Name of research institute or organization:

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

Title of project:

AEROCARB: Airborne European Regional Observations of the Carbon Balance

Project leader and team:

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Project description:

AEROCARB, which is a EU-funded project of the CARBOEUROPE cluster, involves 13 institutions in 8 European countries. The prime objective is to estimate and monitor the net European carbon balance on monthly to decadal time scales, as a means to corroborate EU-wide controls of CO_2 emissions. Closely connected to this is the study of spatial and temporal variations of the CO_2 sources and sinks over the European continent.

In addition to the CO_2 measurements highly precise atmospheric O_2 concentration measurements are performed. Atmospheric O_2 is a powerful tracer of the carbon cycle that brings key information on the ocean versus land partitioning of carbon fluxes. O_2 measurements will be used for evaluating how much CO_2 of marine origin is present in the European air shed.

Our laboratory undertook the commitment to perform high precision O_2/N_2 measurements. Additionally we are responsible for running the flask sampling station at Jungfraujoch. At this high altitude research station the measured O_2/N_2 ratios represent “background” values independent of direct local anthropogenic influences.

Routine biweekly flask sampling was performed throughout the year 2003. Figure 1 shows measurements of the O_2/N_2 ratio and CO_2 concentrations at the Jungfraujoch from October 2000 to December 2003. For O_2/N_2 measurements all samples taken at ambient pressure are highly influenced by flask storage drift. Permeation of air components through the Viton O-ring sealings of the flasks results in a significant change in O_2/N_2 when the samples are stored too long. This permeation effect has masked any real atmospheric signal. The corrected O_2/N_2 ratios, however, show a seasonal amplitude of 0.15 per mil. The flask storage drift is in particular dependent on the pressure difference of the sample air and the ambient air at the storage location. To minimize such permeation influences we therefore modified the sampling box in order to be able to pressurize the samples to about 950mbar, which corresponds to ambient storage pressure at Bern. Additionally 1000ml flasks instead of 500ml flasks have been used to further reduce any adverse effects. This new sampling procedure was started in August 2002.

CO_2 measurements of the same samples are also influenced by storage drifts. The corrected values vary between 365 and 382 ppm. The oxidation ratio of these samples is -1.8 ± 0.2 mol O_2/mol CO_2. This points to a mixed influence of oceanic and land biospheric sources since the ocean signature is close to a factor minus two whereas the land biosphere signature is about -1.1 mol O_2/mol CO_2.

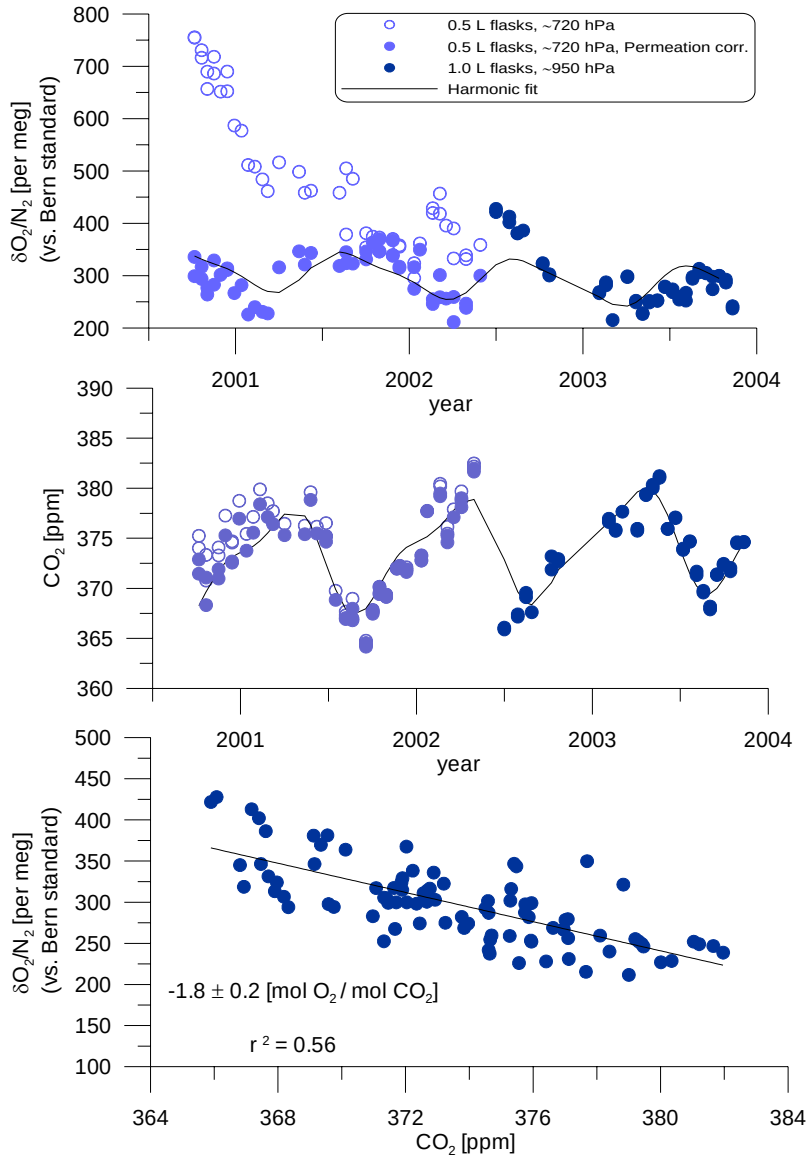

Figure 1: O_2/N_2 and CO_2 measurements at Jungfraujoch.

On the same air samples we also performed carbon isotope measurements. We used a syringe method using only about 1 ml STP of air. The precision is about 0.1 permil compared to 0.02 permil using a conventional CO_2 extraction. However, our principle is very fast and we can do several replicates. The variability on Jungfraujoch for $\delta^{13}C$ is about 1 permil (Figure 2). From a Keeling plot we obtain a intercept of –23.3 ± 0.8 permil. This is consistent with preferential exchanges with the terrestrial biosphere and a very small fossil fuel contribution (note that fossil fuel has a $\delta^{13}C$ value of about –28 permil compared to –25 permil for the terrestrial biosphere).

In 2004 we will set up continuous O_2/N_2 and CO_2 analysers at Jungfraujoch. With these state-of-the-art instruments it will be possible to monitor O_2/N_2 and CO_2 continuously and to prevent any flask storage and sampling problems.

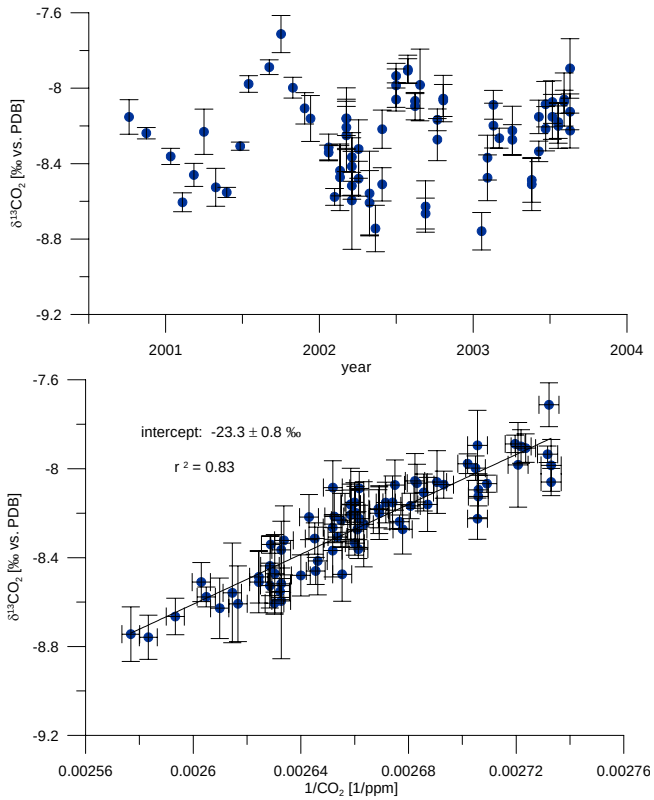

Figure 2: $\delta^{13}C$ and CO_2 measurements at Jungfraujoch

Key words:

European Carbon Balance, High precision O_2/N_2 measurements, CO_2, Flask sampling

Internet data bases:

http://www.aerocarb.cnrs-gif.fr/

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