CO 2 total column amounts at TCCON sites Izana (28.3 N, 16.5 W) and Karlsruhe (49.1 N, 8.5 E)

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CO_2 Total Column Amounts at TCCON Sites Izaña (28.3 N, 16.5 W) and Karlsruhe (49.1 N, 8.5 E)

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Abstract. The Total Carbon Observing Network (TCCON) is a global network of ground-based Fourier Transform Spectrometers recording direct solar spectra in the near-infrared (NIR) spectral region. Accurate and precise column-averaged abundances of different greenhouse gases (GHGs) are retrieved, which are used for carbon cycle research [1] and for satellite validation (e.g. SCIAMACHY, GOSAT, OCOII). Official TCCON data are generated using the GFIT code compared FTIR retrieval results with in-situ measurements developed at NASA/JPL [2]. In this study, we compare FTIR retrieval results with in-situ measurements as well as the GFIT code with the radiative transfer and retrieval algorithm PROFFIT [3].

Keywords: Remote sensing, FTIR-spectroscopy, TCCON.
PACS: 07.07.Df , 33.20.Ea

INTRODUCTION

The Total Carbon Observing Network (TCCON) is a global network of ground-based Fourier Transform Spectrometers recording direct solar spectra in the near-infrared (NIR) spectral region. With stringent requirements on the instrumentation, data processing and calibration, accurate and precise column-averaged abundances of CO_2, CH_4, N_2O, HF, CO, H_2O, and HDO are retrieved. Achieving such high precision is essential for using the column-averaged data in carbon cycle research [1] and for satellite validation (e.g. SCIAMACHY, GOSAT, OCOII). TCCON was established in 2004. Actually there are 19 sites affiliated around the world, Izaña being fully operational since May 2007 and Karlsruhe since September 2009. While Izaña is a subtropical high mountain observatory located at 2.4 km altitude over a temperature inversion layer acting as a natural barrier for local pollution, Karlsruhe is a continental site located at 110m a.s.l. in a flat terrain.

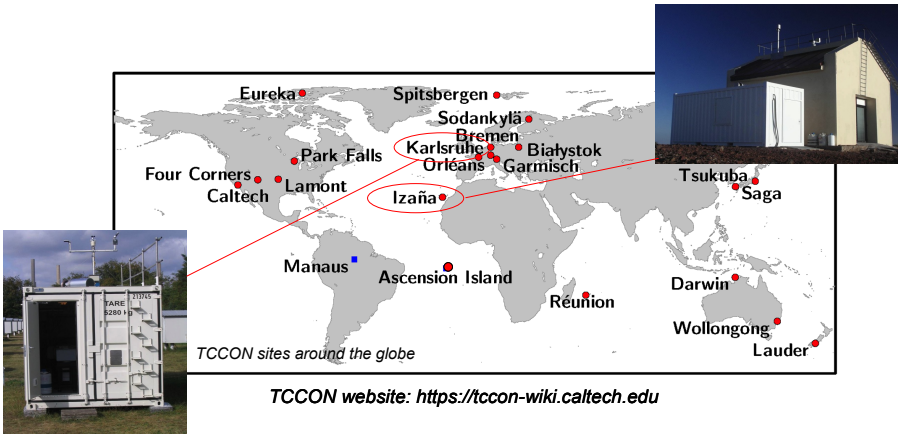

FIGURE 1. Map of the TCCON sites. Blue: Future site, red: Operational site.

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RESULTS

Official TCCON data is generated by using the fitting algorithm GFIT, developed at NASA/JPL (e.g. Toon et al. [2]). In this work we will apply a different procedure for calculating the trace gas abundances from the measured spectra, the fitting algorithm PROFFIT [3].

Izaña – FTIR vs. In-Situ

The advantage of the Izaña-site is the availability of collocated in-situ measurements. Figure 2 shows the daily mean FTIR-XCO_2 Volume Mixing Ratio (VMR) and simultaneous in-situ CO_2 VMR from May 2007 to November 2011 at Izaña site. The seasonal cycle of CO_2 is clearly visible with low CO_2 concentrations in summer and high concentrations in winter. The bias between FTIR- and in-situ data is about 1%. Figure 3 shows a correlation plot between the retrieved XCO_2 VMR and the in-situ VMR (collocated night measurement, mostly in the free troposphere). The comparison indicates excellent agreement with respect to the WMO calibration scale: PROFFIT: 0.989 ± 0.003; GFIT: 0.989 ± 0.002 [4].

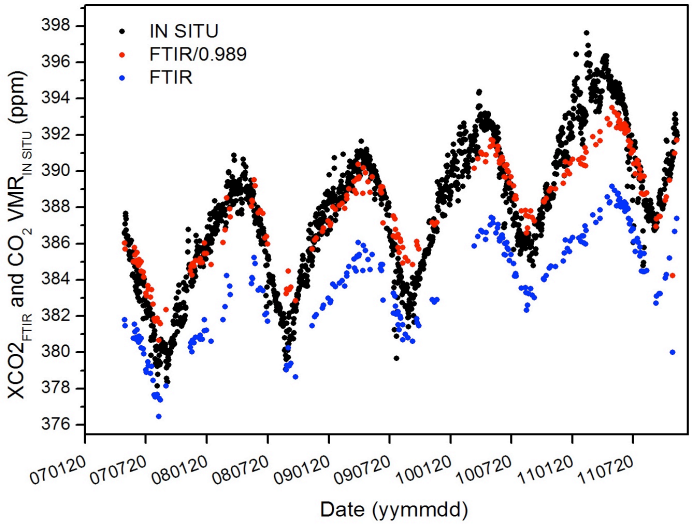

FIGURE 2. Daily mean FTIR XCO_2 VMR and simultaneous in-situ CO_2 VMR at the Izaña site.

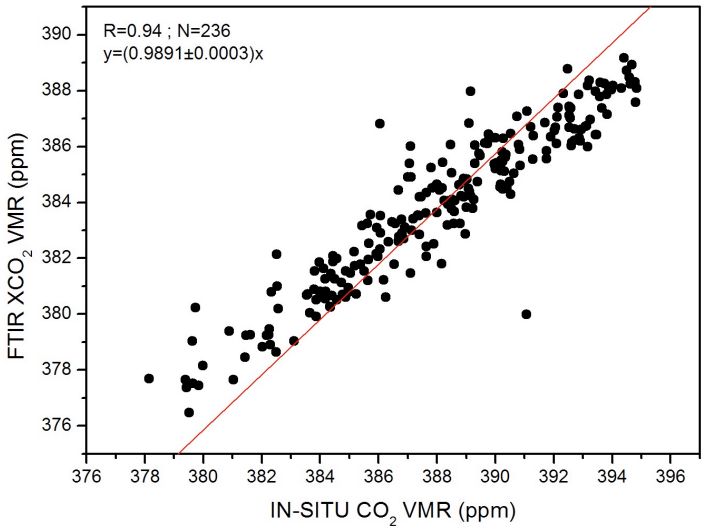

FIGURE 3. Correlation plot between retrieved FTIR XCO_2 and in-situ CO_2.

Karlsruhe – GFIT vs. PROFFIT

For Karlsruhe we compare the two different fitting algorithms GFIT and PROFFIT. Figure 4 shows the daily mean XCO_2 FTIR-measurements at Karlsruhe site from April 2010 to March 2012 analyzed with PROFFIT and GFIT. The seasonal cycle is clearly visible and the bias between the two algorithms is very low. Figure 5 shows the correlation plot between the XCO_2 values for PROFFIT and GFIT. We see a very good agreement with a standard deviation of ~0.25 ppm and a bias of ~0.05%.

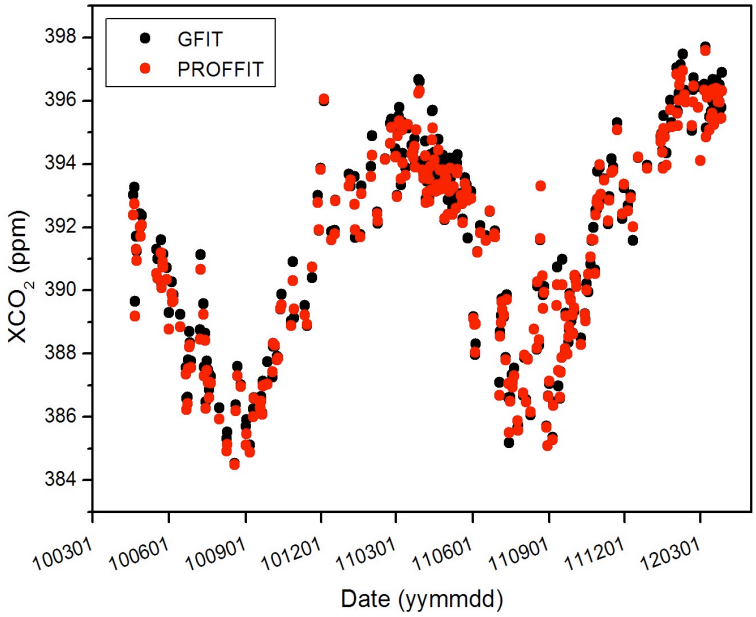

FIGURE 4. Daily mean XCO_2 FTIR measurements at Karlsruhe analyzed with GFIT and PROFFIT.

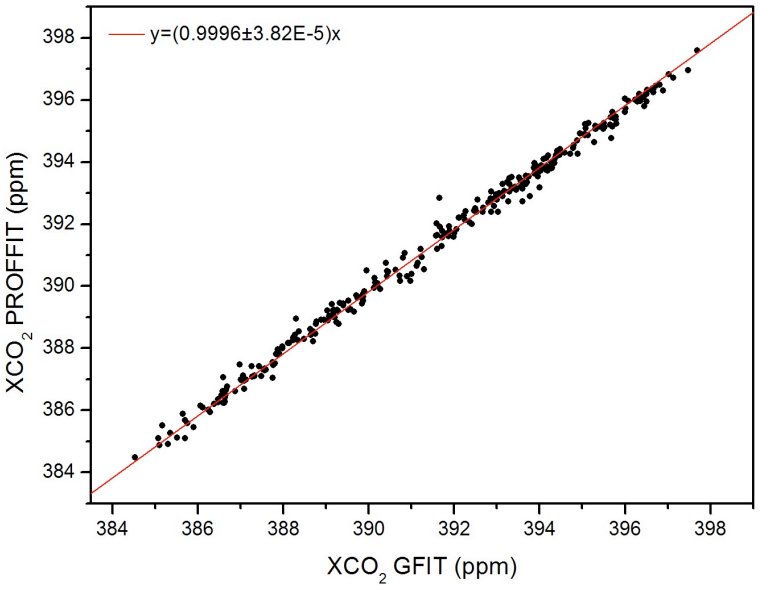

FIGURE 5. Correlation plot between the XCO_2 values for GFIT and PROFFIT.

CONCLUSIONS

In this study we presented the FTIR CO_2 VMR values at the TCCON sites Izaña and Karlsruhe. In both cases, the seasonal cycle of CO_2 is clearly visible. For Izaña we compared FTIR retrieval results with collocated simultaneous in-situ measurements. There is an excellent agreement between the FTIR and in-situ results with respect to the WMO calibration factor of 0.989. For Karlsruhe we applied two different radiative transfer and retrieval algorithms (GFIT and PROFFIT). We see a very good correlation between the results for the two different algorithms.

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