Summary of Korea Global Atmosphere Watch

2014 Report

KMA

영문 요약

☐ Greenhouse gases

The Anmyeondo global atmosphere watch (GAW) station has been monitoring seven greenhouse gases including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), three chlorofluorocarbons (CFC-11,12,113), and sulfur hexafluoride (SF_6) since 1999. Measurements of greenhouse gases such as CO_2 and CH_4 began at the Gosan station in 2012, and at the Ulleungdo Dokdo and the Dokdo stations in 2013. The annual mean concentrations of CO_2 are as follows: Anmyeondo (404.8 ppm) > Gosan (404.2 ppm) > Dokdo (403.3 ppm) ≥ Ulleungdo Dokdo (403.1 ppm). The average value measured at Ulleungdo was 1.7 ppm lower than that at Anmyeondo. Growth rate of CO_2 concentration at Anmyeon is 2.09 ppm/yr during the last decade, similar to the global growth rate of 2.07 ppm/yr during the same period. The annual average concentrations of greenhouse gases were increased from 2013 to 2014, rising to 1,970 ppb (△12.7 ppb) for CH_4, 327.2 ppb (△1.1 ppb) for N_2O, and 9 ppt (△0.4 ppt) for SF_6. On the other hand, the annual mean concentrations of chlorofluorocarbons, which are regulated in accordance with the Montreal Protocol, declined to 228.3 ppt (▽7.8 ppt) for CFC-11, 514.0 ppt (▽0.4 ppt) for CFC-12, and 72.2 ppt (▽1.5 ppt) for CFC-113. The concentrations of those gases in the atmosphere have continued to drop, marking the lowest annual average concentrations since observations began in 1999.

☐ Reactive gases

Reactive gases belong to the main observation parameters in the GAW due to their effect on air quality, and because they also act as precursors to generate greenhouse gases and aerosols. Their relatively short life time in the atmosphere results in wide regional differences. The Anmyeondo and Gosan stations began measuring carbon monoxide (CO), nitrogen oxides (NO_X), sulfur dioxide (SO_2), and surface ozone (O_3) in 2004 and 2012, respectively. The annual concentration of O_3 at Anmyeondo had remained nearly the same until 2010, but since then, has gradually fallen. It declined to 33.5 ppb in 2014, down 7.2 ppb (22.2%) from the previous year. The annual mean concentration of O_3 monitored at Gosan increased to 44.8 ppb by 3.4 ppb (7.5%) from a year earlier, and was higher than that found at Anmyeondo. While the mean concentration of NO_X at Anmyeondo dropped to 5 ppb in 2014, 1.3 ppb (27%) lower than the previous year, at Gosan it was similar to that (3.4 ppb) of 2013. As for CO, the annual mean was 306.5 ppb at Anmyeondo, nearly the same as it was in 2013, while that at Gosan was 217 ppb, up 16.4 ppb(7.6%) from a year earlier. The average annual concentration of SO_2 at Anmyeondo was 1.7 ppb in 2014, a 0.8 ppb drop(−48%) compared that in 2013, and at Gosan it was measured at 0.5 ppb, lower than that of Anmyeondo and similar to that in 2013.

☐ Atmospheric radiation

Monthly averages of direct solar radiation measured in January, March, May and June in 2014 was higher than those in 2013, but, in the other months, showed lower or similar figures compared to those in 2013. The annual mean in 2014 was lower than that during the last 15 years (from 1999 to 2013) and also in 2013. Scattered

solar radiation was higher in December, January, February, June and July than in 2013, and the annual average in 2014 was higher than that during the last 15 years and in 2013. Solar downward radiation in March, April, and August was higher than usual while in the other months it was higher than in a typical year. Solar downward and upward radiations were lower than usual. Net radiation was higher in May, June and July but remained nearly the same in the other months. At Gosan, the monthly direct solar radiation in 2014 was similar to that of a typical year but was higher in May and June than usual. The annual mean direct solar radiation was lower than the average during the last six years (from 2008 to 2013) and the average for 2013. Scattered solar radiation was low in the winter but high in the summer.

□ Aerosols

Secular variations in aerosol mass concentration observed in Anmyeon have shown a slightly declining tendency, and the data for 2014 display trends generally are similar to those of the previous year. In terms of seasonal variation, aerosol mass concentrations in the spring were high due to air stagnation and a migratory anticyclone coming from the Asian continent, but soon decreased and remained a little low due to an influx of clean air and the washing effects of rain. The values for Aerosol Optical Depth (AOD) were higher in spring and relatively low in autumn and winter. When collecting air, the values of PM2.5 exceeded the average of normal years, and component analysis showed high concentrations of NO_3^-, SO_4^{2-}, and NH_4^+. Considering those results, it appears that the PM2.5 values for 2014 were greatly influenced by ultrafine particles consisting of NO_3^- and SO_4^{2-}. Recently, Korea has been significantly affected by condensed pollutants released into

the air from the Asian Continent and which tend to be carried to the Korean Peninsula by the prevailing westerly winds. In 2014, in particular, largest cities in China experienced 100 to 260 days of smog, whereas Seoul had 157 days. According to observations made in 2014 at Seosan Regional Meteorological Office near Anmyeondo, the number of foggy days in the spring also increased to a total of 53 days.

□ Stratospheric ozone and Ultraviolet radiation

The total ozone column(TOC) average at Anmyeondo for 2014 was 324 DU, and among monthly average of TOCs the highest was 361 DU in May and the lowest was 283 DU in October. The highest monthly TOC at Pohang was 348 DU in April, but the average and minimum values were not determined due to lack of observation data. The average TOC at Gosan for 2014 was 305 DU, a lower value than that of Anmyeondo. The highest and the lowest values monitored at Gosan were 336 DU in March and 274 DU in November, respectively. Among TOC data, the highest values were measured at Anmyeondo, followed by Pohang and Gosan, in descending order of latitude. Similar seasonal features were present at the three sites and showed regular changes, becoming higher in spring and lower in summer and autumn. With regard to monthly variations of UV-A and UV-B radiations, both values were high in summer and low in winter, because the solar elevation angle which influences UV radiation is bigger in summer. Due to latitudinal differences, Gosan located in the southern region recorded the highest UV radiation, while the northernmost site Gangneung marked the lowest.

☐ Precipitation chemistry

The annual average amounts of precipitation measured in 2014 were 802.0 mm for Anmyeondo, 1,282.6 mm for Uljin, 1,490.0 mm for Gosan, and 1,552.2 mm for Ulleungdo which marked the highest value. Compared with the average levels at the sites, all areas except Anmyeondo recorded higher values. The average acidity (pH) of the precipitation for 2014 measured at the same sites was 4.75. This was lower than the pH 4.80 average for 1997 to 2012, and higher than the pH 4.73 average of 2013. The average acidity monitored at each observatory site was pH 4.69 for Anmyeondo, pH 4.72 for Uljin, pH 4.90 for Gosan, and pH 4.69 for Ulleungdo; among these, Anmyeondo and Ulleungdo marked the lowest and Gosan the highest. With regard to the ion concentrations of 2014, most values observed at Anmyeondo were lower than the averages for 2013 and from 1997 to 2013, but the NO_3^- and NH_4^+ concentrations were higher than the average for 1997 to 2013. Uljin's ion concentrations in 2014 were similar to those of the average for 2013, but were higher than the 1999 to 2013 average for every ion; in particular, the numbers were even higher for Cl^- and Na^+. In Gosan, most concentrations were lower than the averages for 2013 and from 1998 to 2013, while in Ulleungdo they were higher than the averages from 1997 to 2013, especially in terms of the Cl^-, and Na^+ levels. Looking into annual average ion concentrations per each station, all ions except NH_4^+ measured at Ulleungdo marked significantly higher values than those of other sites. The levels of SO_4^{2-}, one of main causes of acidification, were highest at Ulleungdo followed by Uljin, Anmyeondo, and Gosan. In the case of NO_3^-, the results for Ulleungdo were the highest followed by Anmyeondo, Uljin, and Gosan.

영문 약어 목록

ADAM	Asian Dust Aerosol Model
AERONET	Aerosol Robotic Network
ANSTO	Australian Nuclear Science and Technology Organization
AOD	Aerosol Optical Depth
APS	Aerodynamic Particle Sizer
BAPMoN	Background Air Pollution Monitoring Network
BC	Black Carbon
BSRN	Baseline Surface Radiation Network
CCL	Central Calibration Laboratory
CIE	Commission Internationale de l'Eclairage
CPC	Condensation Particle Counter
CPSCF	Conditional Potential Source Contribution Function
CRDS	Cavity Ring-Down Spectroscopy
DQO	Data Quality Objective
EC	Electric Conductivity
ECD	Electro Capture Detector
EUV	Erythemal Ultraviolet
ESRL	Earth System Research Laboratory
FID	Flame Ionization Detector
GAW	Global Atmosphere Watch
GAWTEC	Global Atmosphere Watch Training and Education Centre
GAWSIS	Global Atmosphere Watch Station Information System
GC	Gas Chromatograph
GLC	Gas Liquid Chromatograph
GO_3OS	Global Ozone Observing System

GSC	Gas Solid Chromatograph
GSRN	Global Surface Radiation Network
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
IQR	Interquartile Range
LCD	Liquid Crystal Display
MED	Minimal Erythema Dose
MPoLAR	Multi-wavelength Polarization Lidar for Atmospheric Research
NASA	National Aeronautics and Space Administration
NDIR	Non-Dispersive InfraRed
NILU	Norwegian Institute for Air Research
NOAA	National Oceanic and Atmospheric Administration
OMI	Ozone Monitering Instrument
OPC	Optical Particle Counter
PFR	Precision Filter Radiometer
PMOD	Physikalisch-Meteorologisches Observatorium Davos
PSC	Polar Stratospheric Cloud
QA	Quality Assurance
RCC	Regional Calibration Centre
RRT	Round Robin Test
SAC	Science Activity Centre
SAG	Scientific Advisory Group
SMPS	Scanning Mobility Particle Sizer
SOP	Standard Operating Procedure
SSA	Single Scattering Albedo
TOMS	Total Ozone Mapping Spectrometer
TSP	Total Suspended Particle
TUV	Total UltraViolet radiation
UN	United Nations
UV-A	Ultraviolet-A
UV-B	Ultraviolet-B

UNEP	United Nations Environment Programme
UVI	Ultraviolet Index
WCC	World Calibration Centre
WCCAP	World Calibration Centre for Aerosol Physics
WCP	World Climate Programme
WDC	World Data Centre
WDCA	World Data Centre for Aerosols
WDCGG	World Data Centre for Greenhouse Cases
WDCPC	World Data Centre for Precipitation Chemistry
WDC-RSAT	World Data Centre for Remote Sensing of the Atmosphere
WMO	Word Meterological Organization
WORCC	World Optical Depth Research and Calibration Centre
WOUDC	World Ozone and Ultraviolet Radiation Data Centre
WRDC	World Radiation Data Centre
WWRP	World Weather Research Programme
WWW	World Weather Watch Programme