Application: ATMO-TNA-3--0000000051

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ATMO-ACCESS Third call for Trans-National Access

Scientific activity report

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ATMO-ACCESS Scientific Activity report

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Field of activity: *(ENV-ATMO - Earth and environmental sciences/Atmospheric domain, ENV-HYDRO - Earth and environmental sciences/Hydrosphere domain, ENV-LITHO - Earth and environmental sciences/Lithosphere, ENV-ECOBIO - Earth and environmental sciences/Eco-biosphere, PHY - Physics astronomy, astrophysics, CHEM - Chemistry, BIO-MED - Biological, medical sciences and biotechnology, ENG-TECH - Engineering and technology, EGY - Energy, ART - Humanities and arts, ISC - Information science and communication, SOC - Social sciences, MS - Material sciences, MATH - Mathematics)*

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Executive summary

We are using a portable EM27/SUN spectrometer of the Collaborative Carbon Column Observing Network (COCCON)[1] which is dedicated as a Travel Standard for the Total Carbon Column Observing Network (TCCON) [2] to compare TCCON site world wide to a common reference which is located in Karlsruhe.
In the framework of this project, the TCCON site at Izaña was visited. There, we collected 11 days of side-by-side measurements.

Scientific objectives

The objective is to validate the site-to-site biases of TCCON stations worldwide. This is done by using a portable EM27/SUN FTIR spectrometer as a Traveling Standard which visits several TCCON sites.

Reason for choosing station/ infrastructure

The IzañaTCCON site is of special interest for two reasons:
The first is its high altitude: Due to the low surface pressure, the air is less humid. This causes less disturbing absorption H2O absorption lines in the range of other species. Current FTIR retrieval results need to be empirically corrected at large solar zenith angles due to less accurate spectroscopic data. These empirical corrections are derived at approximately sea level. Therefore, it is of special interest to see, if the corrections are valid at high altitudes as well.
Second, the Izañasite can be regarded as a background site (little air pollution due to less industry and land mass around the site). Hence, the measurements there are important to validate the background GHG concentrations in the atmosphere.

Activities during the TNA (research, training, events, ...)

We conducted a online training for the on-site personal on how to use and set up the Travel Standard (TS).
After this the TS was controlled remotely, by the on-site personal as well as remote from Karlsruhe.

Method and experimental set-up

We are using ground-based solar-viewing FTIR-spectrometers to measure the concentration of greenhouse-gases in the atmosphere.
The experimental set-up used here is a side-by-side measurement of two different spectrometers: The stationary TCCON spectrometer at the Izaña site and the portable low-resolution EM27/SUN spectrometer used as the COCCON Travel Standard.
During the side-by-side measurements the TCCON spectrometer collected high-resolution measurements with its standard spectral resolution of 0.02cm^-1 as well as low-resolution measurements with a spectral resolution of 0.5cm^-1, which matches the resolution of the EM27/SUN. This is done as the resolution influences the retrieved gas concentration.

Preliminary results and conclusions

As preliminary results, for the high-resolution data, we found a relative deviation to the Karlsruhe reference site of -0.03 % for XCO2, -0.023% for XCH4. Both are within the expected site-to-site error of the TCCON which is 0.1% for XCO2, 0.27% for XCH4 [2].
For the low-resolution data, we found deviations of 0.057% for XCO2, and 0.0176% for XCH4.
For XCO we found deviations of -4.05% for the high-resolution data and -7.33% for the low-resolution data. The expected TCCON site-to-site error for XCO is 8.1%.

Outcome and future studies

Future studies will give a broader range of TCCON sites, which can be used to compare the Izaña TCCON site.

References

[1] M. Frey et. al 2019: "Building the COllaborative Carbon Column Observing Network (COCCON): long-term stability and ensemble performance of the EM27/SUN Fourier transform spectrometer", AMT

[2] Laughner et. al 2023: "The Total Carbon Column Observing Network's GGG2020 Data Version", preprint at ESSD.

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