new iterative approach that we developed. Using this improved method, we derived a significantly lower calibration factor of 0.974 ± 0.002 ($\pm 1\sigma$). This corresponds to a correction of all TCCON CH_4 measurements by roughly -7 ppb.