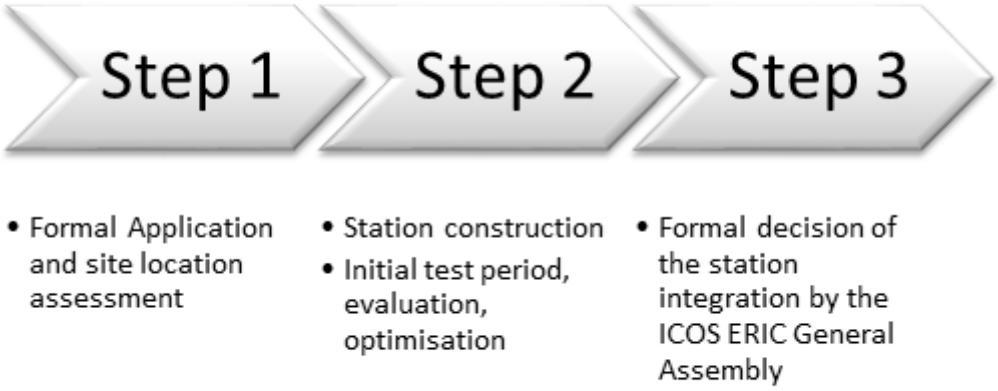
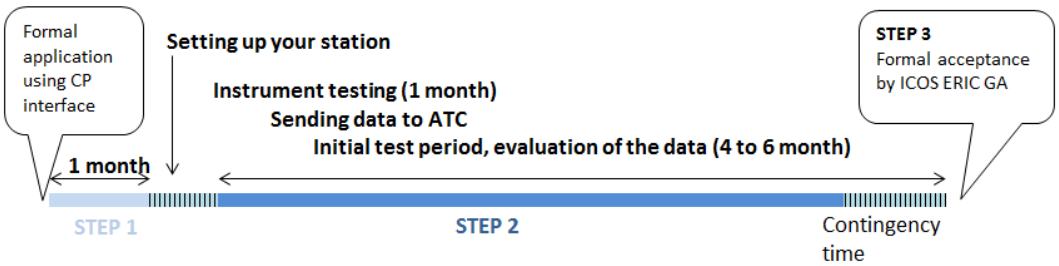
Executive summary of ICOS ATC Step 2 labelling report for the ICOS class 1 station Hohenpeissenberg

Executive summary n°: ATC-DE-LA-ES-009-1.0

This document is an executive summary of the ICOS ATC Step 2 labelling report for ICOS class 1 station Hohenpeissenberg (HPB).

A candidate atmospheric station officially becomes ICOS when it receives the ICOS label. The ICOS Station Labelling is a 3 step process summarized in the graphs below.





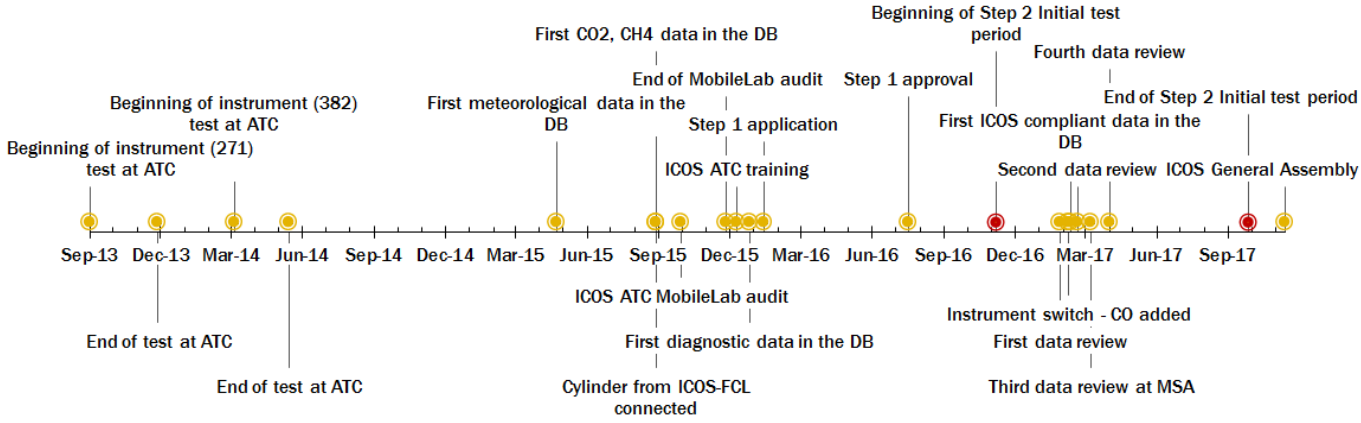
Once the data flow from the station to the ATC is in place, a phase of measurement optimization starts, the so called initial test period. This is done in close collaboration between the station PI and the ATC. This period typically lasts 4 to 6 months to gather enough time-statistics. The period can be prolonged if need be.

During the initial test period, the following metrics have been thoroughly investigated to make sure the measurements were meeting the ICOS specifications and quality standards required:

- Amount of data quality control and validation
- Time of actual measurement vs calibrations
- Optimized stabilization time to flush the sampling system
- Calibration drift and quality control

- Temperature dependence of the instruments
- Meteorological measurements
- Target gas measurements
- Diagnostic parameters
- Measurements uncertainties

The graph below shows the station installation and operation timeline relevant to the ICOS Atmosphere labelling process.



Hohenpeissenberg is providing ICOS specifications compatible data since 2017-02-15.

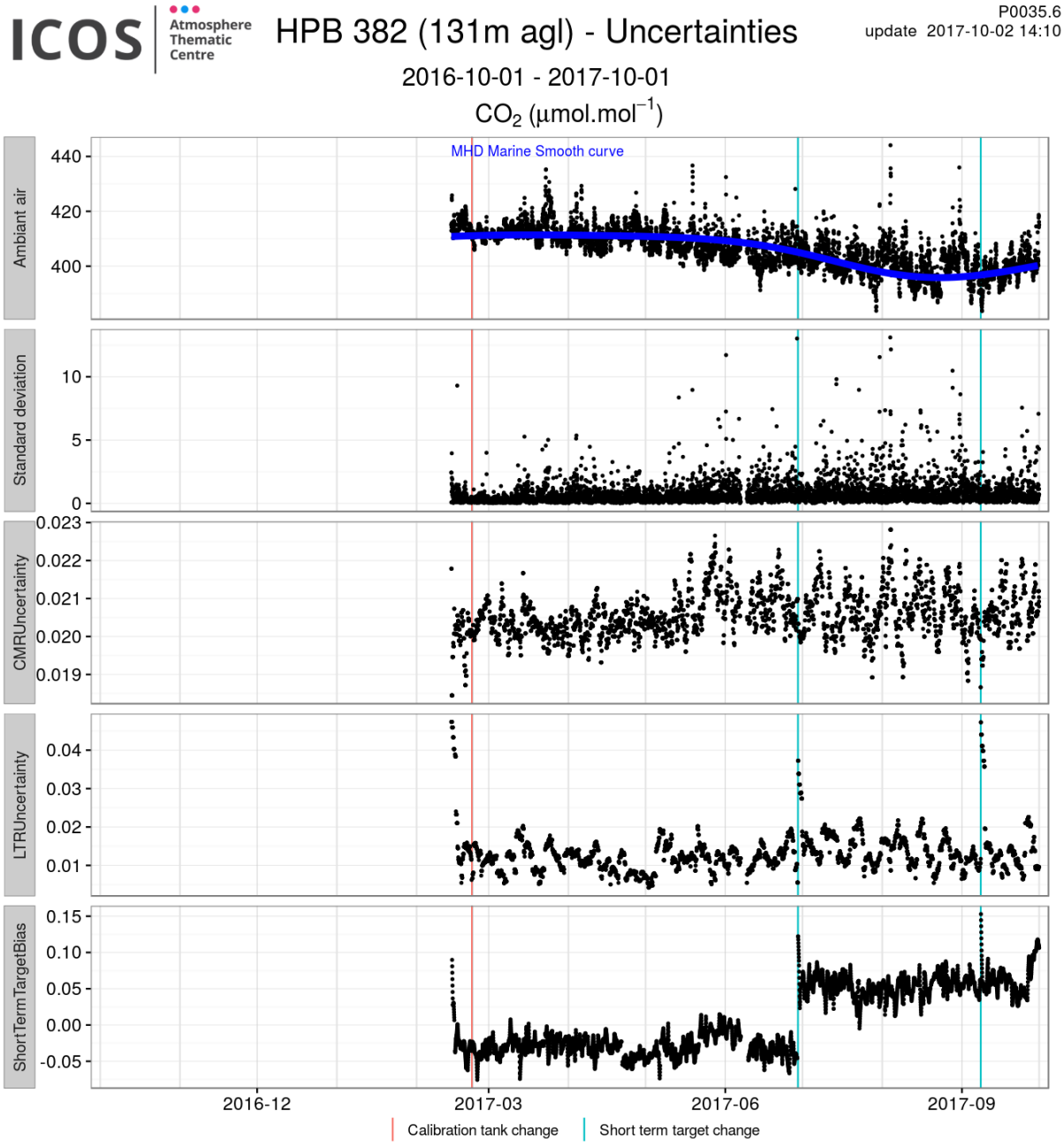
During the initial test period, the data quality has been improved thanks to the collaboration between the PIs and the MLab.

Before the the initial test period, the inlet pressure had been as low as 400mbar and was not as stable as wished. The stability of the flushing flow rate and the instrument inlet pressure have been improved during the testing period.

At the end of the labelling step 2 initial test period, the following recommendations have been made to the station PIs:

- (***, important, -): It is recommended to continue the flagging of raw data on a weekly basis.
- (*, minor, 2017): It is possible to reduce the flushing time for the target to 10 minutes but for the calibration gases keep 15 minutes. Target measurement can be reduced to 25 minutes and calibration gases measurement should stay at 30 minutes.
- (*, minor, 2017): The calibration frequency should be kept at one every 15 days.
- (*, minor, 2017): It is possible to reduce to three calibration cycles instead of four. The first cycle must be rejected for stabilization.
- (**,important, 2018): The calibration set calibrated on a GC should be recalibrated on the reference instrumments (Picarro and LGR) in order to try to understand the biases observed in CO_2 and CO.
- (*, minor, 2017): The pressure of target, reference and calibration gas should be adjusted to get slightly above the ambient air value.
- (***, critical, 2017): We recommend to perform the mandatory testing of the sampling system integrity (twice a year) as soon as possible to complete quality control strategy.

The following graphs presents on the first panel the data, CO_2, CH_4 and CO respectively on each graph, of the station for the period relevant to the ICOS labelling. The four panels below the first one provide the associated uncertainties for different time scales (see glossary for detailed definitions)



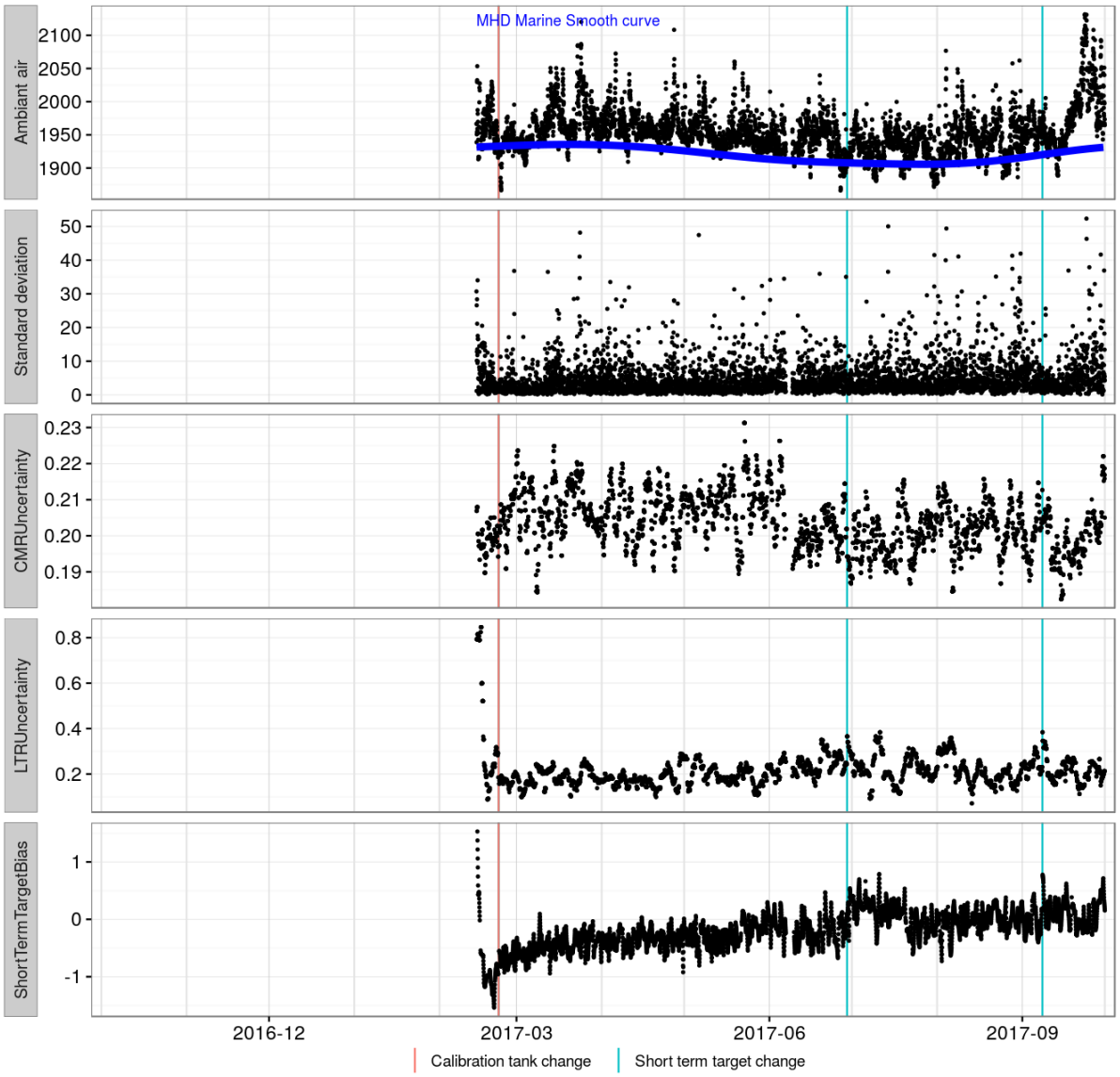
ICOS Atmosphere Thematic Centre

HPB 382 (131m agl) - Uncertainties

P0035.6
update 2017-10-02 14:10

2016-10-01 - 2017-10-01

CH_4 (nmol.mol^{-1})



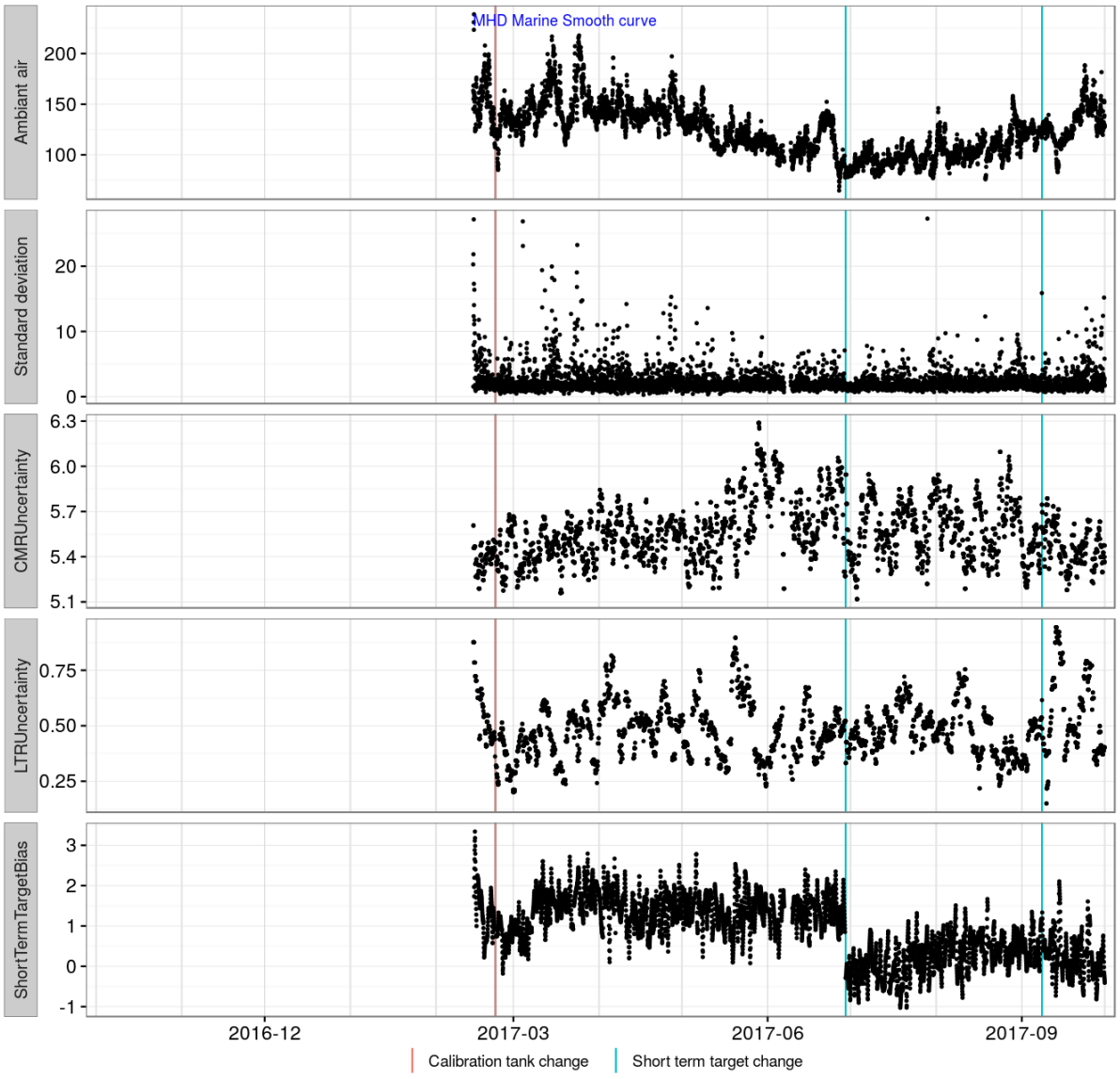
ICOS Atmosphere Thematic Centre

HPB 382 (131m agl) - Uncertainties

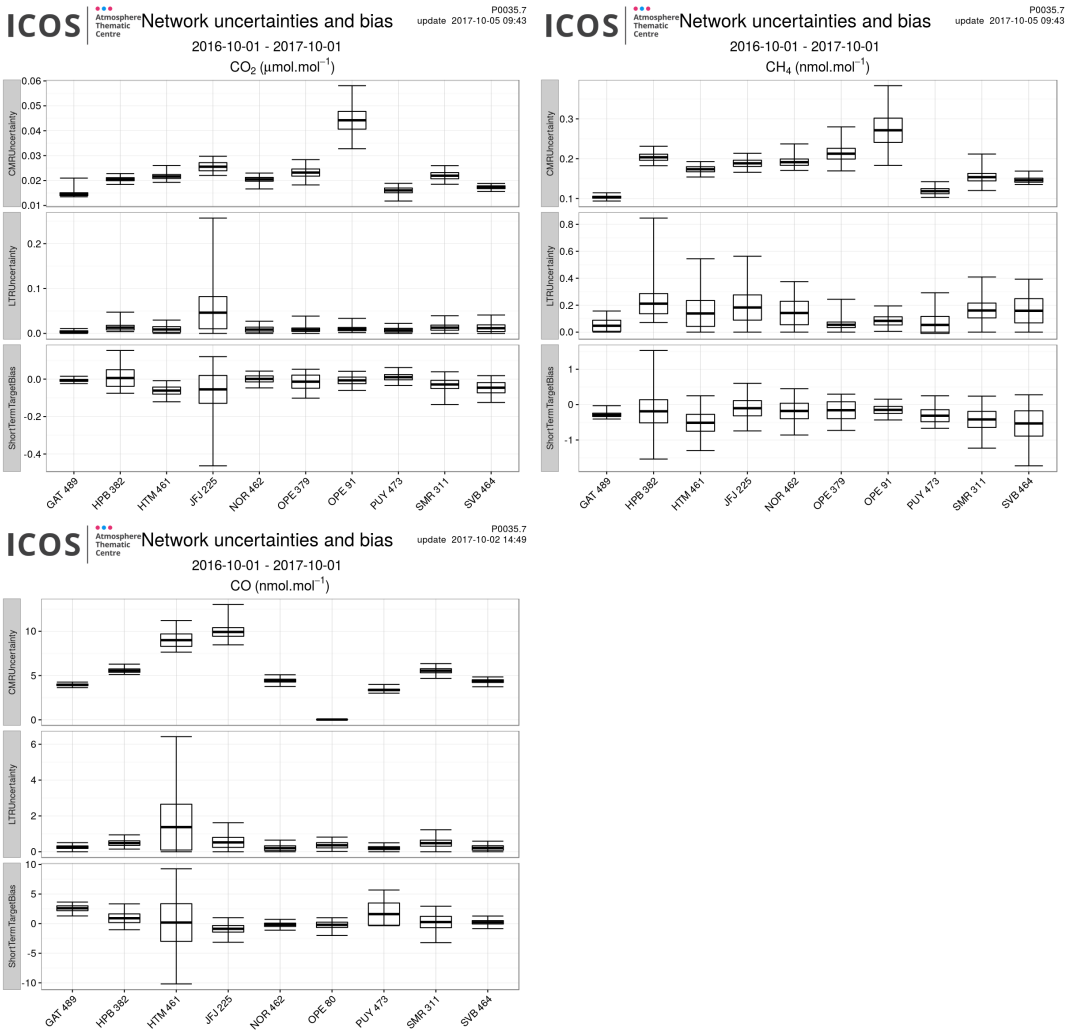
P0035.6
update 2017-10-02 14:10

2016-10-01 - 2017-10-01

CO (nmol.mol^{-1})



The figure below shows a summary of the uncertainties linked to the measurements put in perspective with the other candidate or actual ICOS stations.



Based on the data provided during the initial test period, we recommend that the Hohenpeissenberg station (HPB) is labelled as part of the ICOS Atmospheric Network.

For more information, you can consult these documents:

ID	Associated documents	Reference
AD1	ICOS atmospheric station specifications	ATC-GN-GN-SP-1.28
AD2	ICOS step 1 report	ATC-DE-LA-RP-001-1.0
AD3	ICOS ATC Metrology Laboratory Evaluation report for the ICOS instrument 382	ATC-ML-IT-RP-14-2.0
AD4	ICOS ATC MobileLab Audit report	ATC-MOL-AU-RP-004-1.3
AD5	ICOS ATC Step 2 labelling report for the ICOS station HPB	ATC-DE-LA-RP-009-1.0
AD6	ICOS ATC station website	https://icos-atc.lsce.ipsl.fr/HPB

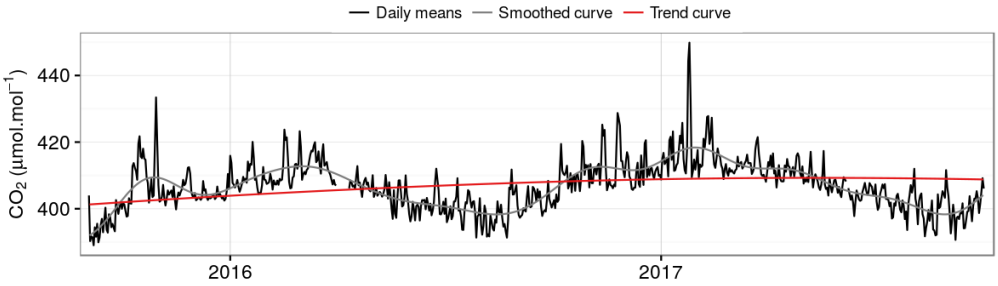
The next page aims at giving a first partial identity card to the actual station measurments. From top to bottom is shown:

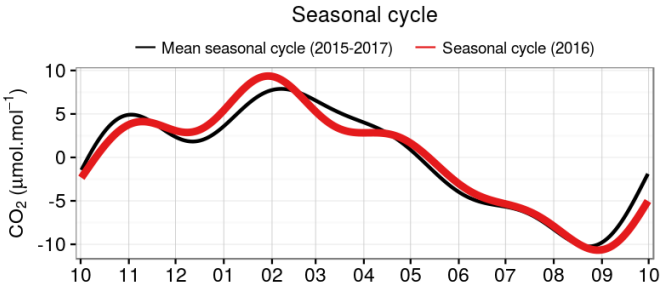
- Site photo + station general name/location information
- CO_2 daily measurements overlaid with linear trend and seasonal cycle
- Seasonal cycle, diurnal cycle and vertical profiles (by seasons)
- Hourly standard deviation together with a wind rose of CO_2 residuals. These graphs are a measure of the importance of local sources and an indication of averaged direction of potential strong sources/sinks of CO_2

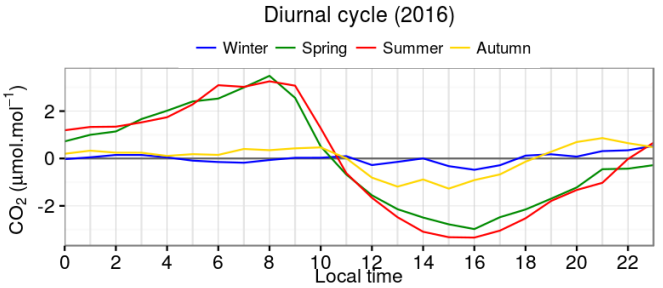
ICOS National Network Germany

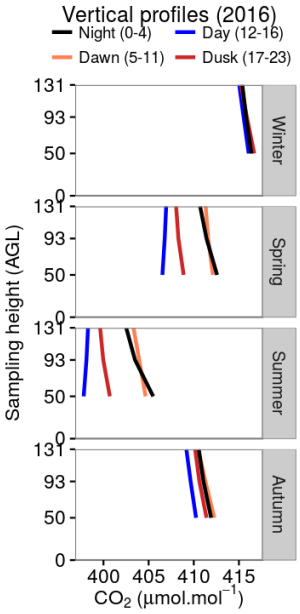
Hohenpeissenberg (HPB), Germany - CO_2

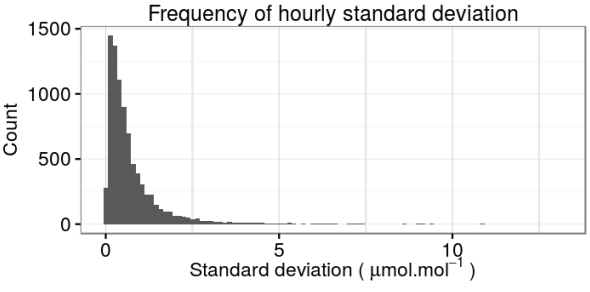
47.8011°N - 11.0246°W, 934m ASL (131m AGL)

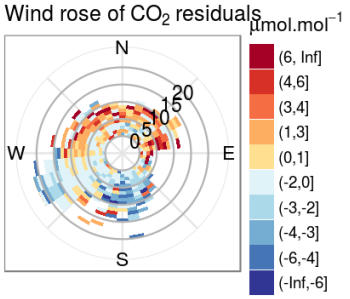












List of abbreviations and glossary (by alphabetical order)

ATC: Atmospheric Thematic Center

CMR: Continuous Measurement Reproductibility

CP: Carbon Portal

ICOS: Integrated Carbon Observation System

ICOS-FCL: ICOS Flask and Calibration Laboratory

LTR: Long-Term Repeatability

Calibration: As detailed in the ICOS specifications, three to four standard gases (known concentrations calibrated at the ICOS-FCL) are measured one after the other at least four times for 30 min each calibration sequence (each set of the three to four cylinders measurement is hereafter called a cycle). Usually the first cycle is used to flush the calibration lines. Then the calibration function using a linear fit is calculated.

CMR: In the MLab, the continuous measurement repeatability is evaluated with the standard deviation of the continuous measurements of a cylinder over 24 hours. Using the station data, the CMR is calculated using regular but not continuous measurements of the short term target gas. We calculate the moving monthly average of the standard deviations of raw data over 1 min intervals.

Long term target: gas with known concentrations (calibrated at the ICOS-FCL) that is measured on a monthly basis to insure data quality continuity through the different short term target changes

LTR: In the MLab, a target gas is measured for 30 min bracketed by around 5 hours of wet ambient air over 72 hours of total measurements. For each measure, only the last 10 min are averaged. The long-term repeatability is then expressed through the standard deviation of these averaged measures. Using the station data, we calculate the moving standard deviation of the averaged short term target measurement intervals over 3 days as in the MLab.

Short term target: gas with known concentrations (calibrated at the ICOS-FCL) that is measured frequently (two to three times a day) to follow short term instrument variability.

Short term target bias: difference between the short term target injection average and its assigned value.