

Name of research institute or organization:

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**Abteilung für Klima- und Umweltphysik, Physikalisches Institut,  
Universität Bern**

Title of project:

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CarboEurope-IP: Assessment of the European Terrestrial Carbon Balance

Project leader and team

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Luca Valentino, Peter Nyfeler, Hans-Peter Moret

Project description:

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The present concentration of carbon dioxide (CO<sub>2</sub>) in the atmosphere is higher than in the past 420,000 years or maybe even in the past 20 million years, and it continues to rise. The primary causes are fossil fuel combustion and deforestation. Globally, the land biosphere (excluding the part subject to deforestation) takes up 30% of the fossil fuel emissions and thus is presently reducing the speed of anthropogenic climate change. Yet our understanding of this carbon sink, which is mainly located north of the Tropics, its partitioning between Europe, North America, and Asia, its controlling mechanisms and its vulnerability to changes in climate and land management are still uncertain. Coupled climate models indicate that, in the near future, carbon release from existing carbon pools in the biosphere could be large enough to offset any attempts of technical CO<sub>2</sub> emission reduction. Meeting the scientific challenge of establishing the full carbon budget of a continent with acceptable accuracy has also high political relevance because the Kyoto Protocol includes carbon sources and sinks in the terrestrial biosphere.

CarboEurope-IP aims to understand and quantify the present terrestrial carbon balance of Europe and the associated uncertainty at local, regional and continental scale.

The key innovation of the CarboEurope-IP is in its conception as to apply single comprehensive experimental strategy, and its integration into a comprehensive carbon data assimilation framework. The observational and modelling programme will run at unprecedented spatial and temporal resolution. This will allow for the first time a consistent match of bottom-up and top-down estimates of the regional variation in carbon sources and sinks.

The division of Climate and Environmental Physics at the Physics Institute of the University of Bern takes part in CarboEurope-IP through measurements of CO<sub>2</sub>, O<sub>2</sub> and δ<sup>13</sup>C on CO<sub>2</sub> on three flask sites, namely Jungfraujoch (CH), Puy de Dome (F) and Griffin (UK). Continuous records of CO<sub>2</sub> and O<sub>2</sub> have to be analysed at Jungfraujoch combined with flask analyses for δ<sup>13</sup>C whereas at the other two locations only flask samples are determined.

A system for continuous measurements of O<sub>2</sub> and CO<sub>2</sub> was installed at Jungfraujoch Station on December 7, 2004. The CO<sub>2</sub> concentration is measured by a conventional infrared analyser whereas the O<sub>2</sub> concentration is measured with two principles, a paramagnetic technique and a fuel cell technology. The flask analyses are made on dedicated mass spectrometers.

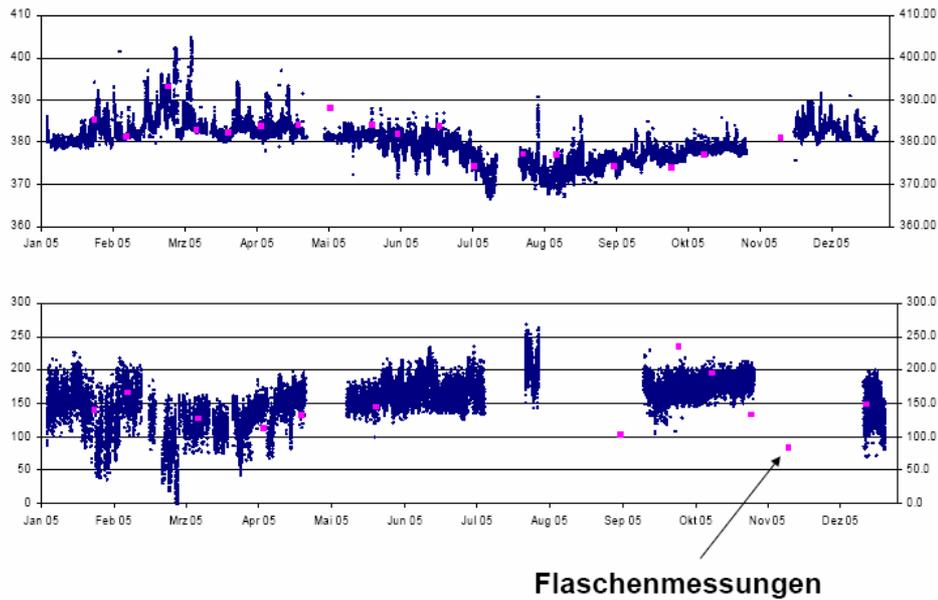


Figure 1: Preliminary continuous CO<sub>2</sub> and O<sub>2</sub> results at Jungfraujoch. The CO<sub>2</sub> concentrations are given in parts per million (ppm) in the upper panel whereas O<sub>2</sub> is given in per meg units in the lower panel. The purple squares show the flask values that were taken during the year 2005.

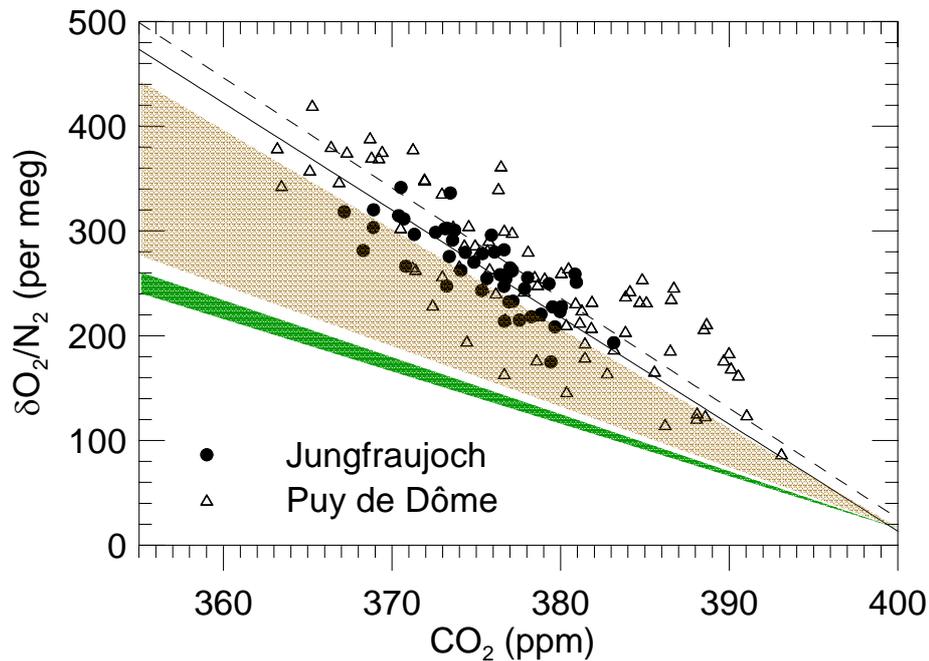


Figure 2: Correlation plot between O<sub>2</sub>/N<sub>2</sub> and CO<sub>2</sub> on flask samples taken at Jungfraujoch (Switzerland) and at Puy de Dôme station (France). The brown area documents the range of oxidation factors for fossil fuel components (coal, oil and natural gas) whereas the green area represents exchanges between atmosphere and the biosphere.

Key words:

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European carbon balance, high precision oxygen measurements, carbon dioxide, isotopes, atmospheric sampling, trace gases

Internet data bases:

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<http://www.lsce.cnrs-gif.fr/CE-atmosphere>

Collaborating partners/networks:

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Centrum voor IsotopenOnderzoek, Groningen, The Netherlands  
Laboratoire des Science du Climat et de l'Environnement, UMR CEA-CNRS, CE Saclay, Gif sur Yvette, France

Scientific publications and public outreach 2005:

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**Refereed journal articles**

Sturm, P., M. Leuenberger, and M. Schmidt, Atmospheric O<sub>2</sub>, CO<sub>2</sub> and δ<sup>13</sup>C observations from the remote sites Jungfrauoch, Switzerland, and Puy de Dôme, France, *Geophysical Research Letters*, **32** (doi:10.1029/2005GL023304), L17811, 2005.

Sturm, P., M. Leuenberger, F.L. Valentino, B. Lehmann, and B. Ihly, Measurements of CO<sub>2</sub>, its stable isotopes, O<sub>2</sub>/N<sub>2</sub>, and 222Rn at Bern, Switzerland, *Atmospheric Chemistry and Physics*, 1680-7375/acpd/2005-5-8473, 2005.

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