Recent accelerated growth observed for HCFCs in the atmosphere

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Air sampling at South Pole
The Montreal Protocol has outlined a pathway for recovery of stratospheric ozone.

HCFCs (hydrochlorofluorocarbons): Used as temporary substitutes, but still deplete ozone and affect climate.

CFCs, halons, etc.

And other...

HFCs
Is the Montreal Protocol working?
Most ODSs are decreasing, replacements (HCFCs) are increasing

Summarizing trends for all ODSs:
Effective Equivalent Chlorine (EECl)

Global EECl
[Cl + (Br*60)]*f
Down
11% from peak!!

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Gauging progress in the return of EESC to 1980 levels:

Dave Hofmann’s Ozone Depleting Gas Index

ODGI_2007 = 73

ODGI = 100

ODGI = 0

For mid-latitudes

ESRL Data
A1 (WMO 2006)
EESC in 1980
Past Data

1980 level
ODGI = 0
HCFCs as of 2004:

Global atmospheric increases for HCFCs had slowed:

* Rate of Cl increase in 2004 was 6 ppt/yr (compared to 9 ppt/yr in 2000)

* Increases were less than projected 4 years earlier in WMO(2003):

(NOAA and AGAGE data in WMO, 2007)
HCFCs as of 2004:
Developed country consumption AND production on the decline:

(UNEP data tables, 2008)
Recent changes in global HCFC mixing ratios and growth rates

Accelerated growth as of 2004 (WMO 2007) for the 3 abundant HCFCs

CI from HCFCs:

- in 2004: +5.9 ppt/yr
- in 2007: +9 ppt/yr
Implications:
Changes in Emissions

* derived from global changes and box models
* compared to recent WMO (2007) scenario Ab projection…

→Substantial emission increases recently!

142b emissions in 2007 are TWICE those in recent WMO scenario
The halocarbon surface flask sampling network

- High Altitude
- Marine Boundary Layer
- Not used; non-background
Atmospheric Distribution Changes for HCFC-142b

Site / Global (annual mean mixing ratios)

Sampling Site Latitude (NH only)

<table>
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1999: Global rate of increase was comparable in 1999 and 2007.
Rapidly Increasing Production and Use of HCFCs in Developing Countries...

In 2006:
- 80% of global HCFC production was from developing countries.
- 50% of global consumption from China.

Developing country consumption & production of HCFCs is capped in 2013.

Where will we be in 2013?

(UNEP data tables, 2008)
Implications: Changes in Total Atmospheric Chlorine From Ozone-depleting Gases:

Only HCFCs continue to add more chlorine to the atmosphere each year…

Declines in Cl from CFCs have recently become larger than from CH$_3$CCl$_3$
HCFC Emissions
(Direct GWP-weighted)

A 35% increase since 2004
Global fossil-related CO₂ emissions ~25-30 Gt/yr

From obs
WMO, 2007
Conclusions:

The ODGI better conveys the progress we are making to reduce the atmospheric abundance of ozone-depleting gases…

*Thanks Dave!*

HCFC abundances have increased at accelerated rates since 2004.

HCFCs are the one remaining compound class offsetting declines in Cl from other ODSs.

Emissions of HCFCs have increased by up to 70% since 2004 (for HCFC-142b).

The atmospheric data point to enhanced emissions since 2004 in the lower latitudes of the NH, concurrent with substantial increases in HCFC production and consumption in developing countries.

→ In contrast to years before 2004, developing nations are now determining changes in the abundances of HCFCs across the globe.
Understanding the cause of the changes since 2004

→ Source driven (emissions changes are a factor of 2 for HCFC-142b)
→ Where is the enhanced source? Northern vs. Southern Hemisphere?

Simple 3-box model calculation:

Most of the record is well simulated with a fairly constant 95% of emissions in NH.
Changes in the distribution of HCFC-142b relative to 2004

Site mean / Global mean (relative to 2004)

- kum
- thd
- brw
- alt
- mlo
- nwr
- mhd

12-month running means