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. The flask samples for precision O_2/N_2 measurements are collected at 6 ground-based stations (Jungfraujoch (CH), Puy-de-Dôme (F), Lutjewad (NL), Schauinsland (D), Hegyhatsal (HU), Mace Head (IRL)) as well as at 6 vertical profile stations (Orléans (F), Griffin (UK), Thüringen (D), Schauinsland (D), Hegyhatsal (HU), Bialystok (P)).

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 2002. Figure 1 shows measurements of the O_2/N_2 ratio at the Jungfraujoch from October 2000 to October 2002.

All samples taken at ambient pressure at Jungfraujoch 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.

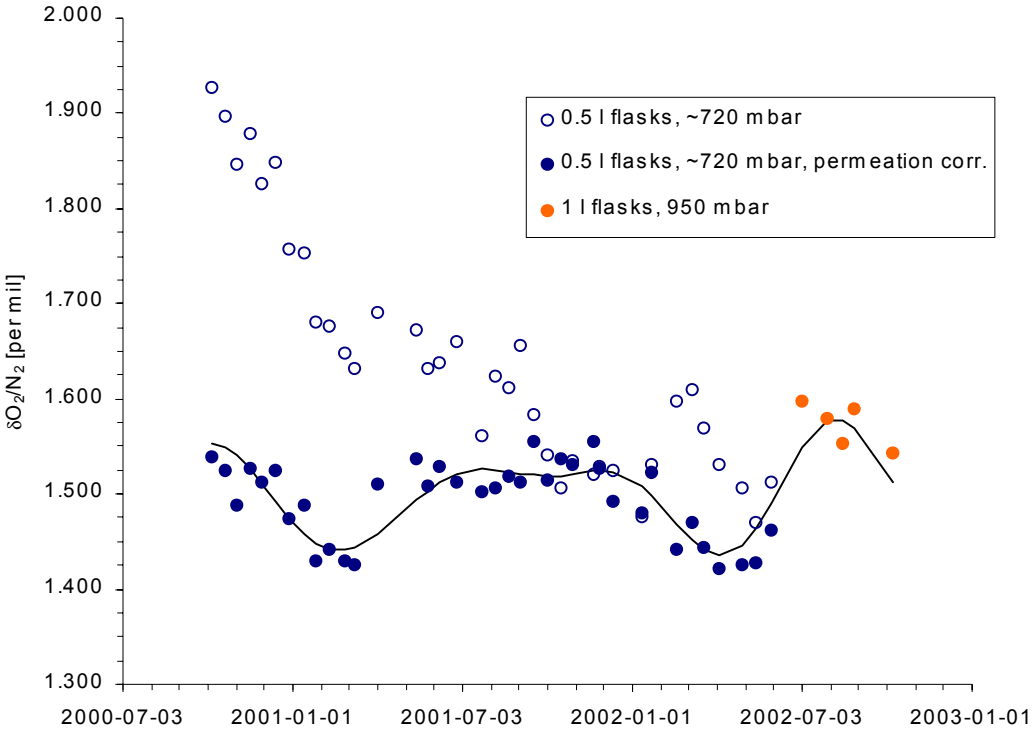

Figure 1: O_2/N_2 ratio at the Jungfraujoch from October 2000 to October 2002. The values are reported as deviations from a reference gas (LK560944) in per mil. Samples taken at ambient pressure are influenced by flask storage drift (open circles). The values corrected for this permeation effect show a seasonal amplitude of about 0.15 per mil (blue dots). To minimize gas permeation through the Viton sealings of the flasks the sample air is pressurized to 950mbar since August 2002 (orange dots).

However, we encountered still some difficulties with sampling. Several flasks were damaged due to shipping problems despite careful packing. Another uncertainty arises from samples, which seem to be locally influenced by polluted air (In Figure 1 only samples regarded as representative of "background" air conditions are shown). Future measurements will reveal if a different location of the air intake has to be chosen.

Figure 2 shows the CO_2 concentration of the same samples from October 2000 to October 2002. The measurements are not corrected for flask storage drift, because the permeation influence on CO_2 concentration is small compared to the seasonal amplitude and of the same magnitude as the analytical precision.

In 2003 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.

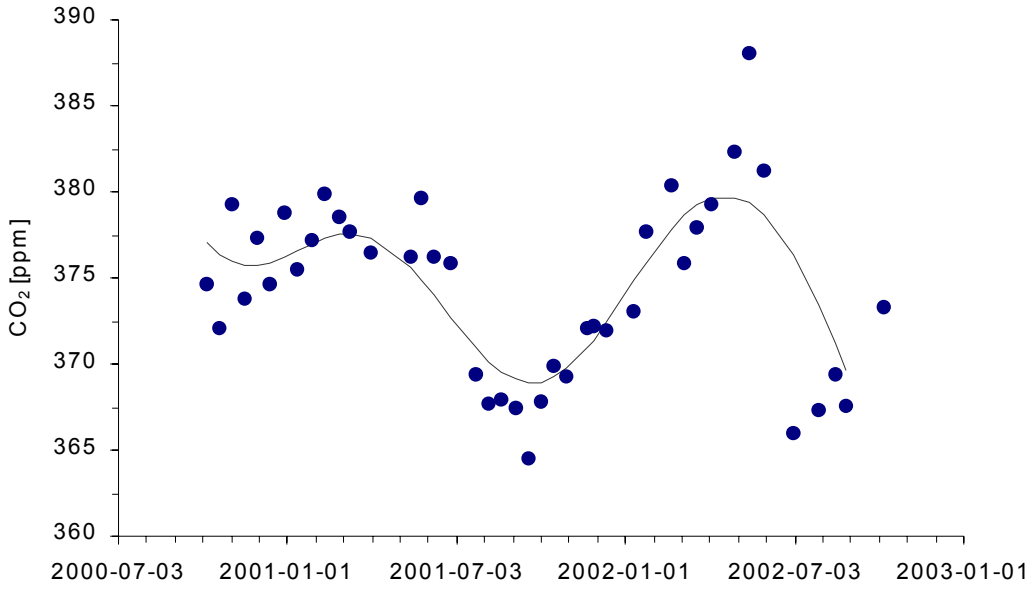

Figure 2: CO_2 concentration from October 2000 to October 2002.

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/

Collaborating partners/networks:

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Scientific publications and public outreach 2002:

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