



# Equatorial measurements in the Total Carbon Column Observing Network (TCCON)

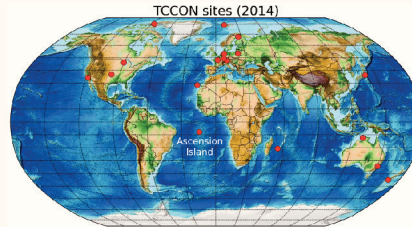
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## Motivation

Total column measurements from satellites have become more and more important for deriving sources and sinks of major greenhouse gases. However, these satellite measurements cannot be validated with the existing in situ network. Therefore, the Total Carbon Column Observing Network (TCCON) was started 10 years ago to provide the most accurate total-column reference measurements of CO<sub>2</sub> and other greenhouse gases. TCCON has grown to a network of about 20 stations. Still, most of them are in the Northern Hemisphere. To improve the poor coverage in the tropics, MPI-BGC installed a TCCON station strategically located between the poorly sampled continents Africa and South America.

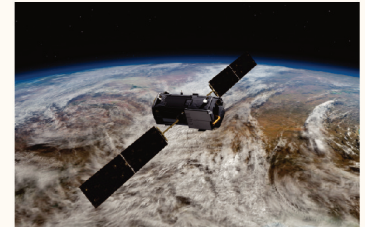
## TCCON

A network of ground-based stations that measures total columns of major greenhouse gases. MPI-BGC runs the only equatorial TCCON station on Ascension Island.



## Satellite calibration/validation

TCCON provides the only reference for GHG observing satellites like GOSAT or OCO-2. Ascension Island is the key validation site for ocean (sun glint) measurements.

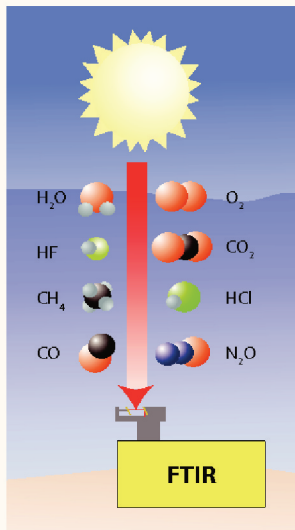


## Ground based total column measurements

Satellites measure the total column which is difficult to compare to surface in situ measurements.

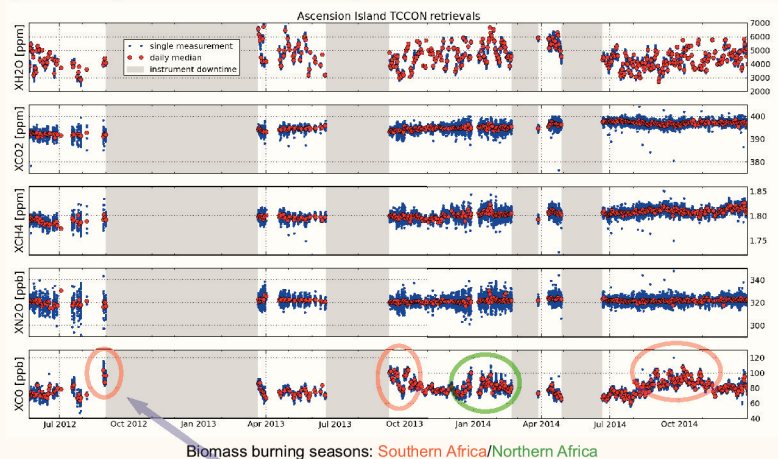
To measure total columns from the ground, one looks at sunlight that has passed through the whole atmosphere. The solar spectrum is then analyzed with a Fourier-Transform Infrared (FTIR) spectrometer. The trace gas molecules absorb the sunlight in a characteristic way. The FTIR instrument combines high resolution with large bandwidth. It allows measuring many species with high precision simultaneously.

The result is column-averaged dry-air mole fraction of a gas (also called Xgas).



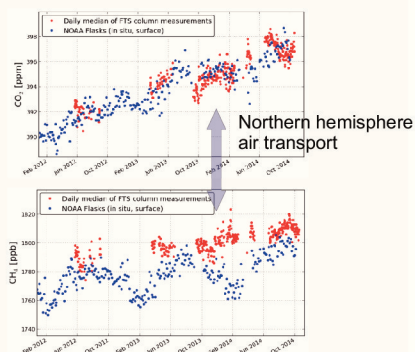
## First equatorial time series of XH2O, XCO2, HCH4, XN2O, and XCO

Despite severe technical problems due to the rough environment, Ascension Island has provided total-column greenhouse gas measurements since May 2012.



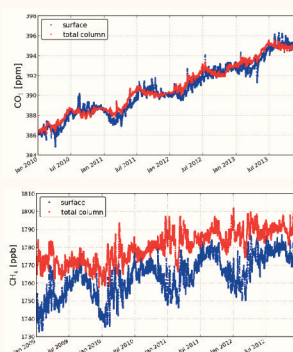
## Complimentary total column and in situ measurements for CO<sub>2</sub> and CH<sub>4</sub>

Total column measurements provide a complimentary view on the atmosphere. Seasonal enhancements in column values vs. in situ are likely due to transport of northern hemisphere air masses above the PBL.



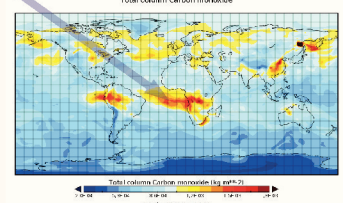
## Corresponding seasonal signals in modeled CO<sub>2</sub> and CH<sub>4</sub>

Modeled surface and total column values show a similar behavior as the measured time series. The total column/in situ difference can be used to validate the transport models as soon as there is enough data overlap.



## Biomass burning signals from CO

The largest measured variations are in XCO. Some events could be mapped to CO plumes in modeled MACC data.



## Conclusions

The TCCON station Ascension Island provides the first equatorial measurements of total-column greenhouse gases. It is also a key site for satellite validation. Besides biomass burning events, the measurements also reveal interhemispheric transport at altitudes far above the range of in situ measurements.



More information:

<https://www.bgc-jena.mpg.de/bgc-systems/pmwiki2/pmwiki.php/ARS/Facilities>

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