

Name of research institute or organization:

Climate and Environmental Division, Physics Institute, University of Bern

Title of project:

High precision carbon dioxide and oxygen measurements at Jungfraujoch

Project leader and team:

Prof. Dr. Markus Leuenberger, project leader

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Project description:

In 2012 the combined online CO₂ and O₂ measurements at Jungfraujoch, which had been initiated in late 2004 at Jungfraujoch, were continued. Long-term changes in CO₂ and O₂ contents in the atmosphere were calculated from hourly averages of night time data (2am to 6am) to assure that only background values are considered. The thick line corresponds to a two harmonic spline calculation that was applied to the data for which values beyond 2.7 σ were excluded. This means that, if the data is normally distributed, 99% of the data points were kept for further calculation. This procedure was repeated until convergence. With the remaining values the trends and seasonality of the CO₂ and O₂ change were calculated. CO₂ increases at a rate of 1.94 ± 0.01 ppm / yr, O₂ and APO decreases at a rate of -26.6 ± 0.2 per meg / and of -16.4 ± 0.2 per meg / yr respectively, in which the uncertainty is the error of the linear component of the fit. The accuracy and precision of the oxygen and APO decrease rates are less robust and should be taken with care due to increasing variability of the analyser during 2011 and 2012. A replacement of the oxygen paramagnetic cell is planned for 2013.

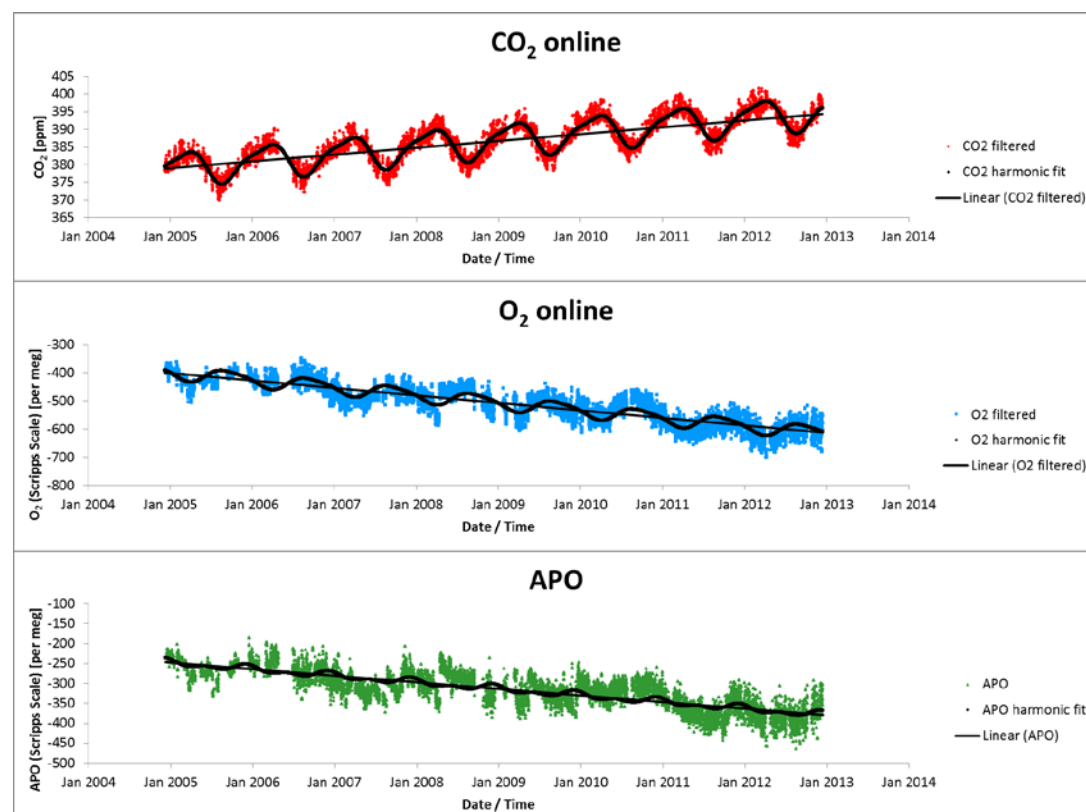


Figure 1: Filtered CO₂ (red), O₂ (blue) and APO (green) values at Jungfraujoch with linear and harmonic fits.



Figure 1: Seasonalities at Jungfraujoch for CO₂ in 2012 (red) and averaged since 2005 (orange) first panel; for O₂ in 2012 (blue) and averaged (turquoise) second panel; for APO in 2012 (green) and averaged (lime) third panel.

The seasonal changes of CO₂ and O₂ are shown in Figure 2. These were calculated by subtracting the long-term mean as well as the linear trends from the original data. There is generally a good agreement from year to year for the CO₂ seasonality as documented by the upper panel. The situation is different for O₂ and APO as obvious from the middle and lower panel. The variability of seasonal amplitudes is large for our O₂ measurements. Part of which has to do with the larger uncertainty of O₂ measurements.

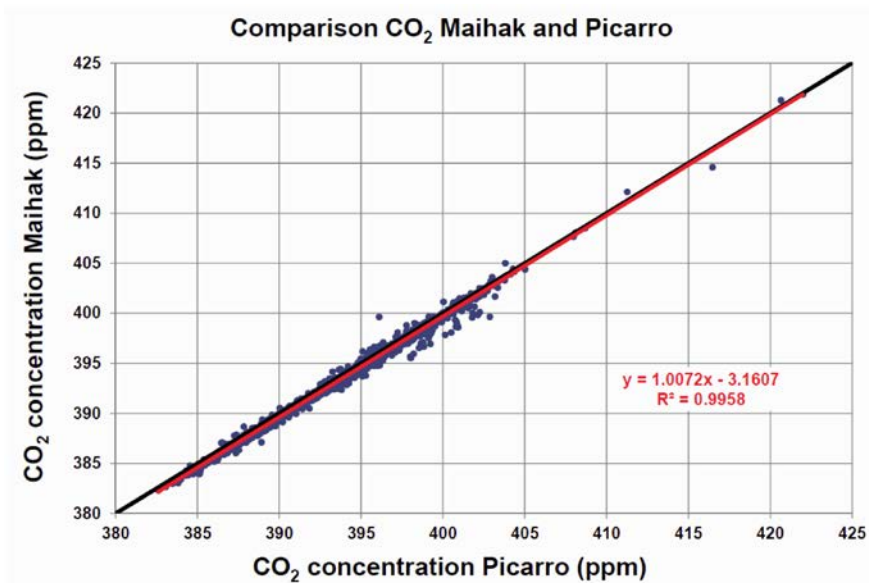


Figure 3: Plot of the Maihak data versus the Picarro data. The indicated fit equation is based on all data.

The comparison between the CO₂ measurements performed by Empa and ours was continued. The agreement is good as documented in Figure 3. As agreed we will focus on a technical publication regarding this CO₂ intercomparison at Jungfraujoch in 2013. The responsibility of the continuous CO₂ measurements will be moved from the University of Bern (Climate and Environmental Physics Division) to Empa according to the agreement made between the Swiss GCOS office, the Empa and the University of Bern.

Key words:

Greenhouse gas, climate change, CO₂ emissions

Internet data bases:

The Jungfraujoch data can be downloaded from our homepage (http://www.climate.unibe.ch/?L1=research&L2=atm_gases) or from the WMO GAW: World Data Centre for Greenhouse Gases (<http://ds.data.jma.go.jp/gmd/wdcgg/cgi-bin/wdcgg/accessdata.cgi?index=JFJ646N00-KUP&select=inventory>; 182 times since 1.3.2011)

Collaborating partners/networks:

IMECC partners, Swiss GCOS office, EMPA

Scientific publications and public outreach 2012:

Refereed journal articles and their internet access

van der Laan-Luijkx, I.T., S. van der Laan, C. Uglietti, M.F. Schibig, R.E.M. Neubert, H.A.J. Meijer, W.A. Brand, A. Jordan, J.M. Richter, M. Rothe, and **M.C. Leuenberger**, Atmospheric CO₂, δ(O₂/N₂) and δ¹³CO₂ measurements at Jungfraujoch, Switzerland: results from a flask sampling intercomparison program, *Atmos. Meas. Tech. Discuss.*, 5, 7293-7322, doi:10.5194/amtd-5-7293-2012, 2012.
<http://www.atmos-meas-tech-discuss.net/5/7293/2012/>

Data books and reports

Leuenberger M., S. van der Laan, I.T. van der Laan-Luijkx, M.F. Schibig, Comparison of continuous in-situ CO₂ observations at Jungfraujoch using two different measurement techniques, Third GCOS interim report, 2012.

Leuenberger M., WMO World Data Centre for Greenhouse Gases, c/o Japan Meteorological Agency 1-3-4, Otemachi, Chiyoda-ku Tokyo 100-8122, Japan, CO₂ Data from Jungfraujoch (downloaded 182 times since 1.3.2011).

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