Fiducial Reference Measurements for Ground-Based Infrared Greenhouse Gas Observations (FRM4GHG) and their use for S5P validation.

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Several new portable spectrometers have become available during the recent years. However the performances of these instruments have not been fully characterized. The ESA project “Fiducial Reference Measurements for Ground-Based Infrared Greenhouse Gas Observations (FRM4GHG)” aims at characterizing several portable spectrometers for measuring the greenhouse gases CO2, CH4 and CO, and at using their data for validation of the ESA Sentinel-5 Precursor (S5P) instrument (TROPOMI). The spectrometers have been collocated at the Sodankylä site of the Total Carbon Column Observing Network (TCCON; Wunch et al., 2011) and they have been performing greenhouse gas measurements during the years 2017 and 2018, next to the standard TCCON instrument. The latter has been operated in both normal high-resolution mode and also in the special low-resolution mode, similar to the portable spectrometers. The remote sensing total column measurements from the spectrometers are accompanied by balloon borne AirCore (Karion et al., 2010) in-situ measurements of the vertical profiles of the greenhouse gases up to about 25 km altitude. These AirCores have been launched on a regular basis from the Sodankylä site. The acquired profiles are calibrated to WMO standards, and are used as reference profiles for the remote sensing measurements.

In this presentation, the almost final results of the project will be shown, including results of the validation of S5P using the low resolution spectrometer data. We will also discuss the non-linearity effects that have been discovered in the TCCON spectra, and the methodologies that have been developed to correct for these effects.

The presentation will include future perspectives regarding the ground-based networks for remote sensing measurements of greenhouse gases, and their exploitation for satellite and model validation purposes and for carbon cycle studies.

References

Karion, A., Sweeney, C., Tans, P., Newberger, T., AirCore: An Innovative Atmospheric Sampling System, J. Atmos. Ocean. Technol., 27, doi:10.1175/2010JTECHA1448.1, 2010.

Wunch, D., Toon, G.C., Blavier, J.F.L., Washenfelder, R.A., Notholt, J., Connor, B.J., Griffith, D.W.T., Sherlock, V., Wennberg, P.O., The Total Carbon Column Observing Network, Phil. Trans. R. Soc. A, 369, doi:10.1098/rsta.2010.0240, 2011.