Regional Greenhouse Gases Observation Strategy of KMA

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1 Introduction

- Korea Meteorological Administration (KMA) has participated in the WMO/GAW program since 1996. As of 2009, two regional GAW stations, Anmyeon-do (47132) and Pohang (332), are operated.
- At Anmyeon-do station which is a main and integrated GAW observatory of KMA, various kind of atmospheric species are monitored with regard to several research fields such as greenhouse gases, reactive gases, aerosols, atmospheric radiation, precipitation chemistry, UV-radiation and stratospheric ozone. Pohang station is only for the observation of the total ozone concentration.

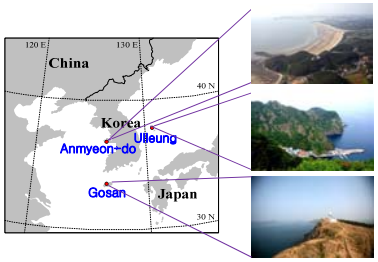


Fig. 1. Korean GAW network.

- Since an integrated GAW station can provide a lot of information to help comprehensive understanding, KMA tried to expand the state of the art GAW network as a result a new observatory at Gosan that is well known as a background supersite of ABC program and ACE-Asia project was established in 2008. Korean GAW network will be complete by 2010 establishing Ulleung-do station (Fig. 1)
- In addition, KMA have a plan to monitor CO2 concentration at the Antarctic King Sejong station at the end of 2009 in cooperation with the Korea Polar Research Institute.

Fig. 2. Antarctic King Sejong station

2 GHG Measurements

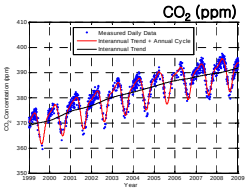
- Five species of greenhouse gases (CO_2, CH_4, N_2O, CFC-11 and CFC-12) and two additional gases (CFC-113, SF_6) have been measured at Anmyeon-do station since 1999 and since 2007, respectively. All of the GHG observation are based on continuous measurements.

	Station	Measurement	Data resolution	Period
CO_2	Anmyeon-do	NDIR	30 seconds	1999 ~ present
	Gosan	NDIR	30 seconds	2009 ~ present
CH_4	Anmyeon-do	GC-FID	30 minutes	1999 ~ present
N_2O	Anmyeon-do	GC-ECD	1 hour	1999 ~ present
CFC-11	Anmyeon-do	GC-ECD	1 hour	1999 ~ present
CFC-12	Anmyeon-do	GC-ECD	1 hour	1999 ~ present
CFC-113	Anmyeon-do	GC-ECD	1 hour	2007 ~ present
SF_6	Anmyeon-do	GC-ECD	1 hour	2007 ~ present

3 Result of GHG measurements

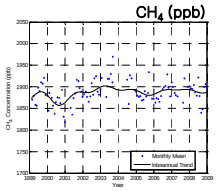
- Period : 1999 ~ 2008

CO_2 (ppm)



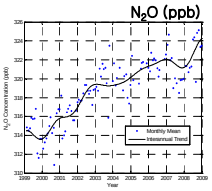
- Average of 2008 : 391.4 ppm
- Growth rate : 2.3 ppm/yr

CH_4 (ppb)



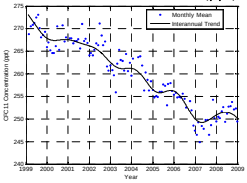
- Average of 2008 : 1888 ppb
- Growth rate : 1.9 ppb/yr

N_2O (ppb)



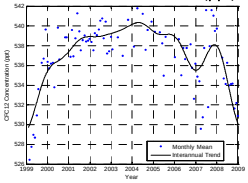
- Average of 2008: 322.6 ppb
- Growth rate : 1.0 ppb/yr

CFC-11 (ppt)



- Average of 2008 : 251.2 ppt
- Growth rate : −2.4 ppt/yr

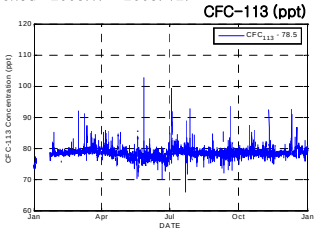
CFC-12 (ppt)



- Average of 2008: 534.3 ppt
- Growth rate : −0.02 ppt/yr

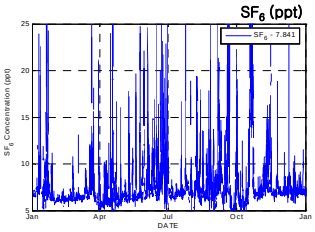
- Period : 2008.1. ~ 2008. 12.

CFC-113 (ppt)



- Average of 2008 : 78.5 ppt

SF_6 (ppt)

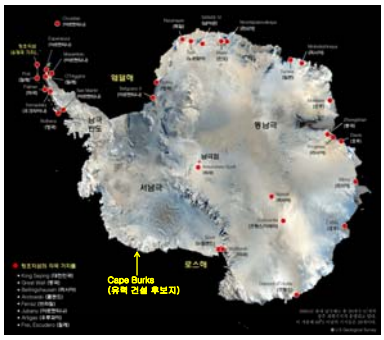


- Average of 2008 : 7.8 ppt

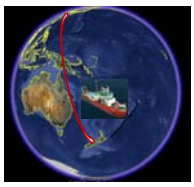
- Considering that the annual mean CO_2 concentration measured from Mauna Loa station was 385.6 ppm in 2008, that of Anmyeon-do in Korea was about 5.8 ppm high.
- It is found that N_2O steadily increased while CFC-11 and -12 evidently decreased.
- The fluctuation of SF_6 was highly depended on the down stream from the industrial complex and populated area.

4 Strategy of GHG obs.

- Expansion of observing newtwork
  - Canister sampling was carried out using the plane in very populated region in Korea.
  - Simultaneously, surface sampling was done. Therefore, the vertical distribution of greenhouse gases could be measured.
  - Continuous GHG measurement system for aviation and voyage was under development in cooperation with the Korea Research Institute of Standard and Sciences (KRISS).



  - The Korea Polar Research Institute has operated not only the King Sejong station in South Pole but also the Dasan station in North Pole. In addition, establishment of a new station at the Cape Burks in South Pole is planned.
  - Considering that the region of the planned second Antarctic station at Cape Burks is the quick melting region and data sparse area, it will give significant and meaningful data.
  - In addition, cooperation between KMA and the Korea Polar Research Institute will allow the horizontal observation using the ship measurement from North Pole to South Pole.
  - It is expected that the ship measurement gives the north-south distribution of the greenhouse gases and helps the understanding of the global distribution of them.



- Expansion of the species of greenhouse gases and employment of anew measurement.
  - The KMA has a plan to increase the monitored species of greenhouse gases in cooperation with the KRISS.
  - The KMA will officially operate the measuring system for new species after the KRISS finish the research and development of the GHG national standards.
  - CF_4 continuous measuring system will be operated by 2010.

	Station	Period
CF_4	Anmyeon-do	2010 ~
HFC-23	Anmyeon-do	2012 ~
HFC-134a	Anmyeon-do	2013 ~
δ13C, δ18O	Anmyeon-do	2014 ~
HFC-152a	Anmyeon-do	2015 ~

  - A brand-new measurement system, so called Cavity Ring-Down Spectrometer (CRDS) made by PICARRO, was preliminary operated.
  - The CRDS provided considerably longer stable measurement than the NDIR as well as easy-to-use.
  - In the result of the preliminary comparison between CRDS and NDIR, the CRDS showed similar accuracy and performance to measure CO_2 without periodical calibration compared with the NDIR.
  - It is planned to operate the CRDS to measure CO_2, CH_4 and H_2O at the Gosan station from OCT 2009.
- Invitation of Central Calibration Laboratory (CCL) and World Calibration Center (WCC).
  - The KMA has operated the regional GAW stations as a responsible national agency and the KRISS has contributed to the development of the GHG standard scale and showed the excellent performance in the inter comparison among national standard organizations over the world.
  - Since there are no world central facilities for CFCs and SF_6, the KMA and KRISS want to contribute to WMO by inviting the WCC to KMA and CCL to KRISS.

Table 1: Overview of the GAW World Central Facilities (as of May 2007). The World Central Facilities have assumed global responsibilities, unless indicated (Am: Americas; E/A: Europe and Africa; A/O: Asia and the South-West Pacific).

Variable	QA/SAC	Central Calibration Laboratory (CCL) Host of Primary Standard	World Calibration Centre (WCC)	Regional Calibration Centre (RCC)	World Data Centre (WDC)
CO_2	JMA (A/O)	ESRL	ESRL		JMA
CH_4	Empa (Am, E/A) JMA (A/O)	ESRL	Empa (Am, E/A) JMA (A/O)		JMA
N_2O	UBA	ESRL	IMK-IFU		JMA
CFCs, HCFCs, HFCs					JMA

(from GAW report No. 172, pp 18.)