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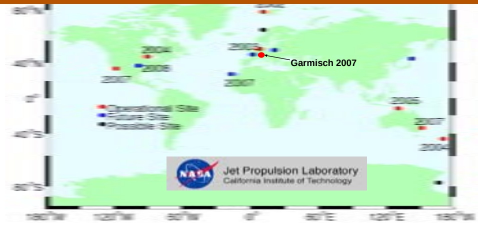

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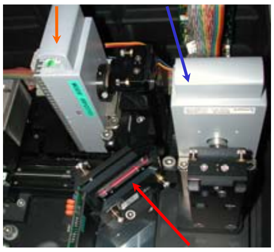
One year of high-precision column measurements of CO_2 and CH_4 derived from near-infrared FTS at the TCCON site Garmisch (47.48 °N, 11.06 °E, 744m a.s.l.)

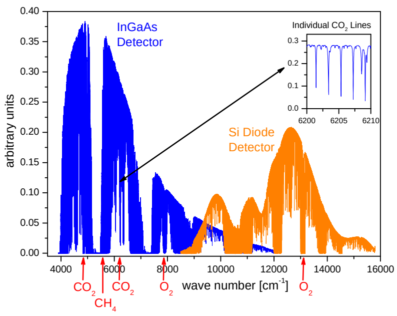
Abstract

Since 2007 at Garmisch, Germany (47.48 °N, 11.06 °E, 744m a.s.l.) a Bruker IFS125 HR near-infrared Fourier-Transform-Spectrometer is operated as part of the Total Carbon Column Observing Network (TCCON; http://www.tccon.caltech.edu). Solar absorption spectra in the wave number range 4000 - 16 000 cm^{-1} are recorded continuously during clear sky conditions using dual acquisition from an InGaAs detector and a Si diode. From these spectra, accurate and precise column-averaged mixing ratios of CO_2 and CH_4 are retrieved using measured column ratios CO_2/O_2 and CH_4/O_2. These observations will be used to validate measurements of the NASA Orbiting Carbon Observatory (OCO) satellite mission and will also provide input data for the inverse modeling of sources and sinks of these Kyoto gases. Due to the high atmospheric background columns of CO_2 and CH_4 a single-column-measurement precision of better than 0.1% is required to be able to detect the relatively small effects from the sources and sinks of these species. This paper describes the observatory set up and shows an analysis of the first year of measurement data with a focus on quality control, and on annual as well as diurnal cycles of CO_2/O_2 and CH_4/O_2.

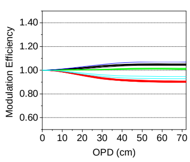
TCCON adaptations:

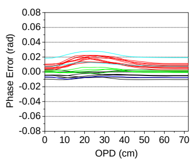
Detectors (Bruker D429/B) & (Bruker D510/B)





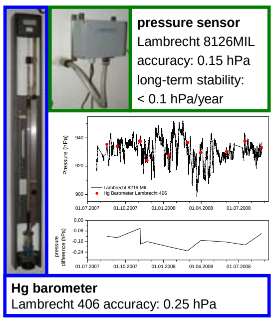
HCl Cell





The ILS is permanently monitored using a HCl cell in the solar beam.

Pressure sensors



Solartracker

New Bruker solar tracker A547N with improved tracking accuracy of +/- 2 min of arc (0.6 mrad)

Time sync

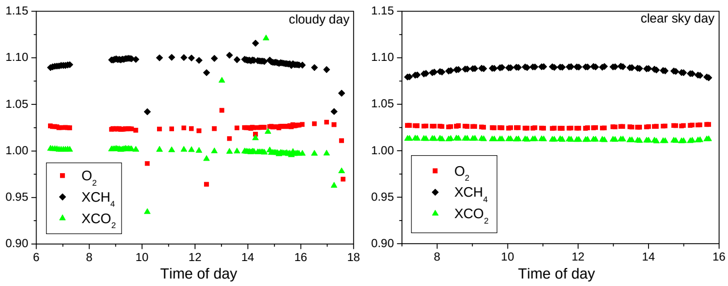
Synchronization of PC-clock by a Hopf 6038 GPS receiver to +/- 1µs

To achieve a single-column-measurement precision of better than 0.1% accurate solar tracking, surface pressure measurements and time synchronization are required.

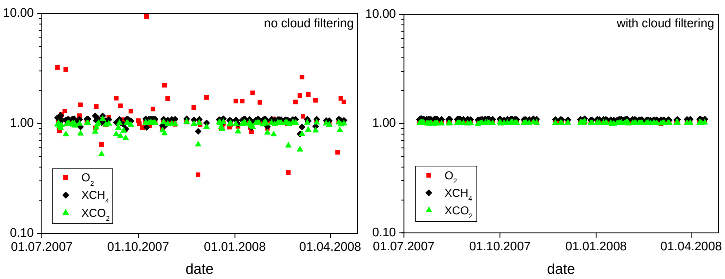
GFIT retrieval results:

The nonlinear least squares profile scaling algorithm (GFIT) is used to retrieve CO_2, CH_4, O_2 column densities. The O_2 retrieval is used to convert the column densities to pressure-weighted column average mixing ratios.

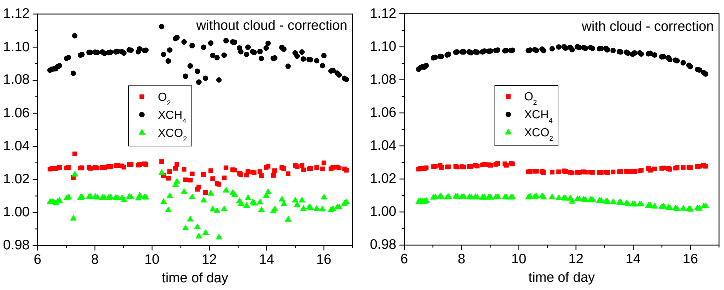
Diurnal variation: cloudy day compared to clear sky day



DC filtering: use InGaAs igram instead of quadrant diode

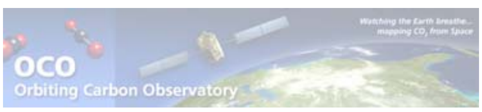


DC correction: implemented igram-smoothing without fft



TCCON provides an essential validation resource:

The TCCON site Garmisch will provide ground-based validation and calibration for upcoming space-based instruments, such as the Orbiting Carbon Observatory (OCO) and Greenhouse Gases Observing Satellite (GOSAT).



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