Trends of halocarbons observed in Ny-Ålesund

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Introduction

Continous measurements of halogenated greenhouse gases in the Norwegian Arctic were initiated in 1999 at the Mt.Zeppelin observatory (*78°54' N, 11°54' E, 474 masl.*) A wide range of halogenated greenhouse gases are measured in situ at this background measurement station. Measurements are performed with high frequency by the use of automated gas chromatographs with a mass spectrometry detector.

This poster presents a summary of a study of the most important halogenated greenhouse gases in the air measured at at the Mt.Zeppelin station. Measurement data from 2001 – 2005 are analyzed for trends and pollution events.

Fig. 1

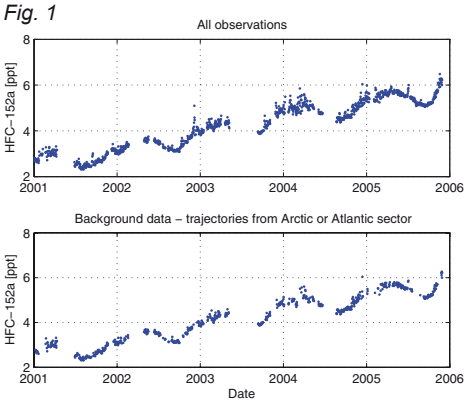


Fig. 2

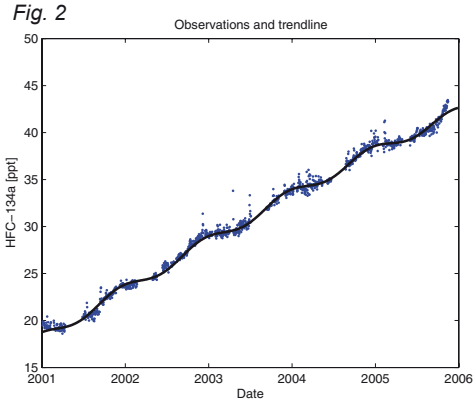
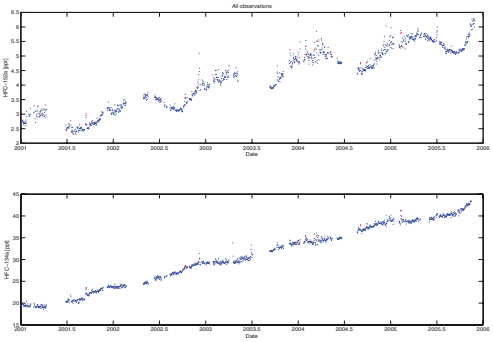


Fig. 3



Methods and observations

Based on the daily mean concentrations, an algorithm is selected to find the values assumed as clean background air. If at least 75% of the trajectories within +/- 12 h of the sampling day are coming from a so-called clean sector (Arctic or Atlantic air masses), one can assume the air for that day to be non polluted. The remaining trajectories from European, Russian or North-American sector are removed before calculating the background.

Figure 1 shows all daily observations (upper panel), and data selected for background concentration calculations (lower panel) for HFC-152a. Most of the spikes, i.e. assumed polluted events, are removed during the filtering.

A Legendre function in combination with a harmonic function is used for calculating the background concentration trendline. The sector algorithm and the Legendre function are described in detail in [Fjaeraa, 2005].

Figure 2 shows the background data as a function of Legendre polynomials in combination with harmonic functions (black line) overloaded the daily means for HFC-134a.

Equation 1 describes the function. Mean mole fractions (a), Trends (b), Curvatures (d), and Seasonal cycles (c and s) for the period 2001 – 2005 were calculated for all measured compounds at Mt. Zeppelin. For HFC-134a, the numbers that describe the mean, trend and growth in the trend are:

a) 32.9 ppt, b) 4.65 ppt/year, d) -0.12 ppt/year^2

The peak events in the observations were studied in combination with air mass trajectories, divided into European, Atlantic, Russian and North American sectors to allocate specific source regions. Due to Mt.Zeppelins remote location, the studies of events are limited to a few case studies.

As an example we have pointed out some episodes for HFC-134a and HFC-152a ; air masses from European sector with peak concentrations about 20-50% higher than the estimated background.

Eq. 1

$$f(t) = a + bNP_1(t=N-1) + (1=3)dN^2P_2(t=N-1) + (1=8)eN^3P_3(t=N-1) + c_1cos(2\pi t) + s_1sin(2\pi t)$$

The observed *f* can be expressed as functions of time measured from the 2N-year interval of interest. The coeffcient *a* defines the average mole fraction, *b* defines the trend in the mole fraction and *d* defines the acceleration in the trend. The *c* and *s* define the annual cycle in mole fractions. N is the mid point of the period of investigation. The polynomial P_3 (with coefficient *e*) is small, but added to better fit the full data set.

Main findings

- Positive trends in the background concentrations were observed for substances which are used as CFC-substitutes (hydrofluorcarbons, hydrochlorofluorcarbons). Background concentrations in the HFCs at Ny-Alesund increased from January 2001 to December 2005 as follows: HFC-134a from 21 ppt to 42 with a major growth rate of 4.65 ppb/year. HFC-152a from 2.7 ppt to 6.2 with a major growth rate of 0.7 ppb/year
- All peak concentrations of the measured gases were significantly lower at Ny-Alesund than at other measurement sites in the SOGE network, due to the stations remote location and the amplitudes of polluted events are small and the episodes are rare.
- One can assume that the chosen filter is a good method for finding mean background concentrations for further work.
- While the CFCs are about to level out or in case of CFC-11 decreasing, the HCFCs are showing moderate increase rates. The HFC concentrations in the atmosphere are still showing substantial yearly increase.
- Most of the polluted episodes are following trajectories from European and/or from Russian sector.
- HFC-134a and HFC-152a were estimated to have the greatest increase in the mixing ratios at Mt.Zeppelin in the 2001- 2005 period, which is consistent with their high European emissions.