Campaign for comparing TCCON to complementary instruments for S5P validation (TCCONcomp) - # 28687

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Rationale

TCCON

- ground-based Fourier Transform Spectrometers (FTS) measuring direct solar absorption spectra in the short-wave infrared (SWIR).
- Products (precision, accuracy between brackets): **XCO_2 (1 ppm, 1 ppm), XCH_4 (5 ppb, 7 ppb), XCO (0.5 ppb, 4 ppb)** + N_2O, HF, H_2O, and HDO .
- Application:
  - satellite validation (Orbiting Carbon Observatory (OCO-2), SCIAMACHY, GOSAT, **TROPOMI, Sentinel**
  - Carbon science

TCCON has grown enormously
But is still lacking stations in regions critical for satellite validation, in particular areas with high albedo in the SWIR, high aerosol load.
Setting up additional TCCON stations is expensive (~ 400 kEuro), demanding as to infrastructure needs, etc.

Objectives

- **Perform simultaneous measurements with different candidate instruments for complementing TCCON and compare performances relative to standard TCCON instrument, during a ~1-year campaign at a TCCON site**
- **Use the campaign data for validation of S5P CH4 and CO**

Campaign set-up

At Sodankyla (TCCON site) – March – October or November 2016

Bruker EM27/SUN (KIT)

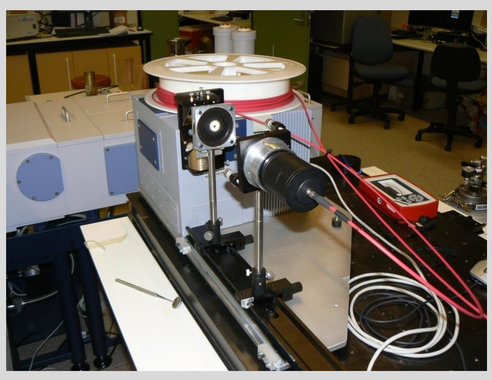
- Resolution: 0.5 cm-1
- Covering CO2, CH4
- Solar tracker directed by camtracker
- Price : ~ 100 kEuro incl. solar tracker + camtracker

References:

- F. Hase, et al. AMT, 8, 3059-3068, 2015
- M. **Frey**, et al., AMT, 8, 3047-3057, 2015

IR cube (UoW)

- Spectral resolution: 0.5 cm-1
- Quartz beamsplitter, InGaAs detector
- Covers CO2, CH4 and CO
- Solar feed from TCCON tracker or 20m fibre



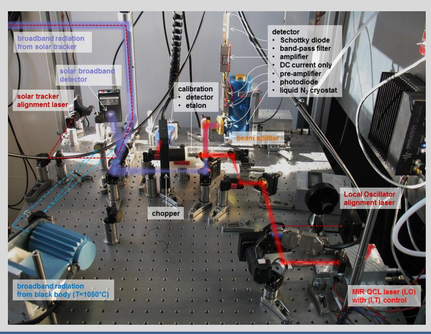
Bruker Vertex70 (BIRA and IUP-Bremen)

- Spectral resolution: 0.16 cm-1
- CaF2 beamsplitter, InGaAs detector
- Covers CO2, CH4 and CO
- Solar feed from TCCON tracker

Initially a laboratory instrument – deployed for the 1st time in solar absorption configuration

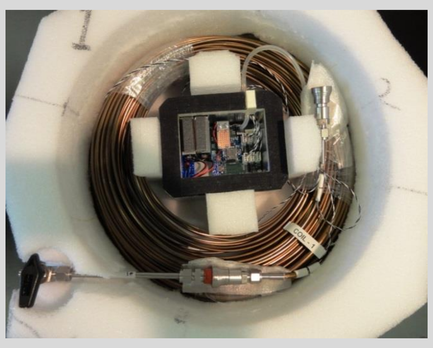
Quantum cascade later heterodyne radiometer (QCLHR)(RAL)

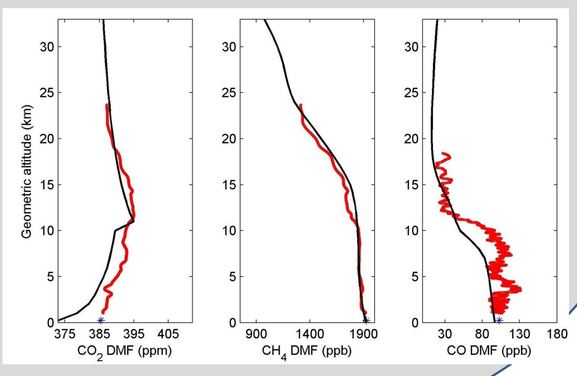
- Research spectrometer – resolution 0.002 – 0.02 cm^{-1}
- Covers CH4 and CO, and CO2 in mid IR
- Solar feed from tracker



Aircore (RUG and FMI)

- In-situ measurement of CO, CH4 and CO2 vertical profiles
- Calibrated to WMO standard
- Balloon-borne, gliding wing system for descent under development





Expected results

- Comprehensive characterisation of various candidate TCCON instruments: precision, accuracy, cost, ease of operation, ….⇒ selection of alternative instrument(s) for complementing the TCCON network for future validation (S5P, Sentinel)
- Contribution to S5P validation