

Name of research institute or organization:

**Centre for Isotope Research (CIO), Groningen**

Title of project:

Flask comparison on Jungfraujoch

Project leader and team:

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Project description:

The European project IMECC (Infrastructure for Measurements of the European Carbon Cycle) was finished last year. This project included an activity called Transnational Access activity (TA). It was designed to broaden and improve access to European Carbon Cycle measurement facilities. One of these facilities is the Research Station at Jungfraujoch. CIO Groningen had submitted a proposal to get access to this research station which was approved in 2009. The goal behind this TA activity is to compare combined flask takings in regard to CO<sub>2</sub> and O<sub>2</sub> concentrations at Jungfraujoch. Parallel flask samples are taken for CIO Groningen (Netherlands) and MPI-BGC Jena (Germany), in order to check the consistency of CO<sub>2</sub> and O<sub>2</sub> measurements.

As summarized in van der Laan-Luijkx et al., [2012], the results were well comparable for CO<sub>2</sub> regarding both the trend as well as the amplitude.

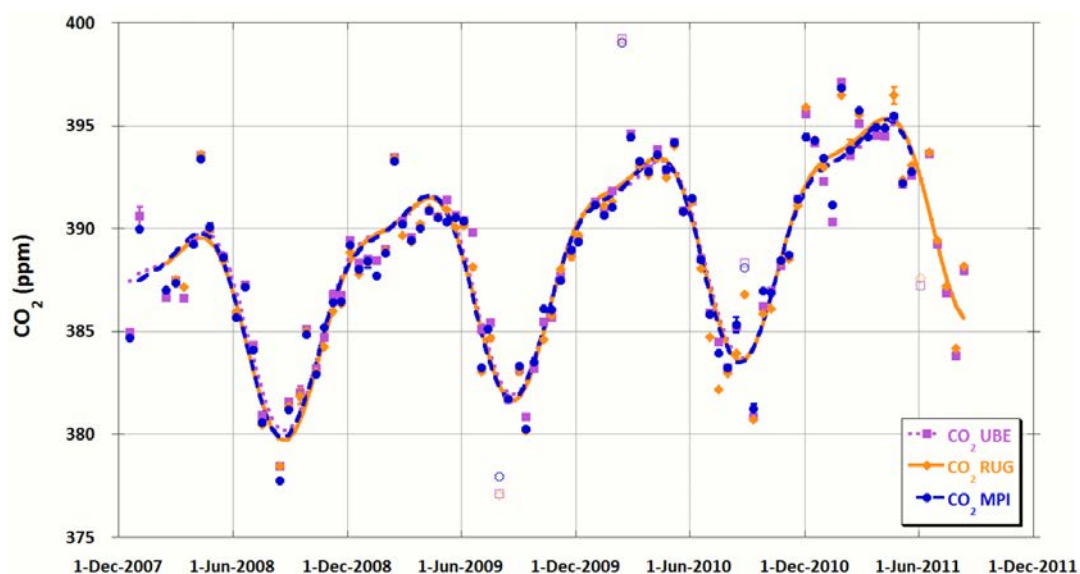


Figure 1: CO<sub>2</sub> concentration at Jungfraujoch, Switzerland from flask samples measured by three laboratories: University of Bern (UBE) (pink squares), University of Groningen (RUG) (orange diamonds) and Max Planck Institute in Jena (MPI) (blue circles). The values are the averages of 1, 2 or 3 flasks. The fits through the data are linear trends and double harmonic seasonal components. Open symbols represent those values that are outliers to the fit of the individual data set. The error bars represent the standard error of the average value of 2 or 3 flasks. For single flask measurements error bars are not shown.

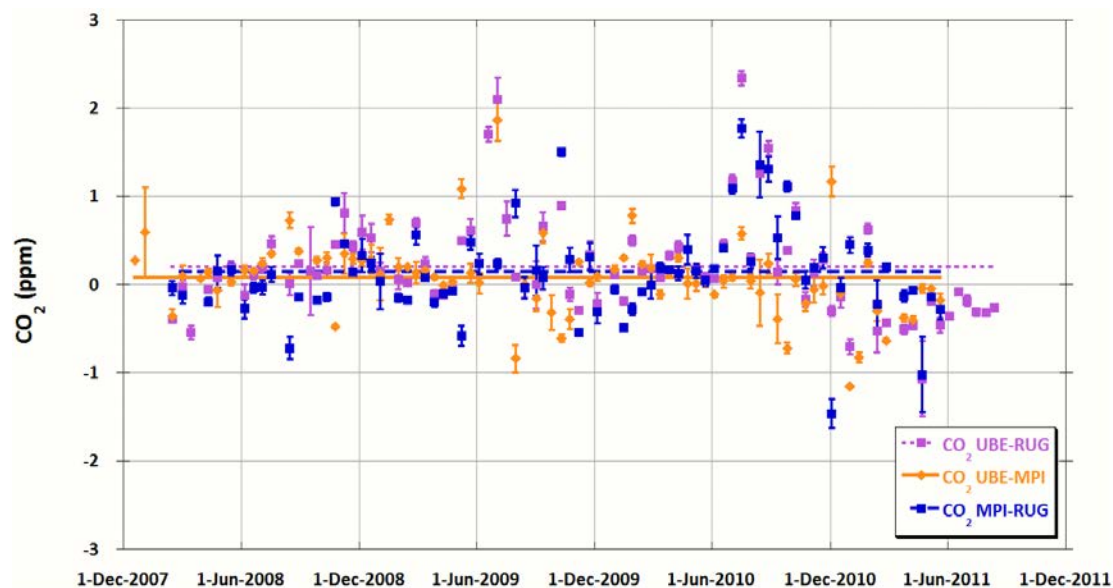


Figure 2: Differences of the  $\text{CO}_2$  concentration measured by each set of two laboratories. Also indicated are the average differences. These are: 0.20 ppm for UBE-RUG, 0.08 ppm for UBE-MPI and 0.14 ppm for MPI-RUG. The error bars represent the quadratically added standard errors of the measurements of the two laboratories.

It is obvious from Figure 1, that the agreement for the  $\text{CO}_2$  concentration is fairly good with a mean offset between the laboratories of around 0.2 ppm, Bern values being higher. Even high values (regional or local contamination) deviating significantly from the background values are in rather good agreement (Figure 2). The largest deviations are about 2 ppm in absolute.

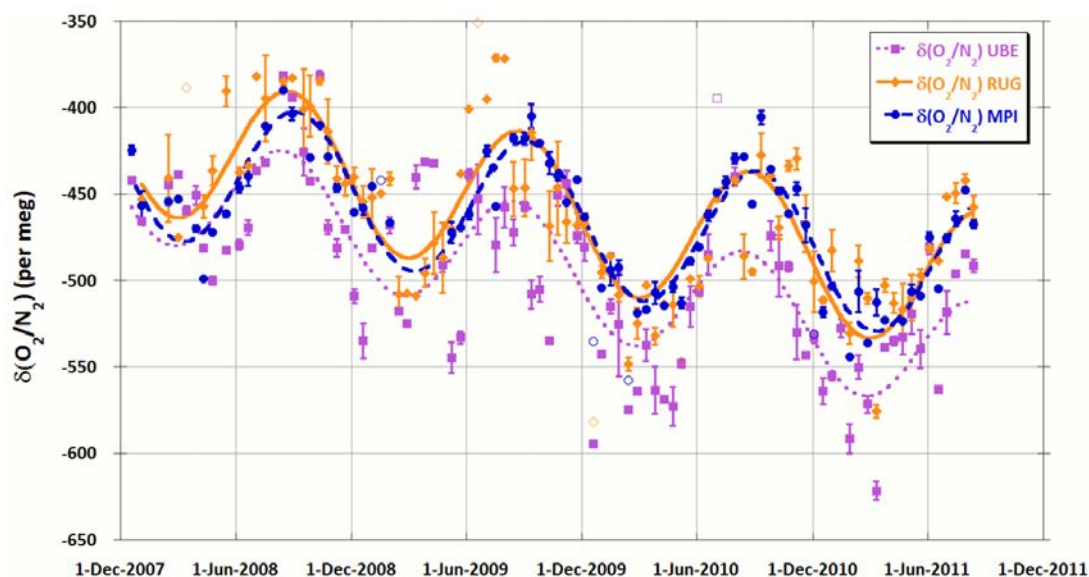


Figure 3:  $(\text{O}_2/\text{N}_2)$  observations from Jungfraujoch, Switzerland from flask samples measured by three laboratories: UBE (pink squares), RUG (orange diamonds) and MPI (blue circles). The values are the averages of 1, 2 or 3 flasks. The fits through the data are linear trends and single harmonic seasonal components. Open symbols represent those values that are outliers to the fit of the individual data set. The error bars represent the standard error of the average value of 2 or 3 flasks. For single flask measurements error bars are not shown.

The agreement is much less robust for oxygen (Figure 3). The mean difference is small but statistically significant with about 35 permeg, Bern values being lower. However, the variation of the difference between the two labs is high and around 40 permeg. This is

significantly larger than the internal precision of both labs. However, the better agreement between the Max Planck institute in Jena and CIO Groningen point – at least partly – to a measuring deficiency at Bern. Despite the fact that the IMECC project was finished in the meantime, the comparison is still ongoing in order to learn more about the difficulties of flask takings.

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**Key words:**

Flask measurements, inter-comparison, oxygen and carbon dioxide measurements, greenhouse gas

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**Collaborating partners/networks:**

IMECC partners

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**Scientific publications and public outreach 2012:**

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**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 CO<sub>2</sub>, δ(O<sub>2</sub>/N<sub>2</sub>) and δ<sup>13</sup>CO<sub>2</sub> 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/>

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