World Data Centre for Greenhouse Gases Data Submission and Dissemination Guide

World Meteorological Organization

Global Atmosphere Watch

Ver. 0.98

Preface

The World Data Centre for Greenhouse Gases (WDCGG), first established in 1990, has now been operating for more than 15 years. The amounts of observation data submitted to and information provided by the WDCGG have increased markedly with recent developments in data processing technology and telecommunication network infrastructure, such as the Internet. Furthermore, the data management of the WDCGG and information demands on the WDCGG have changed. Therefore, the “Data Reporting Manual of the WMO World Data Centre for Greenhouse Gases” (WDCGG No.1) published in 1991, which describes the operations of the WDCGG and data submission formats, has become unsuitable for the current operations of the Centre.

Since the United Nations Framework Convention on Climate Change (UNFCCC), which has systematized the observation of greenhouse gases, came into force in 1994, concern regarding climate change issues has increased among not only scientists but also the general public. Furthermore, concerns regarding greenhouse and related gases have increased since the Kyoto Protocol came into force in 2005.

Under the circumstances mentioned above, the objectives of the *WDCGG Data Submission and Dissemination Guide* are as follows:

1. To make better use of Archived data, the overall activities of the WDCGG in responding to the social demands of observers, scientific communities, and the public are introduced.
2. To gather more appropriate observation data and associated metadata, the purposes, function, and operational courses of the WDCGG are clarified.

This guide will be updated, as required, on the WDCGG website to adapt in an appropriate manner to changing demands.

***Note: All correspondence should be made in English*.**

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1. WMO/GAW Programme and the WDCGG

1.1. GAW Programme

During the 1970s, important atmospheric environmental issues, such as global warming due to increased levels of greenhouse gases, ozone depletion in the stratosphere caused by CFC emissions, and the acidification of lakes and forests due to acid rain, were addressed. This has resulted in international concern regarding these global environmental problems, which require international coordination and cooperative activities.

With this background, the World Meteorological Organization (WMO), which has contributed to scientific assessment through implementation of the Global Ozone Observation System (GO_3OS) and the Background Pollution Monitoring Network (BAPMoN), consolidated these two monitoring programmes into the Global Atmosphere Watch (GAW) programme in 1989.

The GAW's missions are:

1. To make reliable, comprehensive observations of the chemical composition and selected physical characteristics of the atmosphere on both global and regional scales.
2. To provide the scientific community with the means to predict future atmospheric conditions.
3. To organize assessments to support the formulation of environmental policies.

To support and achieve these goals, GAW has established World Central Facilities, *i.e.*, Scientific Advisory Groups (SAGs) to organize and co-ordinate GAW activities based on parameters, Quality Assurance/Science Activity Centres (QA/SACs) to perform network-wide data quality functions, Central Calibration Laboratories (CCLs) to host the reference standards, World Calibration Centers (WCCs) to provide instrument calibrations and training to the stations, and World Data Centres to archive and provide the atmospheric measurement data and associated metadata.

There are five GAW WDCs—for Greenhouse Gases, Ozone/ UV, Precipitation Chemistry, Solar Radiation, and Aerosols—which gather, archive, and provide observation data at stations all over the world. Furthermore, they collaborate closely with other GAW facilities, such as SAGs, QA/SACs, *etc.*, to improve data quality, interpretation, and analysis, which play important roles in promotion of the GAW.

1.2. History and goals of the WDCGG

The WDCGG, which is one of the WDCs under the WMO GAW programme, has been operating since October 1990 at the Japan Meteorological Agency (JMA). In October 2002,

the WDCGG took over the role of the World Data Centre for Surface Ozone (WDCSO) from the Norwegian Institute for Air Research (NILU).

The objectives of the WDCGG are to support scientific assessment and correspondence policy for environmental issues such as global warming, ultimately to contribute towards reducing societal environmental risks, and to meet the requirements of related environmental conventions.

1.3. Functions of the WDCGG

Since its establishment in 1990, the WDCGG has been principally working to achieve the objectives of the WDCGG. In addition, the WDCGG has improved its operation and functions in accordance with the GAW Strategic Plans published in 1997 and 2001 (updated in 2004). The current operations of the WDCGG are composed of the following five functions:

a. To gather measurement data and associated metadata of greenhouse and related trace gas species from various platforms of the GAW observation network and relevant international research programmes.
b. To archive these data continuously for long-term use after validation.
c. To make the archived data easily and readily available to users
d. To regularly produce diagnostics on the current status of greenhouse gases and related gases and user supporting information on the archived data.
e. To support development of value-added data products and analytical products by the scientific community.

A schematic diagram of data submission, dissemination, and the data flow in the WDCGG are shown in Figure 1.

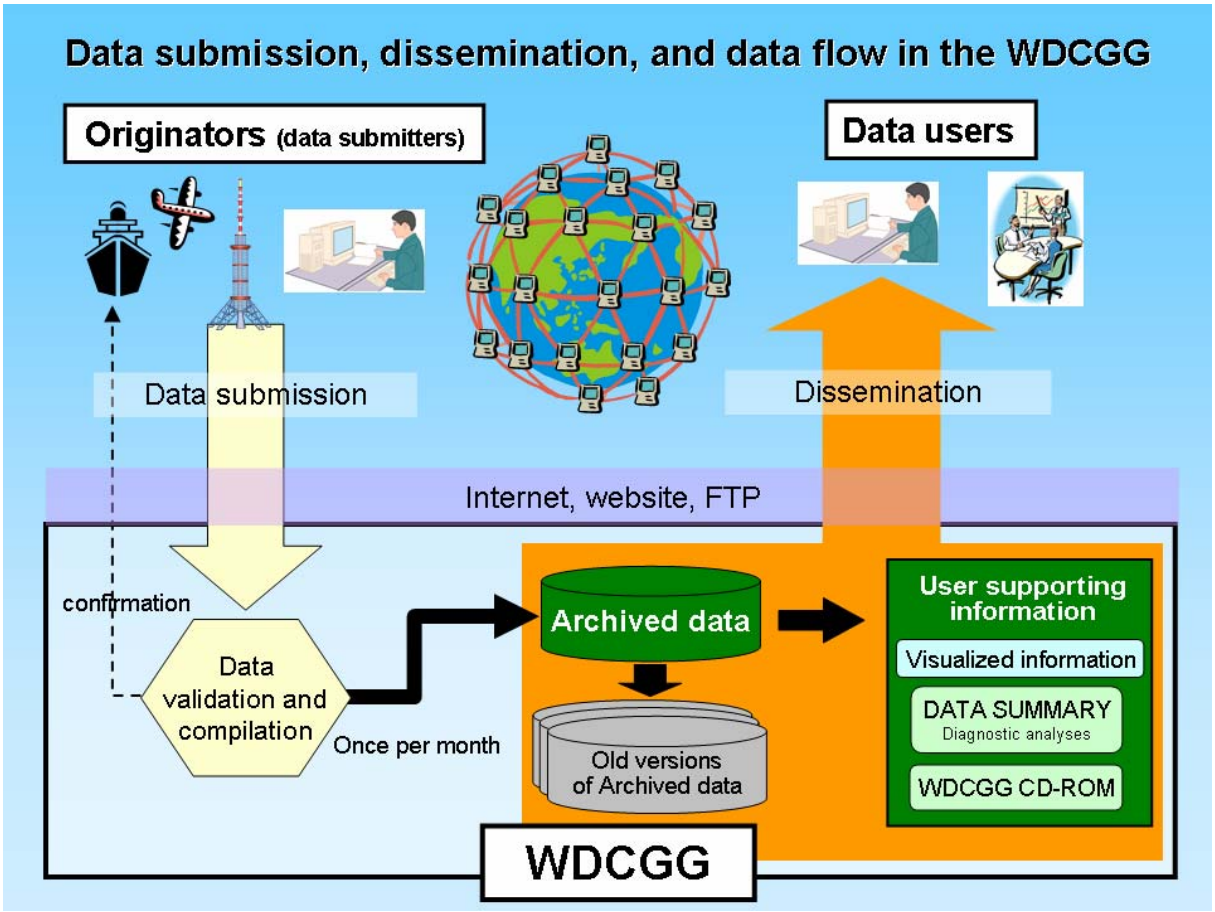

Figure 1 Schematic diagram of data submission, dissemination, and data flow in the WDCGG

2. Definition

Fundamental concepts and terms used in this guide are defined in this section.

2.1. Contributor(s), Supporting Contributor(s), Station Organizer, Contact Person, and Responsible Investigator

The Contributor(s), Contact Person, and Responsible Investigator are designated according to each parameter. The Station Organizer(s) and the Contact Person for the station are designated by each station.

2.1.1. Contributor(s)

The Contributor(s) is an institute(s) or organization(s) that obtains and submits the observation data.

2.1.2. Supporting Contributor(s) (Optional)

The Supporting Contributor(s) is an institute(s) or organization(s) other than the Contributor that technically or financially supports the observation.

2.1.3. Station Organizer

The Station Organizer is an institute or organization that organizes and manages the station or the mobile measurement cruise.

2.1.4. Contact Person for station

The Contact Person for the station is a person who reports or can receive inquiries on station information such as the geography and environment surrounding the station.

2.1.5. Contact Person for measurement

The Contact Person for measurement is a person who can receive inquiries, requests, or consultations on the observation.

2.1.6. Responsible Investigator (Optional)

The Responsible Investigator is a person who is officially or scientifically responsible for the observation.

2.2. Observation data: measurement data and metadata

The observation data consists of measurement data and metadata.

2.2.1. Measurement data

Measurement data consist of measured values, such as the greenhouse gas mixing ratio, and coincident ancillary data, such as associated meteorological data, data quality flag (see Section 2.3), standard deviation, the number of data used to average, *etc*. In the case of observation by mobile platforms, measurement locations (latitude and longitude, *etc.*) are also included in the measurement data. The measurement data must be physical quantities and not “raw data” (see Section 4.1). The WDCGG recommends that the measurement data units should not be in concentrations such as $\mu g/m^3$ but in mixing ratios such as ppm (μmol/mol), ppb (nmol/mol), and ppt (pmol/mol).

2.2.2. Metadata

Metadata are additional information for observation such as observatory locations, sampling conditions, measurement methods, calibrations, traceability of employed scale, quality management information, *etc.* Metadata are essential to utilize measurement data. The published scientific papers are also useful for ensuring the observation. Therefore, the WDCGG requires Contributors to ensure the steady management of metadata as well as measurement data. Contributors should submit the latest information for measurement data, and make the observation conditions clear for data users. If part of the metadata changes, the measurement data version may also change (see Section 5.2). On the other hand, data users should fully understand the metadata, and use the data appropriately for their own purposes.

2.3. Archived data

After acceptance, the observation data are compiled and then stored in the WDCGG and provided to users as “Archived data”. Archived data are updated by accepted data once per month to make them available for users. The diagnostics and user supporting information in the WDCGG are made using Archived data.

2.4. Data quality flag

The data quality flag, which is given by a Contributor, represents the quality of measurement data based on observation conditions, such as the instrumental situation or meteorological conditions that are closely related with source and sink locations around the station. The data quality flag consists of values or characters defined by the Contributors, and each piece of measurement data must have its own data quality flag. The WDCGG recommends use of the NOAA/GMS flagging (Please refer to the metadata of NOAA/GMD).

2.5. Flagging by the WDCGG

The WDCGG may prepare some selected data sets to meet the demands of the scientific community. In this case, the WDCGG may add some flags to the Archived data after consulting with the Science Advisory Group for Greenhouse Gases.

3. Variety of data gathered and archived by the WDCGG

3.1. Measurement parameters

The WDCGG gathers measurement parameters regarding greenhouse gases and related gases in the atmosphere and the ocean. As of 31 December 2006, the WDCGG has archived measurement parameters regarding sixty-four types of gas (see Appendix 1).

3.2. Classification of observation

Measurement data are classified into six observation categories according to the observation platforms or methods used.

1. Air sampling observation at a ground-based station
2. Air sampling 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

3.3. Temporal representation of Archived data

The WDCGG archives hourly mean, daily mean, monthly mean, and instantaneous data. The minimum time interval of instantaneous data is restricted according to the observation platforms: 10 minutes for a ground-based station or a tower (The WDCGG recommends hourly mean data submission), and a minute for mobile platforms. As for hydrographic sampling observation, the WDCGG employs the WOCE (World Ocean Circulation Experiments) exchange format (Refer to the WOCE Hydrographic Program Office, http://woce.nodc.noaa.gov/woce_v3/wocedata_1/whp/index.htm) that is widely used in the hydrographic measurement community as the submission data format.

4. Data submission and acceptance

The WDCGG gathers observation data regarding greenhouse and related gases not only from the GAW observatories network, but also from various co-operating research programmes.

4.1. General information on data submission

The WDCGG requests Contributors to use internet-based data submission (see Section 4.3). The measurement data should not be “raw data,” such as equipment voltage or direct outputs from data loggers, but should be physical quantities, such as mixing ratios after adequate calibration and quality checks for errors from instrument malfunctions or data processing.

The Contributor or Responsible Investigator is responsible for the quality of submitted data. The WDCGG requests that Contributors add a data quality flag to all measurement data whose specific meaning is reported in their metadata. The Standard Operating Procedures (SOPs) for each parameter shown in GAW reports No.97 (ozone measurements) and No.134 (CO_2 measurements) should be referred to.

Contributors are asked to always update their metadata. A history of the instrumentation and calibration methods should also be included or left in the metadata. In the case that submitting data is replaced with existing Archive data), the reasons for the corrections should be clarified (e.g. changes in the scale employed, or corrections of standard gas drift, etc.).

Some temporally averaged data are useful for analyses. The WDCGG recommends that Contributors submit monthly mean and daily mean data, as well as hourly mean or instantaneous data on the background conditions. If the submitted data does not include appropriate averaged data, the WDCGG will produce relevant temporary average data in consideration of the data quality flag aiming at further enhancement of usability.

4.2. First submission

Contributors have to contact the WDCGG (see Section 6) to clarify the submission methods before their first submission.

4.3. Data submission means

The means for data submission to the WDCGG are as follows:

1. ***Electronic mail submission (recommended)***

   Data whose volume is less than 1 MB should be submitted by electronic mail.

2. ***FTP submission***

   If data submission by electronic mail is difficult, data can be submitted by FTP. Contributors have to contact the WDCGG to obtain a password for access to the WDCGG ftp server before their submission.

3. ***Website submission (metadata only)***

   Contributors can submit metadata using the submission form on the WDCGG website. For website submission, it is necessary for the Contributor to contact the WDCGG in advance to obtain the submission path.

4. ***Submission on diskette/CD-ROM***

   The WDCGG receives data submitted on electronic media, such as CD-ROM or diskettes (1.44 MB, Windows format).

5. ***Data security policy***

   Contributors must not make their password available to others.

Note that data submission in hardcopy is no longer accepted.

4.4. Format of measurement data file for submission

With regard to currently submitted data, the WDCGG continues to accept data in the current submission format. In the case of a new submission, the WDCGG strongly encourages Contributors to use the formats defined by this guide. The details of the measurement data file format for submission are described in Appendix 2.

The WDCGG receives files in an ASCII format (plain text) only. The WDCGG does not accept any files in a binary format including MS-Excel or MS-Word, which could include computer viruses, because of computer security.

The submission format of measurement data consists of a header part and a data part. The header part contains information necessary to identify the submitted data and the data part contains the measurement data as a function of time.

4.5. Metadata

Metadata is accepted using the WDCGG website only. Metadata is indispensable for data

users (see Section 2.2.2), meaning that Contributors should inform the WDCGG of observation conditions appropriately according to the metadata format fully aware of their importance.

If any observation conditions change, the Contributor should submit new metadata to the WDCGG with the measurement data. The details of the metadata format are described in Appendix 4.

4.6. Data validation, and acceptance

Before acceptance, the WDCGG validates submitted data, and will inquire about questionable data to clarify the reasons if necessary. In some cases, the WDCGG may consult with the Scientific Advisory Group for Greenhouse Gases or QA/SAC.

When the WDCGG submitted data are accepted, a receipt is sent to the Contributor by electronic mail, facsimile, or postal mail. At the same time, the WDCGG asks Contributors to confirm the compiled data before the upload to the Archived data.

5. Dissemination of Archived data and data supporting information

The WDCGG prepares supporting information, such as visualized information and diagnostic analyses as well as Archived data. This chapter describes methods of distribution and the contents of data supporting information.

5.1. Dissemination of Archived data

After the confirmation by the Contributors is received, the WDCGG archives accepted data and relevant basic information as Archived data. The WDCGG updates Archived data once per month. Details of the Archived data file format are described in Appendix 3.

5.2. Data versions

The version of the Archived data is maintained in each file (viz. every parameter) in the header part of the Archived data, and updated when existing data are replaced by new data that may contain different metadata. All versions of Archived data are stored in the WDCGG, and are also available in addition to the latest Archived data.

5.3. Dissemination of data supporting information

5.3.1. Visualized information

The WDCGG provides visualized information, such as quick plots of time series for measurement data and location maps of observation stations, to outline archived data or to facilitate the finding of target data. They can be utilized and viewed on the WDCGG website.

Please note that the information is not for scientific purposes but for data user convenience.

5.3.2. Diagnostic analyses

The WDCGG summarizes the current status and changes of global greenhouse gases based on the Archived data. These diagnostic analyses by the WDCGG are as follows:

a. Fundamental statistics of Archived data (global mean and hemispheric mean, etc.).
b. Chart of monthly data sequences of all stations with averaged mixing ratio information.
c. Visualization of data analyses, such as three-dimensional representations.

The results and analytical methods used are included in the WDCGG DATA SUMMARY, which is available on the WDCGG website.

5.3.3. WDCGG publications

The WDCGG publishes “WMO WDCGG DATA SUMMARY” and “WMO WDCGG CD-ROM” every year. The contents of these publications are as follows:

a. WMO WDCGG DATA SUMMARY

The DATA SUMMARY includes the latest results of the diagnostic analysis described in Section 5.3.2 as well as location maps of observation stations, a list of observation stations, and a list of Station organizers to provide intelligible information concerning greenhouse gases.

b. WMO WDCGG CD-ROM

The CD-ROM includes Archived data and relevant metadata on Station organizers, stations, measurement methods, and calibration techniques employed. In addition, visualized information such as station location maps, cruise maps and time series graphs of measurement data are available on the CD-ROM.

The WDCGG distributes Archived data and analytical products with these publications to Contributors, National Meteorological and Hydrological Services (NMHSs), and GAW related organizations in collaboration with the WMO. These publications are also available on the WDCGG website.

5.4. WDCGG website

The WDCGG website (http://www.gaw.kishou.go.jp/wdcgg.html) is available via the Internet, and the latest and older versions of Archived data, data supporting information, and the WDCGG publications on the WDCGG website can be accessed from all over the world. Data users can use these data freely on the condition that due credit is given as described in Section 5.5, but for non-profit purposes only.

Metadata submission is also available on this website. The contents and design of the

website can be revised at any time, as necessary and without notification. The WDCGG Data Submission and Dissemination Guide will be updated as required to adapt in an appropriate manner to changing demands. The latest version of this guide can be obtained on the WDCGG website.

5.5. Data dissemination policy and credit for use

All users are required to accept the following conditions set forth by the Commission for Atmospheric Sciences (CAS) WG and supported by the Thirteenth Session of CAS: "For scientific purposes, access to these data it unlimited and provided without charge. By their use you accept that an offer of co-authorship will be made through personal contact with the data providers or owners whenever substantial use is made of their data. In all cases, an acknowledgement must be made to the data providers or owners and the data centre when these data are used within a publication."

For publication contents of analytical outputs or information taken from the WDCGG, the source must be properly acknowledged. Furthermore, in the case of publishing scientific papers using Archived data from the WDCGG after the permission of Contributors has been acquired, the WDCGG requires that authors send reprints of publications to the WDCGG. User cooperation is essential to maintaining and developing the operations of the GAW observation network and the GAW facilities.

The WDCGG can restrict data use for users who do not adhere to the WDCGG data dissemination policy after consultation with the Secretariat of the WMO/GAW.

5.6. GAW Station Information System (GAWSIS)

GAWSIS is being developed and maintained by QA/SAC Switzerland in collaboration with the WMO GAW Secretariat, the GAW World Data Centres, and other GAW representatives to improve the management of information about the GAW network of ground-based stations. An up-to-date, searchable database is also available on the website, including station descriptions, measurement programmes, and available contact people (http://www.empa.ch/gaw/gawsis/). The website is useful for users who require information regarding the GAW network and parameters of greenhouse gases.

6. Contact information

WMO World Data Centre for Greenhouse Gases (WDCGG)
Japan Meteorological Agency
1-3-4 Otemachi Chiyoda-ku Tokyo, 100-8122 JAPAN
Tel: +81-3-3287-3439

Fax: +81-3-3211-4640
E-mail: wdcgg@hq.kishou.go.jp
URL: http://gaw.kishou.go.jp/wdcgg.html

Appendix 1

Measurement Parameters in the WDCGG

The WDCGG has archived measurement parameters of 61 types of greenhouse gases and other related gases including 28 types of volatile organic compounds (VOCs) as of Dec 2006. The WDCGG defines the parameter codes for data format (in Appendix 3 and 4) as shown in the following table.

Table 1. Gas measurement parameters excluding VOCs.

(1) Measurement Parameters excluding VOCs	
Measurement parameter	Parameter code
Carbon Dioxide	co2
Methane	ch4
Nitrous Oxide	n2o
Sulfur Hexafluoride	sf6
Trichloromethane	chcl3
Tetrachloroethylene	ccl4
1,1,1-trichloroethane	ch3ccl3
Chlorofluorocarbons 11	cfc11
Chlorofluorocarbons 12	cfc12
Chlorofluorocarbons 113	cfc113
Hydrochlorofluorocarbons-141b	hcfc141b
Hydrochlorofluorocarbons-142b	hcfc142b
Hydrochlorofluorocarbons-22	hcfc22
Hydrofluorcarbons-134a	hfc134a
Dichloromethane	ch2cl2
Perchloroethylene	c2cl4
Methyl Chloride	ch3cl
Methyl Bromide	ch3br
Ozone	o3
Carbon Monoxide	co
Nitrogen Monoxide	no
Nitrogen Dioxide	no2
Nitrogen Oxides	nox
Total Reactive Nitrogen	noy
Sulfur Dioxide	so2
Hydrogen Peroxide	h2o2
Organic Peroxides	rooh
Stable Carbon Isotopes (CO2)	13co2
Stable Carbon Isotopes (CH4)	13ch4
Stable Oxygen Isotopes (CO2)	c18o2
Hydrogen	h2
Radon-222	222rn
Krypton-85	85kr

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442 Table 2. Gas measurement parameters for VOCs.

(2) Measurement Parameters of Volatile Organic Compounds	
Measurement parameter	Parameter code
Ethane	c2h6
Ethene	c2h4
Propane	c3h8
Propene	c3h6
i-Butane	i-c4h10
n-Butane	n-c4h10
Acetylene	c2h2
t-2-Butene	t2-c4h8
1-Butene	1-c4h8
i-Butene	i-c4h8
c-2-Butene	c2-c4h8
i-Pentane	i-c5h12
n-Pentane	n-c5h12
Propyne	c3h4
1,3-Butadiene	13-c4h6
t-2-Pentene	t2-c5h10
c-2-Pentene	c2-c5h10
Cyclohexane	c6h12
2-M-pentane	2m-c5h12
3-M-pentane	3m-c5h12
n-Hexane	n-c6h14
Isoprene	c5h8
n-Heptane	n-c7h16
Benzene	c6h6
Toluene	c7h8
Ethylbenzene	c8h10
P,m-Xylene	pm-c8h10
o-Xylene	o-c8h10

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Appendix 2

Data File Format for Data Submission

The WDCGG is prepared to accept hourly mean, daily mean, monthly mean, and instantaneous data. With regard to instantaneous data, the minimum time interval is restricted according to observation platforms: 10 minutes for a ground-based station or a tower (i.e., sampling interval should be 6 or less), and one minute for mobile platforms.

As for hydrographic data, the WDCGG accepts only the WOCE (World Ocean Circulation Experiments) exchange format (Refer to the WOCE Hydrographic Program Office (WHPO), http://woce.nodc.noaa.gov/woce_v3/wocedata_1/whp/index.htm) that is widely used in the hydrographic measurement community as the submission data format. For data other than hydrographic data, the WDCGG requests use of a simple and flexible format for data submission as described below.

2. Data File Formats

The WDCGG encourages Contributors to submit data files that meet the following 6 items for all measurement categories except for hydrographic sampling observation by ships (See Section 3.2). The submission data file format consists of a header part and a data part. Details of the submitted data file format are as follows:

1) The data file employs an ASCII format due to computer security policy.
2) The header part includes the following 7 header items that are necessary to identify the submitted data: CONTRIBUTOR, STATION NAME, PARAMETER, DATA TIME INTERVAL, MEASUREMENT UNIT, MEASUREMENT METHOD, AND CALIBRATION SCALE. (The definition of these items is shown in Appendix 4)
3) Each data in the data part is separated with a delimiter such as a space, comma, or tag.
4) The data part should at least include the date, time, mixing ratio, and data quality flag. For averaged data, the number of data used and the standard deviation are also required. Data item names according to Table 4 and Table 5 are defined in the first line of the data part (i.e., the first line of the data part must be the item names of each data column).
5) The date is represented in YYYY-MM-DD. The date for monthly data is represented as the first date of the month. For example, the date of a monthly datum of February 2005 is represented as 2005-02-01. The time is represented in hh:mm. The time for a monthly or daily datum is represented as 00:00. An example of the time for an hourly datum would be 02:00.
6) The data part should use signs such as “-999”, “NA”, or any other combinations of numbers and characters except a space to denote that a datum is not being reported in

the field. The field must NOT be left blank.

The format of the header part and order of the data column are arbitrary. Coincident ancillary data such as associated meteorological data can be included with the gas mixing ratio data in the data part. Refer to Sample 1 as an example.

Sample: Fixed Station – CO_2 (hourly mean data including meteorological data)

CONTRIBUTOR: JMA
STATION NAME: Ryori
PARAMETER: CO2
TIME INTEVAL: hourly
MEASUREMENT UNIT: ppm
MEASUREMENT METHOD: NDIR
OBSERVATION SCALE: WMO X2002

DATE	TIME	DATA	ND	SD	F	WD	WS	H	AT
2006-01-01	01:00	384.85	90	0.096	7	23	13.5	-999	20.3
2006-01-01	02:00	384.94	90	0.100	7	23	-999	84	20.4

Here, DATE is the measurement day, TIME is the measurement time, DATA is the mixing ratio, ND means the number of data used for averaging purposes, SD means the standard deviation from the average, F means the data quality flag, WD means wind direction (degree), WS means wind speed (m/s), H means relative humidity (%), and AT means atmospheric temperature (ºC).

Appendix 3

Data File Format for Archived data

The WDCGG provides hourly mean, daily mean, monthly mean, and instantaneous data with the following five types of its own Archived data formats in accordance with observation categories other than hydrographic observation: air sampling observation at a ground-based station, tower station, or mobile platform, ice core sampling observation, and surface seawater and overlying atmosphere observation (see Section 3.2). For the hydrographic data, the WDCGG provides data using the WOCE (World Ocean Circulation Experiments) exchange format that is widely used in the hydrographic measurement community as the Archived data format.

For each observation category, the WDCGG provides Archived data with a gas mixing ratio data file and a coincident ancillary data (associated meteorological data) file separately.

1. File format of gas mixing ratio file

1.1 Header part of gas mixing ratio file

The header part, denoted by “C” as the first character of the lines, describes meta-information on observation sites, the measurement method, and other necessary information for data usage. The number of header lines is 32. Detailed contents of the header part are described in Table 3.

Table 3 Content of the header part

line	Header item name	Content
01	TITLE:	Observation title (parameter, temporal representative, etc.)
02	FILE NAME:	File name
03	DATA FORMAT:	Format version of this file that is given by the WDCGG
04	TOTAL LINES:	Number of total lines
05	HEADER LINES:	Number of header lines
06	DATA VERSION:	Data version of measurement data (see Section 5.2). The version is given by the WDCGG, and managed using the date.
07	STATION NAME:	Name of the station where the data were observed
08	STATION CATEGORY:	GAW station category
09	OBSERVATION CATEGORY:	Observation category defined in Section 3.2
010	COUNTRY/TERRITORY:	The name of the country/territory where the station is located, or to which the ship or aircraft belongs is described here.
11	PLATFORM:	Fixed station or ship, aircraft etc.
12	CONTRIBUTOR:	See Section 2.1
13	LATITUDE(degree):	Latitude of the station location (decimal)

14	LONGITUDE(degree):	Longitude of the station location (decimal)
15	ALTITUDE (m)	Altitude of the station above sea level
16	NUMBER OF SAMPLING HEIGHTS:	The number of sampling heights from the ground for tower observation. Unity for ground based observation.
17	SAMPLING HEIGHTS (m):	The heights of the sampling intake from the ground. In the case of tower observation, the heights are arranged in decreasing order.
18	CONTACT POINT:	E-mail address, fax number, or telephone number of Contact person for measurement
19	PARAMETER:	Observation parameter
20	COVERING PERIOD:	Period of time in which measurement data are included.
21	TIME INTERVAL:	Temporal resolution of each measurement datum.
22	MEASUREMENT UNIT:	Unit of the mixing ratio.
23	MEASUREMENT METHOD:	Measurement method employed.
24	SAMPLING TYPE:	See Section 2.3.2 in Appendix 4
25	TIME ZONE:	Time difference between measurement time and universal time
26	MEASUREMENT SCALE:	Scale (traceability) employed in the measurement.
27	CREDIT FOR USE:	This is a formal notification for data users. "For scientific purposes, access to these data it unlimited and provided without charge. By their use you accept that an offer of co-authorship will be made through personal contact with the data providers or owners whenever substantial use is made of their data. In all cases, an acknowledgement must be made to the data providers or owners and the data centre when these data are used within a publication."
28		
29		
30		
31	COMMENTS:	Any comments necessary for data usage are described. A definition of remarks (See Table 4 and 2.6 in Appendix 4) is described if needed.
32		

1.2. Data part of gas mixing ratio file

The data part starts from line 33. The first line in the data part (line 33) contains the data item name of the measurement data. Data items and their definitions in the header part of the gas mixing ratio file are described in Table 4. Data items included and their order in the data part differ according to the observation categories. After line 33, the measurement data are described.

The number of digits allocated for each data item is fixed (fixed length formant), and each item name and a datum in its column are right-aligned in the allocated digit. The delimiter of item names and column data is a space. In summary, the data part is in **space-delimited**, **fixed-length, and right-aligned format**. The data items included and their order in accordance with the observation categories are described below.

DATE is represented in YYYY-MM-DD. The date of a monthly mean datum is the first date of its month. For example, 2005-02-01 is used as the date of a monthly datum in February 2005. TIME is represented in hh:mm. The time for a monthly or daily datum is represented

as 00:00. An example of the time for an hourly datum would be 02:00.

An example of data part format

DATE	TIME	DATA	ND	SD	F	CS	REM
1987-01-01	01:00	345.1	41	1.368	...	0	-999
1987-01-01	02:00	352.35	21	2.142	...	0	-999
1987-01-01	03:00	**-999**	**-999**	**-999**	...	0	-999
1987-01-01	04:00	356.73	20	1.798	...	0	-999
(10)*	(5)*	(8)*	(5)*	(7)*	(5)*	(4)*	(4)*

Space

* Allocated digits for each data column

1.2.1 Air sampling observation at a ground-based fixed Station:

The data part contains the following items: DATE, TIME, DATA, ND, SD, F, CS, REM

1.2.2 Air sampling observation using a tower:

The data part contains the following items: DATE, TIME, [DATA, ND, SD, F CS, REM]* ([ ] is repeated the same number of times of as the sampling height number).

The parenthetic data set at each sampling height, namely, DATA, ND, SD, F, CS, and REM is described additionally in the line. The data set is described in decreasing order of the height. The sampling height of each data set is also described in line 17 of the header part.

1.2.3 Air sampling observation using mobile platforms:

The data part contains the following items: DATE, TIME, LAT, LON, ALT, DATA, ND, SD, F, CS, REM

The date and time should be universal time.

1.2.4 Ice core sampling observation:

The data part contains the following items: DATE, DEP, DATA

The date should be estimated air age (year).

1.2.5 Surface seawater and overlying atmosphere observation:

The data part contains the following items: DATE, TIME, LAT, LON, DATA, ND, SD, F, CS, REM (for overlying atmosphere observation),

DATE, TIME, LAT, LON, DATA, ND, SD, F, CS, REM (for surface seawater observation)

Table 4 Data item name list and its format

Item name	Number of digits	"No Data"	Content	Supplementary explanation
DATE	10		Measurement date (YYYY-MM-DD)	7 digits are used only for ice core (Estimated air age)
TIME	5		Measurement time (hh:mm)	
LAT	7	-999	Latitude of sampling location in decimal degrees with North positive and South negative	used only for mobile data
LON	8	-999	Longitude of sampling location in decimal degrees with East positive and West negative	used only for mobile data
ALT	5	-999	Sampling height/depth (m) above/below sea level with height positive and depth negative	used only for mobile (3D) data
DEP	7	-999	Sampling depth of Ice core (m)	used only for ice core data
DATA	9 (13)	-999	Mixing ratios	13 digits are used only for VOCs
ND	5	-999	Number of data used to average the data	
SD	7	-999	Standard deviation	
F	4	-999	Data quality flag	The details of the data quality flag should be specified in the metadata by the Contributor.
CS	4	-999	Calculation Status indicating who calculated the data. “0” means the Contributor. “1” means the WDCGG.	This value is added by the WDCGG.
REM	4	-999	Data remarks	Additional information on data to be included. The definition is described under “COMMENTS” of the header part.

2. File Format for ancillary data file

In the case that the Contributor submits coincident ancillary data such as associated meteorological data in addition to measurement data, the coincident ancillary data are provided in a separated file from the gas mixing ratio file. The ancillary data file also consists of the header part and the space-delimited data part, and uses an ASCII format.

The header part is the same as the gas mixing ratio file. The data part also starts from line 33. The first line in the data part (line 33) defines each data column using the item names

592 Table 5. The number of digits allocated for each data item is fixed (fixed length formant), and
593 each item name is right-aligned in the allocated digit (see Table 5). A space is inserted
594 between data items as the delimiter. Refer to the examples.
595
596 Table 5 Associated meteorological data

Item name	Number of digits	"No Data"	Content	Supplementary explanation
WD	4	-999	Wind direction (degree)*	
WS	4	-999	Wind speed (m/s)	
WF	4	-999	Wind steadiness factor	
H	4	-999	Humidity (%)	
AP	6	-999	Air pressure (hPa)	
AT	5	-999	Air temperature (degree Celsius)	
DT	5	-999	Dew point temperature (degree Celsius)	
ST	5	-999	Sea water temperature (degree Celsius)	
SST	5	-999	Sea surface water temperature (degree Celsius)	
SS	7	-999	Sea water salinity (psu, ‰)	
SSS	7	-999	Sea surface water salinity (psu, ‰)	
RR	5	-999	Precipitation amount (mm)	

597 * WD is the angle in degrees between true north and the direction the wind is blowing from
598 the corresponding increase in a clockwise direction.

Example1) Air sampling observation at ground based station

C01 CO2 hourly mean data (air sampling observation at ground based station)
C02 ryo239n.18.co2.01.g.h0.dat
C03 g1.0
C04 776
C05 33
C06 20061225
C07 Ryori
C08 Regional station
C09 Air sampling
C10 Japan
C11 Ground based station
C12 Japan Meteorological Agency
C13 39.5
C14 141.2
C15 230
C16 1
C17 20
C18 k-Tsuboi@met.kishou.go.jp
C19 CO2
C20 1987-01-01 2006-08-01
C21 Hourly
C22 ppm
C23 NDIR
C24 Continuous
C25 +9
C26 WMO X2004
C27 This is a formal notification for data users. "For scientific purposes, access to these data it unlimited and provided
C28 without charge. By their use you accept that an offer of co-authorship will be made through personal contact with the
C29 data providers or owners whenever substantial use is made of their data. In all cases, an acknowledgement must be
C30 made to the data providers or owners and the data centre when these data are used within a publication.“
C31 Comment:
C32

DATE	TIME	DATA	ND	SD	F	CS	REM
1987-01-01	01:00	345.1	41	2.241	...	0	-999
1987-01-01	02:00	352.35	21	2.142	...	0	-999
1987-01-01	03:00	-999	-999	-999	...	0	-999
1987-01-01	04:00	356.73	20	1.798	...	0	-999

599

Example2) Air sampling observation using tower

C01 CO2 hourly mean data (air sampling observation using tower)
C02 ryo239n.18.co2.01.t.h0.dat
C03 t1.0
C04 776
C05 33
C06 20061225
C07 Ryori
C08 Regional station
C09 Air sampling
C10 Japan
C11 Tower
C12 Japan Meteorological Agency
C13 39.5
C14 141.2
C15 230
C16 2
C17 20,10
C18 k-Tsuboi@met.kishou.go.jp
C19 CO2
C20 1987-01-01 2006-08-01
C21 Hourly
C22 ppm
C23 NDIR
C24 Continuous
C25 +9
C26 WMO X2004
C27 This is a formal notification for data users. "For scientific purposes, access to these data it unlimited and provided
C28 without charge. By their use you accept that an offer of co-authorship will be made through personal contact with the
C29 data providers or owners whenever substantial use is made of their data. In all cases, an acknowledgement must be
C30 made to the data providers or owners and the data centre when these data are used within a publication.“
C31 Comment:
C32

DATE	TIME	DATA	ND	SD	F	CS	REM	DATA	ND	SD	F	CS	REM
1987-01-01	01:00	345.1	41	2.124	...	0	-999	345.11	41	2.324	...	0	-999
1987-01-01	02:00	352.35	21	2.142	...	0	-999	352.35	21	2.142	...	0	-999
1987-01-01	03:00	-999	-999	-999	...	0	-999	352.35	21	2.142	...	0	-999
1987-01-01	04:00	356.73	20	1.798	...	0	-999	356.73	20	1.798	...	0	-999

Example3) Air sampling observation using mobile platform

C01 CO2 instantaneous data (air sampling observation by mobile platform)
C02 eom9990.18.co2.01.m.e0.dat
C03 m1.0
C04 776
C05 33
C06 20061225
C07 Environmental observation and monitoring project
C08 --
C09 Air sampling
C10 Japan
C11 Aircraft
C12 Japan Meteorological Agency
C13 --
C14 --
C15 --
C16 --
C17 --
C18 hmatsued@mri-jma.go.jp
C19 CO2
C20 1987-01-01 2006-08-01
C21 Instantaneous
C22 ppm
C23 NDIR
C24 Continuous
C25 0
C26 WMO X2004
C27 This is a formal notification for data users. "For scientific purposes, access to these data it unlimited and provided
C28 without charge. By their use you accept that an offer of co-authorship will be made through personal contact with the
C29 data providers or owners whenever substantial use is made of their data. In all cases, an acknowledgement must be
C30 made to the data providers or owners and the data centre when these data are used within a publication.“
C31 Comment:
C32

DATE	TIME	LAT	LON	ALT	DATA	ND	SD	F	CS	REM
1987-01-01	01:00	12.121	146.412	11300	345.11	-999	-999	...	0	-999
1987-01-01	01:10	8.192	147.022	11300	352.35	-999	-999	...	0	-999
1987-01-01	01:20	4.073	146.231	11900	350.11	-999	-999	...	0	-999
1987-01-01	01:30	0.235	146.112	11900	356.73	-999	-999	...	0	-999

601

Example4) Ice core sampling observation

C01 CO2 ice core data (Ice core sampling observation)
C02 syo769s.18.co2.10.i.e0.dat
C03 i1.0
C04 40
C05 33
C06 20061225
C07 Syowa station
C08 Regional station
C09 Ice core sampling
C10 Japan
C11 Ice core
C12 Japan Meteorological Agency
C13 -70.211
C14 44.55
C15 2230
C16 --
C17 --
C18 k-Tsuboi@met.kishou.go.jp
C19 CO2
C20 1300-01-01 1800-01-01
C21 Instantaneous
C22 ppm
C23 GC-FID
C24 Ice core
C25 --
C26 WMO X2004
C27 This is a formal notification for data users. "For scientific purposes, access to these data it unlimited and provided
C28 without charge. By their use you accept that an offer of co-authorship will be made through personal contact with the
C29 data providers or owners whenever substantial use is made of their data. In all cases, an acknowledgement must be
C30 made to the data providers or owners and the data centre when these data are used within a publication.“
C31 Comment:
C32

DATE	DEP	DATA	F
1300	-999	345.12	-999
1400	-999	352.35	-999
1500	-999	350.15	-999
1600	-999	356.73	-999

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Example5) Surface seawater and overlying atmosphere observation

C01 CO2 instantaneous data (surface seawater and overlying atmosphere observation)
C02 ryf9990.18.co2.01.s.e0.dat
C03 s1.0
C04 776
C05 33
C06 20061225
C07 Ryofu maru
C08 --
C09 Surface seawater and overlying atmosphere observation
C10 --
C11 Ship
C12 Japan Meteorological Agency
C13 --
C14 --
C15 --
C16 2
C17 10,-5
C18 k-Tsuboi@met.kishou.go.jp
C19 CO2
C20 1987-01-01 2006-08-01
C21 Hourly
C22 ppm
C23 NDIR
C24 Continuous
C25 0
C26 WMO X2004
C27 This is a formal notification for data users. "For scientific purposes, access to these data it unlimited and provided
C28 without charge. By their use you accept that an offer of co-authorship will be made through personal contact with the
C29 data providers or owners whenever substantial use is made of their data. In all cases, an acknowledgement must be
C30 made to the data providers or owners and the data centre when these data are used within a publication.“
C31 Comment:
C32

DATE	TIME	LAT	LON	DATA_A	ND	SD	F	CS	REM	DATA_S	ND	SD	F	CS	REM
1987-01-01	01:00	30.421	140.823	345.12	41	2.134	...	0	-999	345.11	41	2.341	...	0	-999
1987-01-01	02:00	31.111	140.127	352.35	21	2.142	...	0	-999	352.35	21	2.142	...	0	-999
1987-01-01	03:00	30.145	141.019	350.15	19	2.142	...	0	-999	352.35	21	2.142	...	0	-999
1987-01-01	04:00	30.783	140.128	356.73	20	1.798	...	0	-999	356.73	20	1.798	...	0	-999

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Appendix 4

Metadata statement

The WDCGG requires Contributors to submit station, measurement, and other related information as metadata. As metadata is indispensable for effective data use, Contributors should describe it carefully following the instructions listed below. If you have any questions, please contact the WDCGG.

1. Station Information

Station information should be submitted for individual stations.

Station Information

Category
(Fixed, Mobile, Ice core)

Select a suitable observation category from the following items.

Fixed station
- ☐ Ground based
- ☐ Tower

Mobile platform
- ☐ Ship
- ☐ Aircraft
- ☐ Other ( )

☐ Ice Core

Station name
(Fixed, Mobile, Ice core)

The station name (In the case of mobile platform, platform name, project name, *etc*.) is described here.

Station organizer(s)
(Fixed, Mobile, Ice core)

This is an institute or organization contributing to the station management, or the measurement of the cruise. The organization‘s name, acronym, country/territory, and website (URL) should be included.

Contact Person for station
(Fixed, Ice core)

The Contact Person for the station is the person who is contacted regarding geographical or general environment information concerning the station. The person’s name, office address, phone/FAX number, and e-mail address should be included.

Latitude
(Fixed, Ice core)

The latitude of the station in decimal degrees with 1/1000 degree precision; positive (+) for North latitude, negative (-) for South latitude

Longitude
(Fixed, Ice core)

The longitude of the station in decimal degrees with 1/1000 degree precision; positive (+) for East longitude, negative (-) for West longitude

Altitude
(Fixed, Ice core)

The height of the station above sea level in meters.

WMO Region
(Fixed)

Select a suitable region from the following items

- ☐ REGION I (Africa)
- ☐ REGION II (Asia)
- ☐ REGION III (South America)
- ☐ REGION IV (North and Central America)
- ☐ REGION V (South-West Pacific)
- ☐ REGION VI (Europe)
- ☐ Antarctica
- ☐ Inter regional

Country/Territory
(Fixed, Mobile, Ice core)

The name of the country/territory where the station is located, or to which the ship or aircraft belongs is described here.

Address
(Fixed, Mobile, Ice core)

Postal address of the station

Time zone
(Fixed)

The time zone of the station should be described here (*i.e.*, the difference between local time and UTC (local time – UTC)).

GAW Category
(Fixed)

Select a suitable GAW category from the following items.

- ☐ Global
- ☐ Regional
- ☐ Contributing
- ☐ NA (not applicable)

Station environment
(Fixed, Mobile)

For fixed stations, brief descriptions of the topography, climate (mean temperature, annual amount of precipitation, wind direction frequency), vegetation type and human resources (city, factories, etc.) around the station should be presented here, whereas for mobile platforms, other information on the mobile platform, such as the name and characteristics of the ship or aircraft, the period of cruise or flight, frequency (if the cruise (flight) operates on a regular basis), the area or tracks of the cruise or flight, and the project name etc, should be included.

Example (Description of climate):
The yearly mean temperature is 10.3°C, and the temperature can be less than 0°C during winter. The summer mean temperature is about 22°C. It snows during winter, but not much. The annual precipitation is about 1350 mm. Most of the precipitation is concentrated from June to August. The wind direction is dominantly from W to WNW with an annual mean wind speed of 4.2 m/s.

Example (Description of vegetation type and human resources):

The observatory is surrounded by insignificant shrubs and grass. The nearest town is the city of Groningen (168,000 inhabitants) at a distance of about 25 km in the ESE direction. The annual frequency of ESE winds, which could carry pollution from the city directly, is usually less than 1%.

Example (Aircraft):
Uses a regular Boeing 747-200 flight (typical cruise speed: 895 km/h) of a commercial airliner over the western Pacific between Narita in Japan (35N) and Cairns in Australia (30S).

2. Measurement Information

The measurement information should be submitted for individual parameters.

2.1 Parameter

Parameter

Select a parameter (gas name) from Table 1 and Table 2 in Appendix 1.

Contributor(s)

The Contributor is the institute or organization who obtains and submits the measurement data (See Section 2.1.2 in Guide). The organization's name, acronym, country/territory, and website (URL) are included. In some cases, the Station organizers *for the measurement* may be different from Station organizers *for the station*.

Contact Person for measurement

The Contact Person for measurement is the person who is contacted regarding the submission of data and the measurement information (See Section 2.1.4 in Guide). This person's name, office address, phone/FAX number, and e-mail address should be included.

Responsible Investigator (optional)

The Responsible Investigator is the person who is officially or scientifically responsible for the observation (See Section 2.1.5 in Guide). This person's name, office address, phone/FAX number, and e-mail address should be included.

2.2 Observation

Category

Select a suitable category from the following items.

- ☐ Air sampling observation (including mobile platform)
- ☐ Ice core observation
- ☐ Surface seawater and overlying atmosphere observation
- ☐ Hydrographic sampling observation
- ☐ Other ( )

Situation

Select the most appropriate measurement situation.

- ☐ ongoing
- ☐ interrupting
- ☐ terminated

Time zone

Select a suitable time zone used in a timestamp of the measurement data. In the case of "Local time" or "Other", the UTC offset should be described (i.e., the difference between observation time and UTC (observation time – UTC)).

- ☐ UTC

☐Local time( )
☐Other( )

2.3 Sampling

Sampling height (depth)

The height (depth) of the air (seawater) sampling above the ground (below sea level) in meters; positive for height and negative for depth, apart from mobiles (3D) whose altitudes are included in the measurement data.

Example 1
(Air sampling observation – Height of air intake): 20
Example 2
(Tower observation – Heights of air sampling intake): 27, 18, 8.8, 2
Example 3
(Surface seawater observation – Depth of ship inlet): -5

Sampling type

Select a suitable sampling type from the following items.

- ☐ Continuous (including gaschromatograph sampling)
- ☐ Flask
- ☐ Filter
- ☐ Ice Core
- ☐ Bottle (for hydrographic data)
- ☐ Other ( )

Sampling and analysis frequency

A brief description of the sampling frequency should be presented here.

Example 1 (gas chromatograph sampling):
Air is discretely sampled and analyzed every 30 minutes

Example 2 (flask sampling):
Air is sampled in a bottle every week.

Example 3 (continuous measurement):
Continuous flow of 5 liters per minute and data is analyzed every 30 seconds.

Sampling environment

A brief description of the information on sources and sinks on the measurement gas measured should be presented here.

Example 1:
The station is located in an agricultural plain with some forests that could affect the CO_2 mixing ratio in calm conditions.

Example 2:

The station is surrounded by forests and on the southeast side of the middle (230 m a.s.l.) of a small hill on the east coast of northern Japan. While a power plant using fossil fuel, which could affect the CO_2 mixing ratio, is located 10 km south of the station, the frequency of southerly winds is usually less than 8%. In the case of southerly winds, the measurement data is flagged.

Other description for sampling and analyses

Detailed descriptions concerning sampling should be presented here. For example, information on air sampling intake (height, shape, materials, etc.), tubing (materials, diameter, and length, *etc.*), flow rate, and dehumidification for *in situ* measurements, bottles used (volume and material) for flask sampling, and procedures or conditions for flask sampling etc.

Example 1 (Fixed Station – Flask sampling observation):

Air is sampled in a bottle once a week during northerly wind conditions. The sampled air is compressed to 2 atm in the bottle by a vacuum pump after a 5-minute ventilation.

Example 2 (Fixed Station – Continuous observation):

Air is sampled from a stainless steel intake at 10 m height with 15 liters min^{-1}. The sampled air is introduced to a dehumidification instrument for 10 m through a stainless steel pipe with a diameter of one inch. After dehumidifying to 3 ºC, the sampled air is divided and introduced to the instrument with 3 liters min^{-1} through a 4 m stainless steel pipe with a diameter of a quarter inch.

Example 3 (Mobile Ship – Surface seawater and overlying atmosphere):

The measurements are made in a 60-minute cycle, and standard gases, water samples, and air samples from the ocean surface are measured in the following order in each cycle: Four standard gases are measured for 6 minutes each, 1 water sample is measured for 12 minutes, 2 air samples from the ocean surface are measured for 6 minutes each, and 1 water sample is measured for 12 minutes.

For CO_2 in the atmosphere, marine boundary air was pumped continuously from the foremast (about 13 m above sea level), and an aliquot (250 cm^3 min^{-1}) was dried with an electric cooling unit and magnesium perchlorate before introducing it into the NDIR gas analyzer.

For CO_2 in seawater, the seawater sample was pumped continuously from a ship inlet located ca. 5 m below sea level. It was partly

introduced into a shower-type equilibrator (ca. 6 dm^3 min^{-1}) where the seawater was equilibrated with air in a closed circuit. The seawater-equilibrated air was dried in the same way as the marine boundary air.

Example 4 (Mobile Ship – Hydrographic data):
Discrete samples were taken from depths using 12-L Niskin bottles mounted on a CTD/carousel sampler. Sub-samples for DIC analysis were stored in 250-cm^3 ground glass stoppered borosilicate glass bottles lubricated with Apiezon-L grease after adding 0.1 cm^3 of saturated mercury (II) chloride solution.

2.4 Instrument and analyses

Measurement Method

Select a suitable method from the following items.

- ☐ Gas Chromatography (ECD)
- ☐ Gas Chromatography (FID)
- ☐ Gas Chromatography (RGD)
- ☐ Gas Chromatography (MS)
- ☐ Gas Chromatography (other)
- ☐ Ion Chromatography
- ☐ Light absorption analysis (UV)
- ☐ Light absorption analysis (VIS)
- ☐ NDIR
- ☐ Light absorption analysis (IR, except NDIR)
- ☐ Chemiluminescence
- ☐ Fluorometry
- ☐ Coulometry
- ☐ Mass Spectrometry
- ☐ Titration
- ☐ Filter
- ☐ Other( )

Current status and history of instruments used

The period in use, product name, and manufacturer of the instrument are described.

Example 1 (CO_2):

Period in use	*Product Name*	*Manufacturer*
1988 April - 1998 Apri,	*VIA-500R,*	*Horiba Ltd.*
1998 June - present,	*VIA-510R,*	*Horiba Ltd.*

Example 2 (Surface O_3):

Period in use	*Product Name*	*Manufacturer*
1984 January-1988 March,	*Original ozone meter using KI method,*	*made by Reserach Insituite*

1988 April - 1998 May,	*Model 1003PC,*	*Dasibi Corporation*
1998 June - present,	*Model 49C,*	*TEI Corporation*

Description of instruments

The instrument specifications (resolution, measurement range, and linearity, etc,) are described here.

Example:
Range: 0 to 1000 ppm.
Sensitivity: Minimum detectable mixing ratio is 20 ppm for a 0- to 1000ppm span.
Precision: approximately 2 percent of span.
Accuracy: approximately 5 percent of span after calibration.
Rise time: 90 percent (maximum) 30 seconds
Fall time: 90 percent (maximum) 30 seconds
Zero drift: (maximum) 10% in 8 hours
Span drift (maximum) 10% in 8 hours
Linearity (maximum deviation) 2% of full scale

2.5 Calibration

Current scale employed in the measurement

The clarification of the current scale used in the measurement should be described here.

Note: Concerning the WMO reference standard, please refer to WMO GAW Report No.142 “Strategy for the Implementation of the Global Atmosphere Watch Programme (2001-2007).”

Example 1: *WMO mole fraction scale*
Example 2: *SIO-1998 scale*
Example 3: *Traceable to Tohoku University Standard gases*
Example 4: *GAW reference standard scale hosted by NIST*
Example 5: *Observer’s standard scale*
Example 6: *Traceable to national standard scale*

Measurement calibration

The calibration for determining the mixing ratio is described here. Procedures for analyses are also described here, for example, the introduction order (sequences) of sample gas and standard gases (or zero gas) to the instrument, their duration, the number of calibration points, etc.

Example 1 (CO_2):
The non-linear fitting curve is determined every 4 days by a set of 5 station working standard gases in a pyramid manner with 10 minutes for each stage. The mixing ratio is determined by this fitting curve. Every day, target gas is introduced to check the system performance.

Example 2 (CH_4):

The mixing ratio is determined by the liner regression line determined every hour by two working standard gases that closely bracket the ambient mixing ratio. Every 8 hours, target gas is introduced after the two working standard gases. The difference between the assigned mixing ratio and the measured mixing ratio is a measure of the overall system performance.

Example 3 (Surface O_3):

The zero level of the instrument is checked every day. The 4 span gases (50, 100, 150, 200 ppb) from the transfer standard instrument are introduced once a month. The mixing ratio is determined by the leaner regression line from zero level and the 4 spans.

Scale and Calibration (traceability)

Detailed descriptions of information on scales employed and calibration of standard gases (instrument) are given here. For example, information on the hierarchy of standards (headquarters and station), reference standard gases (instruments), frequency of calibration and the latest calibration, history of calibration, and information on intercomparison.

Hierarchy of standards

Example:

The primary standard gases in the national centre are calibrated by WMO reference standard gases. The secondary standard gases in the national centre are calibrated by the primary standard gases. The working standard gases in the station are calibrated by the secondary standard gases.

Reference standard (in the case of observer's standard scale)

Example 1 (CH_4):

Two standard gases were made by Nippon Sanso Inc. in 2004 using a gravimetric method whose production method was developed and maintained by Tohoku University. Their mixing ratios were about 1800 and 2000 ppb and their lifetime will be about 4 years.

Example 2 (Surface O_3):

A standard UV photometer (Thermo Electron Corp. Model 49PS), which was calibrated by the manufacturer in 2003, was used. The scale is calibrated by the manufacturer every two years.

Frequency of calibration and latest calibration

Example 1 (CO_2):

The primary standard gases are calibrated by WMO reference standard gases at WMO CCL every 3 yeasrs. The latest calibration at CCL was performed in November 2003. The secondary standard

gases are calibrated by the primary standard every 6 months. The working standard gases in the station are calibrated by the secondary standard gases before and after use (period of use is about 3-4 months).

Example 2 (Surface O_3):

The primary standard instrument (Thermo Electron Corp. Model 49PS) is compared with NIST SRP #15 at the WMO World Calibration Center, Swiss Federal Laboratories for Materials Testing and Research (EMPA), every 3 years. The latest calibration was performed in April 2004. The transfer standard ozone monitor, which is a Thermo Electron Corp. Model 49C, is calibrated by the primary instrument every 6 months.

Calibration history

Example 1 (CO_2):

1st generation (1988 Apr. – 1991 Apr.)
Calibration date (Calibration standard)
1987 Apr. at SIO (WMO X85)
1991 May at SIO (WMO X85)
2nd generation (1991 Apr. – 1998 Jun.)
Calibration date (Calibration standard)
1990 Apr. at SIO (WMO X87)
1994 Apr. at SIO (WMO X93)
1999 Jul. at CMDL (WMO Mole Fraction)
3rd generation (1998 Jun. –)
1997 Apr. at CMDL (WMO Mole Fraction)
2000 Apr. at CMDL (WMO Mole Fraction)

Example 2 (Surface O_3):

1984 April – 1988 March: Original ozone generator using KI method.
1988 April – 1998 May: TEI Model 49PS with the EPA certification
1998 June – present: TEI Model 49PS which is calibrated with the WMO reference standard (SRP) at NIST every two years.

Information on intercomparison

Example:

1. WMO CO_2 round robin 1991/1992 (WMO, SIO: 1991-1992)
Analysis date: 1991-05
Remark: WMO/GAW report #X2
2.WMO CO_2 round robin 1999/2000 (WMO, CMDL: 1999-2000)
Analysis date: 1999-11
Remark: WMO/GAW report #X2
The results are available on the internet (http://…)

2.6 Data Processing

Measurement Unit

The measurement unit is described here.

Data Processing

Details of how to process and average outputs from the instrument are described here. The criteria used for any data selection in the data processing are also described.

Example:

The raw data from the instrument is collected by the data acquisition system, and stored in the system as one minute average raw data. The minutely averaged raw data is converted to physical data using zero/calibration factors measured in the observation sequences. Invalid data caused by instrumental malfunction are checked by comparison/correlation with other trace substances and meteorological data or with information from the station logbook.

Processes for averaging

Detailed processes on hourly, daily, monthly data or data selections on qualities are described.

Example :

Hourly data are generated by arithmetic means from the per-minute data without including invalid data. If the most frequent hourly wind direction is not W-SW, the corresponding hourly data is flagged as "0". Otherwise, hourly data is flagged as "1". If the number of valid data within an hour is less than 30, the hourly mean value is flagged as "2". If all data within an hour are invalid, the hourly mean value is "-999.9".

The arithmetic means of hourly data are adopted as daily data with a "0" flag if more than 80% of hourly data with a "0" flag are available. Otherwise, daily data is flagged as "2". If all data within a day are invalid (-999.9), daily data is "-999.9".

The arithmetic means of daily data are adopted as monthly data with a "0" flag if more than 1/3 of daily data with a "0" flag are available. Otherwise, monthly data is flagged as "2". If all data within a month are invalid (-999.9), monthly data is "-999.9".

Data Quality Flag

The WDCGG does not have a common definition on data flagging, and Contributors should define their own data flags, and make clear their criteria of data flagging.

Example 1:

Flag: Data Category

0: Background data

1: Data possibly affected by polution (wind direction is W - SW)

2: Insufficient number of averaging data

3: Invalid data

Example 2:

Flag	*Criteria1*	*Criteria2*	*Data Category*
	(Insufficient number of data)	*(High standard deviation)*	
0	*Yes*	*Yes*	*Out of background*
1	*No*	*Yes*	*Ditto*
2	*Yes*	*No*	*Ditto*
3	*No*	*No*	*Background condition data*

Data Remarks

Data submitters who submit data with data remarks should provide a definition.

Example:

Remarks are expressed as "xxxx c." The meanings of the symbols are as follows:

xxxx : Flask ID number

c : Sampling collection method code. Here, "p" means a portable, battery powered pump, "T" means an evacuated flask, and "S" means using the in situ CO_2 measurement air intake system.

3. Other Information

Scientific Aim

Descriptions of the aims of measurement are presented here.

Example 1:

To provide data for research and study to reveal long term trends.

Example 2:

To monitor suburban regions for pollution research.

Example 3:

To quantify fluxes for budget estimation with a limited observation period (campaign research).

Reference

Any references to the measurement, such as the instruments, data processing, and calibration, in the literature or URLs should be described here.

Example:

*Tsutsumi, Y., K. Mori, M. Ikegami, T. Tashiro, K. Tsuboi, 2006: Long-term trends of greenhouse gases in regional and background events observed during 1998-2004 at Yonagunijima located to the east of the Asian continent. Atmospheric Environment, **40**, 5868-5879.*

http://gaw.kishou.go.jp/japan/ryo.html

ACRONYMS

CCL:	Central Calibration Laboratory
CMDL:	Climate and Monitoring Diagnostics Laboratory
ECD:	Electron Capture Detector
FID:	Flame Ionization Detector
GAW:	Global Atmosphere Watch
GAWSIS:	GAW Station Information System
IR:	Infrared
MS:	Mass spectrometry
NDIR:	Non Dispersive Infrared absorption
NIST:	National Institute of Standards and Technology
QA/SAC:	Quality Assurance/Science Activity Center
RGD:	Reduction Gas Detector
SAG:	Science Advisory Group
SIO:	Scripps Institution of Oceanography
SRP:	Standard Reference Photometer
UTC:	Coordinated Universal Time
UV:	Ultra Violet
VIS:	Visible
WCC:	World Calibration Center
WDCGG:	World Data Centre for Greenhouse Gases