

Name of research institute or organization:

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**Institut für Umweltphysik, Universität Heidelberg**

Title of project:

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Long-term observations of  $^{14}\text{CO}_2$  at Jungfraujoch

Project leader and team:

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Ingeborg Levin, project leader  
Bernd Kromer

Project description:

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$^{14}\text{C}$  is the natural radioactive carbon isotope which is produced in the atmosphere by cosmic ray induced reactions with atmospheric nitrogen. The radioactive half life of  $^{14}\text{C}$  is 5730 years. The natural equilibrium level of atmospheric  $^{14}\text{CO}_2$  has been disturbed by man's activities in the last century, via the ongoing input of fossil fuel  $\text{CO}_2$  into the atmosphere known as Suess effect, and through nuclear detonations in the atmosphere in the 1950s and early 1960s.  $\text{CO}_2$  from burning of fossil fuels, due to its age of several hundred million years, is free of  $^{14}\text{C}$ ; adding fossil fuel  $\text{CO}_2$  to the atmosphere, therefore, not only leads to an increase of its  $\text{CO}_2$  mixing ratio but also to a decrease of the  $^{14}\text{C}/^{12}\text{C}$  ratio in atmospheric  $\text{CO}_2$ . From a  $^{14}\text{CO}_2$  measurement at a polluted sampling site, e.g. on the European continent, we can directly calculate the regional fossil fuel  $\text{CO}_2$  surplus, if the undisturbed background  $^{14}\text{CO}_2$  level is known.

Atmospheric  $^{14}\text{CO}_2$  observations at Jungfraujoch serve as this background for other observational sites in Central Europe. The measurements have been started in 1986 and were continued without interruption until today. The Jungfraujoch background  $^{14}\text{CO}_2$  level was used to calculate the fossil fuel  $\text{CO}_2$  component at Schauinsland station as well as in Heidelberg from respective  $^{14}\text{CO}_2$  observations. These results are described in detail by Levin et al. [2003], and in a recently submitted manuscript by Gamnitzer et al. [2005]. All Jungfraujoch data until the end of 2003 have been published by Levin and Kromer [2004].

References:

- Gamnitzer, U., U. Karstens, B. Kromer, R. Neubert, H. Meijer, H. Schroeder and I. Levin, 2005. Carbon Monoxide: A quantitative tracer for fossil fuel  $\text{CO}_2$  ? submitted to J. Geophys. Res. December 2005.
- Levin, I., B. Kromer, M. Schmidt and H. Sartorius, 2003. A novel approach for independent budgeting of fossil fuels  $\text{CO}_2$  over Europe by  $^{14}\text{CO}_2$  observations. *Geophys. Res. Lett.* 30(23), 2194, doi. 10.1029/2003GL018477.
- Levin, I. and B. Kromer, 2004. The tropospheric  $^{14}\text{CO}_2$  level in mid-latitudes of the Northern Hemisphere (1959-2003). *Radiocarbon* 46(3), 1261-1272.

Key words:

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carbon dioxide, Radiocarbon, fossil fuel  $\text{CO}_2$ , climate, Kyoto Protocol

Internet data bases:

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<http://www.iup.uni-heidelberg.de/institut/forschung/groups/kk/>

<http://www.radiocarbon.org/IntCal04.htm>

Collaborating partners/networks:

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CarboEurope-IP (<http://www.carboeurope.org/>)

Scientific publications and public outreach 2005:

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**Refereed journal article**

Gamnitzer, U., U. Karstens, B. Kromer, R. Neubert, H. Meijer, H. Schroeder and I. Levin, 2005. Carbon Monoxide: A quantitative tracer for fossil fuel CO<sub>2</sub> ? submitted to J. Geophys. Res. December 2005.

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