

**The 3<sup>rd</sup> Asian GAW Workshop on Greenhouse Gases**

# **Greenhouse Gases Monitoring Activities of Korea Global Atmosphere Watch Center (KGAWC) in 2010**



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**Contents**

- Introduction of Korea Global Atmosphere Watch Center (KGAWC)
- Results of Greenhouse Gases Monitoring Activities in 2010
- Development of Technology for Long-term monitoring and assessment of Carbon dioxides

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### Introduction about KGAWC

#### Organization :

Korea Meteorological Administration(KMA)/  
Climate Science Bureau/

Climate Policy Division

Climate Prediction Division

Korean Peninsula Weather and Climate Division

Korea Global Atmosphere Watch Center (KGAWC)

KGAWC is one of the WMO/GAW regional stations (station name : Anmyeon-do)

#### Geographical location :

The center of west coast of Korean Peninsula  
Latitude is 36 N, Longitude 126 E  
Height station baseline is 45.7 m



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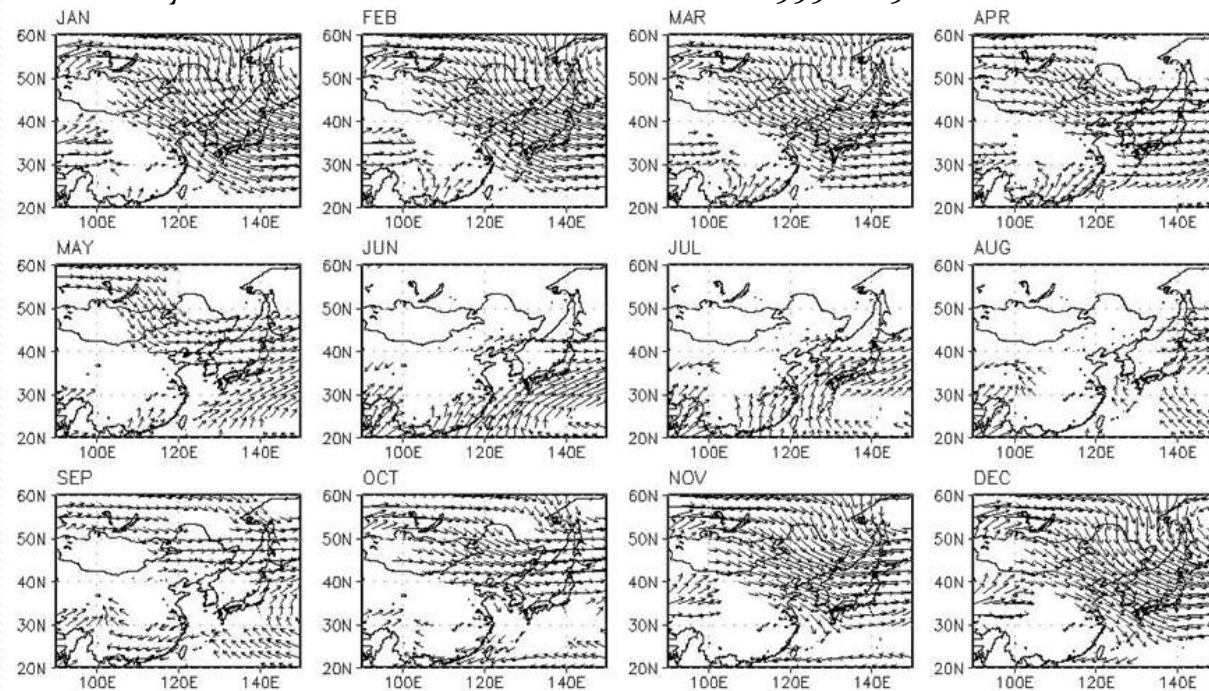
## Introduction about KGAWC

### Meteorological Location :

#### Seasonal wind streams over the Korean Peninsula

1. Winter : **northwest** wind stream
2. Summer : **southwest** wind stream
3. Spring and Autumn : **west** wind stream
4. Wind depended on synoptic weather pattern : Easterlies (East wind stream)

#### Monthly mean wind over the Korean Peninsula for 1999-2009



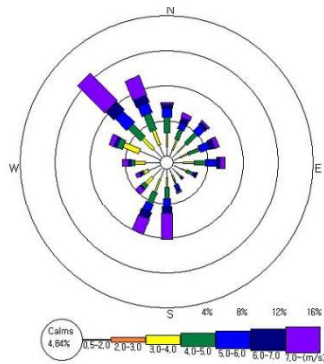
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## Introduction about KGAWC

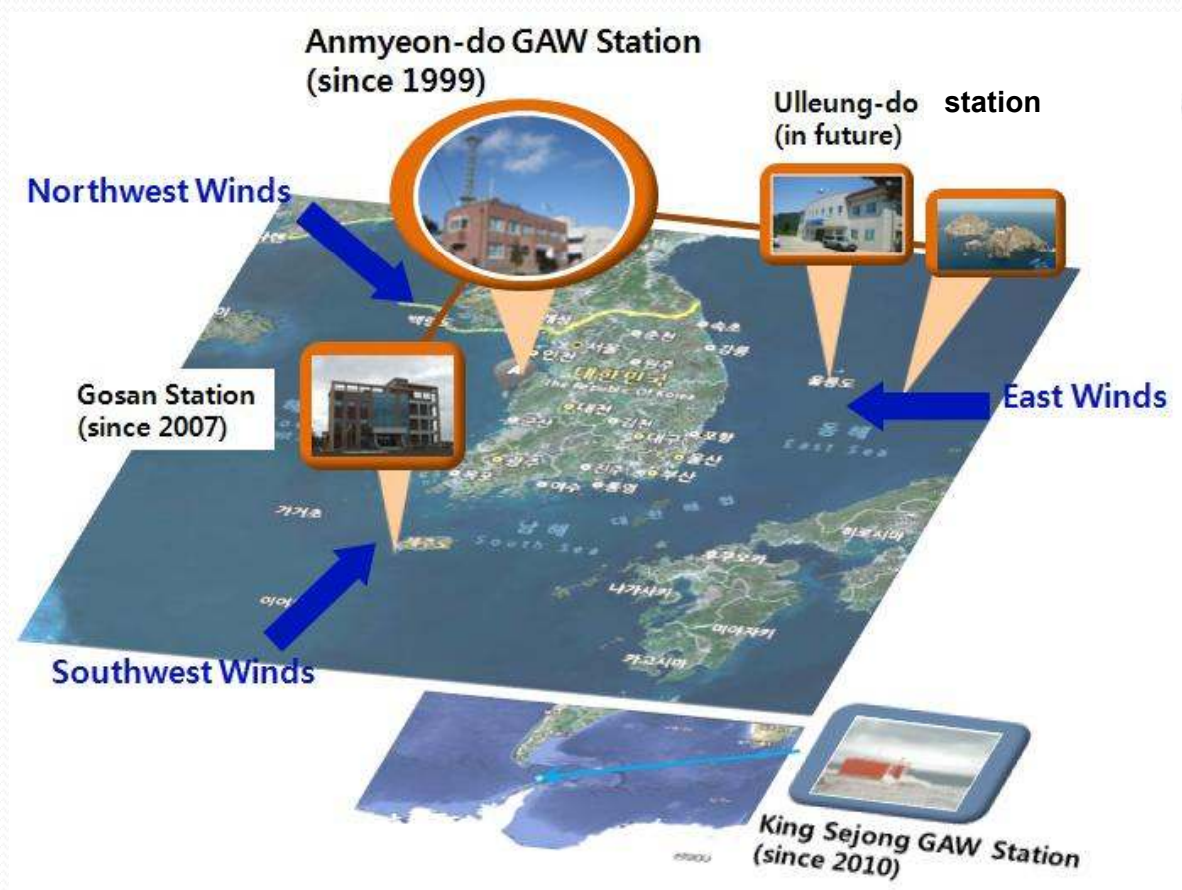
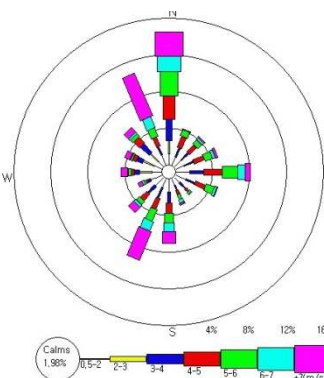
### Meteorological Location :

### Wind Rose in Anmyeon-do station

#### 2009



#### 2010



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## Introduction about KGAWC

### KGAWC's Systems for Measuring GHGs

#### 1. Air Sampling Systems

- 40m Toll tower
- Inlet system
- Pumping system

#### 2. Dehumidification Systems

- Cooler system
- Chemical trap system
- Nafion drier

#### 3. Measuring Systems

- Gas analyzer
  - GC (Gas Chromatography)
  - NDIR (Non-dispersive infrared sensor)
  - CRDS (On testing)
- Standard Gas
  - KRISS Standard scale (CO<sub>2</sub> etc.)
  - WMO mole fraction Scale (SF<sub>6</sub>)

#### 4. QA/QC Systems

Based on GAW report No. 184

#### 1. Air Sampling



40m Toll tower



Flask Air Sampling System

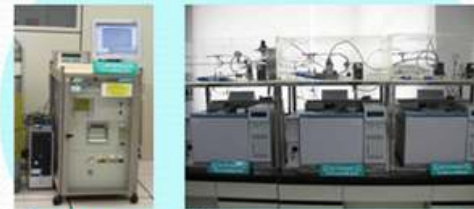
#### 2. Dehumidification



Magnesium perchlorate  
Mg(ClO<sub>4</sub>)



#### 3. Measurement

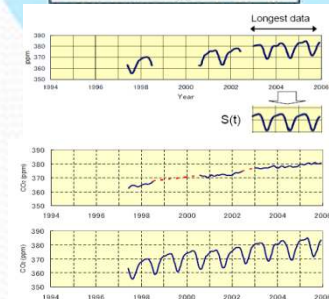
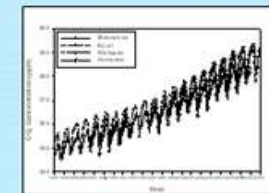


NDIR(CO<sub>2</sub>) GC(CH<sub>4</sub>, N<sub>2</sub>O, CFCs)



GC/MSD (SF<sub>6</sub>)

#### 4. Data QA/QC



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## Introduction about KGAWC

### Recent contribution of KMA on WMO/GAW program

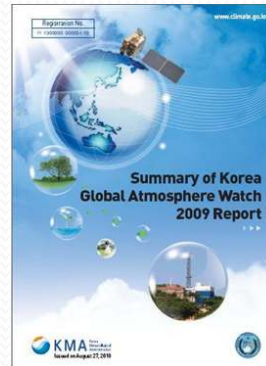
1. International Workshop: *the Asian GAW Workshop on Greenhouse Gases*
2. Publication, *Summary of Korea Global Atmosphere Watch 2010 Report*
3. Contribution to GAW
  - *Asian GAW Greenhouse Gases Newsletter*
  - CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, CO, SF<sub>6</sub> reference gas intercomparion (WMO)
  - Methane reference gas intercomparison for Asia (JMA)
  - Data sharing to WDCGG (JMA)



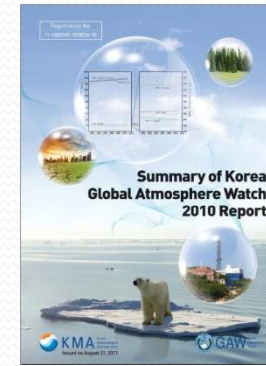
The 1<sup>st</sup> Asian GAW workshop in 2009



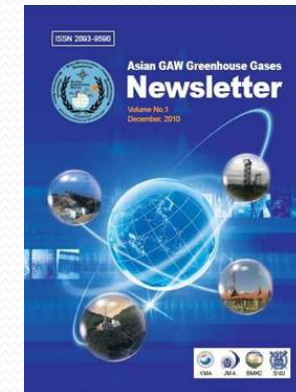
The 2<sup>nd</sup> Asian GAW workshop in 2010



Summary report in 2010



Summary report in 2011

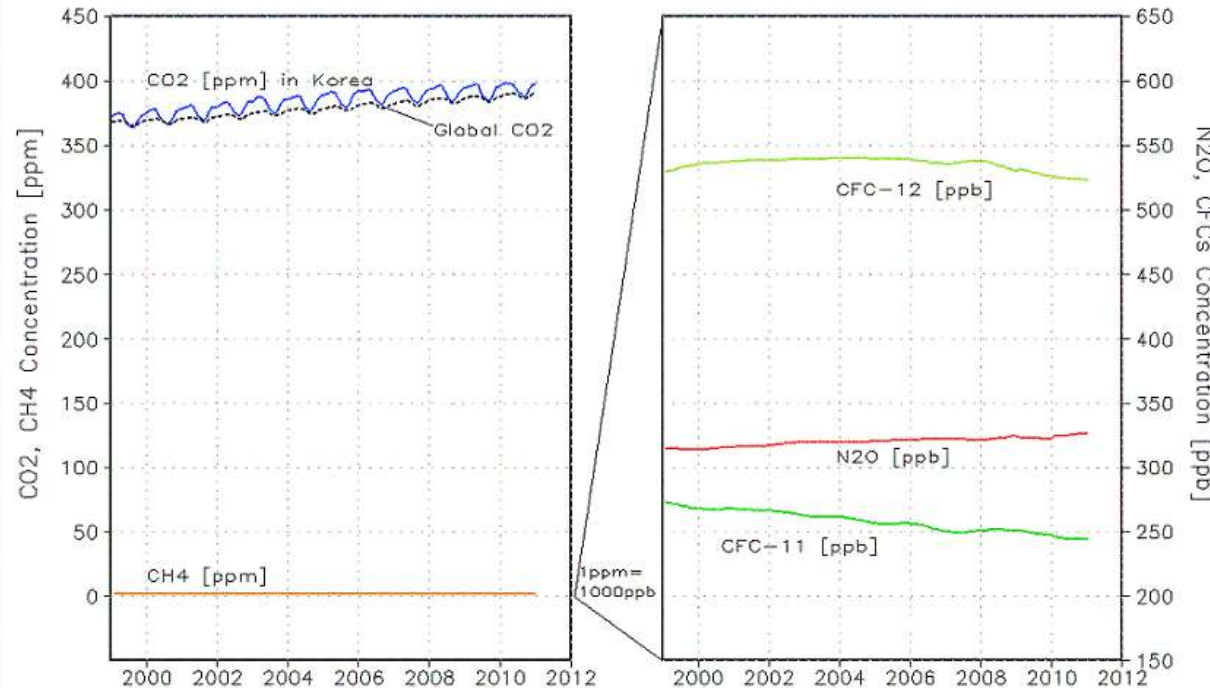


Newsletter (published in 2010)

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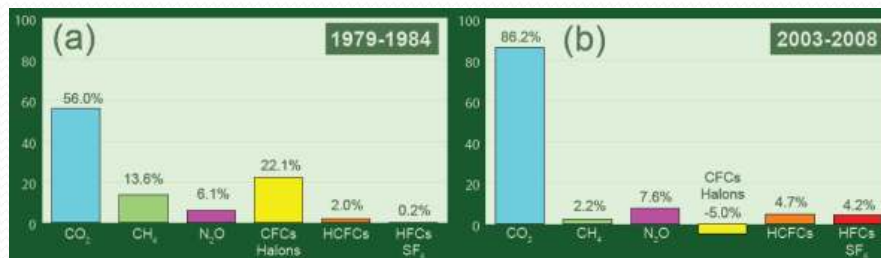
## Results of Greenhouse Gases Monitoring

### Change of Greenhouse Gases concentration in Anmyeon-do for 1999-2010



- Changes of GHGs (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, CFCs) concentrations for 1999-2009.

CO<sub>2</sub> has gradually increased from 370.7 ppm in 1999 to 394.5 ppm in 2010



※ Radiative forcing by GHGs for different periods.  
(GAW Greenhouse Gases Bulletin, 2010)



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# Results of Greenhouse Gases Monitoring

Table 1. Anmyeon-do and global CO<sub>2</sub> concentrations (ppm) and annual mean CO<sub>2</sub> growth rates for 1999-2010.

Year		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Anmyeon -do	Concentration (ppm)	370.7	373.8	376.9	379.7	382.6	384.3	387.2	388.7	389.9	391.4	392.5	394.5
	Growth rate (ppm/year)	+2.9	+3.4	+2.8	+3.2	+2.1	+2.4	+2.1	+1.5	+1.6	+1.2	+0.9	+2.0
Global mean	Concentration (ppm)	367.6	368.8	370.3	372.4	374.9	376.7	378.8	380.9	382.7	384.8	386.3	388.6
	Growth rate (ppm/year)	+1.4	+1.2	+1.9	+2.4	+2.2	+1.6	+2.4	+1.8	+2.1	+1.8	+1.8	+2.4

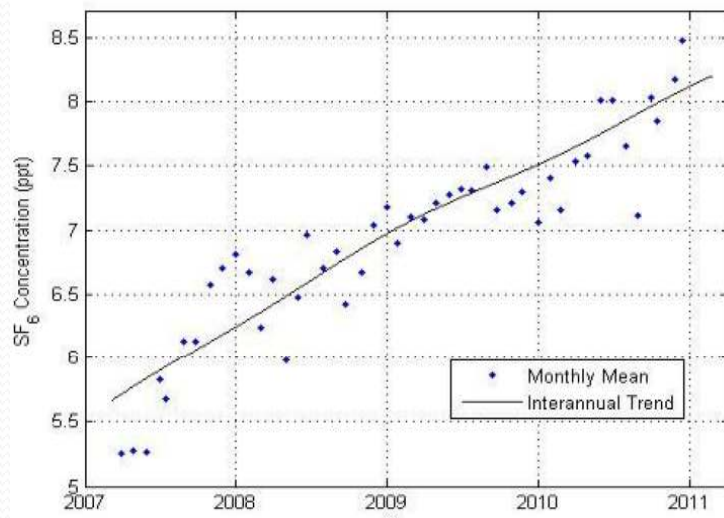
Table 2. Average concentrations for 2010 and annual mean growth rates for the 12-year period from 1999 through 2010 of major GHGs in the background atmosphere of the Korean Peninsula.

GHGs	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	CFC-11	CFC-12
Average concentrations in 2010	394.5 (ppm)	1.914 (ppm)	325.2 (ppb)	244.7 (ppt)	524.2 (ppt)
12-year avg. growth rates	+2.12 (ppm/year)	+0.00320 (ppm/year)	+0.96 (ppb/year)	-2.30 (ppt/year)	-0.84 (ppt/year)

- mean concentration for 2010 and annual mean growth rate averaged for 1999-2010.

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SF<sub>6</sub> concentration in Anmyeon-do for 2007-2010.



SF<sub>6</sub> concentration in 2010 is 7.8 ppt  
SF<sub>6</sub> increased by 0.6 ppt from 7.2 ppt in 2009.



Monthly mean mole fraction of sulphur hexafluoride (SF<sub>6</sub>) from 1995 to 2009 averaged over 15 stations (WMO Greenhouse Gas Bulletin, 2010)

-Sulphur hexafluoride (SF<sub>6</sub>) is a potent long-lived greenhouse gas controlled by the Kyoto Protocol. It is produced artificially and used as an electrical insulator in power distribution equipment. Its mixing ratio has increased to double that in the mid-1990s.

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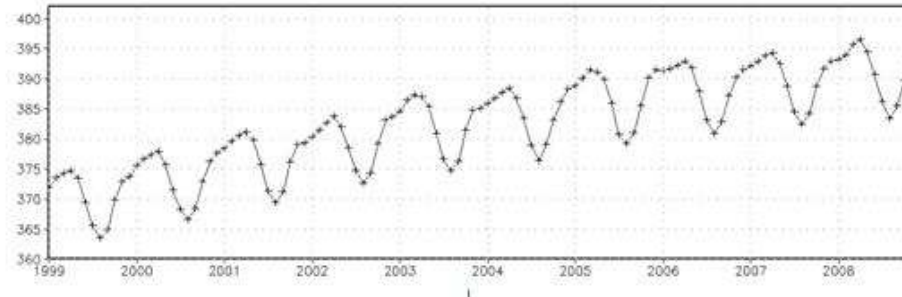
# Development of Technology for Long-term monitoring and assessment of Carbon dioxides

**Table 3.1 Highlights of possible climate impacts discussed in this chapter**

Temp rise (°C)	Water	Food	Health	Land	Environment	Abrupt and Large-Scale Impacts
1°C	Small glaciers in the Andes disappear completely, threatening water supplies for 50 million people	Modest increases in cereal yields in temperate regions	At least 300,000 people each year die from climate-related diseases (predominantly diarrhoea, malaria, and malnutrition)  Reduction in winter mortality in higher latitudes (Northern Europe, USA)	Permafrost thawing damages buildings and roads in parts of Canada and Russia	At least 10% of land species facing extinction (according to one estimate)  80% bleaching of coral reefs, including Great Barrier Reef	Atlantic Thermohaline Circulation starts to weaken
2°C	Potentially 20 - 30% decrease in water availability in some vulnerable regions, e.g. Southern Africa and Mediterranean	Sharp declines in crop yield in tropical regions (5 - 10% in Africa)	40 - 60 million more people exposed to malaria in Africa	Up to 10 million more people affected by coastal flooding each year	15 - 40% of species facing extinction (according to one estimate)  High risk of extinction of Arctic species, including polar bear and caribou	Potential for Greenland ice sheet to begin melting irreversibly, accelerating sea level rise and committing world to an eventual 7 m sea level rise
3°C	In Southern Europe, serious droughts occur once every 10 years  1 - 4 billion more people suffer water shortages, while 1 - 5 billion gain water, which may increase flood risk	150 - 550 additional millions at risk of hunger (if carbon fertilisation weak)  Agricultural yields in higher latitudes likely to peak	1 - 3 million more people die from malnutrition (if carbon fertilisation weak)	1 - 170 million more people affected by coastal flooding each year	20 - 50% of species facing extinction (according to one estimate), including 25 - 60% mammals, 30 - 40% birds and 15 - 70% butterflies in South Africa  Collapse of Amazon rainforest (according to some models)	Rising risk of abrupt changes to atmospheric circulations, e.g. the monsoon  Rising risk of collapse of West Antarctic Ice Sheet  Rising risk of collapse of Atlantic Thermohaline Circulation
4°C	Potentially 30 - 50% decrease in water availability in Southern Africa and Mediterranean	Agricultural yields decline by 15 - 35% in Africa, and entire regions out of production (e.g. parts of Australia)	Up to 80 million more people exposed to malaria in Africa	7 - 300 million more people affected by coastal flooding each year	Loss of around half Arctic tundra  Around half of all the world's nature reserves cannot fulfil objectives	
5°C	Possible disappearance of large glaciers in Himalayas, affecting one quarter of China's population and hundreds of millions in India	Continued increase in ocean acidity seriously disrupting marine ecosystems and possibly fish stocks		Sea level rise threatens small islands, low-lying coastal areas (Florida) and major world cities such as New York, London, and Tokyo		
More than 5°C	The latest science suggests that the Earth's average temperature will rise by even more than 5 or 6°C if emissions continue to grow and positive feedbacks amplify the warming effect of greenhouse gases (e.g. release of carbon dioxide from soils or methane from permafrost). This level of global temperature rise would be equivalent to the amount of warming that occurred between the last age and today - and is likely to lead to major disruption and large-scale movement of population. Such "socially contingent" effects could be catastrophic, but are currently very hard to capture with current models as temperatures would be so far outside human experience.					

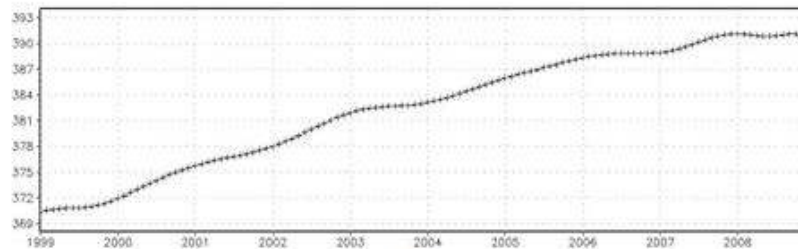
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# Development of Technology for Long-term monitoring and assessment of Carbon dioxides

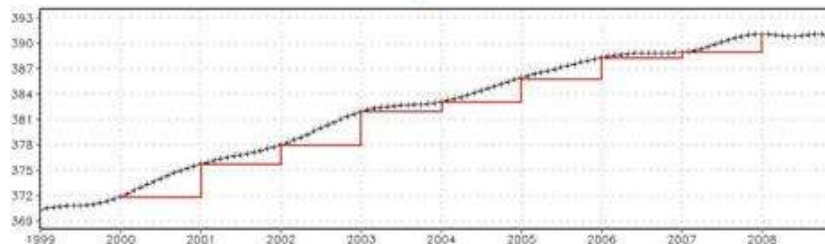
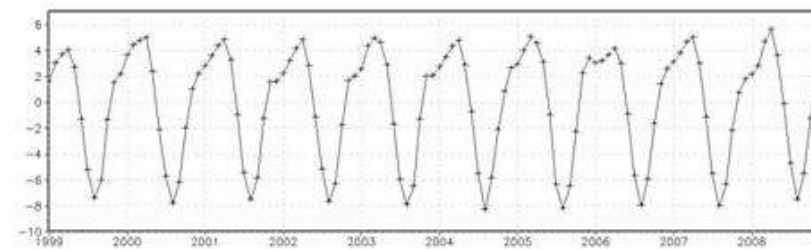


Carbon dioxides concentration data observed in GAW station

Cut off High frequency variation  
Anthropogenic CO<sub>2</sub> emission



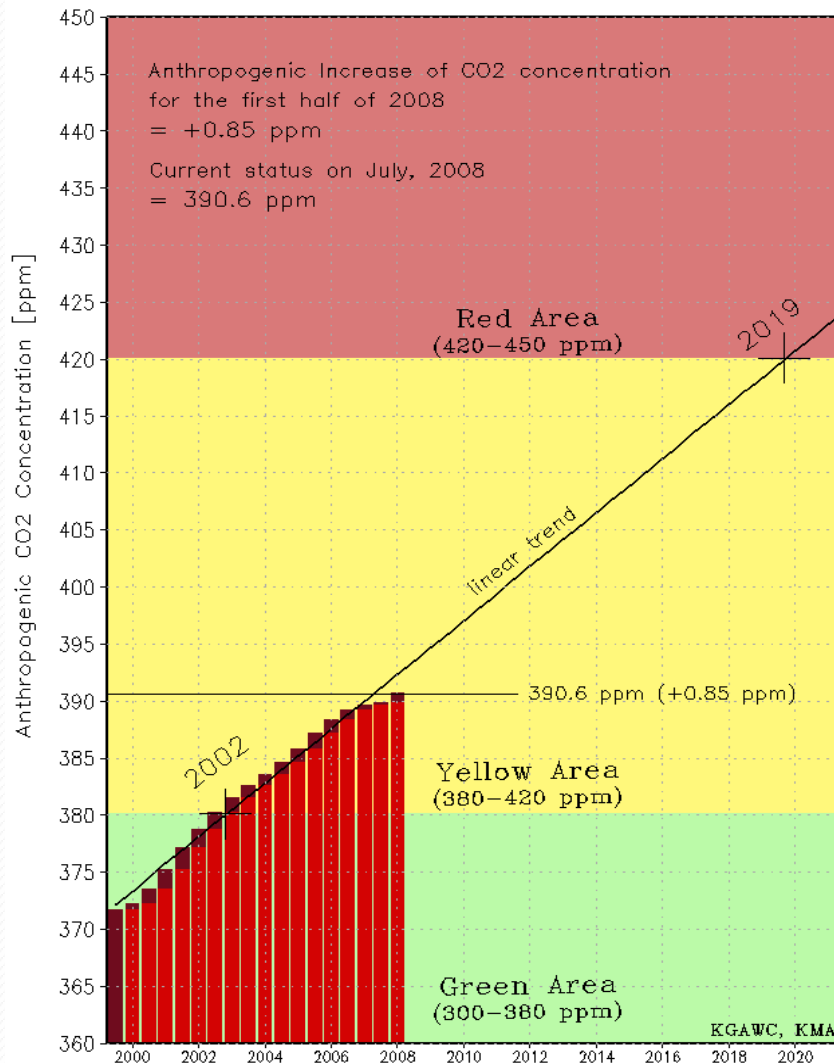
Residual  
Effects of transportation and vegetation



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# Development of Technology for Long-term monitoring and assessment of Carbon dioxides

### Long-term monitoring and Assessment of Carbon Dioxides



- Information of Carbon dioxides for the public  
Our results is CO<sub>2</sub> concentration around the Korean peninsula goes up the red level in 2019 and the human will face on serious risks induced by climate change.

level	Concentration range	Impacts
Red level	420-450 ppm (~2°C)	<p>-This level is a very dangerous level near 450 ppm which global mean temperature can be increased to 2°C.</p> <p>Water : Potentially 20-30% decrease in water availability in some vulnerable regions, e.g. Southern Africa and Mediterranean</p> <p>Food : Sharp declines in crop yield in tropical regions (5-10% in Africa)</p> <p>Health : 40-60 million more people exposed to malaria in Africa</p> <p>Land : Up to 10 million more people affected by coastal flooding each year</p> <p>Environment : 15-40% of Species facing extinction (According to one estimate) High risk of extinction of Arctic species, including polar bear and caribou</p>
Yellow level	380-420 ppm	
Green level	280-380 ppm	



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**KMA**  
**KGAWC**

Thank you

