Name of research institute or organization:

Climate and Environmental Physics, University of Bern

Title of project:

AEROCARB

Project leader and team:

PD Dr. Markus Leuenberger, project leader
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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. The project is based on a synergy of atmospheric measurements, mesoscale atmospheric transport models, surface emission data, and diagnostic models of land ecosystems carbon exchange. The unified European network of atmospheric CO_2 and related tracers concentration measurements consists of ground level monitoring stations (Figure 1) and a transect of regular biweekly aircraft CO_2 soundings between the Atlantic and Eastern Europe.

Figure 1: Ground level monitoring stations of the network of atmospheric CO_2 and related tracer measurements within AEROCARB.

Additional 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), Jena (D), Schauinsland (D), Hegyhatsal (HU), Poland site).

Our laboratory undertook the commitment to perform high precision O_2/N_2 measurements in collaboration with the Centrum voor Isotopen Onderzoek (CIO) in Groningen (NL). 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.

After some preliminary tests during June and July 2000, we started routine biweekly flask sampling in October 2000. Since August 2001 the glass flasks are sent from Bern to Jungfraujoch and back in a specially designed sampling box. The sampling procedure is carried out by the custodian of the research station.

We use 500ml glass flasks equipped with stop-cocks containing Viton O-rings. To dry the air during sampling, we use a U-shaped tube filled with magnesium perchlorate as a drying means. A diaphragm pressure pump transfers the air from outside through the drying unit and the two flasks connected in series. The flasks are flushed for 10min at a flow rate of 3l/min.

The flasks are analysed in our laboratory in Bern with a DELTAplusXL Isotope Ratio Mass Spectrometer (IRMS) from Thermo-Finnigan. In order to be able to measure the O_2/N_2 ratio to the required accuracy, we have developed a new gas inlet system, manly based on glass (see Publications section below).

Because atmospheric N_2 is much less variable than O_2, changes in the O_2/N_2 ratio primarily reflect changes in O_2. The atmospheric O_2 concentration varies seasonally due to variations of the net O_2 production of the terrestrial and marine biosphere and due to a temperature dependent solubility of O_2 in the ocean.

Figure 2 shows first measurements of the O_2/N_2 ratio at the Jungfraujoch from October 2000 to January 2001. The measurements show a decrease of the atmospheric O_2 concentration towards winter months.

However, these preliminary measurements exhibit different problems. First, the drying unit worked not as well as expected resulting in water contamination of the sampled air that lowered the reproducibility of the measurements. Secondly, we experienced that the permeation flux of air components through the Viton O-ring sealings is a crucial problem when the samples are stored too long. This effect can be larger than the real atmospheric signal.

It is our task to minimize these effects in order to reach our goal of precise O_2/N_2 records at different locations in Europe.

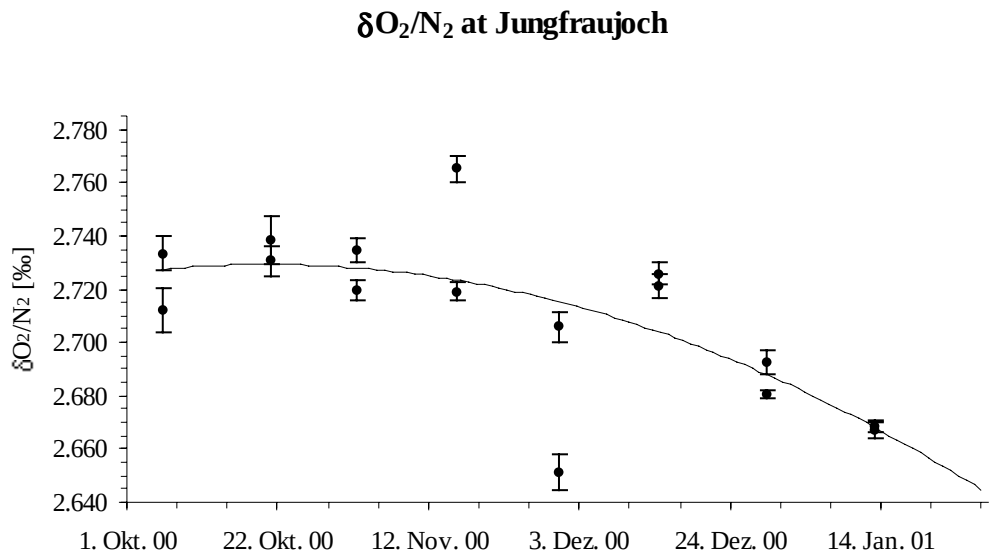

Figure 2: First measurements of the O_2/N_2 ratio at the Jungfraujoch from October 2000 to January 2001

Key words

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

Collaborating partners/networks:

Centrum voor Isotopen Onderzoek (CIO), Groningen, Netherlands

Scientific publications and public outreach 2001:

Leuenberger, M., P. Nyfeler, H. P. Moret, P. Sturm, C. Huber, *A new gas inlet system for an isotope ratio mass spectrometer improves reproducibility*, Rapid Communications in Mass Spectrometry, 14, 1543-1551, 2000

Leuenberger, M., P. Nyfeler, H. P. Moret, P. Sturm, A. Indermühle, J.Schwander, *CO_2 concentration measurements on air samples by mass spectrometry* , Rapid Communications in Mass Spectrometry, 14, 1552-1557, 2000

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