

Recent World Data Centre for Greenhouse Gases (WDCGG) activities

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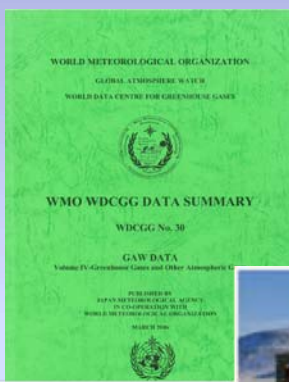
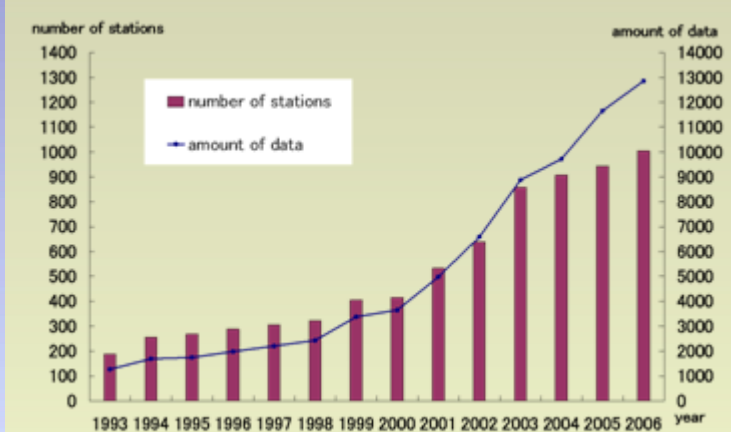
1. Overview of the WDCGG

GAW/WDCGG Overview

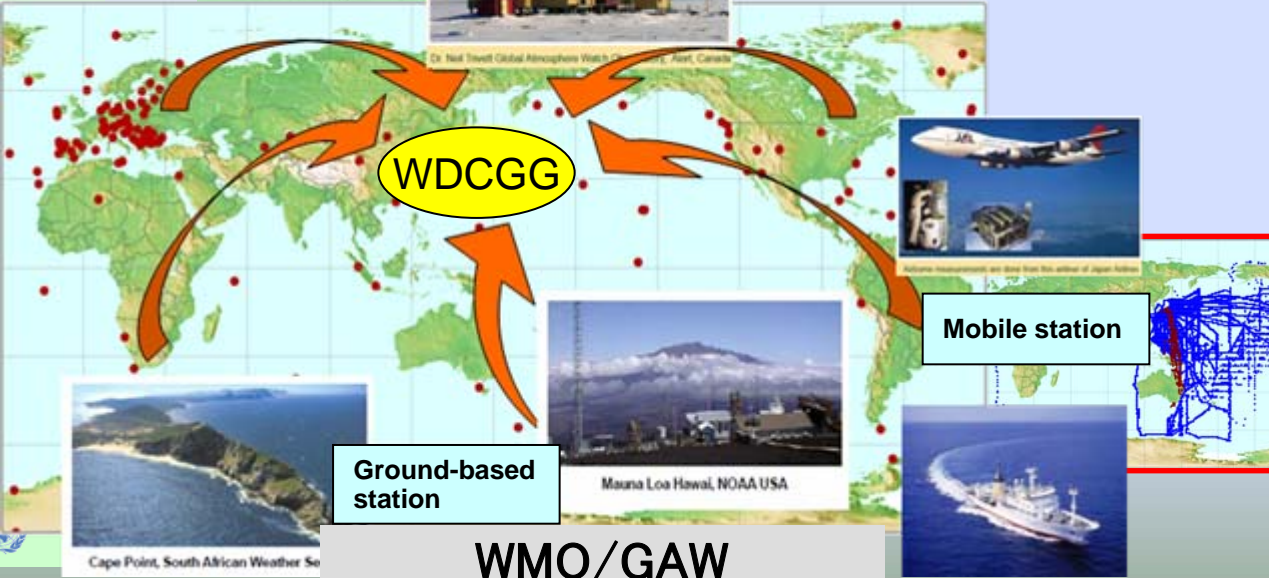
Annual increase of Archived data

Function of WDCGG

- Gathering data and their quality check
- Archive of observation data
- Creation of value added products
- Dissemination of data and products



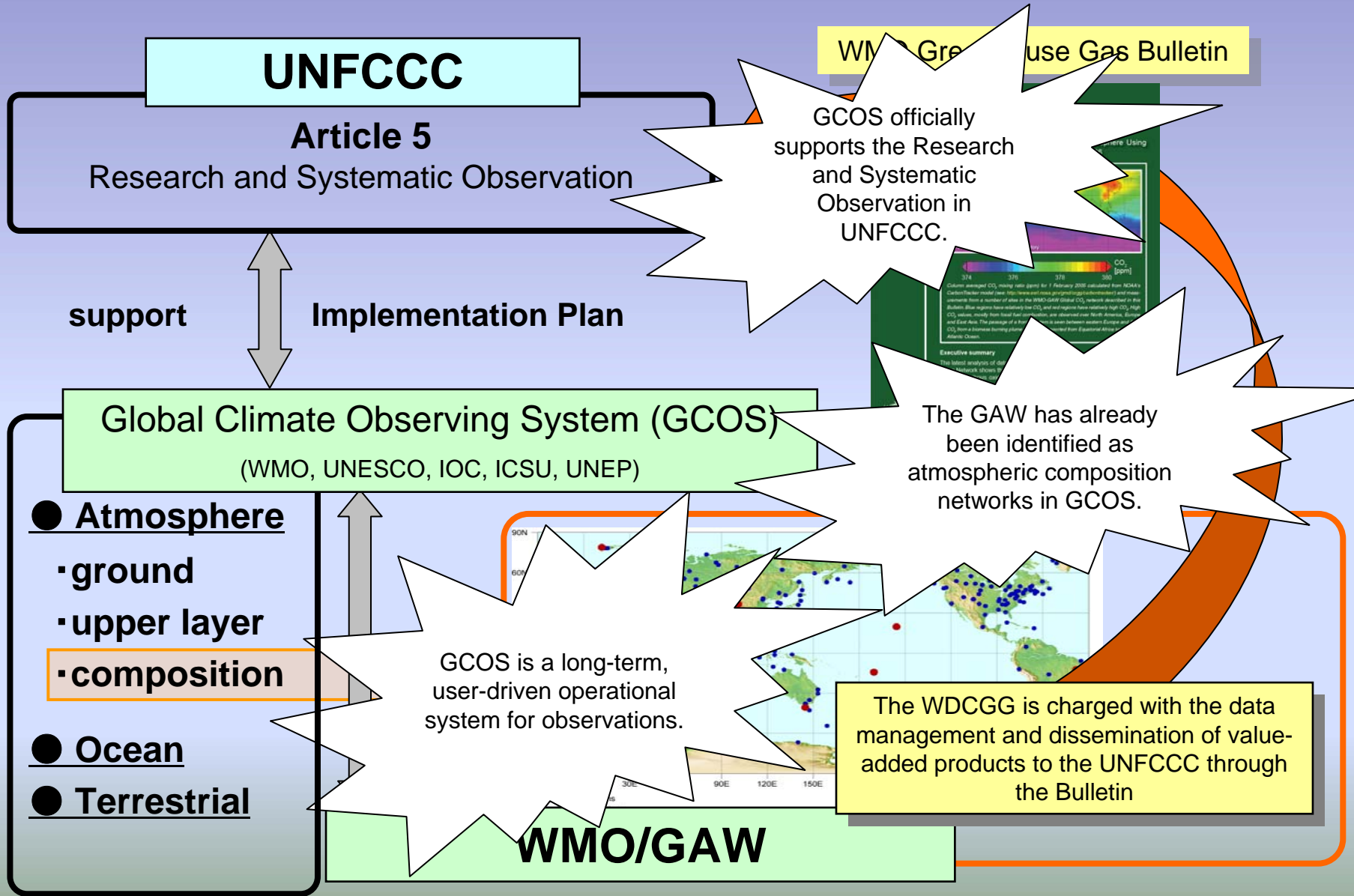
WDCGG website



WMO/GAW

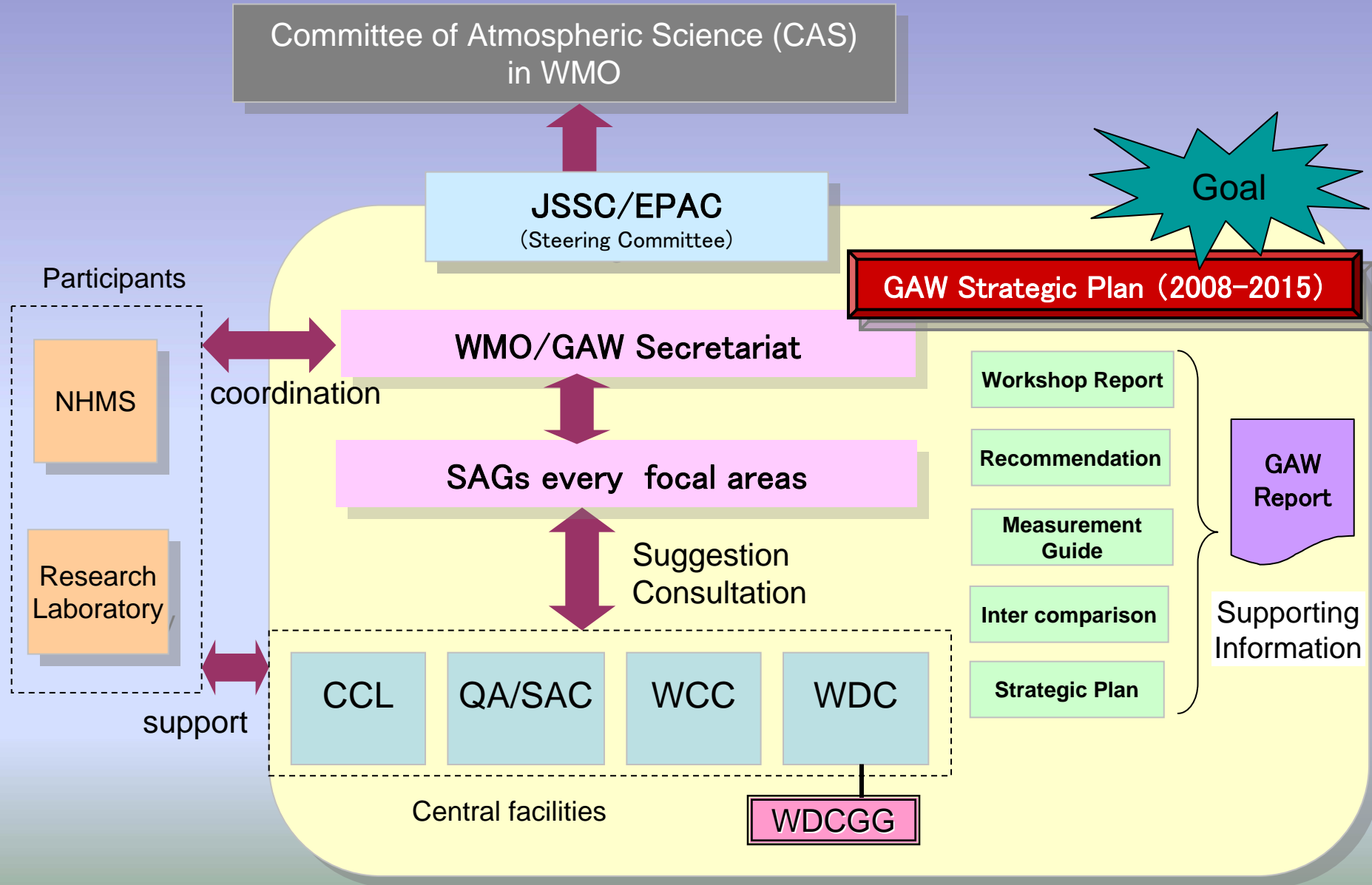
2. WDCGG in the environmental conventions

WDCGG in the environmental conventions



3. WDCGG in the GAW Strategic Plan

Architecture of GAW programme



Main tasks of WDCGG in the GAW Strategic Plan

- Task 3.10 Encourage archiving greenhouse gases data from aircraft monitoring programmes in WDCGG.
- Task 5.11 Implement data management under the agreement between GCOS and WMO/GAW.
- Task 7.21 Review the internal consistency of CO₂ observations archived at the WDCGG.
- Task 7.24 Develop the capability to accept and archive CO₂ column data from satellite observations.
- Task 7.25 Archive and develop integrated data sets using satellite, aircraft and surface-based measurements of CO₂.

GAW Report No. 174

4. The WDCGG Data Submission and Dissemination Guide

World Data Centre for Greenhouse Gases
Data Submission and Dissemination Guide



4-1 Clear definition of observation categories and their Archived data format

Measurement data are classified into six observation categories.

1. *Air sampling observation at ground-based stations*
2. *Air sampling observation for vertical profile (e.g. multi heights observation using a tower)*
3. *Air sampling observation by mobile platforms (e.g., aircraft, ships, etc.)*
4. *Ice core observation*
5. *Surface seawater and overlying atmosphere observation*
6. *Hydrographic sampling observation by ships*

4-2 Change of file format for Archived (dissemination) data

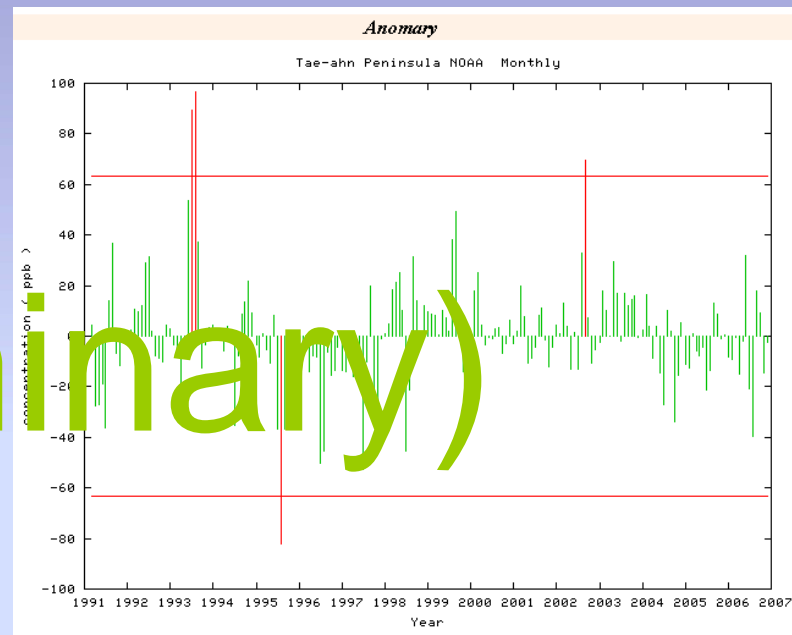
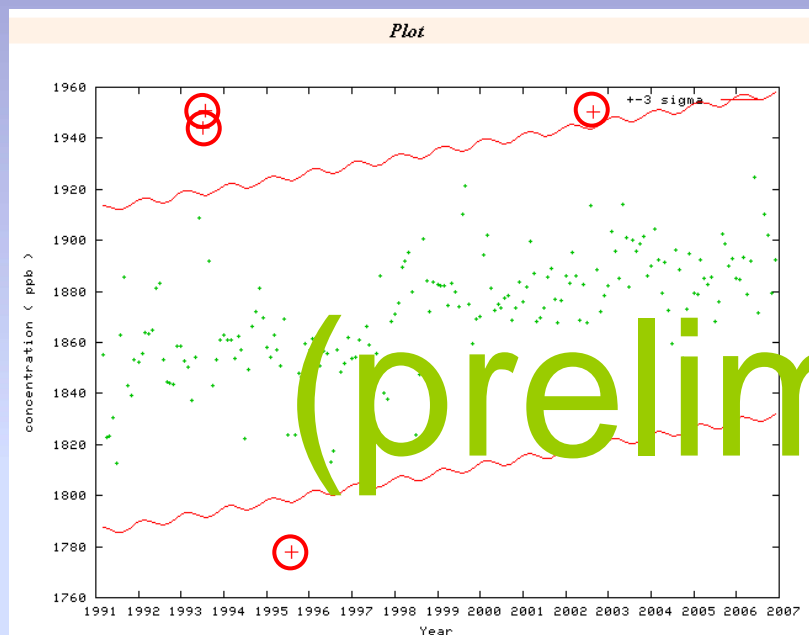
The WDCGG has established new data dissemination file formats.

- 1) FORTRAN fitting format is employed (in order to provide users with more computer-familiar data handlings and to keep minimum users' efforts).
- 2) The WDCGG simplifies the new formats,
 - each file contains mole fraction values of only one parameter;
 - mole fraction data and ancillary meteorological data are separated;
 - all information to read the data file is included in the header part.
- 3) The WDCGG prepared a sample program to read the Archived data file (the program is available on the WDCGG website).

4-3 Archive of all versions of data

- When existing data are replaced by new data that have different quality, a new Archive data version is assigned.
- All versions of Archived data are available (only by FTP for the moment) as well as the latest Archived data on the WDCGG website.

4-4 Submission-data plausible check before acceptance



(preliminary)

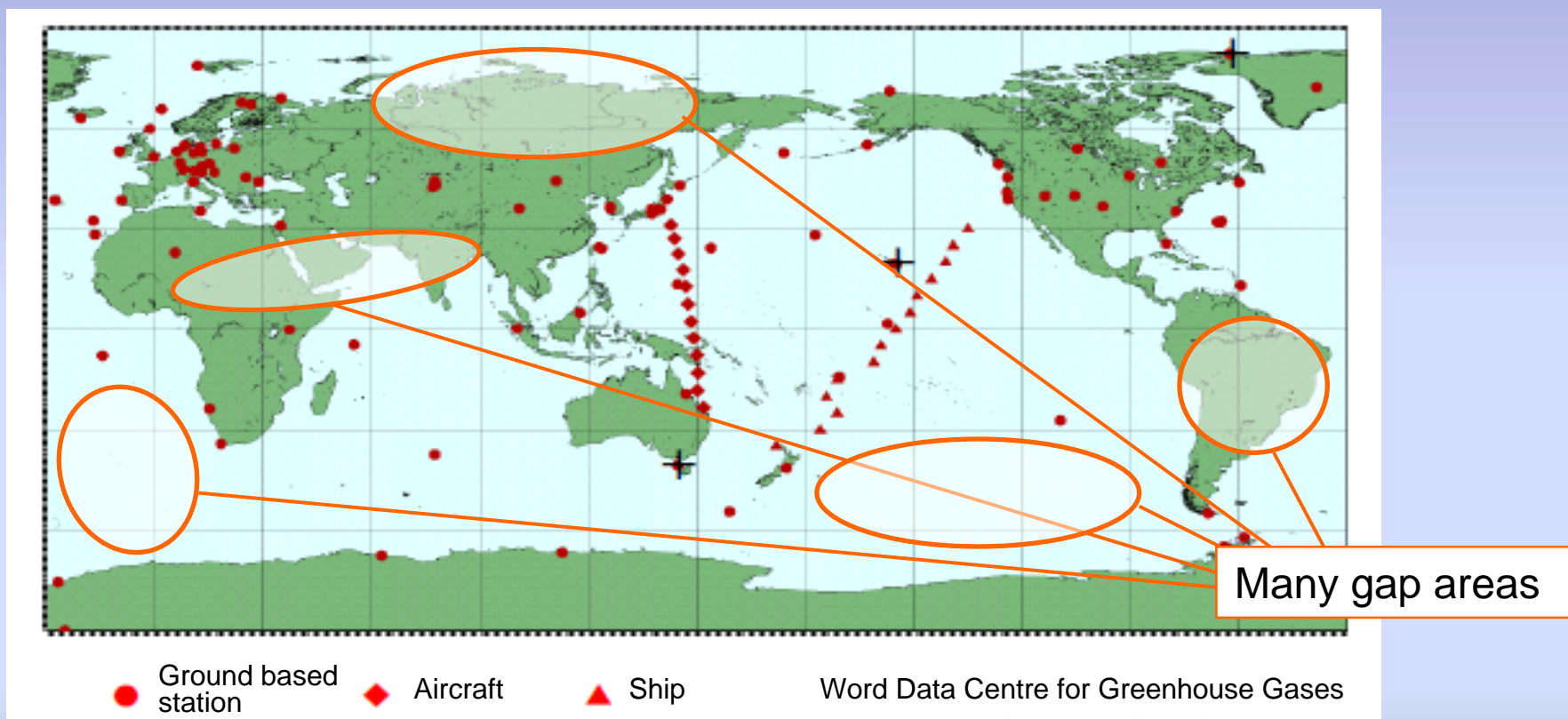
The WDCGG is now testing the check method.

Ex. Statistical check using a standard deviation from climatology.
Threshold = Trend + Monthly Variation + Standard Deviation

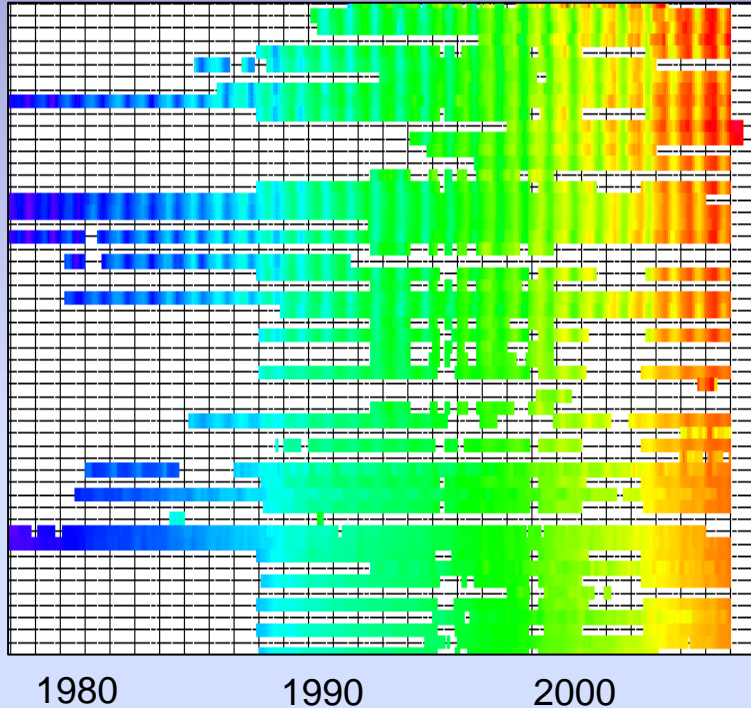
The WDCGG has begun to communicate with some stations.
However, we are now accumulating cases to be checked.

5. Global Analysis Method in the WDCGG

Problem for GAW observation network for greenhouse gases

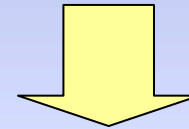


Problems of observation data



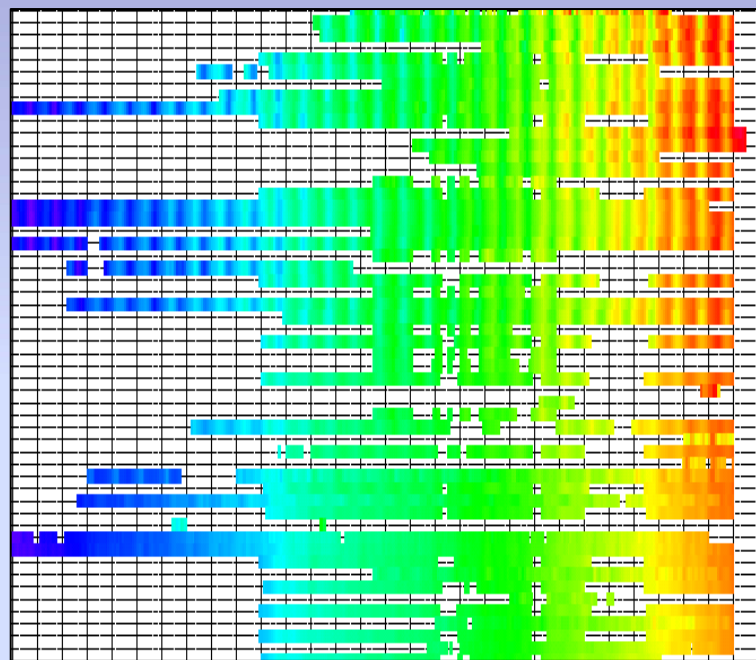
Monthly mean CO₂ data history for all sites.
The sites are set from north to south.

1. Many sites have data gaps during observation period.
2. Observation periods every site are not synchronized

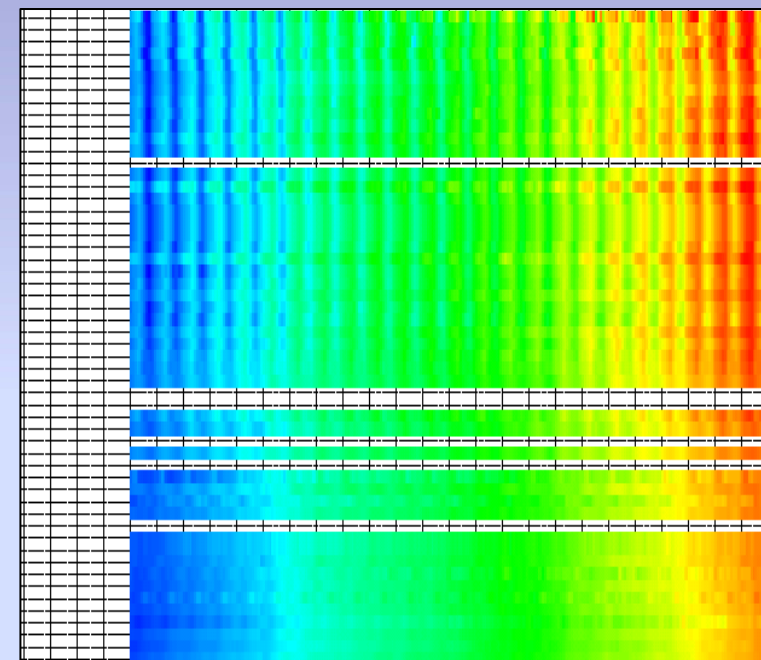
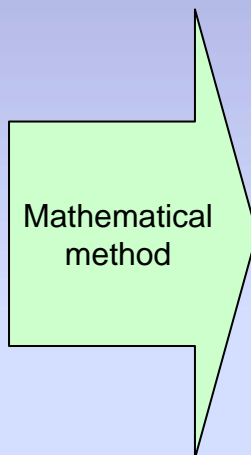


- Therefore, we cannot perform global analyses because station number or station data number have different weights in regions and periods.

A synchronized dataset without no observation gap



1980 1990 2000
Submitted (original) dataset

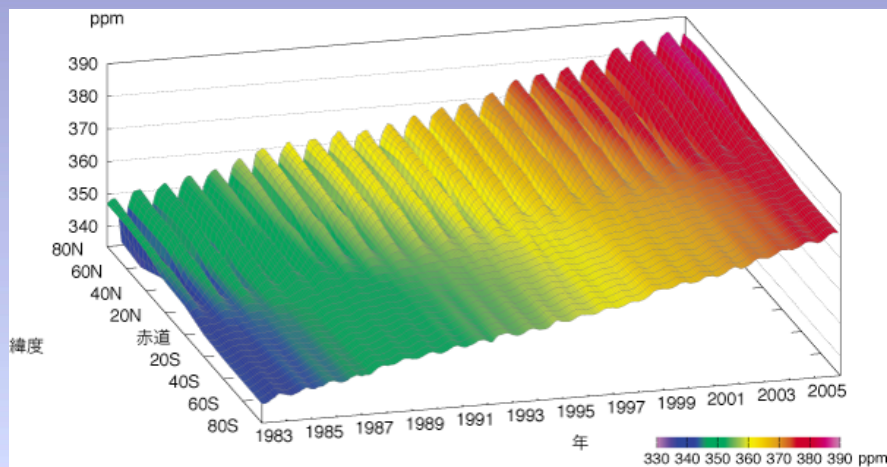


1980 1990 2000

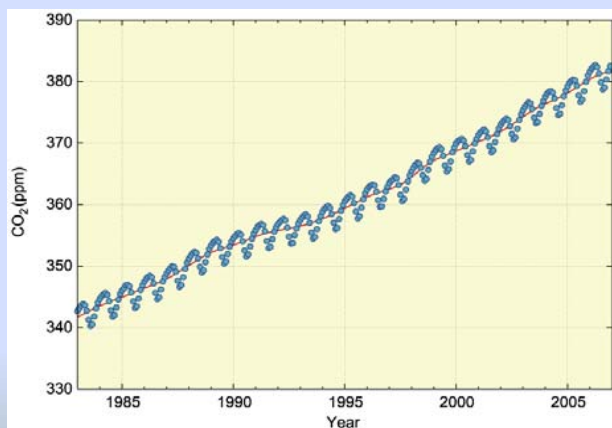
A synchronized dataset without no observation gaps is produced by the WDCGG

This dataset enable us to calculate global statistics.

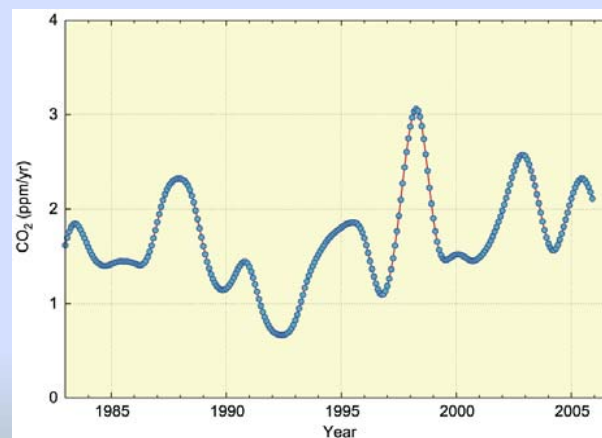
Current analyses on global greenhouse gases



Variation of zonally averaged monthly mean CO₂ mixing ratios (CO₂ carpet)



Global mean CO₂ mole fractions (ppm)



Global mean CO₂ growth rate (ppm/year)

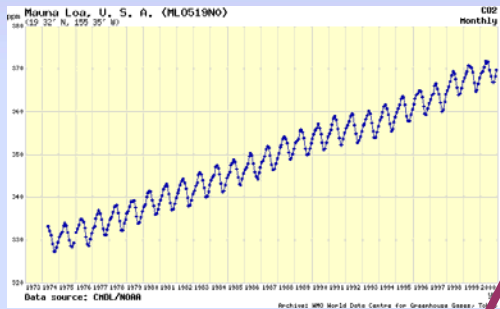
6. Products by the WDCGG

Contents in the WDCGG Website

Searchable Station Directory & Metadata



Online Data Search & Plot



Downloadable Data & Publications



WMO Global Atmosphere Watch
**World Data Centre
 for Greenhouse Gases**

Welcome to the WDCGG WEB SITE

The World Data Centre for Greenhouse Gases (WDCGG) is one of the WDCs under the GAW programme, and to gather, archive and provide data for greenhouse gases (CO₂, CH₄, CFCs, N₂O, surface ozone, etc.) and related gases (CO, NO_x, SO₂, VOC, etc.) in the atmosphere and ocean, observed under GAW and other programmes.

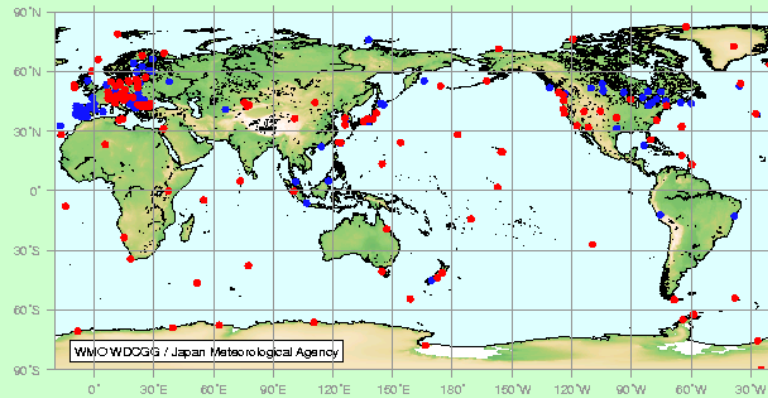
From this web site, you can obtain information on greenhouse gases including WDCGG's publications and measurement data that have been contributed by organizations and individual researchers over the world.

If you would like to submit data for the first time, please refer the WDCGG Data Submission and Dissemination Guide.

- Introduction
- Contributors
- Data/Quick Plot
- Publications
- Related Links
- Update Note
- Home

- Site Map
- Former WDCGG HP
- 日本語版

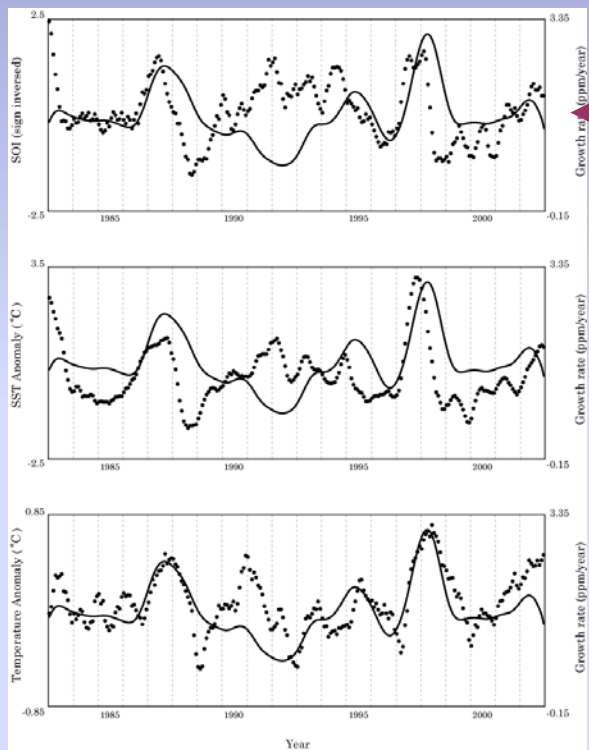
- [WDCGG Data Submission and Dissemination Guide \(PDF 404Kbyte\)](#)
- [ERRATA on the WDCGG GUIDE \(November 2007\)](#)



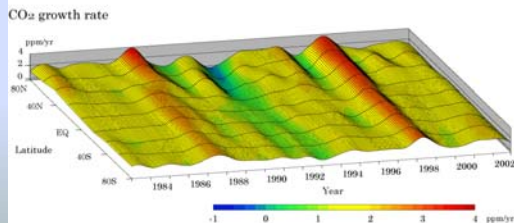
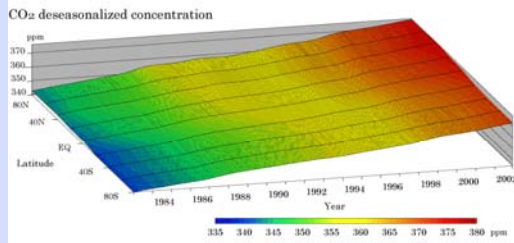
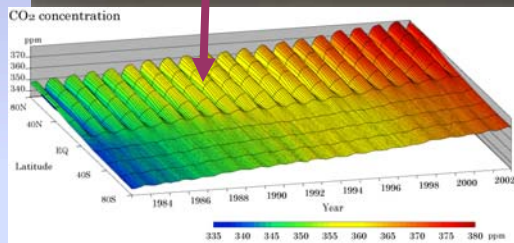
The figure shows the distribution of the fixed stations which contribute data to the WDCGG. The symbol "•" denotes that the data from the station has been updated in the last 365 days.

<http://gaw.kishou.go.jp/wdcgg.html>

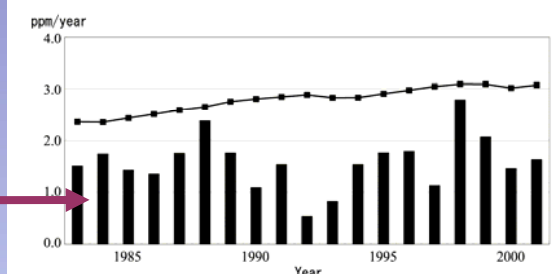
Contents in the WDCGG Data Summary



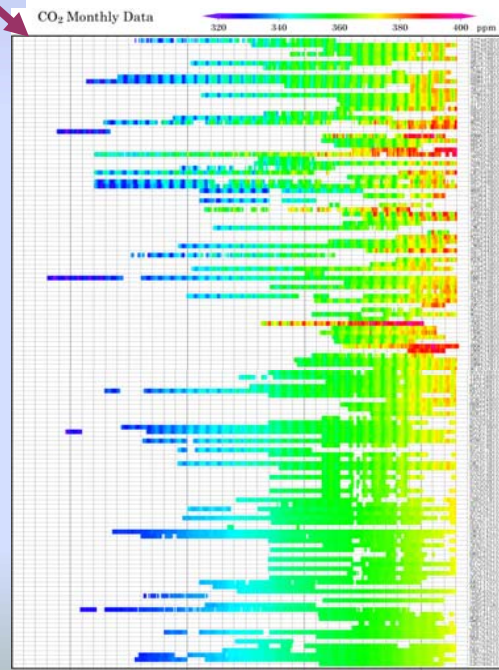
Correlations of CO₂ growth rate in tropics and SOI, SST in the east equatorial Pacific and temperature anomaly of 1000 hPa on land in the tropics.



Three dimensional representations of latitudinal distributions of concentrations (CO₂ carpet).



Time series of observed annual mean CO₂ growth rate in the atmosphere and its comparison with estimated growth rate from anthropogenic emissions. CO₂ Emissions were calculated by CDIAC based on the United Nations Energy Statistics.

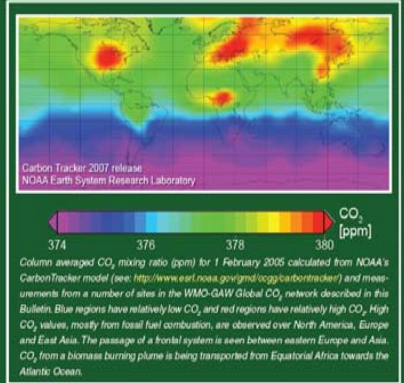


Monthly data history for all stations reported to the WDCGG. Concentrations are illustrated in colors.

WMO Greenhouse Gas Bulletin

WMO Greenhouse Gas Bulletin

The State of Greenhouse Gases in the Atmosphere Using Global Observations through 2006



Executive summary

The latest analysis of data from the WMO-GAW Global Greenhouse Gas Monitoring Network shows that the globally averaged mixing ratios of carbon dioxide (CO₂) and nitrous oxide (N₂O) have reached new highs in 2006 with CO₂ at 381.2 ppm and N₂O at 320.1 ppb. Atmospheric growth rates in 2006 of these gases are consistent with recent years. The mixing ratio of methane (CH₄) remains almost unchanged at 1782 ppb. These values are higher than those in pre-industrial times by 36%, 19% and 155%, respectively. Methane growth has slowed during the past decade. The NOAA Annual Greenhouse Gas Index (AGGI) shows that from 1990 to 2006 the atmospheric radiative forcing by all long-lived greenhouse gases has increased by 22.7%. The combined radiative forcing by CFC-11 and CFC-12 exceeds that of N₂O. They are decreasing very slowly as a result of emission reductions under the Montreal Protocol on Substances that Deplete the Ozone Layer.

Global Atmosphere Watch



World Meteorological Organization
Weather • Climate • Water

No. 3, 19 November 2007

Overview

This is the third in a series of WMO-GAW Annual Greenhouse Gas Bulletins. Each year, these bulletins report the latest trends and atmospheric burdens of the most influential, long-lived greenhouse gases; carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O), as well as a summary of the contributions of the lesser gases. These three major gases alone contribute about 88% of the increase in radiative forcing of the atmosphere by changes in long-lived greenhouse gases occurring since the beginning of the industrial age (~1750).

The Global Atmosphere Watch (GAW) programme of the World Meteorological Organization (WMO) promotes systematic and reliable observations of the global atmospheric environment, including measurements of CO₂, CH₄, N₂O, and other atmospheric gases. Sites where some or all of these gases are monitored are shown in Figure 1. The measurement data are reported by participating countries and archived and distributed by the World Data Centre for Greenhouse Gases (WDCGG) at the Japan Meteorological Agency (JMA).

Statistics on the present global atmospheric abundances are given in Table 1. They are obtained from a global analysis method using a data set which is comparable to the WMO World Reference Standard (<http://gaw.kishou.go.jp/wdco/>).

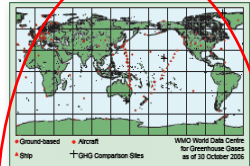
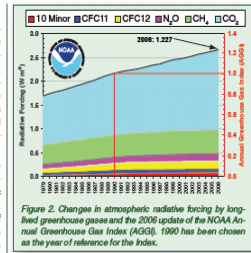


Table 1. Global abundances of key greenhouse gases as averaged over the twelve months of 2006 as well as trends from the WMO-GAW global greenhouse gas monitoring network.

	CO ₂ (ppm)	CH ₄ (ppb)	N ₂ O (ppb)
Global abundance in 2006	381.2	1782	320.1
2006 abundance relative to year 1750 ¹	136%	255%	119%
2005-06 absolute increase	2.0	-1	0.8
2005-06 relative increase	0.53%	-0.06%	0.26%
Mean annual absolute increase during last 10 years	1.93	2.4	0.75

¹ Assuming a pre-industrial mixing ratio of 280 ppm for CO₂, 700 ppb for CH₄, and 270 ppb for N₂O.

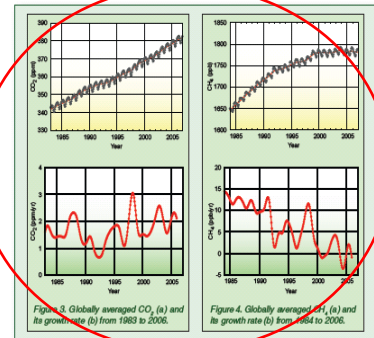


The three major greenhouse gases have been increasing in the atmosphere since the beginning of the industrial age. Water vapour is a natural component of the climate and weather system that is indirectly affected by human activities through changes in temperature, land surface characteristics and aerosol effects on clouds. This Bulletin focuses on those greenhouse gases that are directly influenced by human activities and that are generally much longer lived in the atmosphere than water vapour.

According to the NOAA Annual Greenhouse Gas Index (AGGI), the total radiative forcing by all long-lived greenhouse gases has increased by 22.7% since 1990 and by 23% from 2005 to 2006 (see Figure 2 and <http://www.esr.noaa.gov/gmd/aggi/>).

Carbon Dioxide (CO₂)

CO₂ is the single most important infrared absorbing, anthropogenic gas in the atmosphere and is responsible for 63% of the total radiative forcing of Earth by long-lived greenhouse gases. Its contribution to the increase in radiative forcing is 97% for the past decade and 91% for the last five years. For about 10,000 years before the industrial revolution, the atmospheric abundance of CO₂ was nearly constant at ~280 ppm (ppm=number of molecules of the greenhouse gas per million molecules of dry air). This abundance represented a balance among large seasonal fluxes (on the order of 100 Giga tonnes (Gt) of carbon per year) between the atmosphere and biosphere (photosynthesis and respiration) and the atmosphere and the ocean (physical exchange of CO₂). Since the late 1700s, atmospheric CO₂ has increased by 38%, primarily because of emissions from combustion of fossil fuels (currently about 8.4 Gt carbon per year) and, to a lesser extent, deforestation (~1.5 Gt



carbon per year). High-precision measurements of atmospheric CO₂ beginning in 1958 show that the average increase of CO₂ in the atmosphere corresponds to ~55% of the CO₂ emitted by fossil fuel combustion. The remaining fossil fuel-CO₂ has been removed from the atmosphere by the oceans and the terrestrial biosphere. Globally averaged CO₂ in 2006 was 381.2 ppm and the increase from 2005 to 2006 was 2.0 ppm (Figure 3). This growth rate is larger than the observed average for the 1990s (~1.5 ppm/yr), mainly because of increasing emissions of CO₂ from fossil fuel combustion.

Methane (CH₄)

Methane contributes 18.6% of the direct radiative forcing to long-lived greenhouse gases affected by human activities. Its chemistry also indirectly affects climate by influencing tropospheric ozone and stratospheric water vapour. Methane is emitted to the atmosphere by natural processes (~40%, e.g., wetlands and termites) and anthropogenic sources (~60%, e.g., fossil fuel exploitation, rice agriculture, ruminant animals, biomass burning, and landfills); it is removed from the atmosphere by reaction with the hydroxyl radical (OH) and has an atmospheric lifetime of ~9 years. Before the industrial era, atmospheric methane was at ~700 ppb (ppb=number of molecules of the greenhouse gas per billion (10⁹) molecules of dry air). Increasing emissions from anthropogenic sources are responsible for the factor of 2.5 increase in CH₄. The cycling of methane, however, is complex and managing its atmospheric burden requires an understanding of its emissions and its budget of sources and sinks. Globally averaged CH₄ in

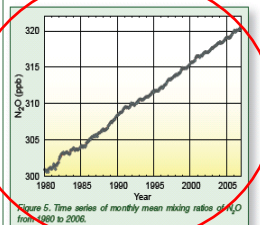
2006 was 1782 ppb, which means a decrease of 1 ppb since 2005 and a decrease of 2 ppb since 2003. (Figure 4). By contrast, methane was increasing by up to 15 ppb per year during the late 1990s. The average growth rate has been 2.4 ppb per year over the past ten years.

Nitrous Oxide (N₂O)

Nitrous oxide (N₂O) contributes 6.2% of the total radiative forcing from long-lived greenhouse gases. Its atmospheric abundance prior to industrialization was 270 ppb. N₂O is emitted into the atmosphere from natural and anthropogenic sources, including the oceans, soil, combustion of fuels, biomass burning, fertilizer use, and various industrial processes. One-third of its total emissions is from anthropogenic sources. It is removed from the atmosphere by photochemical processes in the stratosphere. Globally averaged N₂O during 2006 was 320.1 ppb, up 0.8 ppb from the year before (Figure 5). The mean growth rate has been 0.76 ppb per year over the past 10 years.

Other Greenhouse Gases

The ozone depleting chlorofluorocarbons (CFCs) also contribute to the radiative forcing of the atmosphere. Their overall contribution to the global radiative forcing is significant (12% of the total; <http://www.esr.noaa.gov/gmd/aggi/>).



The WDCGG produces some of the contents in the Bulletin.



WDCGG

WMO Global Atmosphere Watch World Data Centre for Greenhouse Gases

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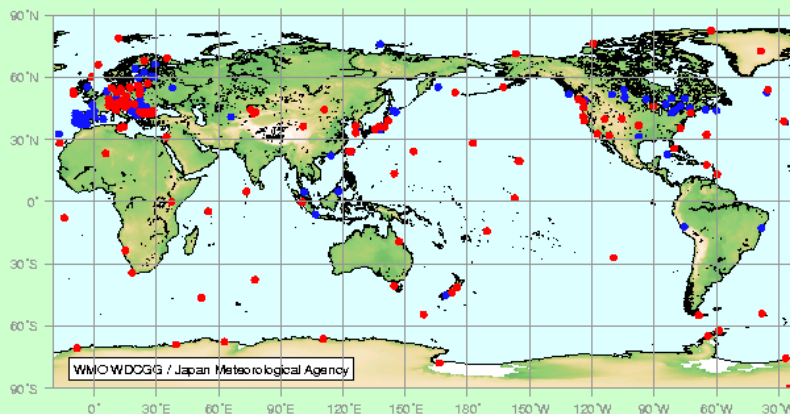
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• [ERRATA on
the WDCGG
GUIDE
\(November 2007\)](#)

Welcome to the WDCGG WEB SITE

Thank you



The figure shows the distribution of the fixed stations which contribute data to the WDCGG. The symbol "•" denotes that the data from the station has been updated in the last 365 days.



This site is maintained by the Japan Meteorological Agency
in cooperation with the World Meteorological Organization
(Created : 2001/07/02 Modified : 2007/11/26)



Solution

- Continuous observation data are decomposed into **a seasonal variation** and **a long-term trend** by Fourier polynomials.
- A linear line is **interpolated** as a trend during data gaps, and the seasonal variation is superimposed on the trend. As a result, the monthly variations during data gaps are retrieved.
- For synchronizing data period, the long-term trend is **extrapolated** along with an averaged trend derived from the stations within the same latitudinal band. The monthly variations are retrieved after superimposing a seasonal variation.

