GAW Activities in Korea

Oct. 20, 2014
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Korea Global Atmosphere Watch Center (KGAWC)
Climate Science Bureau (CSB)
Korea Meteorological Administration (KMA)

KGAWC
- Stations AMY (HQ), JGS, ULL
- Personnel 25
History of KGAWC

- **1987. 1.** Establishment of a weather station at Mt. Soback (Purpose of air pollution measurements)
- **1996. 9.** Movement from Mt. Soback to Anmyeondo
  Beginning of background atmosphere watch at Anmyeondo
- **1998. 4.** Continuous measurement of greenhouse gases and radiation (CO₂, CH₄, N₂O, CFC-11,12, designated a regional GAW station)
- **2003. 12.** Sampling from 40 m tower (AGL) (~86 m ASL)
- **2007. 1.** Beginning of continuous measurement of CFC-113 and SF₆
  Aerosol sampling from the integrated inlet system
- **2009. 1.** Operation of the Jeju Gosan (JGS) station
- **2012. 10.** Establishment of the WMO World Calibration Center for SF₆
- **2014. 5.** Operation of the station at Ulleungdo
Korea Global Atmosphere Watch Center

Observatories of KGAWC
GAW Stations in Korea

- 6 regional GAW stations in the Korean Peninsula
- 1 contributing GAW station
- 1 regional GAW station in Antarctica

King Sejong (KSG), Antarctica: GHGs, Strat. Ozone

Taeahn Peninsula (TAP)
- GHGs

Anmyeon-do (AMY)

Gosan (GSN)
Jeju Gosan (JGS)

Daejeon (DJN)
- Aerosols

Seoul (SEO)
- Strat. Ozone, UV

Pohang (POH)
- Strat. Ozone, UV

Main and Auxiliary Stations of KGAWC

- **Main stations**
  - AMY, JGS, ULL

- **Auxiliary stations (KMA)**
  - B : Strat. Ozone, UV
  - C : Precip. Chem.
  - D : Ozone sonde, UV
  - F : UV

- **Auxiliary stations (Univ.)**
  - A : CO2 flux, Strat. Ozone, UV
  - E : Aerosol LIDAR, AOD
  - G : Radon
  - H : CO2, Strat. Ozone

- 3 main stations and 8 auxiliary stations in the Korean Peninsula
- 1 auxiliary station in Antarctica

- Anmyeondo (AMY)
- Jeju Gosan (JGS)
- Gosan
- Ulleungdo (ULL)
- Seoul
- Gangneung
- Uljin
- Pohang
- Mokpo
- Gwangju
- Gangneung
- Jeju
- Gosan
- H. Antarctica (King Sejong)
Help understand variation in the atmospheric composition over N.E. Asia!!
Measurement Programs in KGAWC
Measurement Programs on GAW

**Greenhouse Gases**

- CO₂, CH₄, N₂O,
- CFC₁₁, 12, 113, SF₆

**Reactive Gases**

- SO₂, CO, NOx, O₃

**Aerosols**

- Physical, chemical, optical properties

**Ozone & UV**

- UV-A, UV-B
- Stratospheric Ozone

**Precipitation Chemistry**

- Acidity, Conductivity
- F⁻, Cl⁻, NO₃⁻, SO₄²⁻,
- Na⁺, NH₄⁺, K⁺, Mg²⁺, Ca²⁺

**Atmospheric Radiation**

- Direct/ diffuse sunlight
- Solar/Terrestrial radiation
- Net radiation
Anmyeondo (AMY) Station

Tower (40m) inlets for gases
Lat.: 36.538 86° (36°32'19.9")
Lon.: 126.329 95° (126°19'47.8")
ASL: 85.119 m

Ground-based RS: Brewer, Sunphotometer, PFR
Lat.: 36.538 65° (36°32'19.1")
Lon.: 126.330 05° (126°19'48.2")
ASL: 56.496 m

Atmospheric Radiation
Lat.: 36.538 46° (36°32'18.5")
Lon.: 126.329 95° (126°19'47.8")
ASL: 47.026 m

AWS, Inlets for aerosols Aerosol LIDAR
Lat.: 36.538 79° (36°32'19.7")
Lon.: 126.330 22° (126°19'48.8")
ASL: 57.697 m

FTS (KMA/NIMR)
Lat.: 36.538 22° (36°32'17.6")
Lon.: 126.331 02° (126°19'51.7")
ASL: 23.810 m
Jeju Gosan (JGS) Station

Lat./Lon.: 33° 18’N / 126 ° 12’E

- **Atmospheric radiation**
  - UV-A, UV-B, PFR
  - Solar/ Terrestrial radiation

- **Precipitation chemistry**
  - Acidity, Conductivity, Ions

- **Greenhouse gases**
  - CO₂, CH₄, N₂O

- **Reactive gases**
  - CO, SO₂, NOₓ, O₃

- **Aerosols**
  - PM₁₀, APS (0.5-20 µm), CPC (0.01-3 µm)
  - AOD
Ulleungdo Station

Greenhouse gases: CO$_2$, CH$_4$, N$_2$O, SF$_6$

Reactive gases: CO, SO$_2$, NOx, O$_3$

Aerosols: PM$_{1,2.5,10}$, AOD, APS (0.5-20 $\mu$m)

Radiation
- UV-A, UV-B, PFR
- Solar/Terrestrial radiation

Precipitation chemistry
- Acidity, Conductivity, Ions
Greenhouse Gases (GHGs)

- CRDS (Cavity Ring Down Spectroscopy)
  - Picarro G2301 (with H₂O), Resol. 5 sec

- GC-ECD (Gas Chromatography – Electron Capture Detector)
  - Resol. 1 hr

Every 4 hours, automatically (similar level of background)
Reactive Gases

- **NOx**: Gas-phase Chemiluminescence
  - Resol. 5 min (42i-TL, Thermo Sci.)

- **SO₂**: Ultraviolet Fluorescence
  - Resol. 5 min (43i-TLE, Thermo Sci.)

- **O₃**: Ultraviolet Photometer
  - Resol. 5 min (49i, Thermo Sci.)

- **CO**: Nondispersive Infrared Photometer (NDIR)
  - Resol. 5 min (48i-TLE, Thermo Sci.)

→ changing to

CRDS (G2401, CO/CO₂/CH₄/H₂O)
Aerosols

- Scanning Mobility Particle Sizer: 0.01-0.5 nm, 54 Ch.
- Aerodynamic Particle Sizer: 0.5-20 μm, 52 Ch.
- Grimm Dust-monitor: 0.25-32 μm, 31 Ch.
- Nephelometer: 3 wavelengths (RGB)
- Aethelometer
- β-ray PM$_{10}$, PM$_{1}$, PM$_{2.5}$, PM$_{10}$ (Grimm Dust-monitor)
- High Volumn Sampler (TSP, PM10, PM2.5, 1 day/ 1 week)
- Sunphotometer: 5 Ch. (368, 500, 675, 778, 862 nm)
- Precision Filter Radiometer: 4 Ch. (368, 412, 500, 862 nm)
- Aerosol LIDAR (1064, 532 nm)
  - Backscattering coeff., Depolarization ratio, Color ratio
Stratospheric Ozone

Brewer #213  Anmyeon, KMA

Brewer #161  WMO/GO3OS Stn No. 332. Pohang, KMA

Brewer #196  Jeju Gosan, KMA

Ozonesonde Model 5A ECC Pohang, KMA
Atmospheric Radiation & UV

- **UV-A**  
  UV-Biometer (320-400 nm)  
  UV-Biometer (280-320 nm)

- **Direct / Diffuse Solar**  
  Pyheliometer (200-2800 nm)  
  Shadow band Pyranometer (305-2800 nm)

- **Radiation balance**  
  Pyranometer, Pyrgeometer (3-50 μm)  
  Net Pyradiometer (0.3-50 μm)

Integrating surface radiation system for upward/downward radiation measurements
Precipitation Chemistry

Automatic Dry & Wet Sampler
- wet (at precipitation), dry (monthly)

- pH meter
- Conductivity meter
- Ion Chromatography
- F⁻, Cl⁻, NO₃⁻, SO₄²⁻, Na⁺, NH₄⁺, K⁺, Mg²⁺, Ca²⁺
- Trust tests

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WCC & Other Activities
KMA/KGAWC has measured SF$_6$ since 2007, was designated as the WCC-SF$_6$ in 2012, and got started with its operation in 2013.
Operation of WCC-SF₆

- WMO CCL (NOAA/ESRL)
- WMO GAW Secretariat

KRISS (Technical support)

WCC-SF₆ (KMA/KGAWC)

Intercomparison of standard gases
Discussion on analytical techniques

Audit
Technical support

WMO GAW Regional Training Center for SF₆

Data classification and collection

GAW Stations

WDCGG (JMA)
Asia-Pacific GAW Workshop

The 1st Asian GAW workshop in 2009

The 2nd Asian GAW workshop in 2010

The 3rd Asian GAW workshop in 2011

The 4th Asian GAW workshop in 2012

The 5th Asian-Pacific GAW workshop in Jeju, Korea, 2013

5th: 11 countries, 64 people

News Letter & ?????

6th: 14 countries, ~70 people
We are making this kinds of graphs for other components in the various fields of GAW, and improving/developing techniques for the GAW activities.
Summary (2 of 2)

- 7 GAW regional stations in Korea
- Operate the 3 main and 7 auxiliary stations related to GAW
- Focus on 6 fields in GAW; GHGs, reactive gases, aerosols, strat. ozone & UV, atmospheric radiation, and precipitation chemistry.
- Operate WCC-SF6
- Hold the Asia-Pacific GAW Workshop
Future Plan

**Isotopes:** $\delta^{13}C$ for CO2 and CH4, $\delta^{15}N$, $\delta^{15}N\alpha$, $\delta^{15}N\beta$ for N2O

**Reactive gases:** VOCs

**Aerosols:** Chemical components, CPC, CCNC

**GHGs, Reactive gases in 2014 → Aerosols in 2015 → Precip. Chem. in 2016**

**Multi-wavelength LIDAR:** Aerosols

**FTIR:** GHGs

- **Atmosphere:** Temp., Precip.
- **Ocean:** Sea level, Surf. temp., Acidity
- **Surface:** Soil moisture, surface reflectivity
- **Cryosphere:** Glaciers, Snow cover
- **Carbon and Other Biogeochemical Cycles**
- **Ecosystem Change**
감사합니다

Thank you!