

## Recent increases in global HFC-23 emissions

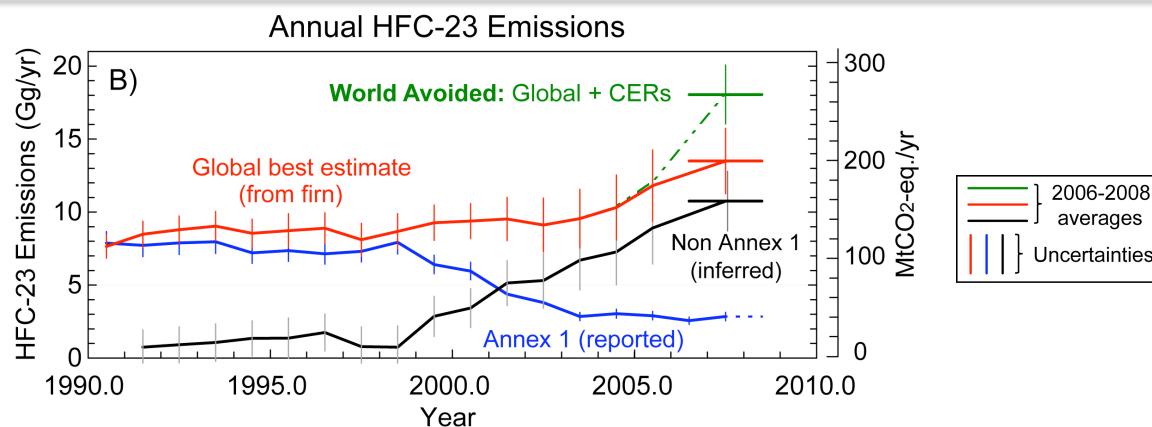
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Accepted for publication in *Geophysical Research Letters*, November 2009.

**Global atmospheric concentrations and emissions of HFC-23 have continued to increase despite efforts in both developed and developing countries to reduce emissions of this potent greenhouse gas during the past decade.**

- Observations:** Recent HFC-23 emissions were derived from gas measurements made in ambient air and in the Antarctic snowpack (firn) three times between 2001 and 2009.

### Background: HFC-23

Hydrofluorocarbon-23 (HFC-23) emissions arise primarily from over-fluorination of chloroform during HCFC-22 production.



Global annual HFC-23 emissions derived from atmospheric and firn air observations.

Global HFC-23 emissions have **increased** by 55% :

- 2006-2008 average:  $13.5 \pm 2$  Gg/yr or  $200 \pm 30$  Mt CO<sub>2</sub>-eq.
- 1990-2000 average:  $8.7 \pm 1$  Gg/yr or  $129 \pm 15$  Mt CO<sub>2</sub>-eq.

Developed country (Annex 1) annual HFC-23 emissions reported to UNFCCC.

- HFC-23 emissions have **decreased** in developed countries from 6 - 8 Gg/yr in the late 1990s to 2.8 Gg/yr in 2007.

### Background:

HFC-23 has a 100-yr global warming potential (GWP) of 14,800 (or 11,700 for UNFCCC CDM purposes).

**1Gg HFC-23 = 14.8 Mt CO<sub>2</sub>-eq**

The GWP of HCFC-22 is 1,810.

Developing country (non-Annex 1) annual HFC-23 emissions. They are inferred here as the difference between derived global emissions and reported Annex-1 emissions. Non-Annex-1 HFC-23 emissions are not reported to the UNFCCC.

- HFC-23 emissions have **increased** steadily in developing countries from 1 - 3 Gg/yr in the 1990s to  $11 \pm 2$  Gg/yr in 2006-2008 as a result of rapidly increasing HCFC-22 production.

**World Avoided:** Global annual HFC-23 emissions from atmospheric observations

+ **Certified Emission Reductions (CERs)** under the UNFCCC Clean Development Mechanism (CDM).

- Without CERs, HFC-23 global emissions would have **doubled** from approximately 9 to 18 Gg/yr between 2000-2002 and 2006-2008.

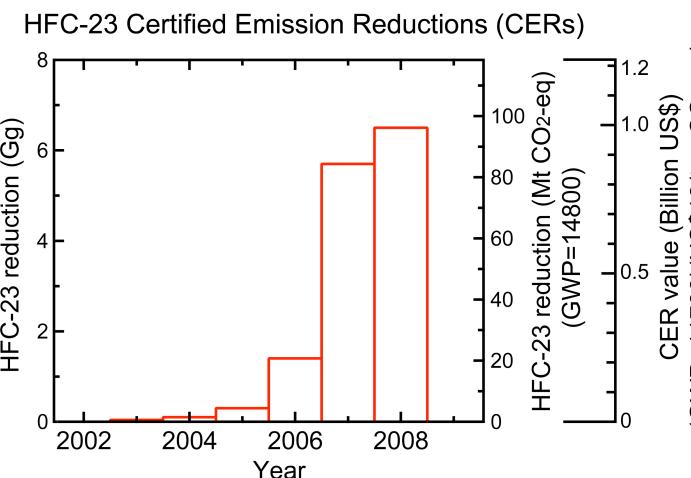
- Substantial amounts of HCFC-22 were produced but **not covered** by existing CDM projects (~57%) in 2007 and the HFC-23 associated with this production appears to be emitted to the atmosphere.

Figure lines

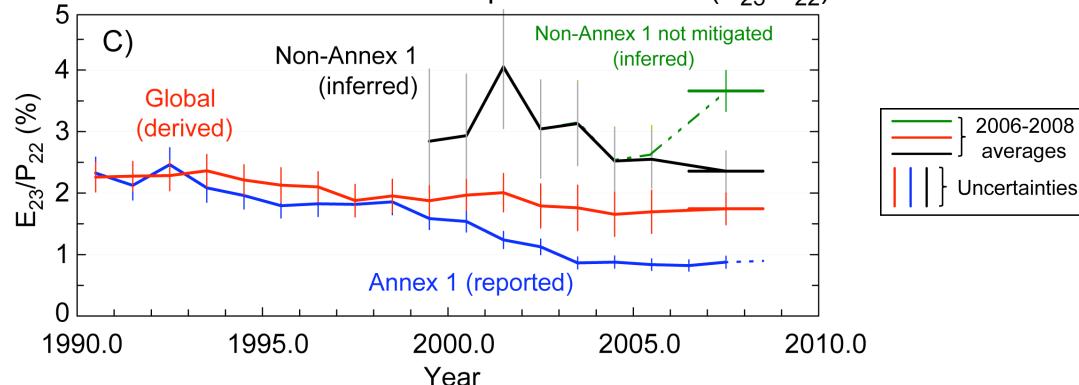
- HFC-23 CERs through 2008 total 14 Gg which corresponds to 208 Mt CO<sub>2</sub>-eq. of climate protection.

- HFC-23 CO<sub>2</sub>-eq. emissions in recent years have been about 1/3 as large as HCFC-22 CO<sub>2</sub>-eq. emissions despite only a 1.5 - 2.5% yield of HFC-23 during HCFC-22 production.

- The total value of CERs between 2003 and 2008 is 2.1 Billion US\$ assuming a HFC-23 GWP of 11700 and a US\$13/ton CO<sub>2</sub>-eq market value.



HFC-23 emission to HCFC-22 production ratio ( $E_{23}/P_{22}$ )



#### Annual ratio of global HFC-23 emissions to global HCFC-22 production ( $E_{23}/P_{22}$ )

- Global HFC-23 emissions as a percentage of total HCFC production have **decreased** since the mid 1990's to an average value of 1.7% in 2006-2008.

Developed country (Annex 1) annual  $E_{23}/P_{22}$  ratios from values reported to UNFCCC and UNEP.

- $E_{23}/P_{22}$  values have steadily **decreased** in developed countries from approximately 2% in the 1990s to 0.9% during 2003-2007.

Developing country (non-Annex 1) annual  $E_{23}/P_{22}$  ratios from inferred HFC-23 emissions and reported HCFC-22 production.

- $E_{23}/P_{22}$  values have **decreased** in developing countries since the early 2000's to reach 2.4 ± 0.3% for 2006-2008.

Developing country (non-Annex 1) annual  $E_{23}/P_{22}$  ratios from inferred HFC-23 emissions and HCFC-22 production not associated with CDM projects.

- $E_{23}/P_{22}$  values in HCFC-22 production not associated with CDM projects are **high** (3.7 ± 0.3%) compared to values in the past obtained in either non-Annex-1 or Annex-1 countries.

#### Background:

Under the Montreal Protocol HCFC-22 production and consumption for non-feedstock uses will end in developed/developing countries in 2020/2030. The Montreal Protocol does not regulate feedstock production of HCFC-22.

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