

Name of research institute or organization:

EMPA Dübendorf, Swiss Federal Laboratories for Materials

Title of project:

Monitoring of halogenated greenhouse gases

Project leader and team

Stefan Reimann, project leader; Konrad Stemmler, scientist; Doris Folini, scientist.

Project description:

Since January 2000 halogenated greenhouse gases and stratospheric ozone depleting substances, including CFCs, HCFCs, HFCs and chlorinated solvents are continuously measured by gaschromatography-mass spectrometry (GCMS) at the high Alpine station of Jungfraujoch. These measurements are a part of a Swiss National project to estimate the Swiss source strengths of these gases as well as a part of the EU-project **SOGE** (System for Observation of Halogenated Greenhouse Gases in Europe).

Within SOGE, fully intercalibrated *in situ* data have been measured since 2001 by GCMS-technique at four European background stations (i.e. Mace Head, Ireland; Ny-Ålesund, Spitsbergen; Jungfraujoch, Switzerland and Monte Cimone, Italy). As an example for the data collected at the 4 SOGE sites the time series of HFC-152a are shown in Figure 1.

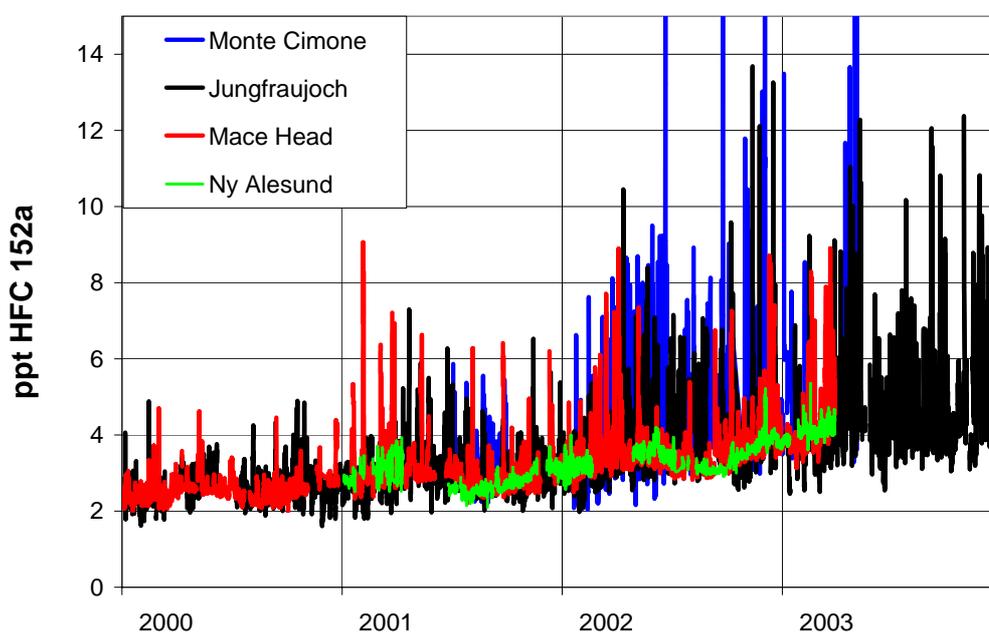


Figure 1: Time series of HFC 152a at the Jungfraujoch (Switzerland), Mace Head (Ireland), Ny-Alesund (Norway) and Monte Cimone (Italy).

Analyses focused on data from Jungfraujoch were used to estimate central European emissions. Our data series are analyzed during meteorological conditions, when the site is influenced by polluted boundary layer air masses. During these periods, the average ratio of halocarbons to carbon monoxide (CO) concentrations above the

tropospheric background concentrations was used to estimate the source strength of these gases from the regions of Europe which most influence the site during pollution events. We are aware of the fact that sources of CO and halocarbons are not necessarily collocated. Nevertheless, we assume that the relative abundances of CO and halocarbons averaged over all pollution events are representative for the European polluted boundary layer. For the calculation of the source strength relatively to CO, EU15 emission estimates of CO from EMEP (<http://webdab.emep.int>) were used as *a priori* information. The derived emissions are representative for the regions which influence the composition of air masses arriving at Jungfraujoch. This leads to an excellent coverage of source regions in central-western Europe (i.e. Germany and France) but also in the heavily industrialised Po-valley (northern Italy). Results of the estimation for the HFCs 134a, 125 and 152a, as well as for the HCFC 141b are shown in Table 1.

Table 1. Estimated European emissions of selected HFCs and HCFCs derived from measurements at Jungfraujoch. [Gg yr^{-1}] 2000-2002.

Compound	
HFC 125	2.2
HFC 134a	23.6
HFC 152a	0.8
HCFC 141b	9.0

HFC 134a, which is predominately used as refrigerant (e.g. in mobile air conditioners) was estimated to have the highest European emission of the halocarbons analysed in the period 2000-2002. Often pollution events showed a parallel increase of HFCs 134a and HFC 125 (also used in air conditioners) but emissions of the latter were about a factor of 10 smaller. For HFC 152a, which is used mainly as an agent for foam blowing, emissions are still small but a rapid increase during the period of 2000-2003 could be observed (see Fig. 1). The emissions of HCFC 141b had the tendency to smaller values in 2002 in comparison to earlier years.

Furthermore, we use a statistical trajectory model to estimate the location of regions in central western Europe which contribute to the observed elevated concentrations at the Jungfraujoch. Thereby, we connect measurement data at the Jungfraujoch with respective back trajectories. The results should be regarded as indicative, showing only potential source regions.

In Figure 2 results of the trajectory statistics are shown. Deduced from our model, southern Europe could be a very potent source region for all of the halocarbons. This seems to be reasonable, since northern Italy is a heavily industrialized area, where industries with known emissions of halocarbons are situated. For HFC 134a and HFC 125 Germany and the eastern part of France were found to be potentially source regions in the north of Jungfraujoch, although their contribution to pollution events at Jungfraujoch was smaller than from the southern direction. For HFC 152a highest concentrations were measured from Germany. Although some emissions seemed to occur in Italy, southern Europe was not as important as a source for HFC 152a as for the two other HFCs discussed above. For HCFC 141b results showed that the most

important sources were located in southern Europe, particularly in Italy. However, elevated emissions were also observed associated with trajectories originating from eastern Germany.

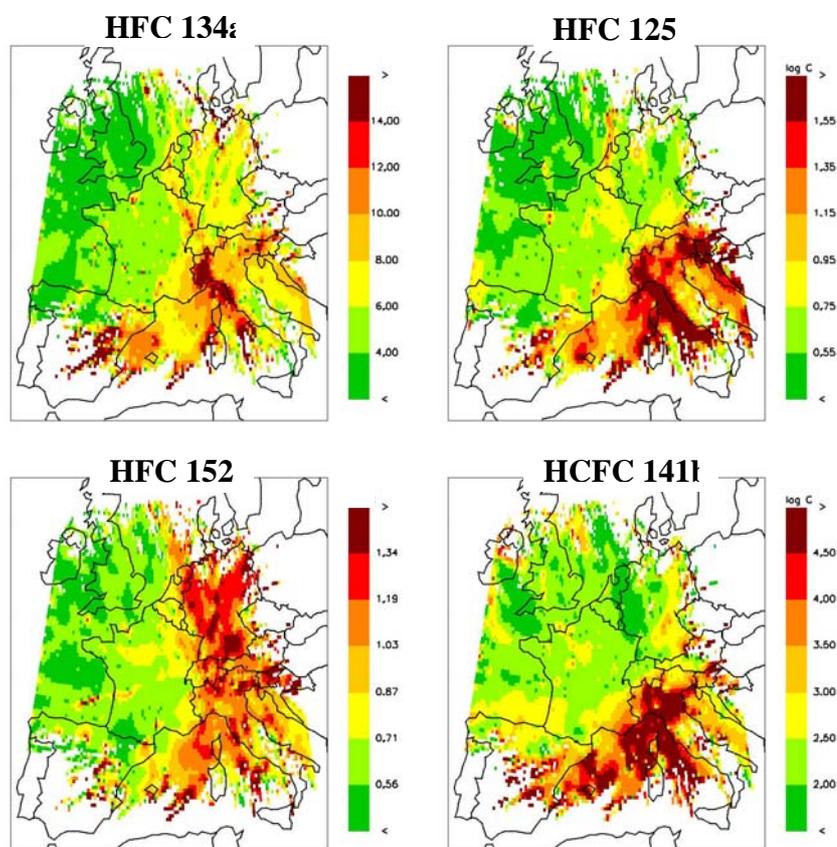


Figure 2: Source regions resulting from trajectory statistics of HFCs 134a, 125, and 152a and of HCFC 141b for 2000-2002 at Jungfraujoch. Units indicate averaged concentrations above the baseline [ppt], linked to trajectories that passed over the respective grid cell.

Key words:

Greenhouse gases, halogenated hydrocarbons, CFC, HCFC, HFC, trajectory model, Kyoto Protocol

Collaborating partners/networks:

EU-project: SOGE (System for observation of greenhouse gases in Europe)
University of Bristol, University of Liège, University of Urbino, University of Oslo,
Alfred Wegener Institut, Norwegian Institute for Air Research (NILU).

National Project Halclim: Buwal.

Scientific publications and public outreach 2003:

Refereed journal articles

Buchmann B., Stemmler K., and Reimann S. Regional emissions of anthropogenic halocarbons derived from continuous measurements of ambient air in Switzerland
Chimia **57** (9), 522-528 2003.

Magazine and Newspapers articles

Tages Anzeiger 16.9. 2003: „Schädliche Kühlmittel“.

Berner Zeitung 17.9. 2003: „Jungfraujoch liefert Beweise“.

Address:

EMPA Dübendorf
Ueberlandstrasse 129
CH-8600 Dübendorf

Contacts

Stefan Reimann
Tel. +41 1 823 5511
e-mail: stefan.reimann@empa.ch
SOGÉ homepage: www.nilu.no/niluweb/services/soge/