

Total column measurements of GHGs from ground-based low-resolution remote sensing instruments and their comparison to TCCON

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The Total Carbon Column Observing Network (TCCON) has been the baseline ground-based network for measuring accurate and precise column-averaged dry air mole fractions of CO₂, CH₄ and CO amongst other gases. However, the number of stations (currently ~25) is limited and has a very uneven geographical coverage. To improve the satellite validation and better contribute to the carbon cycle science studies, a denser distribution of ground-based solar absorption measurement is needed to cover geographical gaps for various atmospheric conditions (humid, dry, polluted, presence of aerosol, varying surface albedo) and to create a large latitudinal distribution. For this reason, several groups are investigating portable low-cost instruments, which can complement the existing networks and thus enhance the validation of satellite measurements.

The “Fiducial Reference Measurements for Ground-Based Infrared Greenhouse Gas Observations (FRM4GHG; <http://frm4ghg.aeronomie.be/>)” campaign has been funded by the European Space Agency (ESA) to characterize the performance of several low-cost portable spectrometers for precise solar absorption measurements of CO₂, CH₄ and CO. These measurements were performed next to the TCCON instrument at Sodankylä for three years since 2017 and one of the instruments performed measurements at the TCCON sites in Australia during the last year. In addition, regular AirCore launches were performed from the Sodankylä site to provide in-situ reference profiles of these gases; this is useful for the verification of the instrument calibration. The intercomparison results show that the tested low-resolution instruments provide high quality data comparable to that of TCCON. The data collected during the campaign were used for satellite validation.

The results of the campaign will be presented with an overview of the accuracy and precision achieved by each instrument. We show the benefits of the portable FTIR remote-sensing instruments by means of a few example cases.