Emission Characteristics of HFC-23 (CHF_3)/HCFC-22 ($CHClF_2$) between Different Air Masses in East Asia

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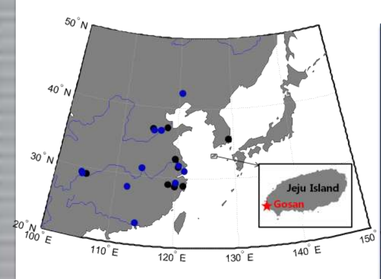
Introduction

- HCFC-22 (chlorodifluoromethane, $CHClF_2$), one of the major components in various refrigeration, is emitted mostly from developing countries, as its consumption is not limited until 2013 by the Montreal Protocol.
- HFC-23 (trifluoromethane, CHF_3), a by-product in the manufacture of HCFC-22, is also a powerful greenhouse gas, as it emission restricted at developed countries by Kyoto Protocol and CDM program un KY led developing country to reduction the emission
- Different emission characteristics will be expected in Northeastern Asian under the different reduction political and incineration process.

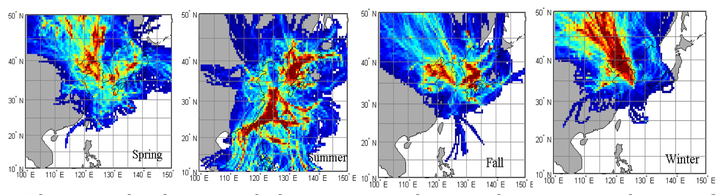
Objectives

- **To known background concentration of HCFC-22 and HFC-23 at Gosan of remote site.**
- **To understand the HCFC-22 and HFC-23 correlation by the different source regions and to estimate the those emission ratio.**
- **To estimate those compound emission in China mainland.**

Measurements



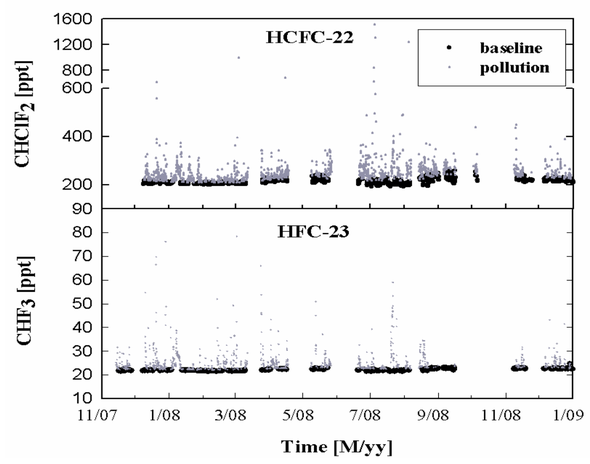
- Station :Gosan, Jeju Island, Korea shown as star.
  - ✓ Black dots for HCFC-22 production factories that participated in the Clean Development Mechanism (CDM) to incinerate HFC-23 co-produced during HCFC-22 production .
  - ✓ Blue dots for factories that did not participate in CDM.
- Measured Instrument: Medusa 'GC-MS'
- Measurement time : 2007,11~
- Data interval: 2hours.



The winds arriving at the site consist of northwesterly and northeasterly continental air for spring, fall, and winter season bringing in signals of pollution from China, Korea, and Japan, except for summer when the monsoon bring oceanic background air from the southern regions.

Results and discussion

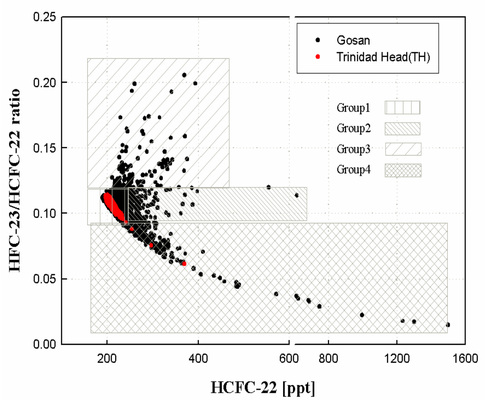
HCFC-22 and HFC-23 Observation



✓HCFC-22 and HFC-23 baseline concentrations measured from November 2007 to December 2008 increased by 1.8 ppt/yr and 0.6 ppt/yr, respectively.

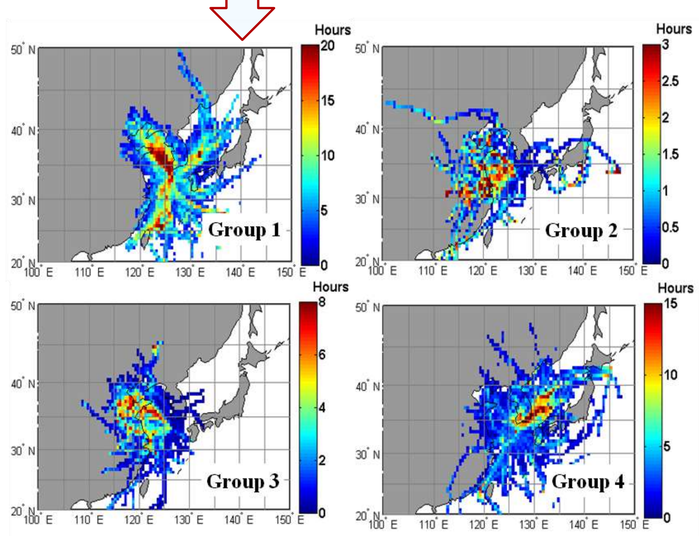
✓Pollution events of these compounds were observed, very frequently (e.g., ~2–3 times) at Gosan than baseline levels.

Comparison of HFC-23/HCFC-22 ratio with Trinidad Head, California, USA



HFC-23/HCFC-22 ratios which were divided into four groups by comparing their HFC-23/HCFC-22 ratio and HCFC-22 concentration with those observed at Trinidad Head, California.

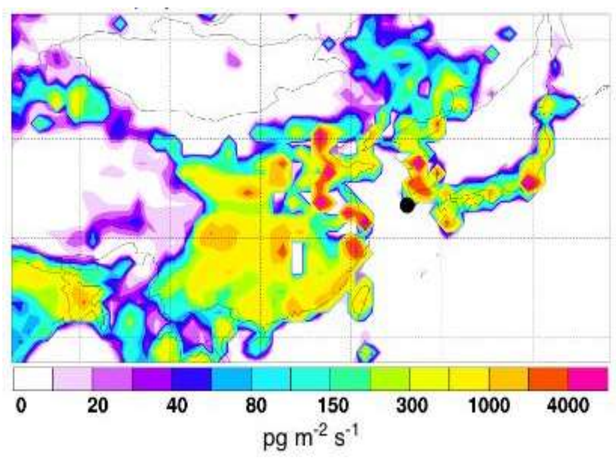
Back-trajectory 'residence time' analysis for these groups



- ✓ group 1 showing background conditions;
- ✓ group 2 and 3 distinguished by different travelling speed of air mass over China;
- ✓ group 4 originating from Japan/Korea were less HFC-23 is released from HCFC-22 production.

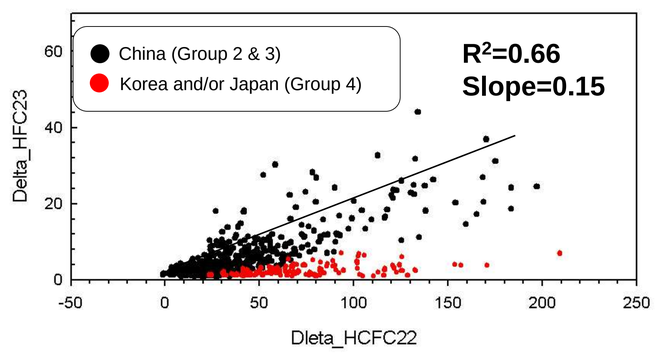
HFC-23/HCFC-22 can be used as a good Indicator for the assessment of pollution with Chinese origin !

Emission Estimate for HCFC-22 and HFC-23
- Inverse Model -



The emission rates of HCFC-22 were derived using Gosan measurements, modeling with a particle dispersion model (FLEXPART) and an inversion algorithm *[Kim et al., 2010].*

- HCFC-22 ratio based method -



If the emission rate of one species(reference tracer) is known, the emission rates of the other compounds can be calculated. HCFC-22, the most abundant HCFC in atmosphere, emission be obtained independently with reasonable certainty by the inverse modeling. HFC-23 emission was estimated by HCFC-22 based ratio method as follows:

$$E_{HFC\text{-}23}=E_{HCFC\text{-}22} \times (\Delta C_{HFC\text{-}23}/\Delta C_{HCFC\text{-}22})$$

- Global Perspective -

The emissions from China were 83 (64 - 109) Gg/yr for HCFC-22, 12 (8.6 - 15) Gg/yr for HFC-23. The HFC-23 values are surprisingly high, accounting for approximately 89% of global emissions. The contribution of HCFC-22 to the global emission is also high, accounting for approximately 23%.

Summary

The baseline concentrations at Gosan of remote sit show 208.3 ppt for HCFC-22, 22.1 ppt for HFC-23 during Nov. 2007 to Dec. 2008.

Our results suggest that the HFC-23/HCFC-22 ratio can be used as a good indicator for the pollution with Chinese origin.

References

Li, A., et al.(2010),Emission characteristics of HFC-23 (CHF3)/HCFC-22 (CHClF2) between Different Air masses in Northeastern Asia*., Journal of Korean Society for Atmospheric Environment, (in press)*

Kim, J., et al. (2010), **Regional Atmospheric Emissions Determined from Measurements at Jeju Island, Korea: Halogenated Compounds from China**, *Geophysical Research Letters*, 37, L12801, doi:10.1029/2010GL043263.