

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; Martin Vollmer, 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 performed in collaboration with the Swiss Agency for the Environment, Forests and Landscape (SAEFL) in order to estimate the Swiss source strengths of these gases. These measurements are also 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-134a are shown in Figure 1.

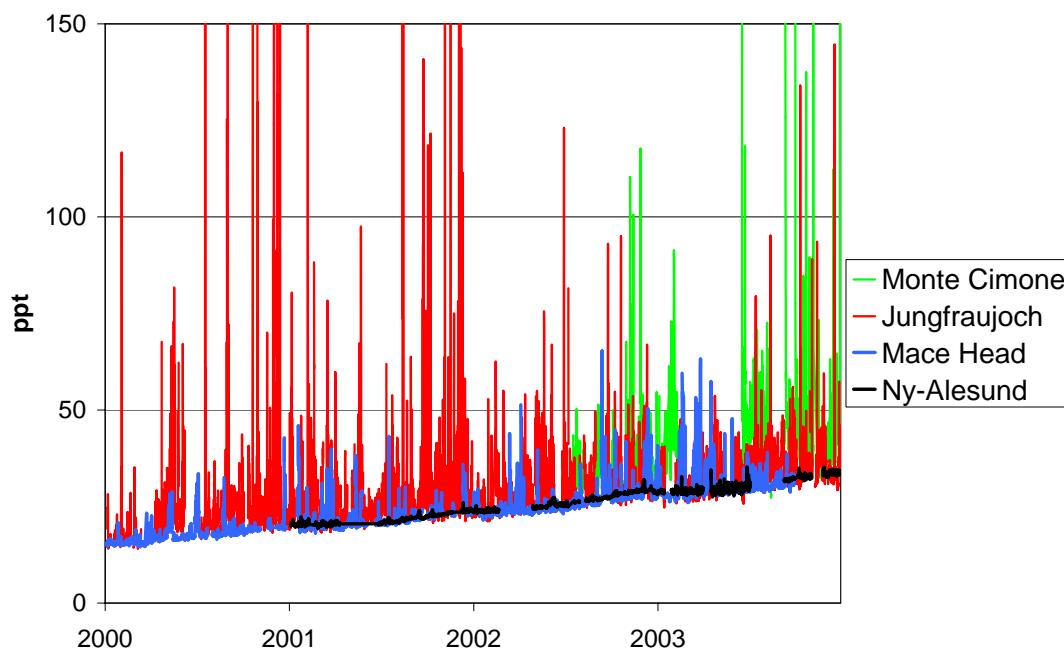


Figure 1: Time series of HFC 134a at the Jungfraujoch (Switzerland), Mace Head (Ireland), Ny-Alesund (Norway) and Monte Cimone (Italy).

Analyses of data from Jungfraujoch were used to estimate European emissions of the halogenated greenhouse gases. During periods where the Jungfraujoch was under the

influence of the European boundary layer, the average ratio of halocarbons to carbon monoxide (CO) concentrations above the tropospheric background concentrations was used to estimate the European source strength of these gases. Although sources of CO and halocarbons are not necessarily co-located, we assume that the relative abundances of CO and halocarbons averaged over all pollution events are representative for the European polluted boundary layer.

HFC 134a, which is mostly used as refrigerant (e.g. in mobile air conditioners) had the highest European emission of the halocarbons analysed in the period 2000-2003. Often pollution events showed a parallel increase of HFCs 134a and HFC 125 (also used in air conditioners) but emissions of the latter were significantly smaller. The emissions of HCFC 141b, which is in the process of being forbidden because of the regulations in the Montreal Protocol, had declining emissions from 2000-03. Instead of this forbidden compound, a new hydrofluorocarbon (HFC 365mfc) could be measured for the first time in 2003.

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.

Results of the temporal development of the emissions for for HCFC 141b and HFC 152a, seen with the trajectory statistics, are shown in Figure 2. Thereby, air from Italy used to be polluted with the now forbidden HCFC 141b – but emissions have declined dramatically. On the other hand, emissions from HFC 152a, which is predominately used in foam blowing, have increased substantially.

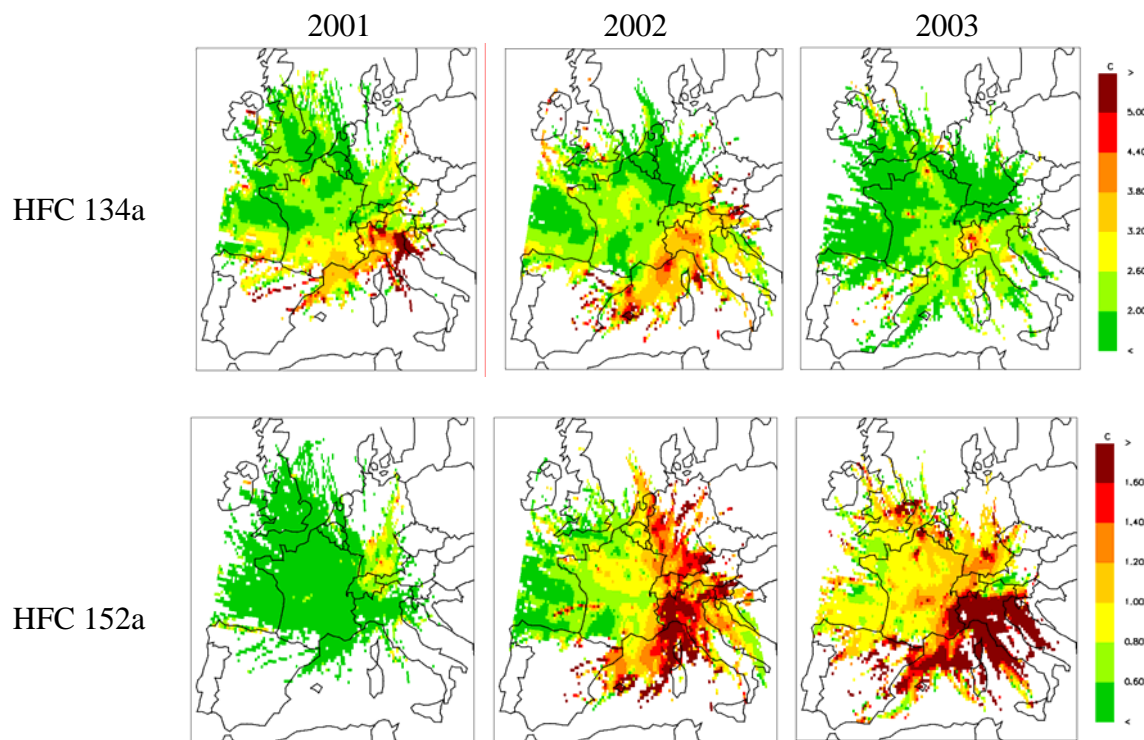


Figure 2: Source regions resulting from trajectory statistics of the HCFC 141b and the HFC 152a between 2001-2003 seen at Jungfraujoch. Units indicate averaged concentrations above the baseline [ppt], linked to trajectories that passed over the respective grid cell.

Key words:

Greenhouse gases, halogenated hydrocarbons, CFC, HCFC, HFC, trajectory model, Kyoto Protocol, Montreal 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/SAEFL.

Scientific publications and public outreach 2004:

Refereed journal articles

Reimann, S., Schaub, D., Stemmler, K., Folini, D., Hofer, P., Buchmann, B., Simmonds, P.G., Grealley, B.R., and O'Doherty, S., Halogenated Greenhouse Gases at the Swiss High Alpine Site of Jungfraujoch (3850 m asl): Continuous Measurements and their Use for Regional European Source Allocation, *J. Geophys. Res.*, Vol. 109, No. D5, D05307 10.1029/2003JD003923, 2004.

Reimann, S., Manning, A.J., Simmonds, P.G., Cunnold, D.M., Wang, R.H.J., Li, J., McCulloch, A., Prinn, R.G., Huang, J., Weiss, R.F., Fraser, P.F., O'Doherty, S., Grealley, B.R., Stemmler, K., Hill, M. and Folini, D. Low European methyl

chloroform emissions inferred from long-term atmospheric measurements, 2005, accepted in Nature.

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