

REPORT

**MONITORING OF OZONE DEPLETING SUBSTANCES
IN THE ATMOSPHERE**

Work carried out under contract for the Ministry of the Environment FY2007

March 2008

REPORT
MONITORING OF OZONE DEPLETING SUBSTANCES
IN THE ATMOSPHERE

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FOREWORD

This report is the result of work carried out under the title, "Monitoring of ozone depleting substances in the atmosphere FY2007". The Ministry of the Environment has observed the status of changes in the atmospheric concentrations of ozone depleting substances and has published the results in accordance with the "Law concerning the Protection of the Ozone Layer through the Control of Specified Substances and Other Measures" (the Ozone Layer Protection Law) Article 22. The ministry contracted with Japan Environmental Sanitation Center Foundation (JESC) for this work to obtain basic data to monitor the status of the selected ozone depleting substances.

Due to their highly inert and non-toxic properties, chlorofluorocarbons (CFCs) and other halogenated hydrocarbons were widely used as refrigerants, solvents, insulators, and so on. However, it became clear scientifically through many studies that these substances are stable or less decomposable in the troposphere and reach the stratosphere and eventually destroy the stratospheric ozone. Therefore, international efforts to protect the ozone layer from this destruction by artificial ozone depleting substances represented by CFCs concluded in the "Vienna Convention for the Protection of the Ozone Layer" adopted in 1985 and the "Montreal Protocol on Substances that Deplete the Ozone Layer" adopted in 1987. In Japan, the Ozone Layer Protection Law, which controls the production of CFCs and other ozone depleting substances based on the Montreal Protocol, was established in 1988 and steady efforts has been made for a reduction in the emissions of these substances.

In developed countries, the production of CFCs, halons, carbon tetrachloride, and 1,1,1-trichloroethane has already been banned. The growth rates of these substances in the atmosphere have been diminishing. Furthermore, the atmospheric concentrations of several substances are already on the decline. However, in the meantime, abundances of the dominant halons are still increasing, and abundances of substitutes for CFCs, such as hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs), are also increasing. Although their potential contribution to ozone depletion is estimated to be less than that of CFCs, HCFCs are still ozone depleting substances and are controlled under the Montreal Protocol. In addition, HFCs are controlled under the Kyoto Protocol due to their strong global warming potential. The impact of these substances on stratospheric ozone depletion and on global warming is of great concern.

In assessing the present efforts to protect the ozone layer, this report should be useful as a study on the status of ozone depleting substances and other related issues. I therefore deeply appreciate the efforts of those involved in carrying out this work.

March 2008

Yotsuyakami-cho 10-6, Kawasaki-ku, Kawasaki-shi
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Chief Director Kobayashi Yasuhiko

ABSTRACT

This is a report of a survey carried out by Japan Environmental Sanitation Center Foundation (JESC) contracted by the Japanese Ministry of the Environment to observe changes in the atmospheric concentrations of selected ozone depleting substances. The Ministry of the Environment has observed the levels of the accumulation of ozone depleting substances in the atmosphere by conducting a series of surveys to determine the atmospheric concentrations of such substances in Hokkaido and Kawasaki City since 1989. The main objective of this work was first to accurately determine the concentrations of selected ozone depleting substances in the atmosphere and next to observe the concentrations of these substances in the air in urban areas in order to monitor the status of their actual emissions.

In Hokkaido, the atmospheric concentrations of 15 substances: CFC-11, CFC-12, CFC-113, CFC-114, CFC-114a, CFC-115, halon-1211, halon-1301, halon-2402, carbon tetrachloride, 1,1,1-trichloroethane, HCFC-22, HCFC-141b, HCFC-142b, methyl bromide, and HFC-134a were measured. In Kawasaki City, the concentrations of seven substances: CFC-11, CFC-12, HCFC-22, HCFC-141b, HCFC-142b, methyl bromide, and HFC-134a in the air were periodically measured using an automatic measuring apparatus.

1. Methods

1.1 Observations in Hokkaido

The areas around Wakkanai and Nemuro in Hokkaido are appropriate locations for the collection of well-mixed atmospheric air samples at a mid-latitude location of the northern hemisphere. The air samples collected in both areas were measured in the laboratory of JESC, and the concentrations of the 15 substances mentioned above were obtained. Metal containers with a volume of 2L or 12L were used in the air sample collections. These containers were cleaned, evacuated, and used in the samplings. The collection of the air samples in Hokkaido was conducted twice for four consecutive days in August 2007 and January 2008. In both areas, five samples were collected over two consecutive days.

The measurement methods for determining the concentrations were as follows: CFCs, halons, carbon tetrachloride, and 1,1,1-trichloroethane were measured by gas chromatography using an electron capture detector (ECD). HCFCs and methyl bromide were measured by gas chromatography using an ECD, the sensitivity of which was improved through the addition of a small amount of O₂ to the carrier gas. HFC-134a was measured by gas chromatograph-mass spectrometry.

1.2. Observations in Kawasaki City

The observations in the urban area were carried out at the facilities of JESC in Kawasaki City. Since the facilities are located approximately at the center of the Keihin industrial area, it is a suitable location to assess the trends in emissions of the measured substances in Japan. Ambient air was introduced to the apparatus through an air intake port on the rooftop of the JESC building. The apparatus carried out the measurement of the seven substances at intervals of five hours.

2. Results

2.1 Results for Hokkaido

The atmospheric concentrations of the 15 substances in the summer and the winter in Hokkaido were obtained. According to the results obtained through the series of investigations in Hokkaido, the following have been clarified.

- (a) The atmospheric concentrations of CFC-115, halon-1301, HCFC-22, HCFC-141b, HCFC-142b, and HFC-134a have continued to increase since the observation program began. The rate of increase in the concentrations of HFC-134a is the highest among these.

- (b) The atmospheric concentrations of CFC-12 and CFC-114 were increasing until the first half of the 1990s, however, since then they have become almost stable.
- (c) The atmospheric concentrations of halon-1211 were increasing until around 2005, however, no significant change has been observed since then.
- (d) The atmospheric concentrations of CFC-11, CFC-113, halon-2402, carbon tetrachloride, and 1,1,1-trichloroethane were increasing for several years from the beginning of the observation program, however, they have been declining over the past 10 or more years. The rate of decrease in the concentrations of 1,1,1-trichloroethane has been the highest among these.
- (e) No significant change has been observed in the concentrations of methyl bromide in recent years.

2.2 Results for Kawasaki City

Continuous atmospheric concentrations of the seven substances from March 1, 2007 to February 29, 2008, in Kawasaki City were obtained. The following status was clarified through the analysis using the results that have been obtained through the series of investigations.

- (a) The concentrations of CFC-11 and CFC-12 in the air have scarcely changed compared to the previous year. The concentrations of both substances were close to the background levels. This indicates that the amount from the emissions of these substances has become very small. However, although not frequently, concentrations of these substances were detected that reached several times the background level, and this indicates that emissions have not been completely eliminated.
- (b) High concentrations of HCFC-22, HCFC-141b, and HFC-134a were frequently detected, and this indicates that considerable quantities of these substances are still being discharged in the area.
- (c) HCFC-142b and methyl bromide are still being discharged in the area, however, it was considered that the amount from the emissions of these substances was not large.

This work covers the period from April 1, 2007 to March 31, 2008, and all work was completed as of March 31, 2008.

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1. OVERVIEW

1.1. OBJECTIVES

This work aimed to monitor the levels of the accumulation in the atmosphere of the ozone depleting substances that are controlled under the "Law concerning the Protection of the Ozone Layer through the Control of Specified Substances and Other Measures" (hereinafter referred to as "the law") as well as the accumulation in the atmosphere of the substitutes for CFCs through the measurement of the atmospheric concentrations of these substances at fixed sampling locations (specified areas in Hokkaido, hereinafter referred to as "the background area" or "Hokkaido"). The collection of well-mixed atmospheric air samples at this mid-latitude location in the northern hemisphere, based on the conclusions of the "Study on the establishment of monitoring methods for atmospheric trace CFCs that modify the stratospheric ozone layer - FY1987" and the "Monitoring of ozone depleting substances in air - FY1988" has made it possible to monitor the status of variations in the concentrations of the ozone depleting substances and their substitutes in the atmosphere and to evaluate the trends in the emissions of these substances through observation of the concentrations of these substances in the air in an urban area (a specified location in Kawasaki City, hereinafter referred to as "the urban area" or "Kawasaki") where it was expected that the observations would accurately reflect the status of emissions of these substances in other urban areas in Japan.

1.2. OBSERVATION ITEMS

(1) Measured Substances in Background Area

In the background area, the concentrations of following 15 substances were measured (see Note 1, Note 2, and Note 3). The concentrations of these substances were determined by analyses of sample airs collected in sample containers.

i) Trichlorofluoromethane (CFC-11)	CCl_3F
ii) Dichlorodifluoromethane (CFC-12)	CCl_2F_2
iii) Trichlorotrifluoroethane (CFC-113)	$\text{CCl}_2\text{FCClF}_2$
iv) Dichlorotetrafluoroethane (CFC-114)	$\text{CClF}_2\text{CClF}_2$
(CFC-114a)	CCl_2FCF_3
v) Chloropentafluoroethane (CFC-115)	C_2ClF_5
vi) Bromodifluoromethane (halon-1211)	CBrClF_2
vii) Bromotrifluoromethane (halon-1301)	CBrF_3
viii) Dibromotetrafluoroethane (halon-2402)	$\text{C}_2\text{Br}_2\text{F}_4$
ix) Carbon tetrachloride	CCl_4
x) 1,1,1-Trichloroethane	CH_3CCl_3
xi) Chlorodifluoromethane (HCFC-22)	CHClF_2
xii) 1,1-Dichloro-1-fluoroethane (HCFC-141b)	$\text{CH}_3\text{CCl}_2\text{F}$
xiii) 1-Chloro-1,1-difluoroethane (HCFC-142b)	CH_3CClF_2
xiv) Methyl bromide	CH_3Br
xv) 1,1,1,2-Tetrafluoroethane (HFC-134a)	CH_2FCF_3

(2) Measured Substances in Urban Area

In the urban area, the concentrations of following seven substances were measured. The concentrations of these substances were obtained through the continuous measurement of ambient air using an automatic measuring apparatus.

- i) CFC-11
- ii) CFC-12
- iii) HCFC-22
- iv) HCFC-141b
- v) HCFC-142b
- vi) Methyl bromide
- vii) HFC-134a

(3) Other observation items

In the background area, the weather, wind direction, wind speed, air temperature and air humidity were recorded at the time the air samples were collected. Weather maps were also compiled for the days on which the sampling was conducted. The wind direction and wind speed at the rooftop of the building of JESC were continuously observed.

1.3. SAMPLING LOCATIONS

(1) Background Area

Air sample collections have been made in the following two areas since the first survey on the "Monitoring of ozone depleting gases in air - FY1988" in FY1988. It was expected that possible local air pollution at both sampling locations would have hardly any impact, given the geographical conditions and the conclusions of past investigations and other considerations (1).

i) Around Nosappu-misaki

Near the tip of Nemuro peninsula in Hokkaido (hereinafter called "Nemuro").

ii) Around Wakkanai

On the seashore around Wakkasakanai, Toyotomi Town, Teshio district, Hokkaido or on the seashore at Mineoka Wakkanai (hereinafter called "Wakkanai").

The sampling locations in the background area are shown in **Figure 1.1**.



Figure 1.1. Sampling locations

(2) Urban Area

To assess the trends in the variation in the emissions of the specified substances in Japan, based on the need for a location that was situated at approximately a central point in the Keihin industrial area and to

provide a suitable location for the observation of an urban area, the facilities of JESC (Yotsuyakami-cho 10-6, Kawasaki-ku, Kawasaki-shi) was selected as the observation point (2)(3). Air sampling was conducted on the rooftop of the JESC building. This sampling location in an urban area is also shown in **Figure 1.1**.

1.4. PERIODS AND SAMPLE SIZE

(1) Background Area

The background air sample collections were conducted during the periods August 20 to 23, 2007 (summer season survey) and January 21 to 24, 2008 (winter season survey). In each survey, ten samples were collected (20 samples in total).

(2) Urban Area

Observations using automatic measurement in an urban area were conducted during the period from March 1, 2007 to February 29, 2008. The automatic measuring apparatus analyzed ambient air at intervals of five hours (about five measurements per day).

1.5. CONFERENCE AND IMPLEMENTATION ORGANIZATION

This work was carried out by JESC. JESC held a meeting with scholars to provide appropriate advice on how to carry out the work. The scholar participants in the meeting were Dr. Yoshihiro Makide, professor emeritus of the University of Tokyo and Dr. Nobuaki Washida, Institute of Physical and Chemical Research (RIKEN).

Note 1) The substances to be measured were selected from the specified substances controlled by the law, including all chlorofluorocarbons (CFCs) in group I of Annex A of the "Montreal Protocol on the Substances that Deplete the Ozone Layer" (the protocol), all halons in group II of Annex A, carbon tetrachloride, and 1,1,1-trichloroethane in Annex B, hydrochlorofluorocarbons (HCFCs) in Annex C and methyl bromide in Annex E. Although not controlled by the law, hydrofluorocarbon (HFC)-134a was added to these subject substances for measurement as it is a major substitute for CFCs. The HCFCs and HFC-134a to be measured were selected from the list as major substances in consideration of the trends in their production and their use in the recent past as well as their expected use in the future.

Note 2) The notation and the order of the description of the substances followed the notation and the order in the annexes of the protocol in principle. Exceptionally, in consideration of the tendency of the notations in the recent dissertations, the notation order of the chemical element symbols was changed to the order of carbon, hydrogen, bromine, chlorine, and fluorine. (Halogen elements are in alphabetical order.) In addition, in some cases where it is necessary to indicate isomers, the notation does not always follow the notation of the protocol. Common substance names shown in the protocol are used in this report for the sake of simplicity.

Note 3) In this report, CFC-11, CFC-12, CFC-113, CFC-114, and CFC-115 are generically referred to as CFCs, halon-1211, halon-1301 and halon-2402 are referred to as halons and HCFC-22, HCFC-141b, and HCFC-142b are referred to as HCFCs, respectively. In addition, CFCs, halons, carbon tetrachloride, and 1,1,1-trichloroethane are generically referred to as "CFCs and other substances".

2. METHODS

2.1. SAMPLE CONTAINERS

Two types of containers with a volume of 2 L (1) and 12 L were used in the sample collections. The respective external appearance of each type of container is shown in **Figure 2.1** and **Figure 2.2**. The sampling containers were made of stainless steel and had valves with a stainless steel body and metal bellows (U.S. Nupro Type SS-4H).

The containers were prepared (see note) by JESC and sent to the NS Environmental Science Consultant Corporation, Sapporo division which conducted the field sampling. This division carried the containers in its own vehicle to the sampling locations and then used them for the sampling.

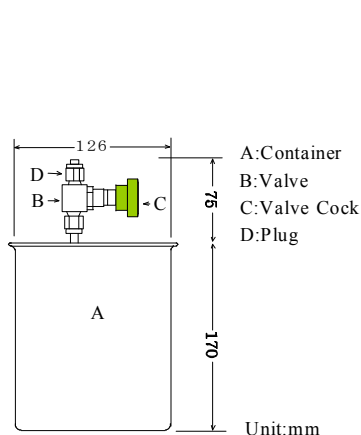


Figure 2.1. 2 L container

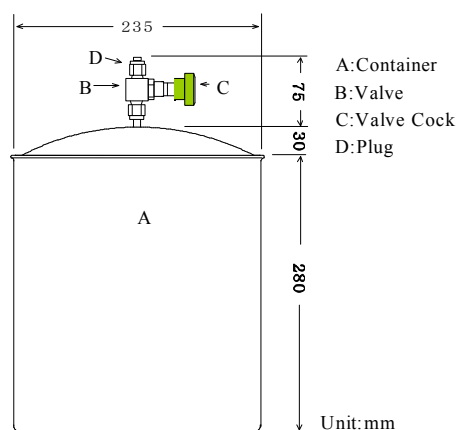


Figure 2.2. 12 L container

2.2. SAMPLE COLLECTION

In the background area (Wakkanai and Nemuro, Hokkaido), the observer selected a seashore location that was suitable for the sampling where the wind was blowing from the sea onto the land. In the sampling procedures, the observer removed the plug of the sampling container beforehand, and held the container against the wind and then opened the valve. The observer closed the valve when the sound of inflowing air stopped and then tightened the plug. Either 2 L containers or 12 L containers were used for the air collections. The air samples were collected at ambient pressure. The observer recorded the wind direction, wind speed, air temperature, and humidity at the time of the sampling using a propeller anemometer, a wind vane, and an Assmann hygrometer. In both locations, the observer collected five samples over two consecutive days. The observer considered the intervals between the samplings to be equal to an hour or longer as far as possible. The observer apportioned the number of samples between the two days.

An outline of the sampling method for the automatic measurement apparatus in the urban area observation (JESC, Kawasaki-shi) is given in section 2.5 and the details of the automatic measuring apparatus are also described in Appendix B.

Note) The preparation of the containers was as follows: The interior of the containers was cleaned using boiling water, then dried and evacuated to a pressure of 0.1 mmHg (about 13 Pa) or less. Next, they were heated for about 1 hour at 120 °C, filled with pure air, immediately evacuated, and then filled with pure air with approximately 1% humidity. The containers were left to stand for a few days, and finally evacuated.

2.3. CALIBRATION GAS

(1) Calibration Gas for Dominant CFCs and Other Dominant Hydrocarbons

The calibration gas for the CFC-11, CFC-12, CFC-113, carbon tetrachloride, and 1,1,1-trichloroethane measurements was prepared through the dilution of the raw gases or concentrated liquids with synthetic air using the dilution system shown in **Figure 2.5** (July 1989). The calibration gas was saved in a 6 L stainless steel container, which was manufactured according to our specifications. The calibration gas contained 0.2 ppbv of carbon tetrachloride and 0.5 ppbv of the other substances.

(2) Calibration Gas for CFC-114, CFC-115, Halons, HCFCs and Methyl Bromide

The calibration gas for the CFC-114, CFC-115, halons, HCFCs, and methyl bromide measurements was prepared through the dilution of the raw gases or concentrated liquids with synthetic air using the dilution system shown in **Figure 2.5** (October 2003). The calibration gas was saved in a 15 L stainless steel container (U.S. Scientific Instrumentation Specialist Inc.). The calibration gas contained 0.1 ppbv of CFC-114, 0.05 ppbv of CFC-115, halon-1211, halon-1301, and halon-2402, 0.2 ppbv of HCFC-22, and 0.1 ppbv of HCFC-142b and methyl bromide.

The calibration gas also contained approximately 0.5 % of water for the purpose of stabilizing the concentrations of the substances, however, the effect of adding water for the improvement of the stability of these substances in a stainless steel container is not well understood (4). The stability of these substances in a stainless steel container kept for a long period of time is also not well understood.

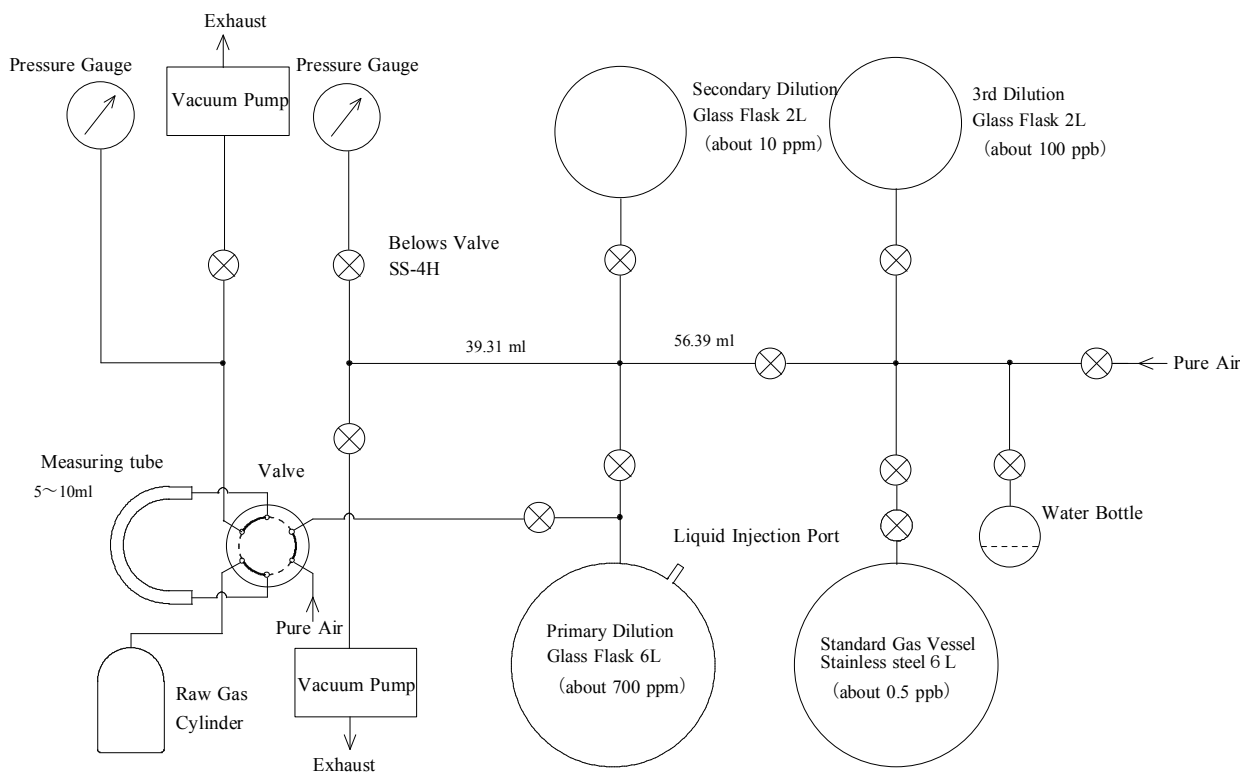


Figure 2.5. Calibration gas dilution system

(3) Calibration Gas for HCFC-141b and HFC-134a

The calibration gas for the HCFC-141b and HFC-134 measurements was purchased from Taiyo Toyo Sanso Inc (December 2001). The calibration gas contained 20.8 pptv of HCFC-141b and 20.8 pptv of HFC-134 diluted with nitrogen, and was pressured in a 10L aluminum alloy cylinder. The stability of HCFC-141b and HFC-134a kept for a long period of time in an aluminum alloy cylinder is not well understood.

(4) Calibration Gas for Daily Measurements

An air sample collected at Wakkanai in March 2000 (a 32L stainless steel container, U.S. BRC) was used as the standard gas for the daily measurement of CFC-11, CFC-12, CFC-113, CFC-114, halon-1211, halon-1301, carbon tetrachloride, 1,1,1-trichloroethane, and HCFC-22. The concentrations of these substances in the daily standard were determined through comparison with the calibration gas mentioned above. The calibration gases mentioned above were used for the daily measurement of CFC-115, halon-2402, HCFC-141b, HCFC-142b, methyl bromide, and HFC-134a.

2.4. ANALYTICAL METHOD

(1) Outline of Analytical Method of CFCs and Other Dominant Substances

Since an electron capture detector (ECD) well responds to many CFCs and other halocarbons (halons, carbon tetrachloride, 1,1,1-trichloroethane) specified as the subject substances for measurement in this program, these substances were measured by gas chromatography using an ECD (hereinafter referred to as the "GC analytical method"). These substances were divided into five groups according to their physical characteristics, typical atmospheric concentrations, and the existence of interfering compounds and suitable analytical conditions were established for each group. The grouping of the substances and the five analytical methods are summarized in **Table 2.1**.

GC analytical method 1 shown in the table was an analytical method that concentrated the compounds in a small amount of the sample air through the introduction of the sample on a cryo-concentration tube kept at an extremely low temperature and with the immediate introduction of the compounds onto the analytical column. This method was applied to the measurement of CFC-11, CFC-12, CFC-113, carbon tetrachloride, and 1,1,1-trichloroethane which exist in high concentrations in the atmosphere.

GC analytical method 1 was not applicable to the precise analysis of the other substances due to the extremely low concentrations of these substances in the atmosphere. Therefore, these substances excluding the above five substances were measured by several methods based on the dual column separation technique to completely separate these substances from other compounds. As shown in the table, GC analytical method 2 was applied to the measurement of CFC-114, GC analytical method 3 was applied to the measurement of CFC-115, GC analytical method 4 was applied to the measurement of halon-1211 and halon-1301 and GC analytical method 5 was applied to the measurement of halon-2402.

Table 2.1. Grouping of CFCs and other halocarbons, and analytical methods

Method	Detector	Analytical column / Precolumn	Substance
GC analytical method 1	ECD	DC-550 25% 4m + OV-101 25% 2m	CFC-11, CFC-113, Carbon tetrachloride, 1,1,1-Trichloroethane
GC analytical method 2	ECD	Alumina PLOT 50m / DC-550 25% 4m	CFC-114
GC analytical method 3	ECD	Alumina PLOT 50m / Carbopack B +1% SP1000 3m	CFC-115
GC analytical method 4	ECD	Carbopack B +1% SP1000 2m / DC-550 25% 4m	Halon-1211, Halon-1301
GC analytical method 5	ECD	Carbopack B +1% SP1000 1.5m / OV-17 25% 5m	Halon-2402

(2) Outline of Analytical Method of HCFCs, Methyl Bromide, and HFC-134a

Although an ECD scarcely responds to HCFCs and methyl bromide in comparison with CFC-11 and carbon tetrachloride, the addition of a small amount of oxygen into the carrier gas fairly improves the sensitivity of the detector to these substances (8). In addition, the measurement method using GC-ECD generally gives a higher accuracy than that using a gas chromatograph mass spectrometer (hereinafter referred to as "GC-MS"). A method using GC-MS was applied to the analyses of urban air in the series of measurements in this survey during 1992-1995. These substances were measured using GC-ECD with the carrier gas flow doped with oxygen. Since it was difficult to precisely measure these substances simultaneously due to the problem of separation, the three HCFCs and methyl bromide were divided into three groups, and suitable analytical conditions were established for each group. CFC-12 could also be analyzed by GC analytical method 1. Since the precision of the measurement was in principle better than that of GC analytical method 1, the concentrations of CFC-12 were determined by this method. Since an ECD is insufficiently responsive to HFC-134a, even when modified by O₂ doping, a GC-MS was applied to the measurement of this substance (see note). The grouping of the substances and the four analytical methods are summarized in **Table 2.2**. The details of each of the measuring methods mentioned above are reported on in Appendix B.

Note) The response of the O₂-doped ECD to HFC-134a did not exceed 1/70 of that of HCFC-142b.

Table 2.2. Grouping of HCFCs, methyl bromide, and HFC-134a and analytical methods

Method	Detector	Analytical column / Precolumn	Substance
GC analytical method 6	ECD (O ₂)	Carbopack B +SP1000 1% 3m / DC-550 25% 4m	HCFC-22, CFC-12
GC analytical method 6	ECD (O ₂)	Carbopack B +SP1000 1% 3m / DC-550 25% 4m	HCFC-142b, Methyl bromide
GC analytical method 6	ECD (O ₂)	Carbopack B +SP1000 1% 3m / DC-550 25% 4m	HCFC-141b
GC/MS analytical method	MS	Carbopack B +SP1000 1% 3m / DC-550 25% 4m	HFC-134a

(3) Calibration of Sensitivity and Calculation of Concentration

The atmospheric concentrations of the subject substances measured were determined by comparison of the areas or heights of the peaks of the substances between the samples and the reference (an air sample in which the concentrations were known or the calibration gas, see Section 2.3) both measured under the same conditions. The reference gas was measured once while the sample analyses were conducted twice or three times. The atmospheric concentrations of the subject substances measured were finally calculated as a value with respect to dry air (volume/volume) through compensation for the humidity observed at the time of the air collection. The resulting concentrations were expressed in parts-per-trillion by volume (pptv, 10^{-12}) or parts-per-billion by volume (ppbv, 10^{-9}). All the concentrations obtained from the background survey are expressed in pptv. The concentrations observed in the urban area in past surveys frequently reached the ppbv level or higher, thus concentrations obtained from the urban area survey are principally expressed in ppbv.

(4) Detection Limit

The detection limits of subject substances measured using the manual analytical methods are shown in **Table 2.3**. The detection limits were calculated from the heights of the peaks equivalent to three times the noise level for the typical sample volumes (see Appendix A).

Table 2.3. Detection limits of subject substances measured using manual analytical methods

(Unit: pptv)

Substance	Detection limit	Substance	Detection limit	Substance	Detection limit
CFC-11	0.5	CFC-115	2	1,1,1-Trichloethane	2
CFC-12	5	Halon-1211	0.2	HCFC-22	10
CFC-113	2	Halon-1301	0.2	HCFC-141b	1
CFC-114	0.5	Halon-2402	0.05	HCFC-142b	1
CFC-114a	0.05	Carbon tetrachloride	1	Methyl bromide	0.5

2.5. AUTOMATIC MONITORING IN URBAN AREA

(1) Monitoring by Automatic Measurement

Since concentrations of the specified substances in urban air vary widely, only a large number of measurements can yield typical values at a sufficient level of confidence through averaging of the results. However, it was difficult to perform such a sufficient number of measurements with manual operations. Therefore, continuous monitoring with an automatic measuring apparatus (hereinafter referred to as the "CFCs automatic measuring apparatus") had been conducted since 1990 (7).

The concentrations of CFCs, carbon tetrachloride, and 1,1,1-trichloroethane in air that had been measured using the "CFCs automatic measuring apparatus" declined and were recently approaching the background levels due to the control of these substances under the ozone layer protection law (7). However, concentrations in air of HCFC-22, HCFC-141b, HCFC-142b, and HFC-134a that emerged as substitutes for CFCs have been continuously increasing (7), and the large amount of emissions of these substances in urban or industrial areas has become of concern.

The "CFCs automatic measuring apparatus" was not applicable to these new substances. Therefore, these substances were measured by analytical methods with air collection using containers and manual operation during 1993-2003, and this survey revealed that the concentrations of these substances in urban air were considerably higher than those in the background area, however, manual measurements could not be performed for more dense surveys or monitoring in detail (8).

A new automatic measuring apparatus (hereinafter referred to as the "HCFCs automatic measuring apparatus" or "the new automatic measuring apparatus" or "the apparatus") that is able to measure these CFC-substitute substances was installed and began operation. This apparatus is equipped with a mass spectrometer as the detector and a sample concentration procedure is adopted that "CFCs automatic measuring apparatus" did not have, thus this apparatus is able to sensitively determine concentrations in air of HCFC-22, HCFC-141b, HCFC-142b, methyl bromide, and HFC-134a, as well as the conventional CFCs and halocarbons. Among the substances that had been measured by the "CFCs automatic measuring apparatus" CFC-11 and CFC-12 will be continuously observed by the new automatic measuring apparatus since the concentrations of these substances are prevalent and emissions of them in urban or industrial areas are of concern.

(2) Measurements by Using of "HCFCs Automatic Measuring Apparatus"

As mentioned above, the HCFCs automatic measuring apparatus (assembled in the laboratory) was used to analyze air samples by gas chromatography with a mass spectrometer. This apparatus analyzed air samples by concentrating a sample of air on a concentration tube that was cooled to -80 °C in a freezer with the subsequent desorption of the concentrated compounds and the introduction of the compounds into the GC-MS for selected ion monitoring detection (SIM). This apparatus operated automatically, including the calibrating operation. The apparatus is installed in a temperature-controlled room. The ambient air was introduced from the sampling air intake (approximately 25 m from the ground) to the apparatus through a stainless steel pipe. The air intake is installed on the rooftop of the building. The concentrations of CFC-11, CFC-12, HCFC-22, HCFC-141b, HCFC-142b, methyl bromide, and HFC-134a in air were determined. The apparatus analyzed the ambient air every five hours. The apparatus operated continuously with the exception of short periods of time due to maintenance, mechanical problems, power failures, or other reasons.

(3) Calibration of Sensitivity

The calibration gas used for the daily calibration was reserved in a 15L stainless steel container, the

interior of which was coated with SiO₂. The calibration gas contained 250 pptv of CFC-11, 500 pptv of CFC-12, 200 pptv of HCFC-22, and 100 pptv of HCFC-141b, HCFC-142b, methyl bromide, and HFC-134a.

(4) Detection Limit

The detection limits for the subject substances measured by the HCFCs automatic measuring apparatus are shown in **Table 2.4**. The detection limits equal to three times the standard deviations obtained from the results of five times repeated measurements of a sample with low concentrations. Of all the subject substances measured, the detection limit was below the current background level.

Table 2.4. Detection limits of subject substances measured using automatic measuring apparatus (Unit: pptv)

Substance	Detection limit	Background level
CFC-11	2	244
CFC-12	4	549
HCFC-22	2	190
HCFC-141b	0.5	21.0
HCFC-142b	1	18.4
Methyl bromide	1	9.4
HFC-134a	1	46.8

Note) Background levels shown here were obtained in January 2007.

(5) Observation of the Weather

Observation of the weather conducted simultaneously with the measurements was necessary since it was expected that the degree of variation of the concentrations of the measured substances in air would considerably depend on the meteorological conditions of the surrounding area as well as the level of emissions. Therefore, in consideration of their importance, the wind direction and wind speed have continuously been observed at the rooftop of the JESC building.

3. RESULTS

3.1. RESULTS IN BACKGROUND AREA

3.1.1. SAMPLING CONDITIONS

(1) Sampling

The sampling dates and locations (names, latitudes and longitudes) in Hokkaido are shown in **Table 3.1**. Maps of these areas are shown in **Figure 3.1** and **Figure 3.2**. The latitudes and the longitudes shown in the table were mainly determined using a GPS receiver.

Table 3.1. Sampling date and location in Hokkaido

Sampling Date and Time			Sampling Location			
Season	Date	Time	Area	Name	Latitude (N)	Longitude (E)
Summer	Aug 20 2007	13 : 00	Wakkanai	Wakkasakanai	45 ° 07' 56"	141 ° 36' 04"
	Aug 20 2007	15 : 00		Wakkasakanai	45 ° 07' 56"	141 ° 36' 04"
	Aug 21 2007	9 : 00		Wakkasakanai	45 ° 07' 56"	141 ° 36' 04"
	Aug 21 2007	10 : 00		Wakkasakanai	45 ° 07' 56"	141 ° 36' 04"
	Aug 23 2007	9 : 00	Nemuro	Goyoumai	43 ° 22' 10"	145 ° 48' 41"
	Aug 23 2007	10 : 00		Goyoumai	43 ° 22' 10"	145 ° 48' 41"
Winter	Jan 21 2008	13 : 00	Wakkanai	Wakkasakanai	45 ° 05' 14"	141 ° 37' 48"
	Jan 21 2008	15 : 30		Wakkasakanai	45 ° 05' 14"	141 ° 37' 48"
	Jan 22 2008	13 : 00		Wakkasakanai	45 ° 05' 14"	141 ° 37' 48"
	Jan 23 2008	11 : 10	Nemuro	Nossappu	43 ° 23' 05"	145 ° 48' 56"
	Jan 23 2008	12 : 30		Nossappu	43 ° 23' 05"	145 ° 48' 56"
	Jan 24 2008	10 : 00		Nossappu	43 ° 23' 05"	145 ° 48' 56"

Note) The contents of this table is based on "Report on Sample Air Collection for Monitoring of Ozone Depleting Substances FY2007", submitted to the Ministry of Environment by NS Environmental Science Consultant Corporation.



Figure 3.1. Sampling locations in Wakkanai Hokkaido

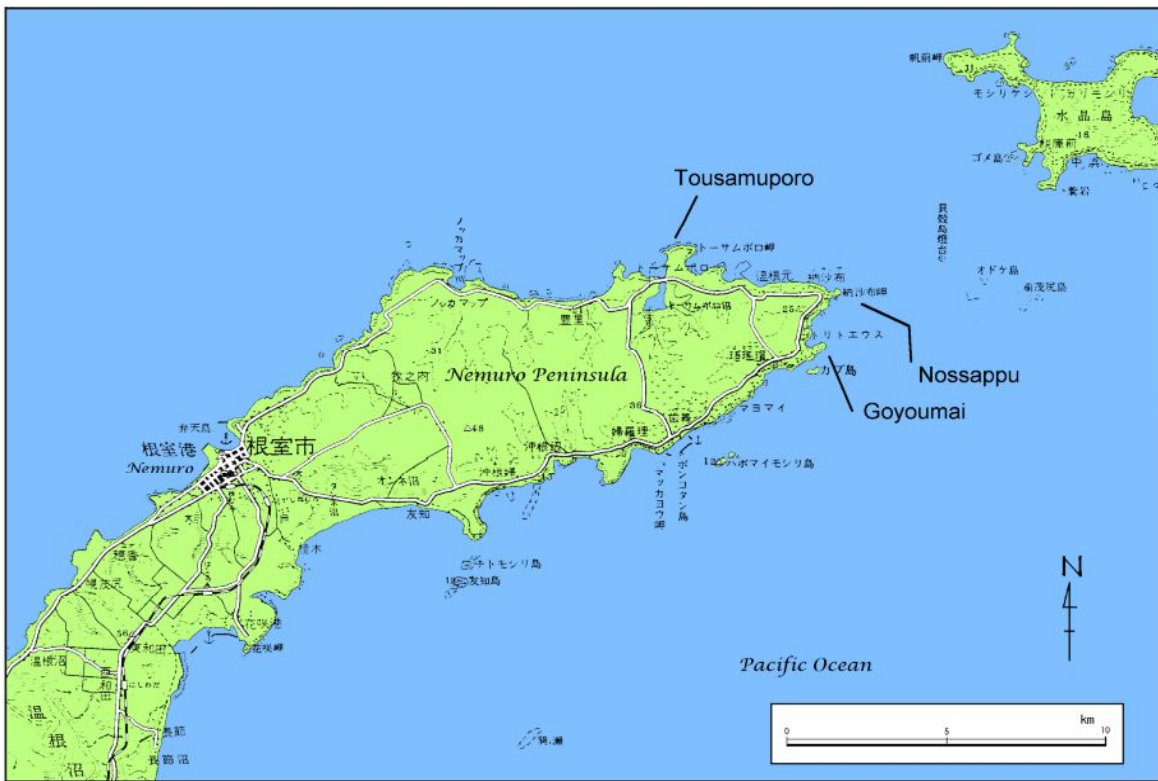


Figure 3.2. Sampling locations in Nemuro Hokkaido

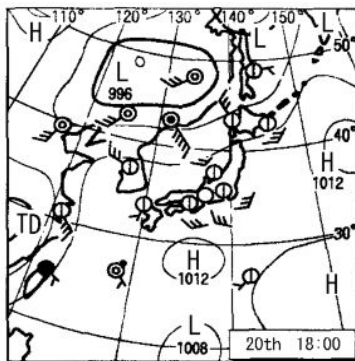
(2) Weather during the Sampling

The weather at the time of the collection of the air samples in Hokkaido was as follows. Weather maps for each sampling day are shown in Figure 3.3.1-Figure3.3.2.

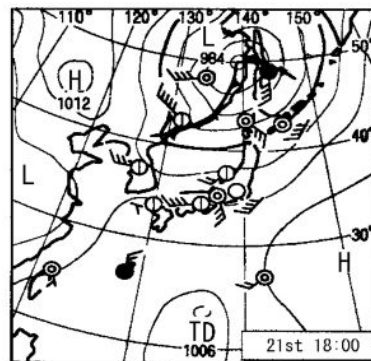
(a) Summer season survey

No typhoon approached Japan during the survey. The severe heat of late summer continued across the western areas of Japan. A low pressure from the Chinese continent slowly approached the Sea of Okhotsk and developed. The low pressure produced strong southerly ~ westerly winds throughout Hokkaido.

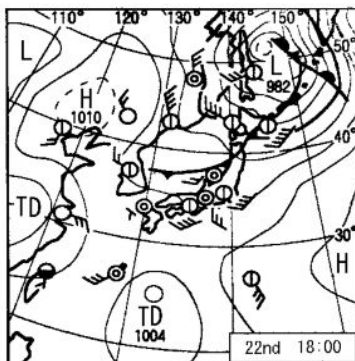
- i) Sampling around Wakkanai was conducted over August 20-21. On August 20, the weather was cloudy. Since a strong west-southwesterly wind (9 m/s) was blowing, the observer conducted the collection of air samples on the seashore of Wakkasakanai (on the western side of the peninsula).
- ii) On the next day August 21, the weather was cloudy. Since a strong westerly wind (7 m/s) was blowing, the observer conducted the collection of air samples on the seashore of Wakkasakanai.
- iii) Sampling around the tip of Nemuro peninsula was conducted over August 22-23. On August 22, the weather was fine. Since a south-southeasterly wind (5 m/s) was blowing, the observer conducted the collection of air samples on the seashore adjacent to the Nosappu-misaki lighthouse.
- iv) On the next day August 24, the region was foggy. Since a southerly wind (2 m/s) was blowing, the observer conducted the collections of air samples on the seashore of Goyoumai (on the southern side of Nosappu).



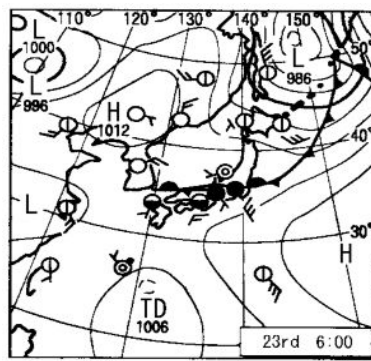
August 20



August 21



August 22



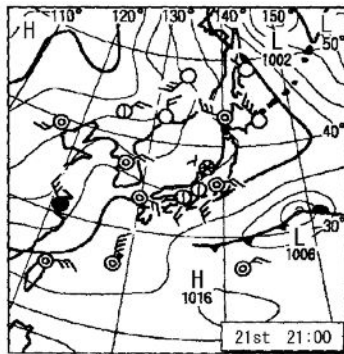
August 23

Figure 3.3.1. Weather maps (summer season)

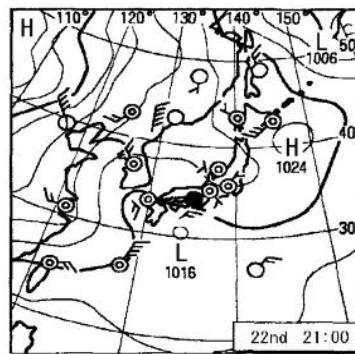
(b) Winter season survey

In the sampling period in the winter season, January 21-24, the wintry pressure pattern continued, and the low temperatures were lower than in a normal year over the major part of the Japanese archipelago. Uncommon for the winter season, no developed low pressure existed across the Sea of Okhotsk, and the weather was calm in Hokkaido for the first half of the survey. On January 24, a low pressure moved into Hokkaido across the Sea of Japan and developed in southern Hokkaido, and this produced strong winds.

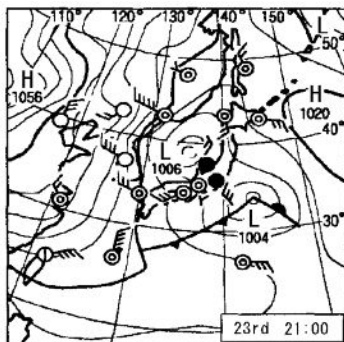
- i) Sampling around Wakkanai was conducted over January 21-22. On January 21, the weather was fine with cloud at times. Since a northwesterly wind (2 m/s) was blowing, the observer conducted the collection of air samples on the seashore of Wakkasakanai (on the western side of the peninsula).
- ii) On the next day January 22, the weather was snow showers. Since a west-northwesterly wind (3-4 m/s) was blowing, the observer conducted the collection of air samples at the identical spot mentioned.
- iii) Sampling around the tip of Nemuro peninsula was conducted over January 23-24. On January 23, the weather was fine. Since a southeasterly or a south-southeasterly wind (3-4 m/s) was blowing, the observer conducted the collection of air samples on the seashore adjacent to the Nosappu-misaki lighthouse.
- iv) On the next day January 24, the weather was cloudy. Since an easterly wind (2 m/s) was blowing, the observer conducted the collection of air samples at the identical spot mentioned.



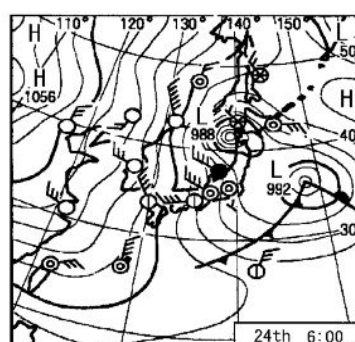
January 21



January 22



January 23



January 24

Figure 3.3.2. Weather maps (winter season)

3.1.2. Concentrations of Measured Substances in Background Area

The observed climatic conditions and the atmospheric concentrations of the measured substances in Hokkaido are shown in **Table 3.2** and **Table 3.3**. Although the concentrations are shown to a maximum of 3 digits, not all the figures mean significant figures.

Table 3.2. Concentrations of the measured substances in the background area
August, 2007 (Summer season in FY2007) (unit : pptv)

Sampling Location	Wakkanai			Nemuro		
	Aug 20	Aug 20	Aug 21	Aug 21	Aug 23	Aug 23
Sampling Date	13 : 00	15 : 00	9 : 00	10 : 00	9 : 00	10 : 00
Sampling Time	Cloudy	Cloudy	Partly Cloudy	Cloudy	Fine	Fine
Weather	WSW	W	WSW	W	SSW	SSW
Wind Direction	8.8	7.4	7.7	8.7	2.6	2.4
Wind Speed (m/s)	22.3	21.8	22.0	22.2	22.6	22.2
Air Temperature (°C)	2.4	2.4	2.4	2.4	1.9	1.8
Abs. Humidity (%)	245	244	245	243	240	240
CFC-11	546	545	547	546	543	543
CFC-12	76.3	77.0	76.3	75.9	75.5	75.6
CFC-113	14.9	15.0	14.8	15.1	14.7	14.4
CFC-114	1.00	1.02	1.03	0.99	0.98	0.99
CFC-114a	8.87	9.02	8.91	9.03	9.13	9.14
CFC-115	4.68	4.65	4.66	4.67	4.68	4.58
Halon-1211	3.38	3.36	3.30	3.34	3.38	3.35
Halon-1301	0.48	0.48	0.48	0.49	0.49	0.47
Halon-2402	95.7	96.4	97.0	96.4	95.3	94.9
Carbon tetrachloride	14.5	14.6	14.7	14.3	14.0	14.3
1,1,1-Trichloroethane	199	197	200	(206)	201	202
HCFC-22	21.2	20.2	21.0	20.7	20.0	21.2
HCFC-141b	20.9	19.8	20.6	20.3	20.4	19.7
HCFC-142b	10.7	10.5	9.56	9.62	9.02	9.18
Methyl bromide	(52.8)	50.2	51.1	50.4	50.4	50.2
HFC-134a						

Note 1) Not all the figures mean significant figures.

Note 2) Results closed by parentheses were not used in hereafter calculations or other considerations because these results are suspected to be outliers affected by possible local air pollution or other factors.

Table 3.3. Concentrations of the measured substances in the background area
January, 2008 (Winter season in FY2007) (unit : pptv)

Sampling Location	Wakkanai			Nemuro		
	Jan 21 2008	Jan212008	Jan 22 200	Jan 23	Jan 23	Jan 24
Sampling Date	Jan 21 2008	Jan212008	Jan 22 200	Jan 23	Jan 23	Jan 24
Sampling Time	13 : 00	15 : 30	13 : 00	11 : 10	12 : 30	10 : 00
Weather	Partly Cloudy	Cloudy	Fine	Fine	Fine	Cloudy
Wind Direction	NW	NW	WNW	SE	SSE	SE
Wind Speed (m/s)	2.5	2.3	3.9	2.9	3.8	9.6
Air Temperature (°C)	-6.0	-5.5	-4.0	-1.0	-1.0	-1.0
Abs. Humidity (%)	0.3	0.3	0.3	0.6	0.6	0.5
CFC-11	241	242	241	241	240	241
CFC-12	543	547	547	545	542	543
CFC-113	77.2	77.7	77.1	77.6	76.4	76.6
CFC-114	14.4	15.3	14.8	15.0	15.0	14.7
CFC-114a	1.04	1.05	0.99	1.04	1.02	1.01
CFC-115	9.08	8.96	9.29	9.13	9.22	8.87
Halon-1211	4.57	4.74	4.60	4.73	4.78	4.64
Halon-1301	3.37	3.36	3.35	3.36	3.36	3.36
Halon-2402	0.46	0.48	0.45	0.48	0.45	0.46
Carbon tetrachloride	95.1	95.7	94.9	96.5	95.8	95.3
1,1,1-Trichloroethane	14.4	14.3	14.3	14.8	14.3	14.9
HCFC-22	197	195	199	196	202	202
HCFC-141b	21.2	20.2	21.0	20.7	20.0	21.2
HCFC-142b	19.7	19.5	20.0	20.0	19.7	19.5
Methyl bromide	9.33	10.4	9.18	9.14	9.14	9.29
HFC-134a	52.3	52.7	50.2	49.7	54.0	51.8

Note) Not all the figures mean significant figures.

3.2. RESULTS IN URBAN AREA

3.2.1. SAMPLING CONDITIONS

(1) Sampling

Air sampling in the urban area observation was conducted at the rooftop of the JESC building (Kawasaki-shi) as mentioned above. The sampling location is shown in **Figure 3.4**. The automatic measurement apparatus measured ambient air at intervals of five hours.

(2) Observation of the Wind

Monthly wind-roses obtained from the observation point at JESC are shown in **Figure 3.5**.

3.2.2. CONCENTRATIONS OF MEASURED SUBSTANCES IN URBAN AREA

(1) Results from the Automatic Measurements

The observed wind direction, wind speed, and the concentrations of CFC-11, CFC-12, HCFC-22, HCFC-141b, HCFC-142b, methyl bromide, and HFC-134a obtained from the automatic measurement from March 1, 2007 to February 29, 2008 are shown in **Figure 3.6**.

The observed wind directions are plotted on the 16-point wind directions in the graph. The vertical axis of the wind direction graph is divided into four divisions and designated as north, west, south, and east from the above. The unit of wind speed is m/s. The unit of concentration is ppbv. Since the number of raw measurement results is large, only daily averages and other calculated results are reported.

(2) Daily-summaries

The averages, and the maximum and minimum concentrations of CFC-11, CFC-12, HCFC-22, HCFC-141b, HCFC-142b, methyl bromide, and HFC-134a calculated from the daily results are tabulated in **Table 3.4**. The meaning and contents of the terms in the table are as follows.

- i) Among the weather observation terms, the "main wind direction" is the most frequent wind direction (for 16-points) as observed 24 times per day.
- ii) "Rate" is the rate of the occurrence of the main wind direction as a percentage.
- iii) "Wind speed" is the average wind speed of the observations made 24 times per day.
- iv) "n" to the right of the "wind speed" column is the number of the valid weather data. The weather data is considered as valid only when both the wind direction record and the wind speed record are valid.
- v) Among the columns of each substances, the "average," "maximum," and "minimum." (unit: ppbv) are

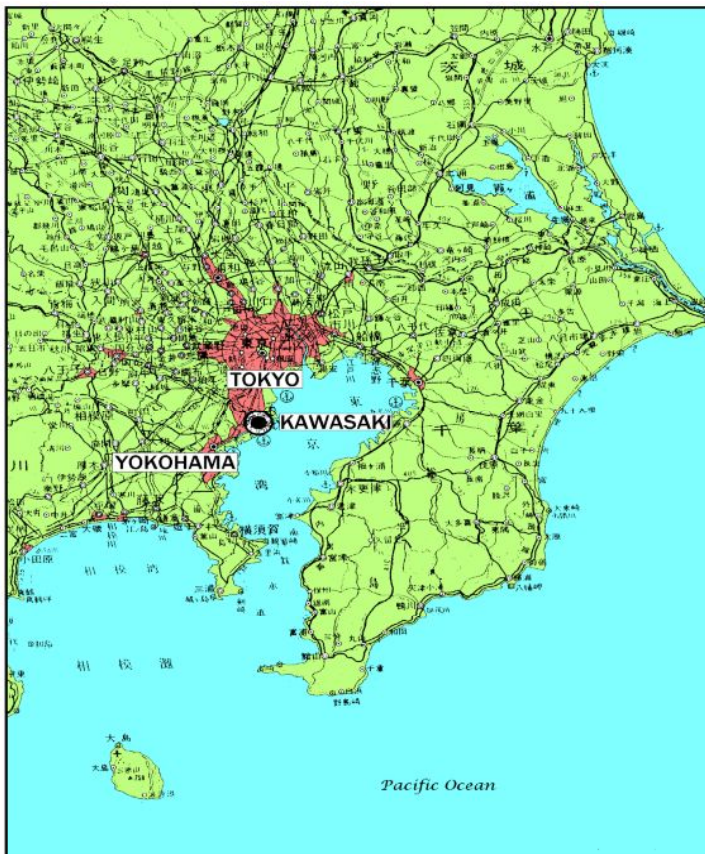


Figure 3.4. Sampling location in urban area

calculated from the measurements taken per day. "n" is the number of valid measurement results.
 vi) "-" means the absence of observations or measurements.

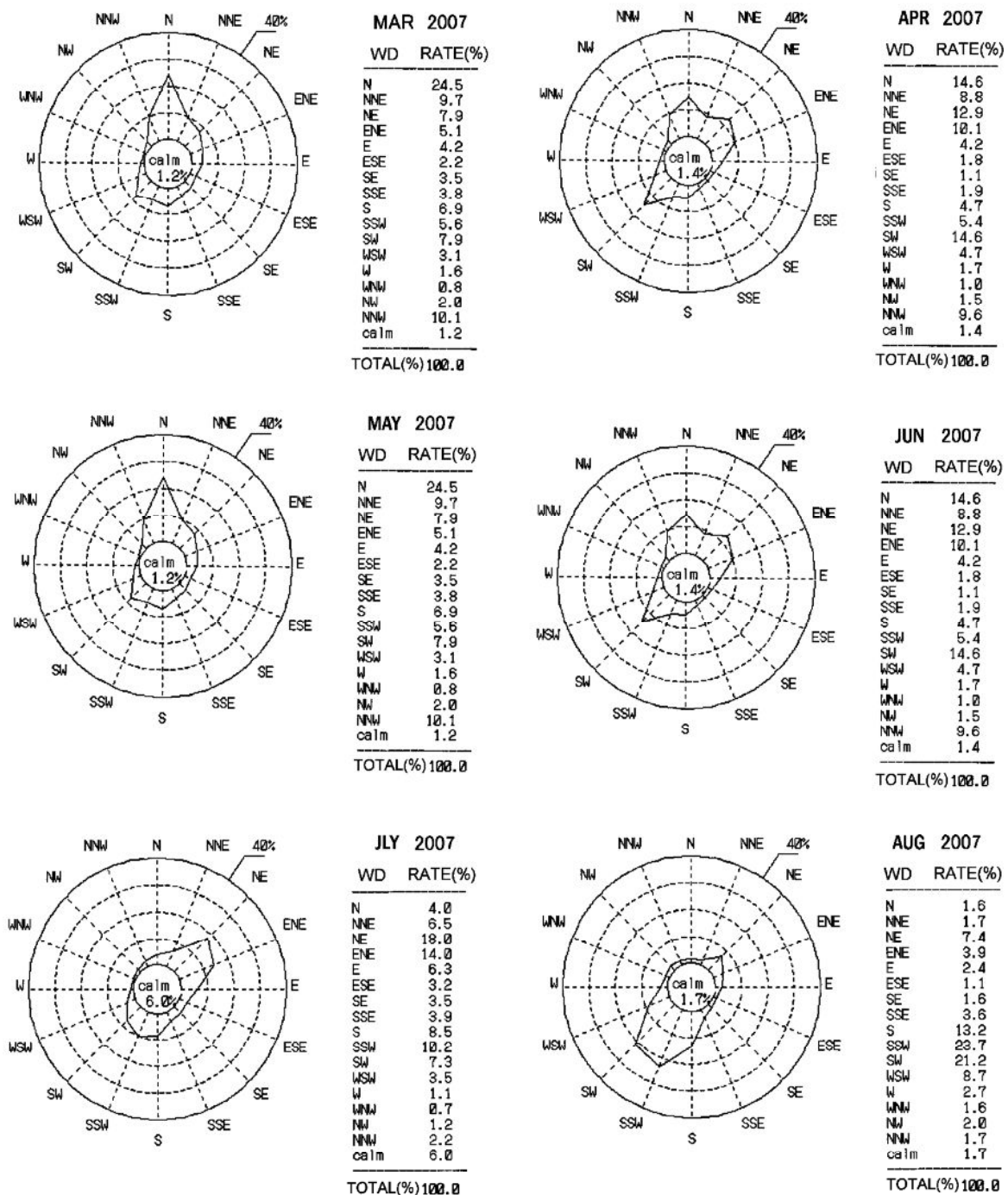


Figure 3.5.1. Monthly wind-rose observed at JESC (March 2007-August 2007)

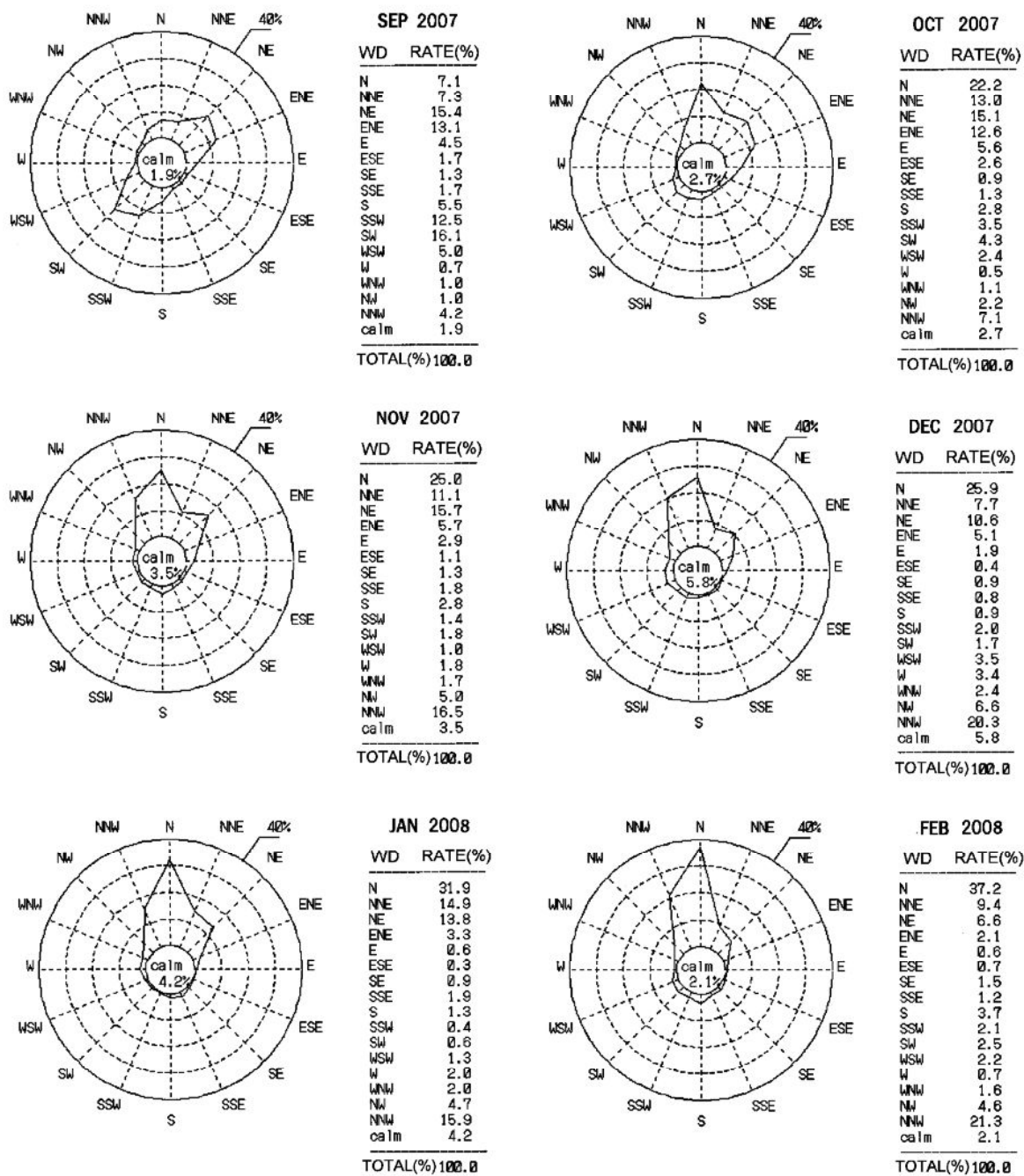


Figure 3.5.2. Monthly wind-rose observed at JESC (September 2007-February 2008)

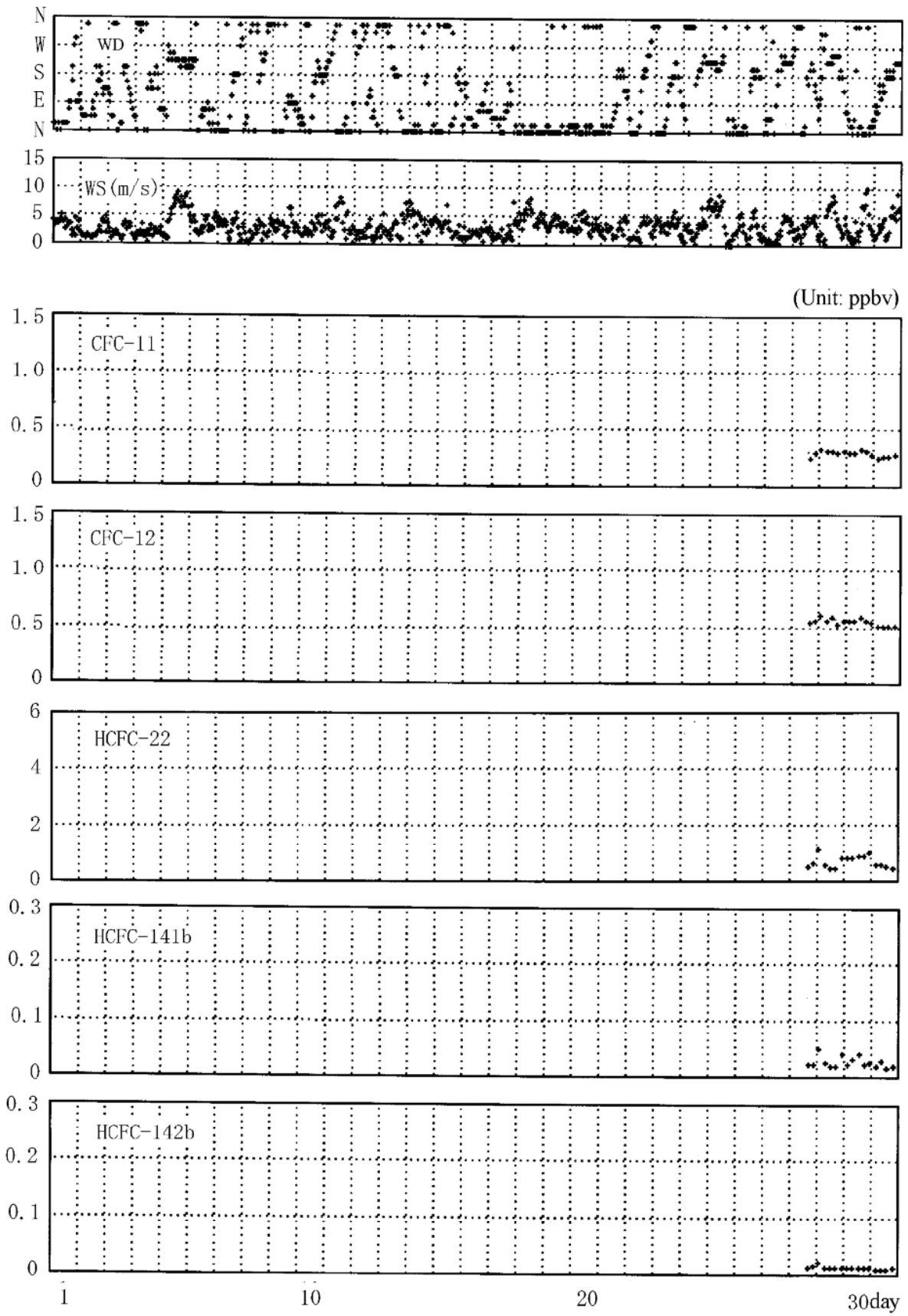


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki (March, 2007)

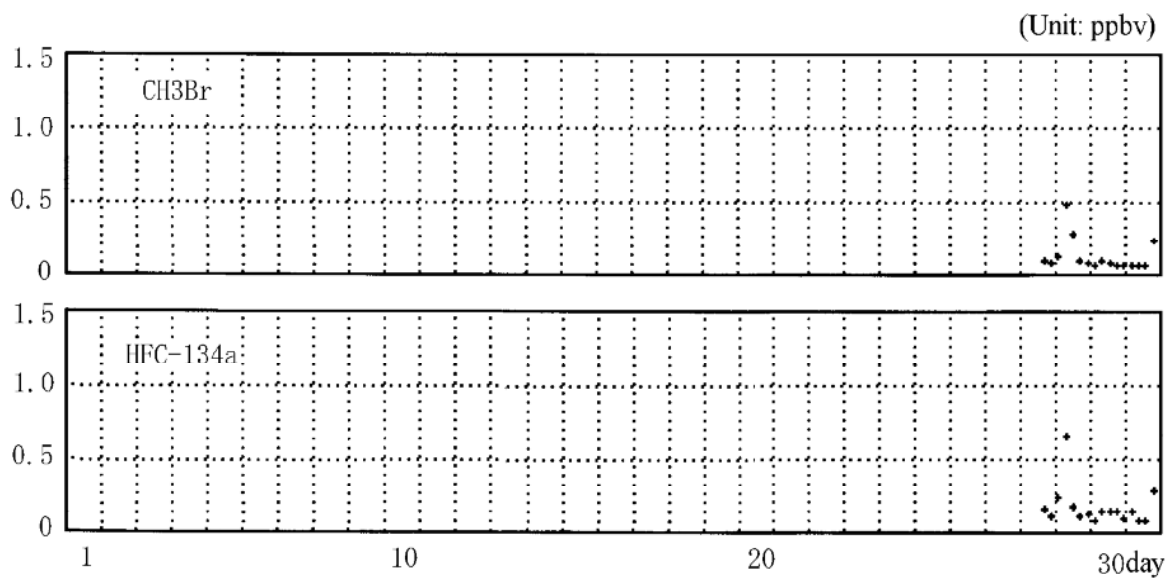


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki (March, 2007)

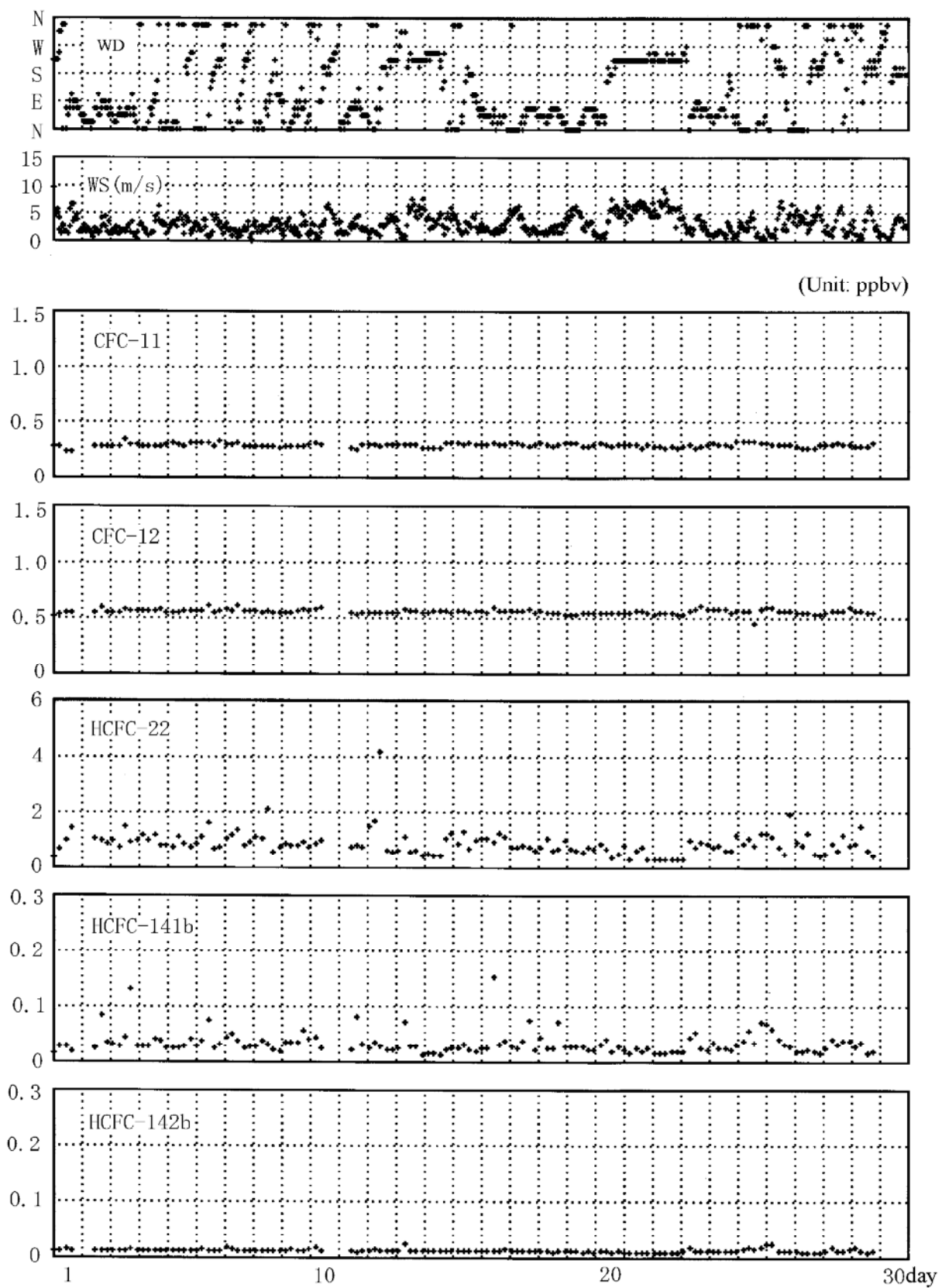


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki (April,2007)

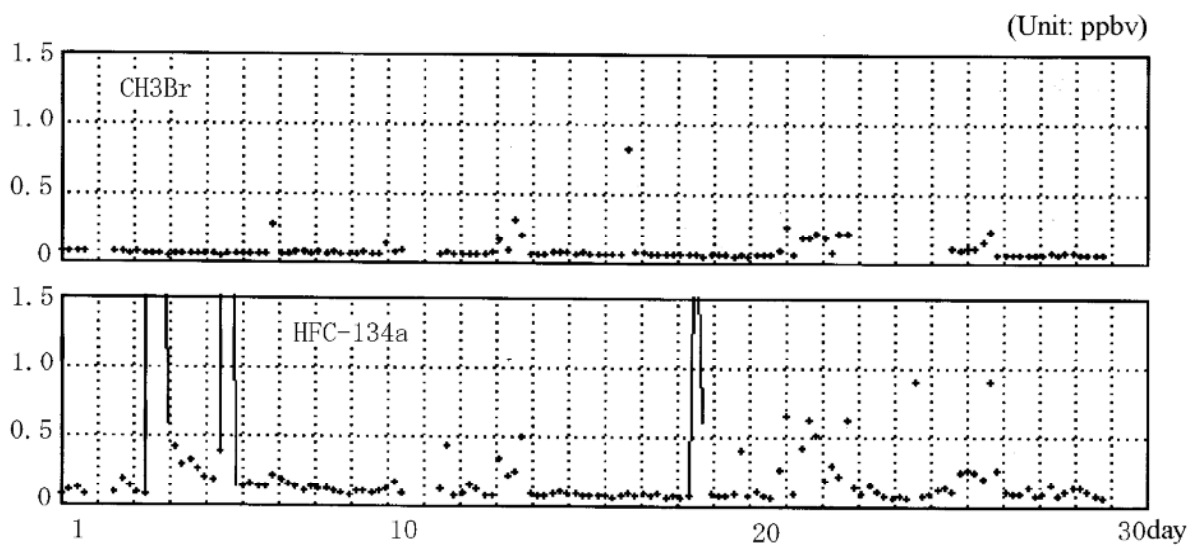


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki (April,2007)

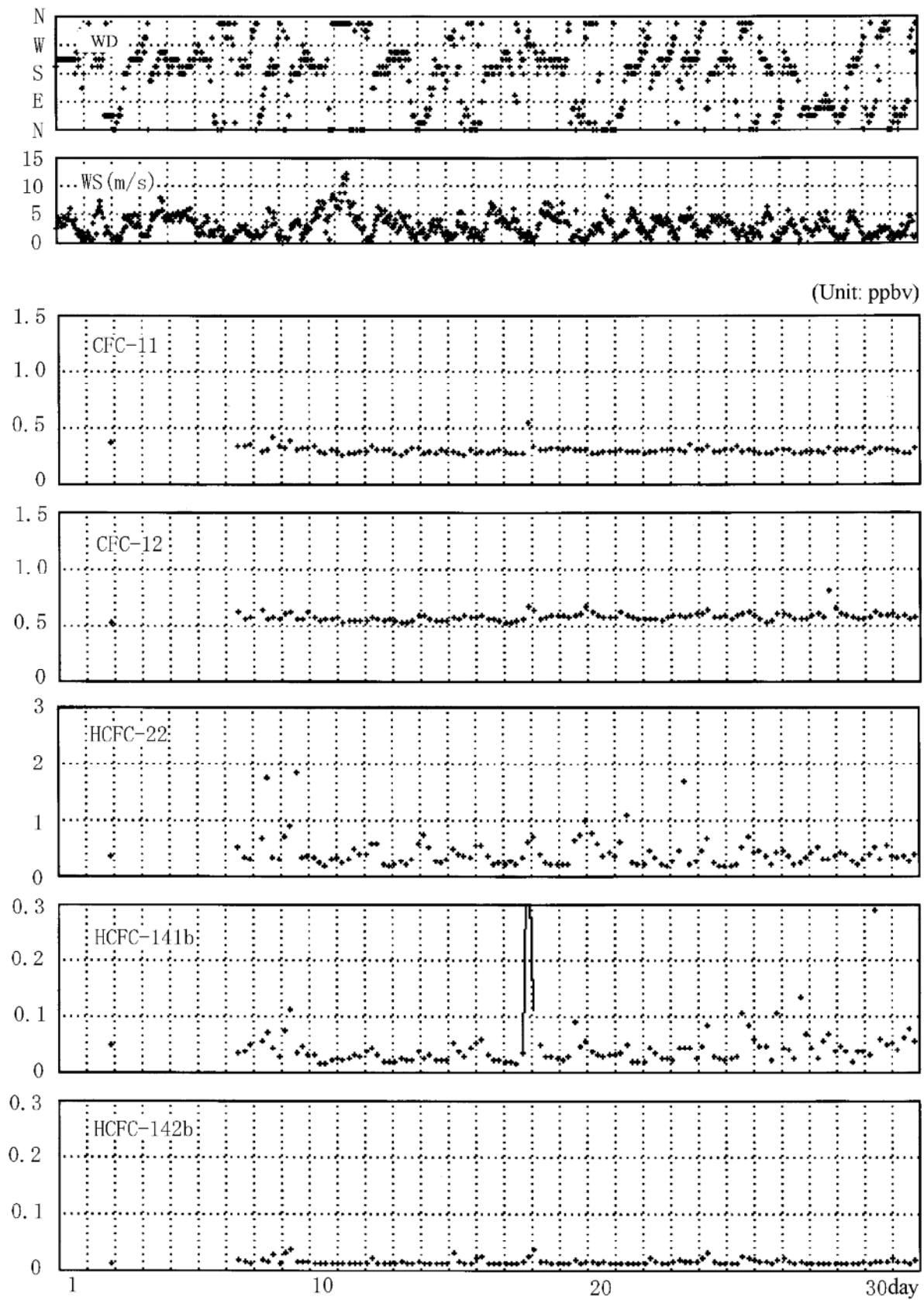


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki (May, 2007)

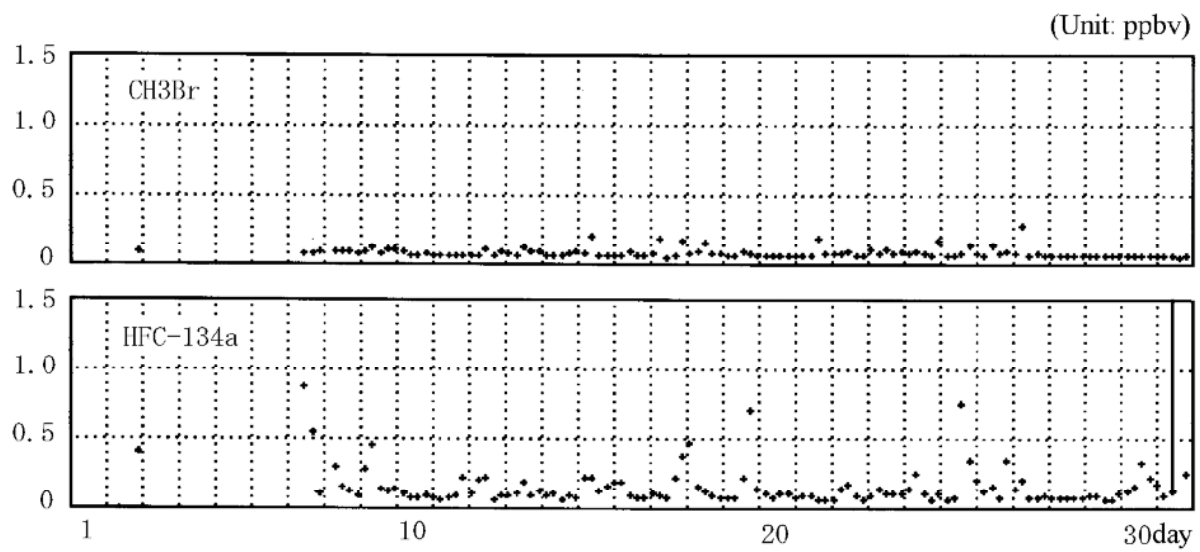


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki (May, 2007)

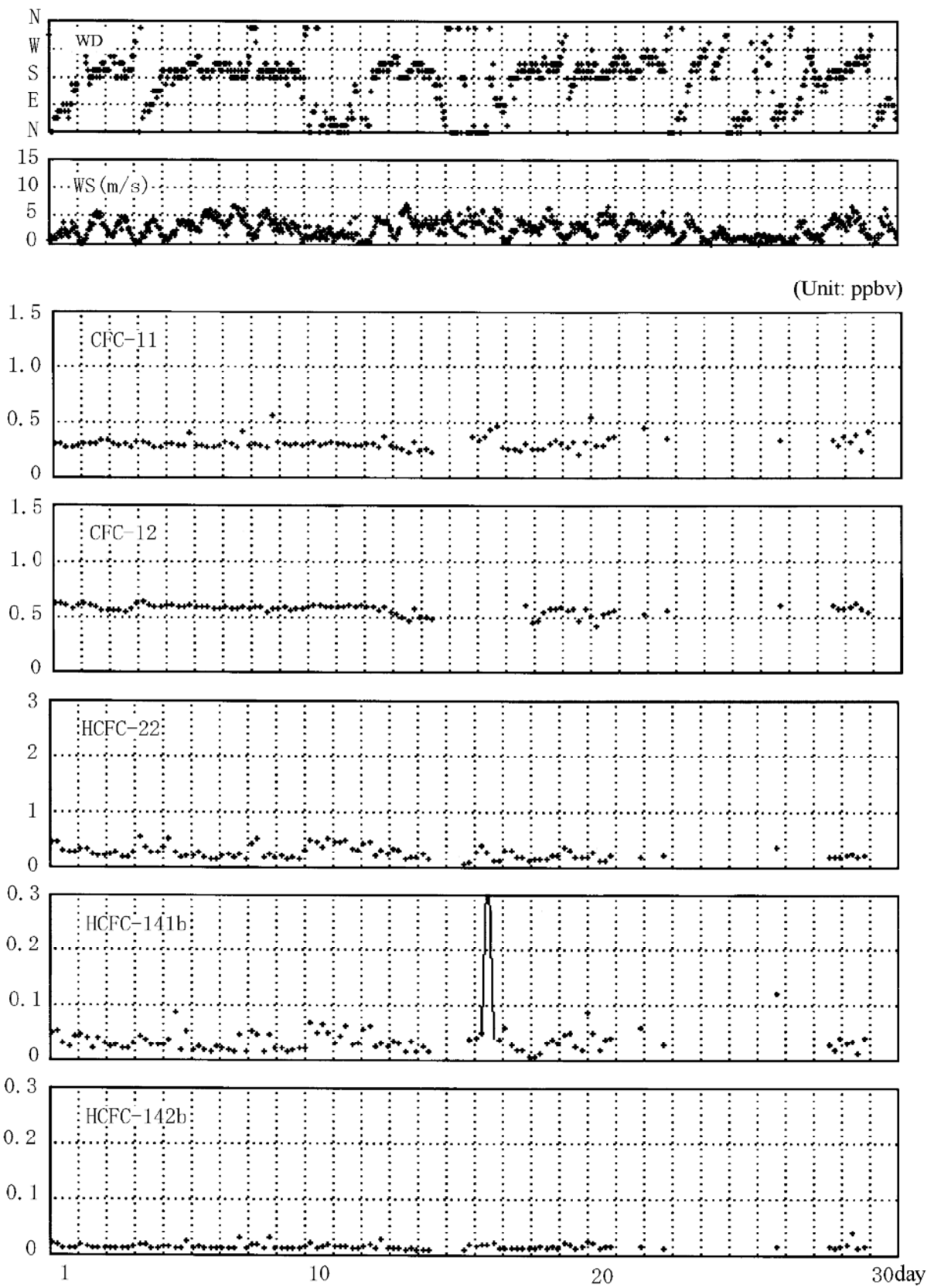


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki (June, 2007)

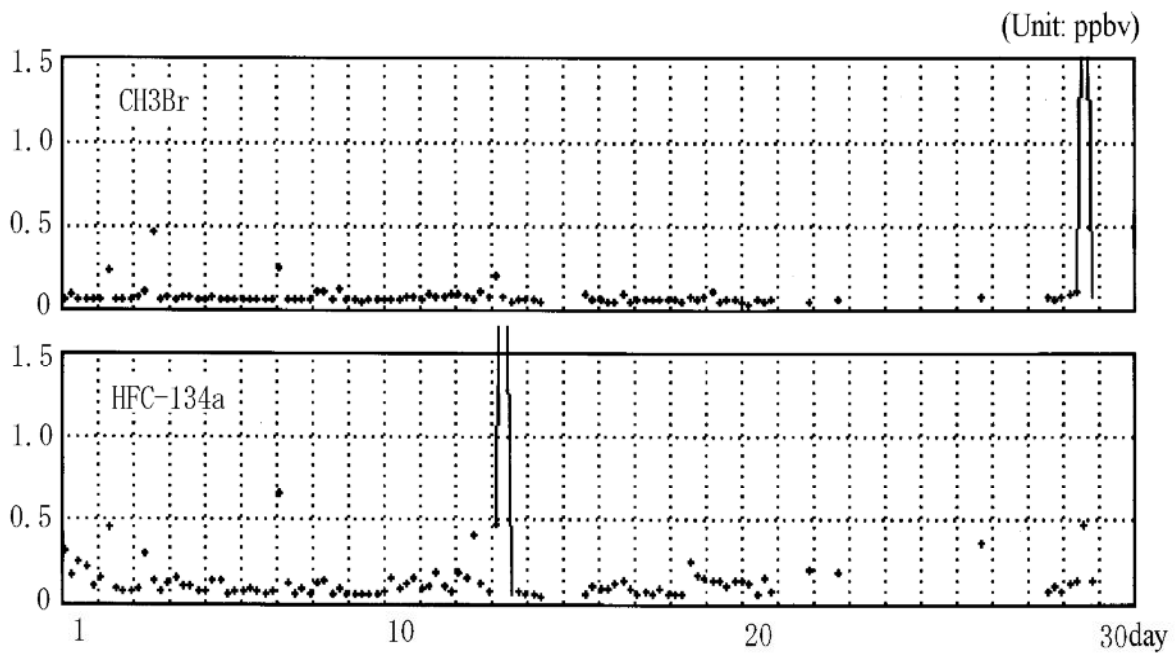


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki (June,2007)

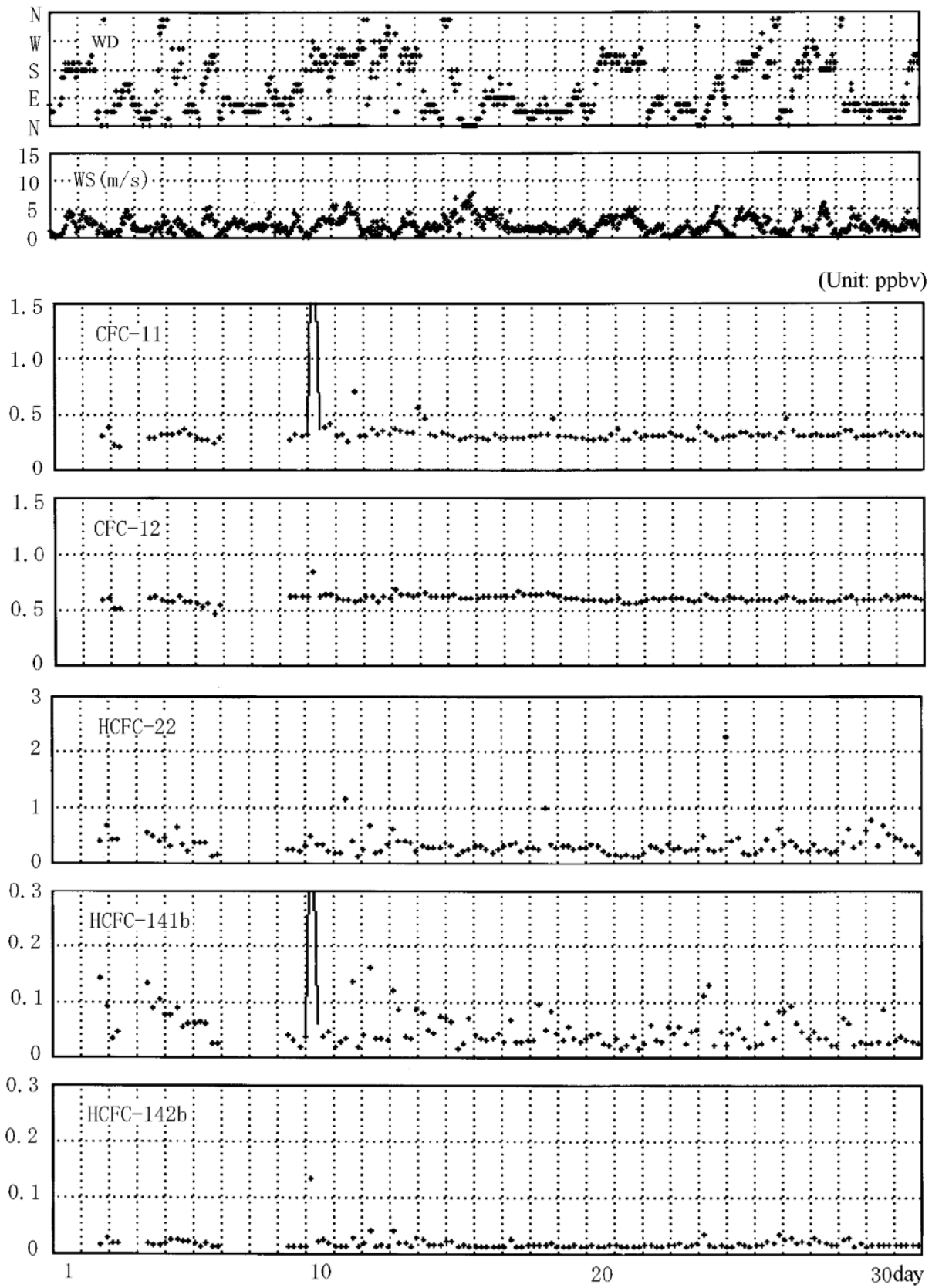


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki (July, 2007)

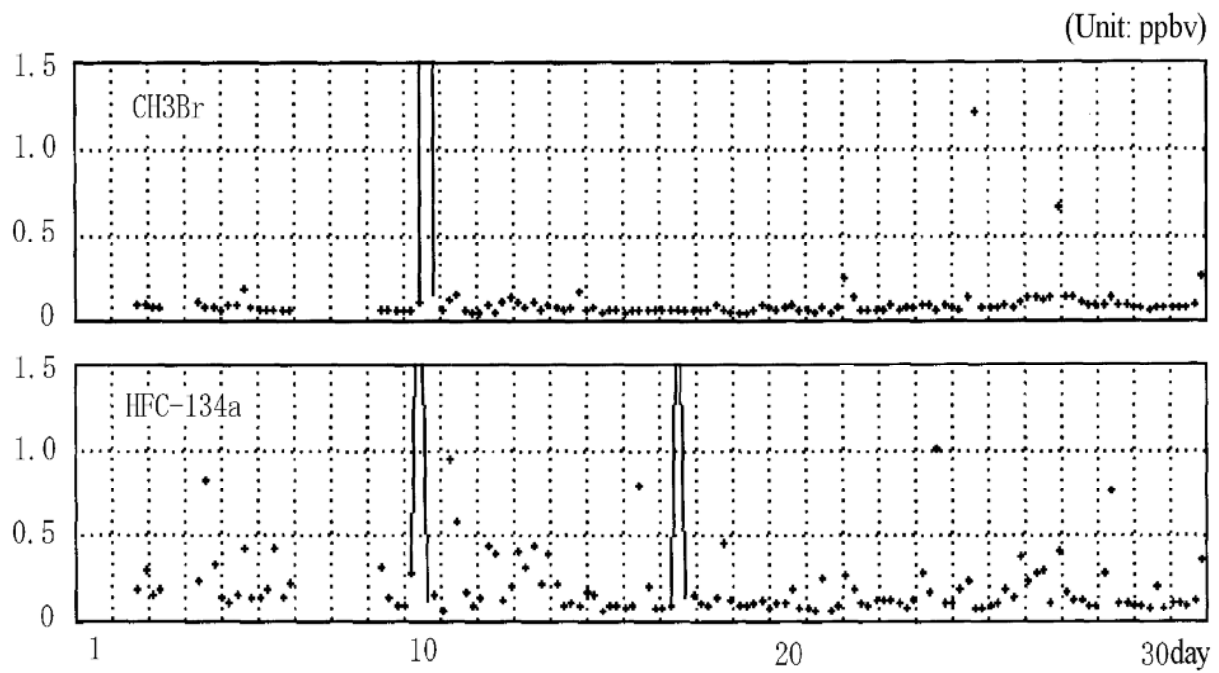


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki (July, 2007)

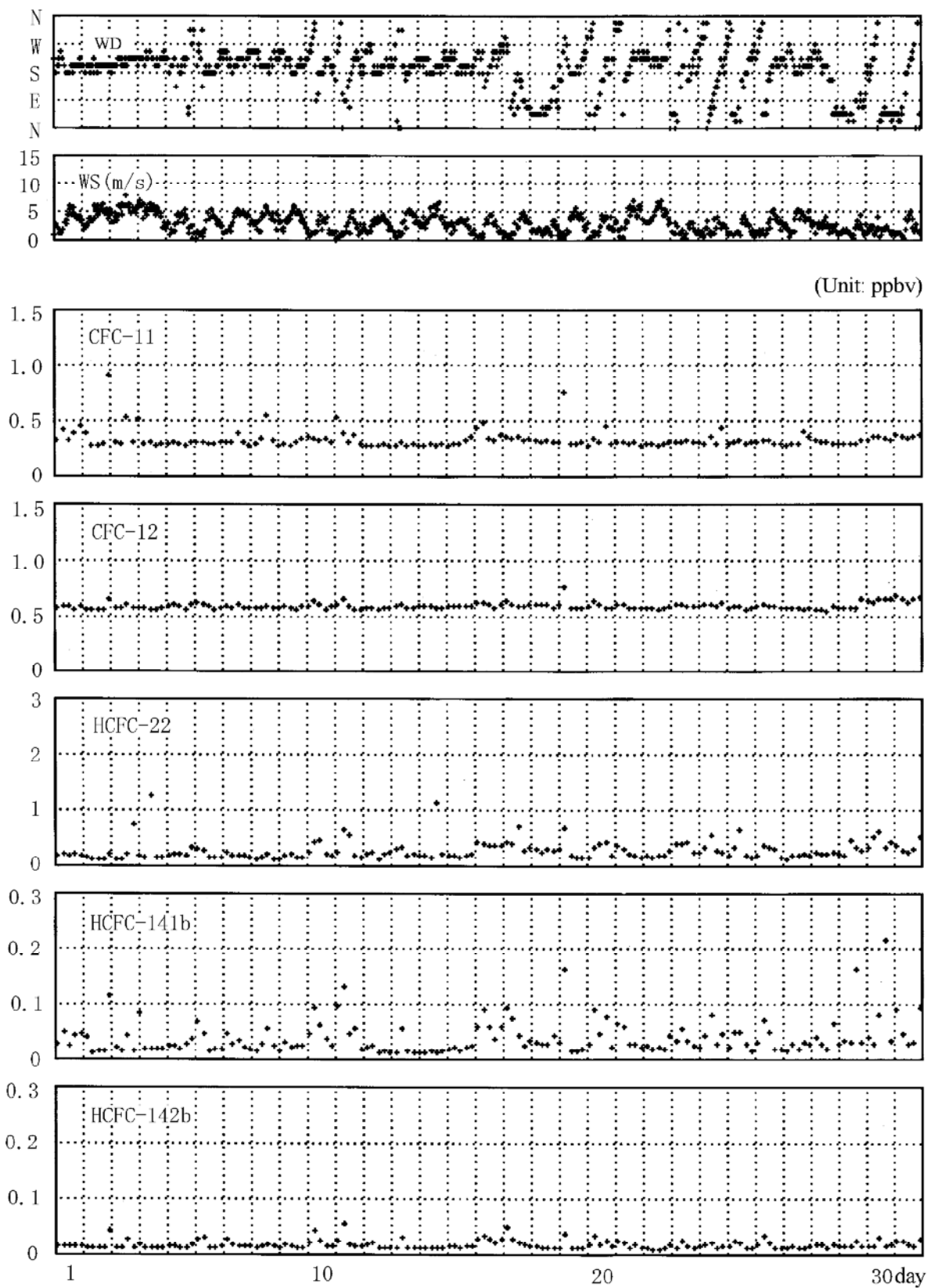


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki(August,2007)

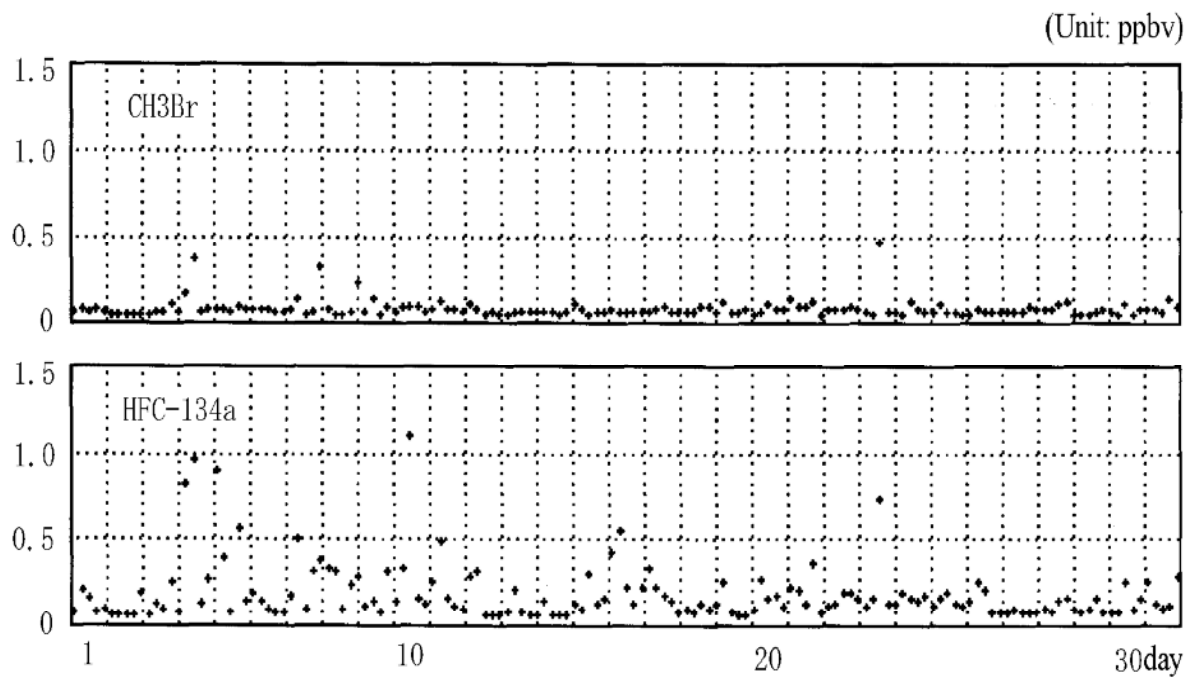


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki (August, 2007)

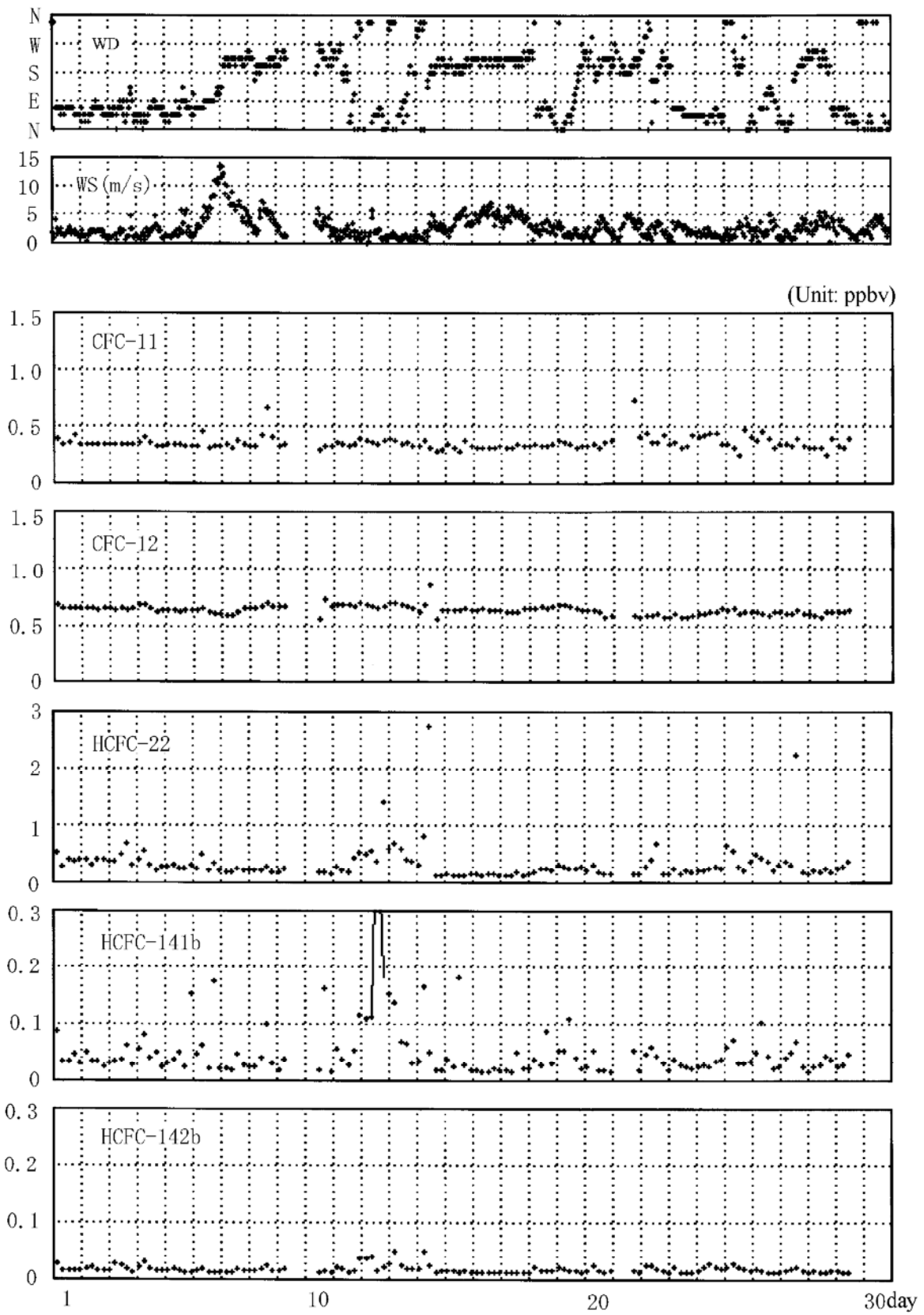


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki (September, 2007)

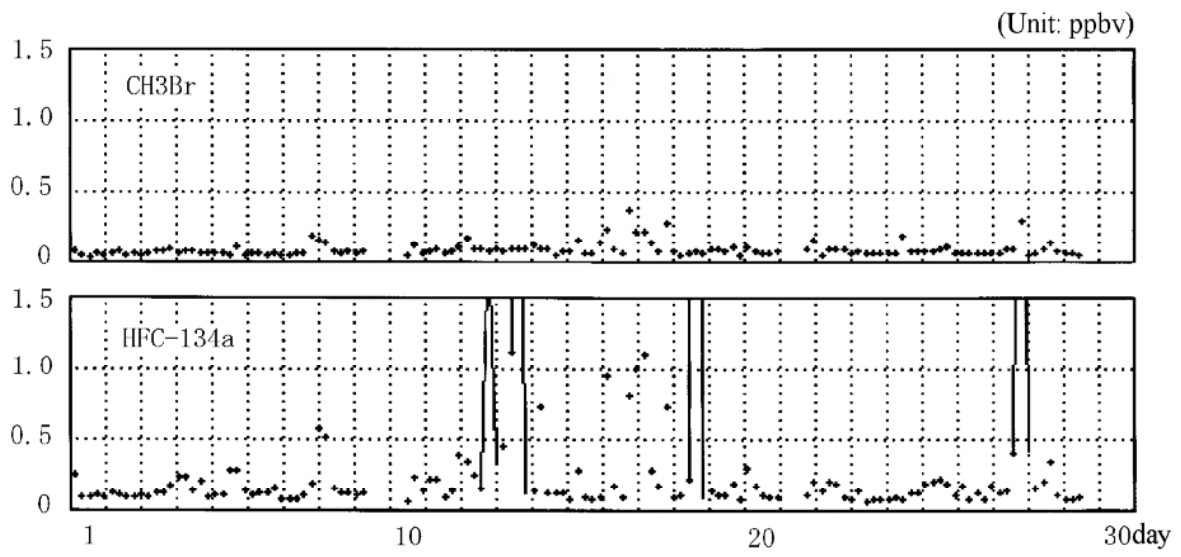


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki (September, 2007)

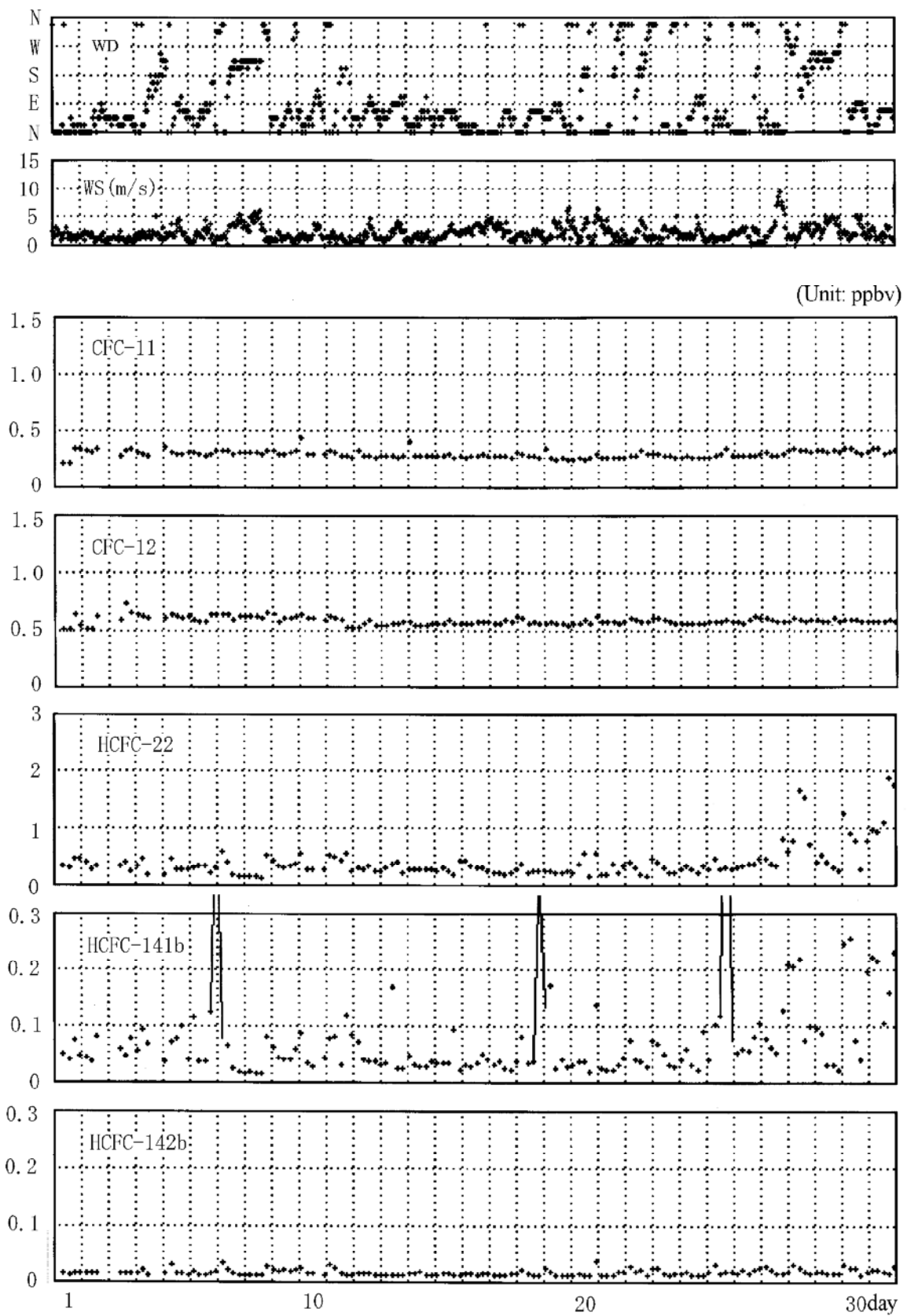


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki (October, 2007)

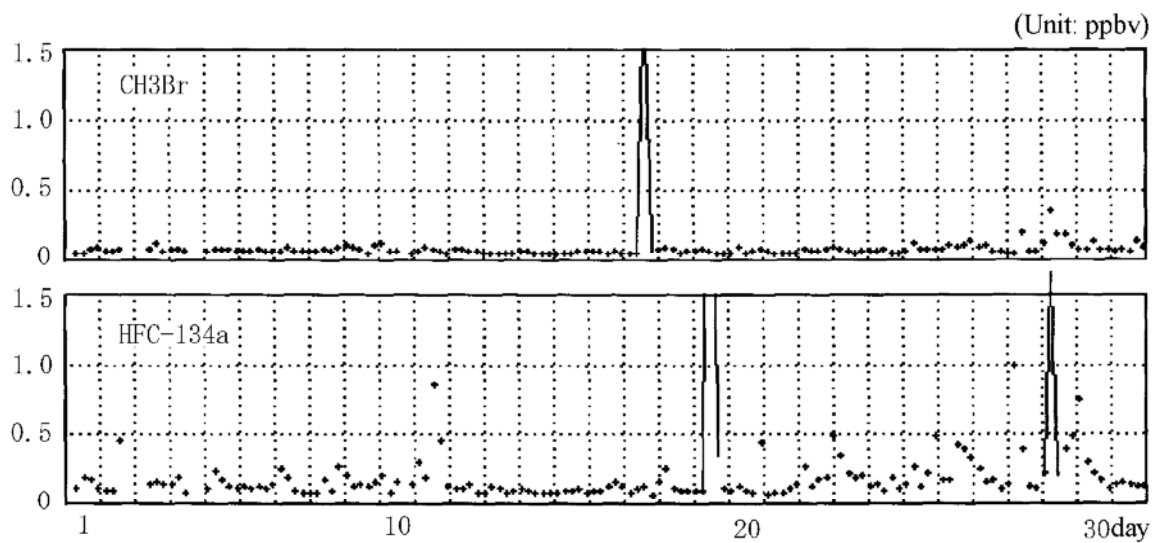


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki (October, 2007)

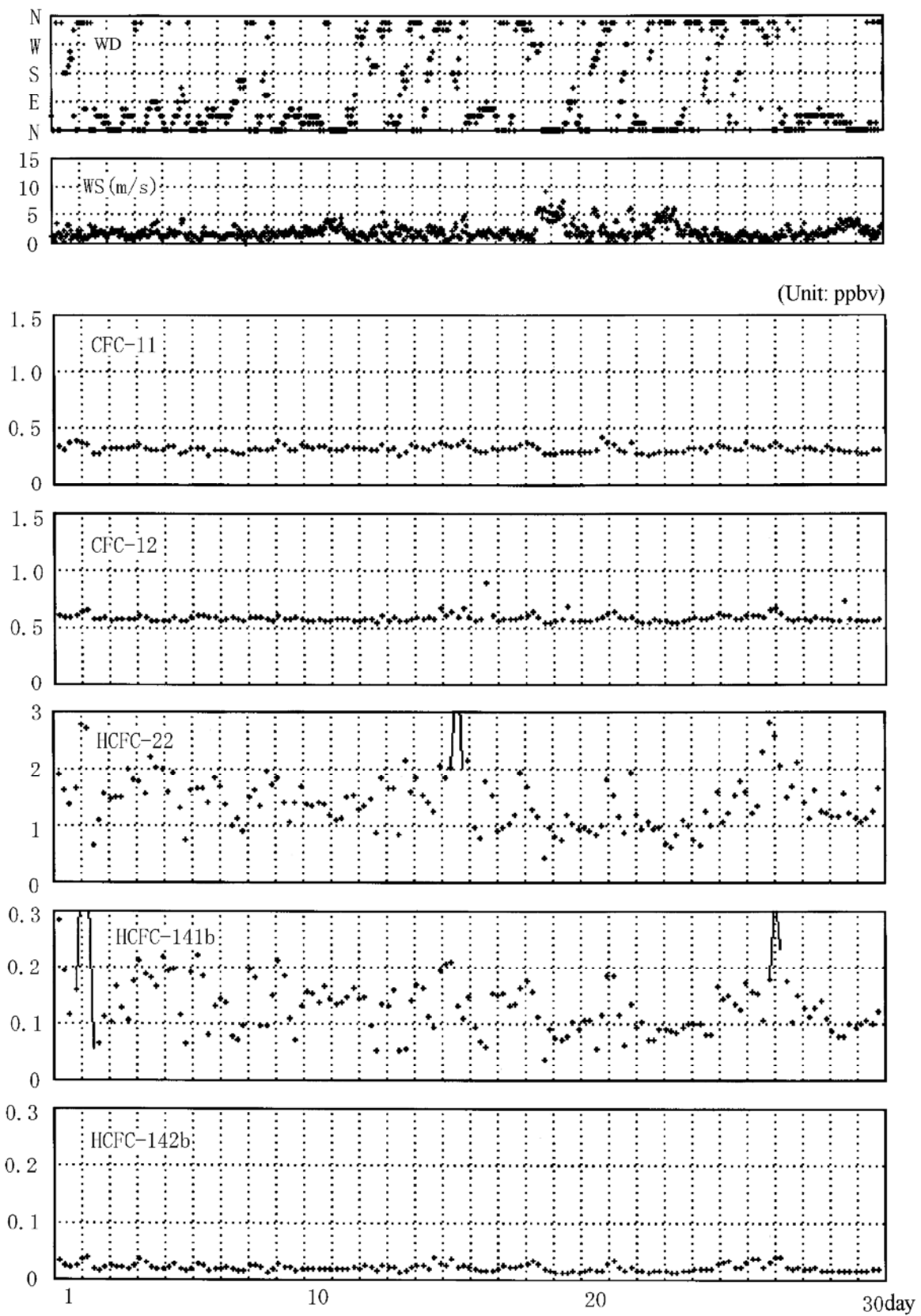


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki(December,2007)

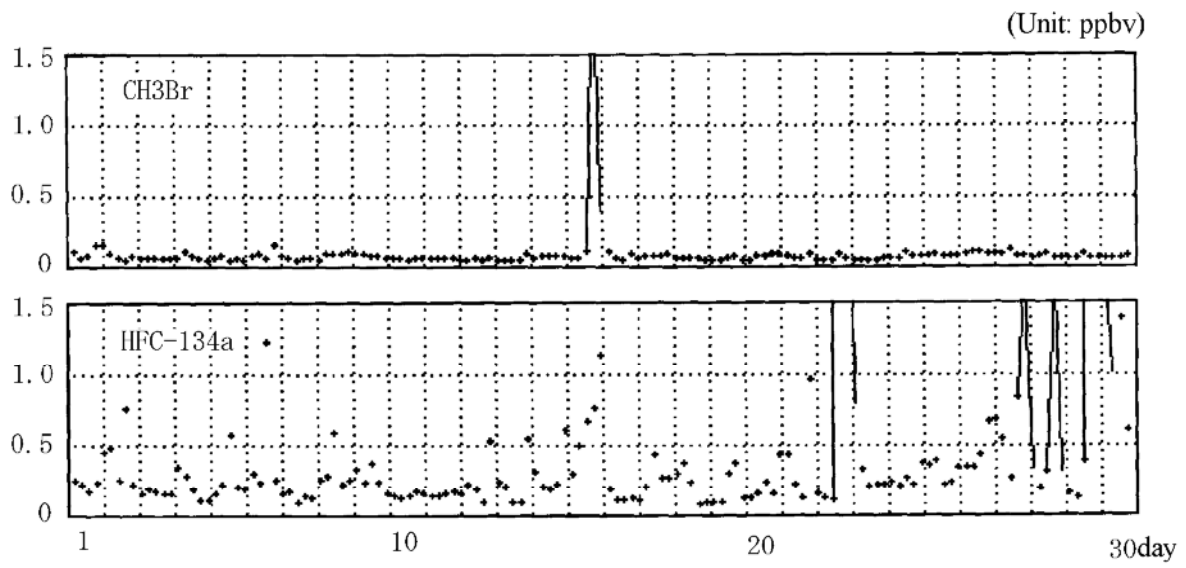


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki(December,2007)

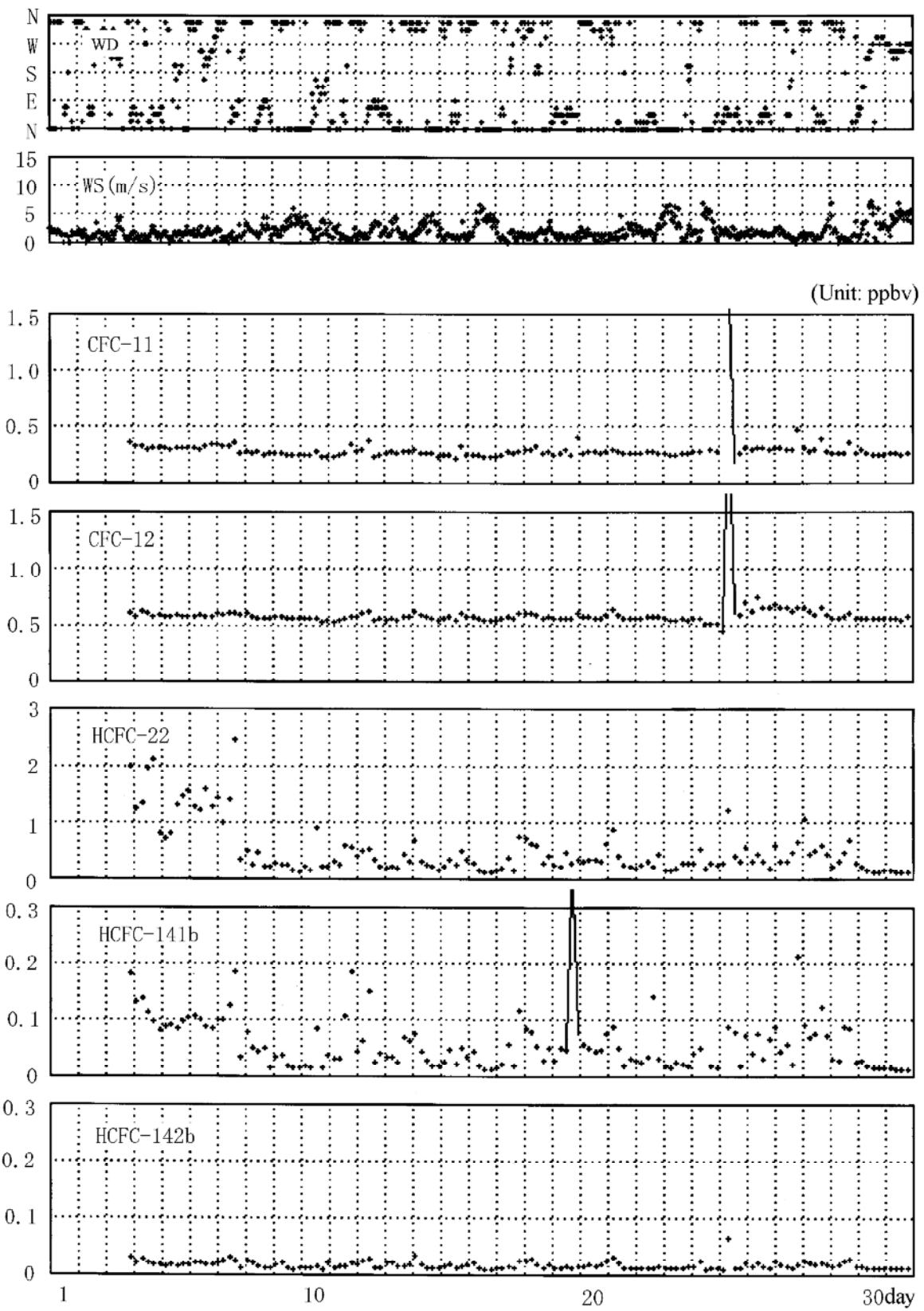


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki (December,2007)

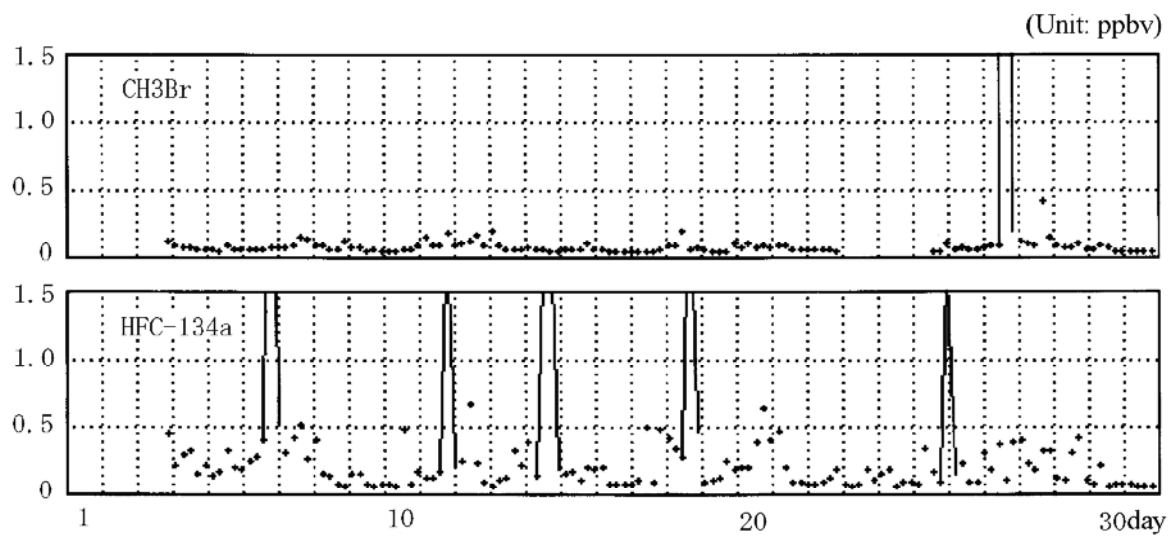


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki(December,2007)

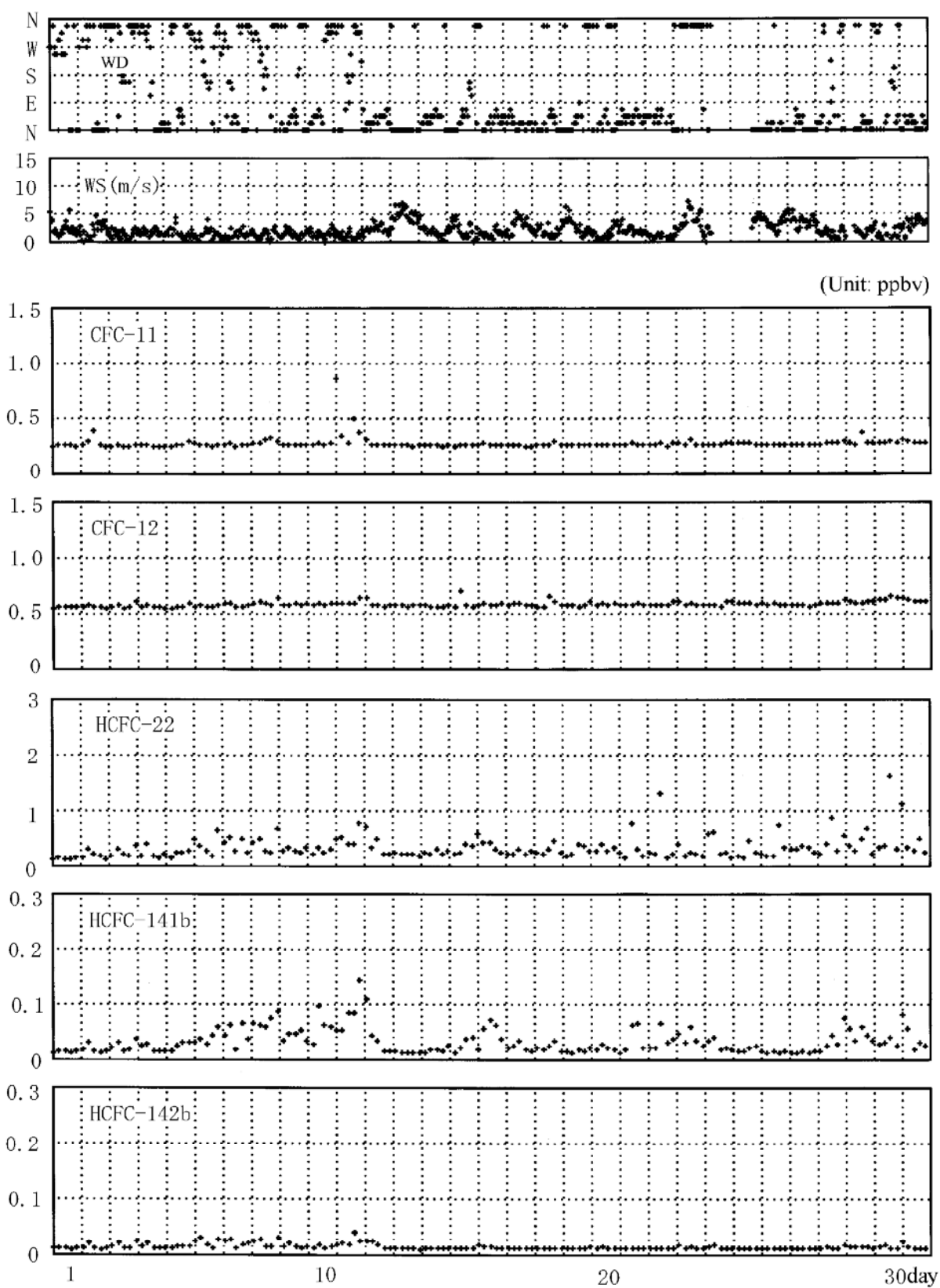


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki (January, 2008)

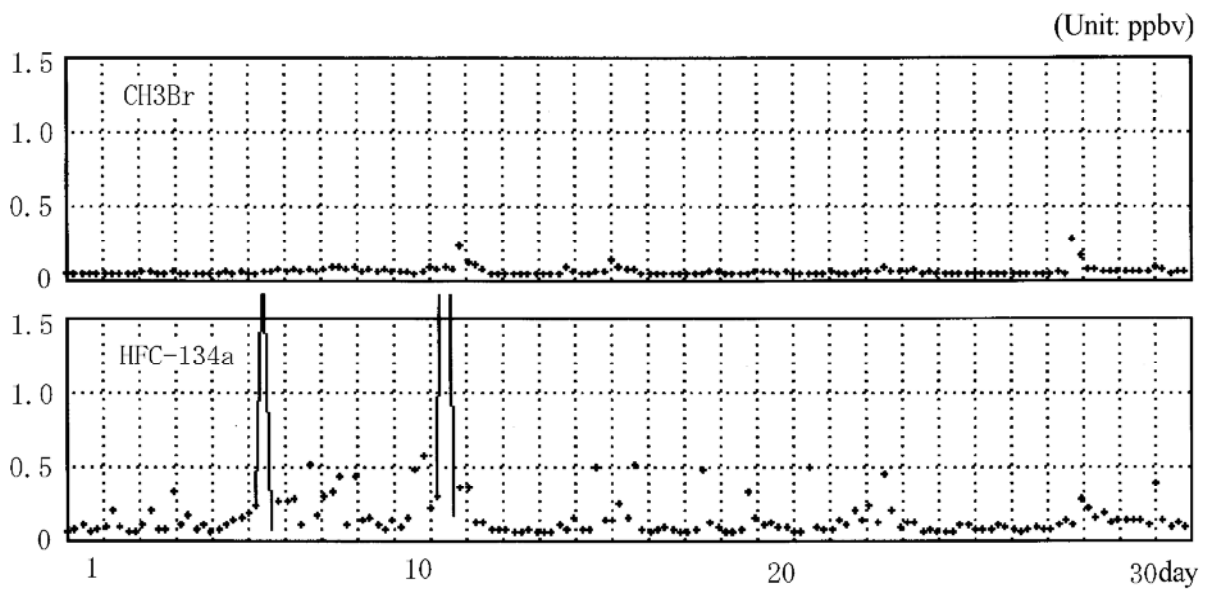


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki(January, 2008)

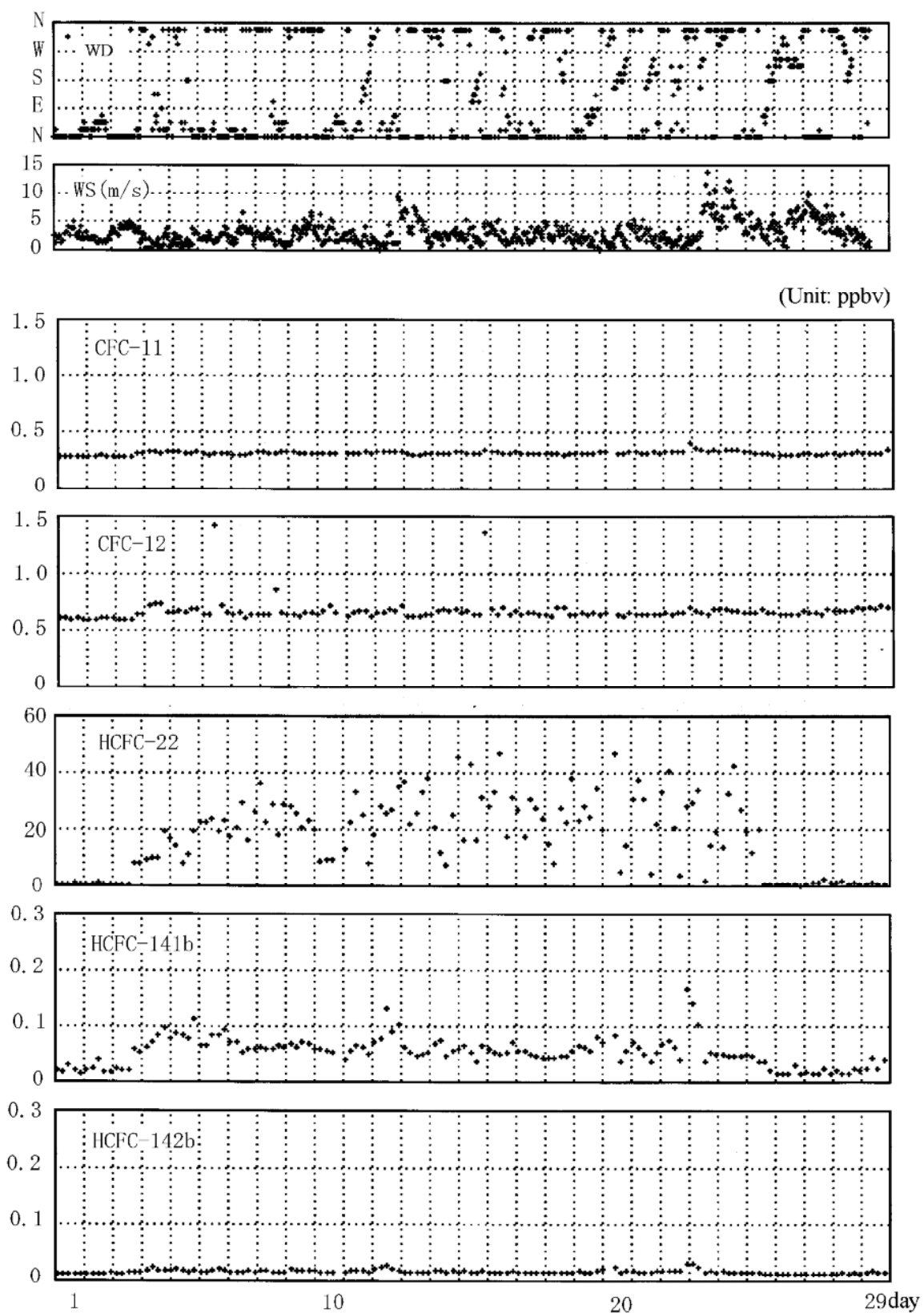


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki (February, 2008)

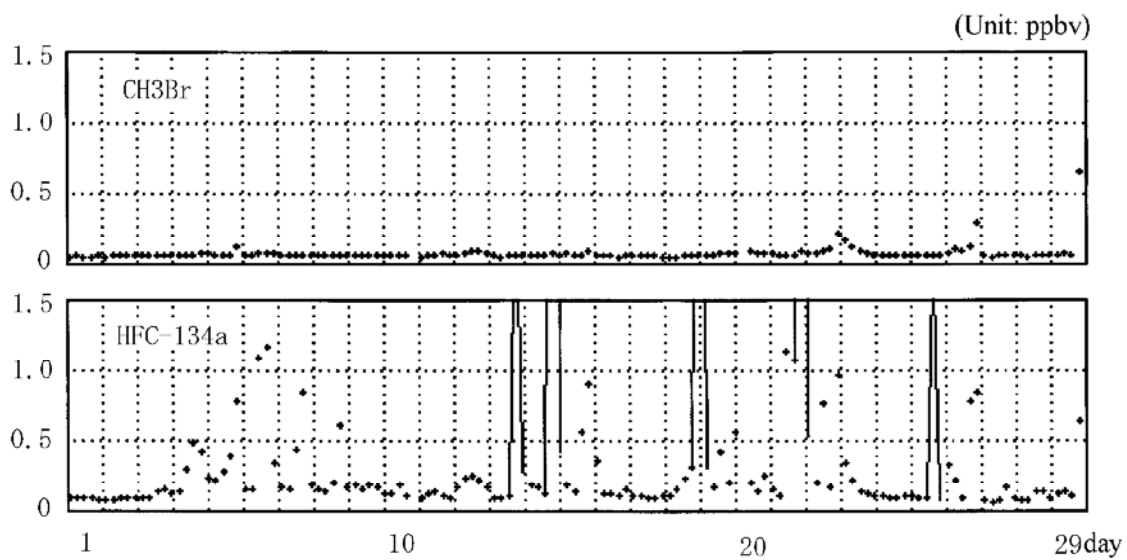


Figure 3.6. Atmospheric concentrations of the measured substances in Kawasaki (February, 2008)

Table 3.4. Daily summaries of the atmospheric concentrations of the specified substances in Kawasaki (Mean, Maximum, Minimum, Number of valid results)
(March, 2007. Concentration unit: ppbv)

Date	Weather		CFC-11			CFC-12			HCFC-22			HCFC-141b			HCFC-142b			Methyl bromide			HFC-134a											
	Main Wind Direc.	Rate (%)	Wind speed (m/s)	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n								
	3 1 THU	NNE	46	3.2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
3 2 FRI	NE	29	1.9	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 3 SAT	NE	17	2.0	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 4 SUN	NNW	21	1.9	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 5 MON	SW	54	5.7	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 6 TUE	N	29	3.4	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 7 WED	N	42	2.9	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 8 THU	NNW	25	2.0	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 9 FRI	N	29	3.2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 10 SAT	S	25	2.8	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 11 SUN	N	46	3.8	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 12 MON	NNW	21	2.0	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 13 TUE	N	29	3.2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 14 WED	N	50	4.0	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 15 THU	N	29	2.8	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 16 FRI	ENE	33	2.2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 17 SAT	NE	33	2.2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 18 SUN	N	83	5.0	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 19 MON	N	58	3.5	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 20 TUE	N	54	3.7	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 21 WED	N	21	2.8	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 22 THU	WSW	33	2.6	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 23 FRI	N	29	3.5	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 24 SAT	SW	29	3.3	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 25 SUN	SW	29	4.2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 26 MON	N	33	3.0	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 27 TUE	SW	33	2.3	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3 28 WED	NNW	21	3.0	24	0.27	0.29	0.25	2	0.55	0.56	0.54	2	0.57	0.63	0.52	2	0.043	0.043	0.042	2	0.028	0.032	0.024	2	0.017	0.017	0.017	2	0.135	0.158	0.111	2
3 29 THU	WSW	25	4.2	24	0.31	0.33	0.29	5	0.57	0.62	0.53	5	0.68	1.15	0.45	5	0.061	0.102	0.037	5	0.030	0.046	0.023	5	0.043	0.096	0.017	5	0.260	0.366	0.108	5
3 30 FRI	N	33	3.6	24	0.30	0.33	0.29	5	0.56	0.59	0.55	5	0.88	1.03	0.81	5	0.055	0.080	0.042	5	0.025	0.038	0.022	5	0.015	0.019	0.012	5	0.118	0.147	0.085	5
3 31 SAT	SW	25	3.9	24	0.27	0.29	0.26	4	0.52	0.52	0.51	4	0.51	0.58	0.42	4	0.041	0.054	0.033	4	0.021	0.022	0.020	4	0.021	0.048	0.011	4	0.146	0.28	0.071	4

* - means absence of the result

Table 3.4. Daily summaries of the atmospheric concentrations of the specified substances in Kawasaki (Mean,Maximum,Minimum,Number of valid results)

(April,2007. Concentration unit:ppbv)

Date	Weather		CFC-11				CFC-12				HCFC-22				HCFC-141b				HCFC-142b				Methyl bromide				HFC-134a						
	Main Wind Direc.	Rate (%)	Wind speed (m/s)	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n					
4 1 SUN	ESE	21	3.6	24	0.25	0.28	0.23	4	0.54	0.55	0.52	4	0.88	1.45	0.39	4	0.045	0.066	0.034	4	0.026	0.030	0.022	4	0.016	0.017	0.015	4	0.098	0.122	0.076	4	
4 2 MON	NNE	29	2.1	24	0.28	0.28	0.27	3	0.57	0.59	0.55	3	0.89	1.05	0.88	3	0.095	0.166	0.053	3	0.024	0.025	0.024	3	0.014	0.015	0.014	3	0.136	0.181	0.091	3	
4 3 TUE	NE	50	1.7	24	0.30	0.34	0.23	5	0.56	0.58	0.55	5	1.04	1.48	0.72	5	0.105	0.280	0.065	5	0.025	0.029	0.023	5	0.012	0.015	0.011	5	2.90	7.90	0.075	5	
4 4 WED	N	38	2.6	24	0.29	0.30	0.23	5	0.56	0.58	0.55	5	1.00	1.21	0.80	5	0.064	0.082	0.053	5	0.024	0.027	0.022	5	0.012	0.014	0.012	5	0.30	0.43	0.197	5	
4 5 THU	N	33	3.0	24	0.30	0.32	0.23	4	0.56	0.57	0.55	4	0.87	1.10	0.72	4	0.057	0.080	0.047	4	0.023	0.026	0.022	4	0.012	0.013	0.010	4	6.3	24.0	0.147	4	
4 6 FRI	NNW	29	2.5	24	0.31	0.33	0.23	5	0.56	0.60	0.54	5	1.01	1.63	0.71	5	0.078	0.148	0.051	5	0.026	0.029	0.022	5	0.021	0.026	0.012	5	0.158	0.21	0.139	5	
4 7 SAT	NNW	29	1.8	24	0.30	0.31	0.23	5	0.57	0.60	0.56	5	1.06	1.35	0.81	5	0.074	0.099	0.048	5	0.028	0.035	0.023	5	0.014	0.016	0.013	5	0.142	0.181	0.110	5	
4 8 SUN	N	21	2.7	24	0.28	0.29	0.27	5	0.55	0.58	0.54	5	1.14	2.10	0.58	5	0.055	0.078	0.039	5	0.024	0.026	0.023	5	0.013	0.015	0.012	5	0.105	0.119	0.084	5	
4 9 MON	N	21	2.3	24	0.29	0.30	0.23	5	0.56	0.58	0.54	5	0.84	0.93	0.77	5	0.079	0.112	0.066	5	0.028	0.034	0.023	5	0.017	0.028	0.013	5	0.107	0.120	0.101	5	
4 10 TUE	NNW	17	3.2	24	0.30	0.31	0.23	2	0.58	0.59	0.57	2	0.97	1.03	0.90	2	0.072	0.090	0.053	2	0.033	0.039	0.027	2	0.018	0.019	0.016	2	0.135	0.172	0.098	2	
4 11 WED	NE	29	2.5	24	0.27	0.29	0.25	3	0.54	0.55	0.53	3	0.76	0.82	0.72	3	0.089	0.160	0.042	3	0.023	0.024	0.021	3	0.013	0.014	0.011	3	0.21	0.44	0.084	3	
4 12 THU	SSW	21	2.5	24	0.29	0.30	0.29	5	0.55	0.55	0.54	5	1.72	4.20	0.56	5	0.052	0.070	0.043	5	0.026	0.032	0.023	5	0.013	0.015	0.013	5	0.105	0.154	0.078	5	
4 13 FRI	SW	58	4.1	24	0.29	0.30	0.23	5	0.56	0.58	0.55	5	0.68	1.10	0.41	5	0.067	0.144	0.028	5	0.029	0.047	0.022	5	0.034	0.063	0.014	5	0.28	0.50	0.088	5	
4 14 SAT	WSW	46	3.7	24	0.28	0.31	0.23	5	0.56	0.56	0.55	5	0.75	1.25	0.42	5	0.037	0.062	0.028	5	0.024	0.025	0.023	5	0.014	0.015	0.012	5	0.089	0.106	0.079	5	
4 15 SUN	S	17	3.0	24	0.30	0.31	0.29	4	0.56	0.56	0.55	4	0.97	1.32	0.67	4	0.049	0.062	0.038	4	0.024	0.027	0.022	4	0.014	0.014	0.013	4	0.079	0.089	0.071	4	
4 16 MON	NE	50	2.3	24	0.30	0.31	0.23	5	0.57	0.60	0.55	5	1.08	1.25	0.94	5	0.109	0.310	0.048	5	0.026	0.031	0.023	5	0.043	0.166	0.012	5	0.080	0.096	0.070	5	
4 17 TUE	N	38	3.4	24	0.30	0.32	0.23	5	0.56	0.58	0.55	5	0.74	0.79	0.65	5	0.074	0.148	0.043	5	0.023	0.025	0.022	5	0.013	0.017	0.011	5	0.081	0.100	0.069	5	
4 18 WED	NE	50	2.1	24	0.30	0.32	0.29	5	0.55	0.56	0.54	5	0.83	1.07	0.60	5	0.076	0.141	0.047	5	0.023	0.028	0.021	5	0.012	0.012	0.011	5	0.59	2.10	0.069	5	
4 19 THU	N	46	4.0	24	0.30	0.32	0.23	5	0.54	0.55	0.52	5	0.67	0.74	0.58	5	0.050	0.068	0.041	5	0.022	0.023	0.021	5	0.011	0.012	0.010	5	0.144	0.40	0.076	5	
4 20 FRI	SW	33	3.6	24	0.30	0.31	0.29	4	0.55	0.55	0.54	4	0.63	0.88	0.40	4	0.059	0.084	0.036	4	0.022	0.024	0.021	4	0.014	0.020	0.011	4	0.131	0.27	0.064	4	
4 21 SAT	SW	36	5.7	24	0.29	0.29	0.27	5	0.55	0.57	0.55	5	0.58	0.82	0.33	5	0.041	0.047	0.031	5	0.021	0.021	0.020	5	0.037	0.053	0.012	5	0.46	0.66	0.088	5	
4 22 SUN	SW	33	5.9	24	0.28	0.28	0.27	5	0.54	0.54	0.53	5	0.31	0.32	0.29	5	0.035	0.040	0.030	5	0.021	0.021	0.020	5	0.036	0.045	0.015	4	0.29	0.62	0.139	5	
4 23 MON	ESE	29	2.9	24	0.29	0.30	0.27	5	0.57	0.60	0.54	5	0.77	0.98	0.32	5	0.065	0.107	0.037	5	0.027	0.039	0.022	5	-	-	-	-	0.100	0.154	0.070	5	
4 24 TUE	NE	58	1.5	24	0.30	0.32	0.23	5	0.57	0.58	0.55	5	0.81	1.19	0.64	5	0.055	0.088	0.043	5	0.023	0.027	0.022	5	-	-	-	-	0.24	0.90	0.067	5	
4 25 WED	N	33	2.1	24	0.32	0.33	0.31	4	0.54	0.58	0.45	4	0.89	1.25	0.79	4	0.100	0.144	0.069	4	0.033	0.036	0.030	4	0.020	0.021	0.019	2	0.161	0.26	0.115	4	
4 26 THU	N	29	3.3	24	0.30	0.31	0.29	5	0.57	0.60	0.56	5	1.13	1.97	0.49	5	0.091	0.135	0.056	5	0.034	0.051	0.023	5	0.027	0.047	0.013	5	0.38	0.90	0.210	5	
4 27 FRI	N	38	4.1	24	0.27	0.29	0.23	5	0.54	0.55	0.54	5	0.78	1.25	0.42	5	0.039	0.045	0.031	5	0.021	0.022	0.021	5	0.012	0.012	0.011	5	0.105	0.146	0.083	5	
4 28 SAT	NNW	29	2.7	24	0.30	0.32	0.30	5	0.56	0.60	0.55	5	0.80	1.16	0.51	5	0.069	0.083	0.050	5	0.029	0.037	0.023	5	0.014	0.016	0.013	5	0.119	0.159	0.085	5	
4 29 SUN	SSW	21	2.8	24	0.29	0.31	0.23	4	0.55	0.57	0.54	4	0.88	1.52	0.46	4	0.048	0.066	0.030	4	0.027	0.036	0.021	4	0.013	0.014	0.012	4	0.087	0.136	0.067	4	
4 30 MON	S	33	2.3	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

- means absence of the result

Table 3.4. Daily summaries of the atmospheric concentrations of the specified substances in Kawasaki (Mean, Maximum, Minimum, Number of valid results)

(May, 2007. Concentration unit: ppbv)

Date	Weather			CFC-11				CFC-12				HCFC-22				HCFC-141b				HCFC-142b				Methyl bromide				HFC-134a				
	Wind Direc.	Wind (%)	Wind speed (m/s)	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	
																																Rate
5 1 TUE	SW	71	3.2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
5 2 WED	NE	21	2.8	24	0.37	0.37	1	0.53	0.53	0.53	1	0.75	0.75	0.75	1	0.102	0.102	0.102	1	0.024	0.024	0.024	1	0.020	0.020	0.020	1	0.40	0.40	0.40	1	
5 3 THU	SW	29	2.6	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
5 4 FRI	WSW	25	3.7	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
5 5 SAT	SW	42	4.6	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
5 6 SUN	SW	38	2.4	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
5 7 MON	SSW	21	1.7	24	0.35	0.37	0.34	3	0.59	0.63	0.57	3	0.78	1.07	0.62	3	0.079	0.088	0.068	3	0.033	0.039	0.027	3	0.017	0.019	0.016	3	0.51	0.88	0.109	3
5 8 TUE	S	21	2.6	24	0.34	0.42	0.30	4	0.58	0.63	0.56	4	1.55	3.50	0.65	4	0.100	0.141	0.054	4	0.038	0.057	0.027	4	0.019	0.020	0.017	4	0.17	0.30	0.088	4
5 9 WED	S	29	2.0	24	0.34	0.39	0.31	5	0.60	0.63	0.56	5	1.69	3.70	0.70	5	0.120	0.230	0.063	5	0.046	0.073	0.029	5	0.021	0.026	0.017	5	0.23	0.46	0.126	5
5 10 THU	SSW	30	4.8	24	0.31	0.34	0.29	4	0.57	0.58	0.55	4	0.54	0.67	0.39	4	0.043	0.061	0.031	4	0.025	0.028	0.023	4	0.015	0.018	0.013	4	0.088	0.111	0.071	4
5 11 FRI	NNW	33	6.7	24	0.29	0.30	0.27	5	0.55	0.58	0.52	5	0.72	0.99	0.52	5	0.053	0.060	0.043	5	0.025	0.028	0.023	5	0.012	0.013	0.012	5	0.103	0.21	0.065	5
5 12 SAT	S	38	3.1	24	0.31	0.34	0.30	5	0.56	0.58	0.55	5	0.79	1.18	0.40	5	0.061	0.089	0.035	5	0.029	0.045	0.022	5	0.015	0.022	0.011	5	0.137	0.22	0.069	5
5 13 SUN	SW	33	2.9	24	0.30	0.34	0.27	5	0.55	0.59	0.53	5	0.65	1.17	0.42	5	0.048	0.072	0.035	5	0.027	0.031	0.024	5	0.018	0.024	0.013	5	0.121	0.189	0.067	5
5 14 MON	NNE	25	2.4	24	0.29	0.31	0.29	5	0.56	0.59	0.54	5	0.84	1.49	0.47	5	0.048	0.061	0.041	5	0.025	0.028	0.022	5	0.014	0.017	0.012	5	0.086	0.105	0.069	5
5 15 TUE	NNW	21	2.2	24	0.29	0.31	0.23	4	0.58	0.60	0.56	4	0.82	1.03	0.72	4	0.081	0.105	0.055	4	0.037	0.061	0.026	4	0.020	0.040	0.013	4	0.181	0.230	0.121	4
5 16 WED	S	33	3.4	24	0.30	0.31	0.23	5	0.57	0.59	0.54	5	0.78	1.13	0.44	5	0.075	0.120	0.044	5	0.033	0.047	0.023	5	0.014	0.018	0.013	5	0.123	0.191	0.072	5
5 17 THU	SW	25	2.9	24	0.34	0.55	0.23	5	0.57	0.68	0.54	5	0.67	1.23	0.42	5	0.197	0.810	0.033	5	0.030	0.061	0.022	5	0.023	0.038	0.011	5	0.175	0.37	0.073	5
5 18 FRI	SW	42	3.7	24	0.32	0.34	0.31	5	0.59	0.64	0.57	5	0.72	1.42	0.41	5	0.097	0.220	0.051	5	0.039	0.074	0.025	5	0.019	0.032	0.015	5	0.186	0.46	0.081	5
5 19 SAT	SW	21	2.8	24	0.31	0.33	0.31	5	0.61	0.67	0.58	5	1.14	2.00	0.42	5	0.098	0.183	0.045	5	0.030	0.037	0.026	5	0.015	0.019	0.013	5	0.24	0.710	0.073	5
5 20 SUN	N	42	2.9	24	0.29	0.30	0.23	4	0.60	0.63	0.58	4	1.11	1.58	0.77	4	0.065	0.078	0.059	4	0.028	0.030	0.026	4	0.013	0.014	0.012	4	0.105	0.117	0.085	4
5 21 MON	SSW	33	2.8	24	0.30	0.31	0.29	5	0.59	0.63	0.57	5	1.02	2.20	0.41	5	0.060	0.100	0.037	5	0.025	0.026	0.024	5	0.017	0.036	0.012	5	0.078	0.095	0.060	5
5 22 TUE	SW	33	2.9	24	0.30	0.32	0.29	5	0.58	0.57	0.55	5	0.67	0.93	0.40	5	0.058	0.066	0.036	5	0.030	0.045	0.024	5	0.015	0.019	0.013	5	0.111	0.179	0.067	5
5 23 WED	SW	38	3.3	24	0.32	0.37	0.30	5	0.59	0.61	0.57	5	1.17	3.40	0.43	5	0.072	0.089	0.045	5	0.031	0.039	0.029	5	0.018	0.022	0.015	5	0.108	0.135	0.086	5
5 24 THU	S	33	3.0	24	0.31	0.35	0.30	5	0.60	0.65	0.58	5	0.71	1.38	0.38	5	0.082	0.167	0.044	5	0.039	0.063	0.027	5	0.020	0.034	0.013	5	0.132	0.25	0.066	5
5 25 FRI	SW	17	2.4	24	0.32	0.34	0.33	4	0.60	0.62	0.57	4	0.63	1.42	0.39	4	0.122	0.210	0.047	4	0.037	0.052	0.026	4	0.017	0.029	0.012	4	0.31	0.76	0.067	4
5 26 SAT	NE	17	2.6	24	0.29	0.31	0.23	5	0.57	0.61	0.53	5	0.78	0.96	0.41	5	0.111	0.210	0.045	5	0.032	0.040	0.025	5	0.018	0.029	0.012	5	0.178	0.34	0.081	5
5 27 SUN	S	25	2.6	24	0.30	0.31	0.23	5	0.58	0.61	0.56	5	0.67	0.97	0.45	5	0.126	0.270	0.051	5	0.033	0.046	0.026	5	0.023	0.037	0.013	5	0.118	0.20	0.078	5
5 28 MON	ENE	30	2.9	24	0.30	0.33	0.23	5	0.65	0.82	0.58	5	0.80	1.06	0.65	5	0.091	0.135	0.049	5	0.026	0.028	0.024	5	0.012	0.013	0.012	5	0.075	0.077	0.072	5
5 29 TUE	NE	29	2.4	24	0.32	0.33	0.30	5	0.58	0.61	0.57	5	0.67	0.90	0.41	5	0.072	0.091	0.040	5	0.027	0.030	0.022	5	0.012	0.013	0.012	5	0.086	0.112	0.067	5
5 30 WED	NE	17	1.6	24	0.31	0.32	0.23	4	0.60	0.63	0.57	4	0.90	1.12	0.63	4	0.220	0.580	0.061	4	0.031	0.034	0.026	4	0.013	0.014	0.013	4	0.20	0.33	0.119	4
5 31 THU	NE	25	2.0	24	0.30	0.32	0.23	5	0.59	0.62	0.57	5	0.70	0.78	0.59	5	0.116	0.158	0.081	5	0.033	0.044	0.026	5	0.013	0.014	0.011	5	5.7	28.0	0.097	5

"-" means absence of the result

(June, 2007 . Concentration unit:ppbv)
 Table 3.4. Daily summaries of the atmospheric concentrations of the specified substances in Kawasaki(Mean,Maximum,Minimum,Number of valid results)

Date	Weather		CFC-11			CFC-12			HCFC-22			HCFC-141b			HCFC-142b			Methyl bromide			HFC-134a																
	Main Wind Direc.	Rate (%)	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n															
	(m/s)	speed																																			
6 1	FRI	ENE	29	1.9	24	0.30	0.31	0.23	5	0.61	0.63	0.58	5	0.73	0.95	0.57	5	0.082	0.108	0.063	5	0.031	0.042	0.024	5	0.014	0.020	0.012	5	0.210	0.320	0.106	5				
6 2	SAT	SSW	28	2.8	24	0.33	0.35	0.31	5	0.59	0.62	0.57	5	0.54	0.70	0.42	5	0.072	0.082	0.042	5	0.028	0.036	0.024	5	0.019	0.040	0.012	5	0.170	0.450	0.072	5				
6 3	SUN	SSW	38	2.7	24	0.31	0.32	0.29	5	0.58	0.62	0.55	5	0.49	0.58	0.38	5	0.050	0.060	0.041	5	0.026	0.030	0.024	5	0.032	0.040	0.011	5	0.148	0.300	0.072	5				
6 4	MON	E	21	2.2	24	0.30	0.32	0.29	4	0.61	0.64	0.59	4	0.74	1.13	0.54	4	0.069	0.088	0.065	4	0.032	0.040	0.024	4	0.014	0.016	0.012	4	0.114	0.162	0.079	4				
6 5	TUE	SSW	54	2.5	24	0.32	0.41	0.29	5	0.60	0.61	0.59	5	0.64	1.07	0.40	5	0.089	0.174	0.088	5	0.033	0.052	0.024	5	0.014	0.017	0.012	5	0.101	0.141	0.069	5				
6 6	WED	SSW	38	4.2	24	0.29	0.30	0.23	5	0.58	0.60	0.57	5	0.41	0.55	0.32	5	0.042	0.049	0.034	5	0.025	0.029	0.023	5	0.012	0.013	0.011	5	0.076	0.094	0.065	5				
6 7	THU	SSW	38	4.6	24	0.33	0.42	0.29	5	0.58	0.60	0.57	5	0.43	0.52	0.30	5	0.048	0.084	0.081	5	0.033	0.065	0.024	5	0.020	0.061	0.011	5	0.199	0.660	0.059	5				
6 8	FRI	SSW	38	3.4	24	0.36	0.56	0.23	5	0.58	0.59	0.55	5	0.63	1.06	0.35	5	0.074	0.106	0.084	5	0.037	0.060	0.023	5	0.019	0.026	0.012	5	0.088	0.142	0.064	5				
6 9	SAT	SSW	50	2.9	24	0.31	0.32	0.30	4	0.58	0.59	0.57	4	0.37	0.44	0.33	4	0.039	0.043	0.032	4	0.025	0.028	0.023	4	0.011	0.011	0.011	4	0.064	0.069	0.057	4				
6 10	SUN	N	25	1.8	24	0.32	0.32	0.30	5	0.60	0.61	0.60	5	0.87	1.04	0.64	5	0.103	0.136	0.045	5	0.034	0.046	0.027	5	0.013	0.015	0.012	5	0.121	0.162	0.075	5				
6 11	MON	NNE	33	1.7	24	0.30	0.31	0.29	5	0.60	0.61	0.59	5	0.84	1.03	0.61	5	0.079	0.126	0.057	5	0.030	0.034	0.025	5	0.016	0.019	0.013	5	0.116	0.187	0.081	5				
6 12	TUE	SSW	29	2.5	24	0.32	0.38	0.23	5	0.58	0.60	0.55	5	0.88	0.95	0.46	5	0.081	0.128	0.048	5	0.035	0.064	0.023	5	0.016	0.021	0.011	5	0.191	0.410	0.078	5				
6 13	WED	S	33	3.8	24	0.27	0.34	0.24	5	0.52	0.58	0.47	5	0.47	0.68	0.32	5	0.053	0.070	0.033	5	0.024	0.026	0.020	5	0.018	0.042	0.009	5	0.870	3.700	0.061	5				
6 14	THU	SSW	38	3.4	24	0.25	0.27	0.24	2	0.49	0.50	0.48	2	0.39	0.48	0.31	2	0.040	0.050	0.030	2	0.020	0.021	0.019	2	0.011	0.011	0.010	2	0.055	0.062	0.047	2				
6 15	FRI	N	50	3.8	24	0.38	0.38	0.33	1	--	--	--	--	0.18	0.20	0.15	2	0.075	0.075	0.075	1	0.026	0.036	0.016	2	0.016	0.019	0.013	2	0.091	0.112	0.069	2				
6 16	SAT	N	42	4.1	24	0.38	0.47	0.23	5	--	--	--	--	0.48	0.82	0.22	5	0.210	0.680	0.078	5	0.035	0.045	0.025	5	0.012	0.018	0.008	5	0.108	0.136	0.091	5				
6 17	SUN	S	33	2.5	24	0.27	0.32	0.23	5	0.53	0.60	0.45	2	0.44	0.62	0.28	5	0.052	0.117	0.012	5	0.025	0.026	0.022	5	0.012	0.012	0.011	5	0.073	0.098	0.057	5				
6 18	MON	SSW	42	3.6	24	0.30	0.34	0.27	5	0.55	0.59	0.47	5	0.36	0.45	0.28	5	0.047	0.072	0.015	5	0.027	0.029	0.024	5	0.013	0.015	0.011	5	0.139	0.240	0.061	5				
6 19	TUE	S	21	2.5	24	0.29	0.33	0.22	4	0.54	0.58	0.47	4	0.53	0.77	0.35	4	0.071	0.100	0.039	4	0.034	0.045	0.024	4	0.014	0.021	0.010	4	0.133	0.144	0.106	4				
6 20	WED	S	42	3.6	24	0.37	0.54	0.29	5	0.52	0.57	0.43	5	0.39	0.57	0.27	5	0.092	0.172	0.035	5	0.036	0.051	0.026	5	0.010	0.012	0.007	5	0.116	0.159	0.070	5				
6 21	THU	SSW	33	3.1	24	0.46	0.46	0.43	1	0.53	0.53	0.53	1	0.37	0.37	0.37	1	0.118	0.118	0.118	1	0.030	0.030	0.030	1	0.009	0.009	0.009	1	0.189	0.199	0.189	1				
6 22	FRI	WSW	33	3.1	24	0.35	0.35	0.35	1	0.56	0.56	0.56	1	0.44	0.44	0.44	1	0.056	0.056	0.056	1	0.025	0.025	0.025	1	0.013	0.013	0.013	1	0.195	0.195	0.195	1				
6 23	SAT	SW	21	2.5	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
6 24	SUN	WSW	25	1.5	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
6 25	MON	NE	38	1.0	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
6 26	TUE	NE	17	1.0	24	0.35	0.35	0.35	1	0.61	0.61	0.61	1	0.75	0.75	0.75	1	0.240	0.240	0.240	1	0.029	0.029	0.029	1	0.015	0.015	0.015	1	0.360	0.360	0.360	1	--	--	--	--
6 27	WED	ENE	17	1.8	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
6 28	THU	S	33	2.9	24	0.34	0.38	0.30	3	0.59	0.61	0.57	3	0.37	0.40	0.34	3	0.057	0.079	0.037	3	0.029	0.031	0.027	3	0.014	0.014	0.014	3	0.083	0.111	0.084	3	--	--	--	--
6 29	FRI	SW	42	3.8	24	0.35	0.43	0.25	4	0.59	0.63	0.55	4	0.44	0.52	0.36	4	0.060	0.084	0.027	4	0.044	0.060	0.025	4	0.157	0.560	0.014	4	0.220	0.470	0.120	4	--	--	--	--
6 30	SAT	E	29	2.4	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	

“-” means absence of the result

Table 3.4. Daily summaries of the atmospheric concentrations of the specified substances in Kawasaki (Mean,Maximum,Minimum,Number of valid results) (July,2007. Concentration unit:ppbv)

Date	Weather	CFC-11		CFC-12		HCFC-22		HCFC-141b		HCFC-142b		Methyl bromide		HFC-134a						
		Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n			
7 1 SUN	S	25	1.8	24	-	-	-	-	-	-	-	-	-	-	-	-				
7 2 MON	S	46	2.3	24	1.35	0.31	2	0.60	0.61	0.59	2	1.09	1.36	0.83	2	0.240	0.290	0.181	2	
7 3 TUE	NE	25	2.0	24	1.22	0.23	2	0.52	0.52	0.51	2	0.88	0.86	0.86	2	0.081	0.094	0.068	2	
7 4 WED	NE	29	1.5	24	1.30	0.32	2	0.61	0.63	0.59	3	0.98	1.12	0.80	3	0.220	0.270	0.184	3	
7 5 THU	N	13	2.0	24	1.34	0.38	3	0.59	0.62	0.57	5	0.81	1.34	0.45	5	0.146	0.180	0.113	5	
7 6 FRI	NE	17	2.2	24	1.28	0.30	5	0.53	0.57	0.47	5	0.57	0.77	0.26	5	0.086	0.134	0.048	5	
7 7 SAT	ENE	50	1.9	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7 8 SUN	NE	38	2.2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7 9 MON	ENE	33	1.9	24	1.31	0.33	3	0.62	0.63	0.62	3	0.46	0.48	0.42	3	0.061	0.084	0.039	3	
7 10 TUE	SSW	21	1.9	24	1.73	2.10	0.34	5	0.68	0.84	0.63	5	0.69	1.03	0.41	5	0.250	0.870	0.077	5
7 11 WED	SW	46	4.0	24	1.39	0.71	5	0.60	0.61	0.58	5	0.83	2.30	0.25	5	0.094	0.270	0.035	5	
7 12 THU	WSW	25	1.4	24	1.34	0.37	5	0.61	0.63	0.58	5	0.67	1.38	0.37	5	0.121	0.330	0.063	5	
7 13 FRI	SW	21	1.9	24	1.40	0.58	5	0.65	0.69	0.63	5	0.81	1.24	0.42	5	0.148	0.240	0.070	5	
7 14 SAT	NE	29	1.6	24	1.37	0.47	4	0.63	0.66	0.62	4	0.57	0.60	0.54	4	0.195	0.163	0.086	4	
7 15 SUN	N	29	4.1	24	1.31	0.32	5	0.62	0.63	0.60	5	0.53	0.77	0.28	5	0.100	0.144	0.029	5	
7 16 MON	E	29	3.8	24	1.30	0.33	5	0.62	0.63	0.61	5	0.53	0.64	0.41	5	0.074	0.089	0.060	5	
7 17 TUE	E	42	2.0	24	1.30	0.32	5	0.64	0.67	0.62	5	0.64	0.77	0.47	5	0.073	0.137	0.054	5	
7 18 WED	NE	63	1.6	24	1.35	0.46	5	0.63	0.65	0.62	5	0.88	1.97	0.53	5	0.122	0.196	0.061	5	
7 19 THU	NE	42	1.7	24	1.30	0.32	5	0.60	0.61	0.59	4	0.58	0.66	0.50	4	0.076	0.112	0.059	4	
7 20 FRI	SSW	21	2.0	24	1.30	0.33	5	0.59	0.60	0.58	5	0.51	0.68	0.31	5	0.087	0.086	0.045	5	
7 21 SAT	SSW	35	2.4	24	1.32	0.38	5	0.58	0.61	0.56	5	0.28	0.31	0.25	5	0.060	0.073	0.033	5	
7 22 SUN	ENE	21	1.3	24	1.32	0.34	5	0.60	0.61	0.59	5	0.55	0.71	0.40	5	0.079	0.116	0.049	5	
7 23 MON	NE	33	1.1	24	1.32	0.40	5	0.60	0.61	0.58	5	0.49	0.56	0.47	5	0.088	0.111	0.050	5	
7 24 TUE	N	21	2.3	24	1.31	0.34	5	0.60	0.63	0.59	4	0.59	0.97	0.42	4	0.156	0.260	0.045	4	
7 25 WED	SSW	33	2.6	24	1.32	0.34	5	0.60	0.62	0.58	5	1.41	4.60	0.32	5	0.089	0.108	0.040	5	
7 26 THU	SSW	21	2.2	24	1.32	0.35	5	0.60	0.62	0.58	5	0.69	1.24	0.38	5	0.093	0.167	0.046	5	
7 27 FRI	NE	25	1.8	24	1.35	0.47	5	0.60	0.62	0.58	5	0.61	0.83	0.45	5	0.128	0.188	0.067	5	
7 28 SAT	S	46	2.5	24	1.32	0.33	5	0.59	0.60	0.58	5	0.48	0.67	0.36	5	0.063	0.093	0.045	5	
7 29 SUN	NE	33	1.9	24	1.34	0.37	5	0.61	0.63	0.59	4	0.82	1.27	0.53	4	0.093	0.143	0.043	4	
7 30 MON	NE	50	2.0	24	1.32	0.35	5	0.60	0.63	0.60	5	1.16	1.57	0.60	5	0.075	0.175	0.047	5	
7 31 TUE	NE	21	2.0	24	1.32	0.34	5	0.61	0.62	0.59	5	0.70	0.96	0.39	5	0.062	0.075	0.049	5	

*,- means absence of the result

Table 3.4. Daily summaries of the atmospheric concentrations of the specified substances in Kawasaki (Mean, Maximum, Minimum, Number of valid results)

Date	Weather Main Wind Rate (%) Wind Direc.	CFC-11		CFC-12		HCFC-22		HCFC-141b		HCFC-142b		Methyl bromide		HFC-134a																	
		Mean	Min.	Max.	n	Mean	Min.	Max.	n	Mean	Min.	Max.	n	Mean	Min.	Max.	n														
		(m/s)																													
10 1 SAT	N 37	1.8	24	0.36	0.22	4	0.55	0.63	0.51	4	0.79	0.95	0.64	4	0.108	0.152	0.062	4	0.032	0.034	0.028	4	0.013	0.019	0.008	4	0.141	0.181	0.104	4	
10 2 SUN	N 46	1.5	24	0.33	0.35	0.31	3	0.65	0.62	0.51	3	0.70	0.84	0.57	3	0.109	0.168	0.076	3	0.083	0.094	0.082	3	0.013	0.015	0.012	3	0.210	0.450	0.090	3
10 3 MON	NE 58	1.2	24	0.32	0.35	0.23	3	0.66	0.73	0.59	3	0.66	0.82	0.59	3	0.124	0.159	0.085	3	0.081	0.091	0.030	3	0.017	0.024	0.013	3	0.144	0.158	0.133	3
10 4 TUE	N 17	1.9	24	0.30	0.32	0.23	3	0.63	0.64	0.61	3	0.66	0.91	0.37	3	0.146	0.187	0.113	3	0.035	0.046	0.025	3	0.014	0.015	0.014	3	0.139	0.198	0.084	3
10 5 WED	ENE 21	2.2	24	0.32	0.35	0.23	5	0.62	0.64	0.60	5	0.61	0.95	0.37	5	0.132	0.200	0.075	5	0.036	0.061	0.028	5	0.014	0.015	0.012	5	0.150	0.230	0.104	5
10 6 THU	ENE 25	1.8	24	0.30	0.33	0.23	5	0.61	0.64	0.58	5	0.61	0.69	0.46	5	0.300	0.860	0.077	5	0.031	0.036	0.026	5	0.013	0.015	0.012	5	0.123	0.148	0.105	5
10 7 FRI	SSW 29	2.6	24	0.31	0.33	0.30	4	0.62	0.64	0.59	4	0.68	1.21	0.31	4	0.092	0.154	0.086	4	0.043	0.070	0.026	4	0.014	0.019	0.012	4	0.152	0.260	0.075	4
10 8 SAT	SW 33	3.4	24	0.32	0.33	0.30	5	0.63	0.65	0.61	5	0.45	1.05	0.27	5	0.059	0.165	0.031	5	0.032	0.055	0.025	5	0.014	0.019	0.011	5	0.137	0.260	0.073	5
10 9 SUN	NE 33	1.3	24	0.31	0.32	0.23	5	0.61	0.64	0.58	5	0.72	0.86	0.62	5	0.098	0.122	0.079	5	0.041	0.044	0.037	5	0.017	0.021	0.011	5	0.150	0.200	0.118	5
10 10 MON	NNE 21	2.0	24	0.33	0.44	0.23	4	0.61	0.64	0.60	4	0.71	1.15	0.55	4	0.097	0.178	0.055	4	0.035	0.052	0.026	4	0.014	0.024	0.010	4	0.146	0.198	0.082	4
10 11 TUE	N 21	1.2	24	0.30	0.32	0.27	5	0.58	0.63	0.53	5	0.90	1.13	0.49	5	0.157	0.240	0.063	5	0.039	0.063	0.027	5	0.013	0.018	0.009	5	0.380	0.850	0.119	5
10 12 WED	NE 33	1.7	24	0.29	0.34	0.27	4	0.56	0.59	0.54	4	0.59	0.68	0.52	4	0.095	0.143	0.075	4	0.030	0.032	0.028	4	0.013	0.015	0.011	4	0.109	0.133	0.079	4
10 13 THU	E 33	2.1	24	0.28	0.29	0.27	5	0.56	0.58	0.55	5	0.62	0.80	0.46	5	0.115	0.340	0.050	5	0.025	0.028	0.023	5	0.009	0.010	0.009	5	0.085	0.121	0.077	5
10 14 FRI	NNE 33	1.4	24	0.31	0.40	0.27	5	0.56	0.58	0.55	5	0.57	0.59	0.54	5	0.069	0.093	0.058	5	0.029	0.035	0.025	5	0.010	0.012	0.009	5	0.090	0.111	0.077	5
10 15 SAT	ENE 42	1.9	24	0.28	0.30	0.27	5	0.57	0.59	0.56	5	0.58	0.89	0.37	5	0.087	0.189	0.043	5	0.027	0.029	0.025	5	0.010	0.011	0.009	5	0.087	0.104	0.074	5
10 16 SUN	N 58	2.9	24	0.28	0.29	0.27	5	0.57	0.58	0.56	5	0.67	0.89	0.51	5	0.074	0.100	0.054	5	0.030	0.031	0.028	5	0.012	0.013	0.009	5	0.119	0.161	0.088	5
10 17 MON	N 46	3.0	24	0.27	0.28	0.23	4	0.58	0.59	0.57	4	0.41	0.43	0.39	4	0.057	0.075	0.046	4	0.027	0.031	0.024	4	0.097	0.360	0.009	4	0.094	0.118	0.070	4
10 18 TUE	ENE 42	1.9	24	0.28	0.31	0.23	5	0.59	0.62	0.56	5	0.54	0.76	0.41	5	0.200	0.640	0.069	5	0.032	0.042	0.026	5	0.014	0.019	0.011	5	0.142	0.260	0.091	5
10 19 WED	NE 38	2.4	24	0.28	0.35	0.25	5	0.57	0.57	0.55	5	0.47	0.52	0.41	5	0.159	0.340	0.050	5	0.032	0.048	0.023	5	0.012	0.015	0.008	5	1.050	4.600	0.098	5
10 20 THU	N 33	2.5	24	0.27	0.30	0.25	5	0.58	0.62	0.56	5	0.74	1.11	0.30	5	0.104	0.270	0.037	5	0.038	0.077	0.025	5	0.013	0.017	0.009	5	0.164	0.430	0.079	5
10 21 FRI	N 46	2.8	24	0.27	0.27	0.23	5	0.57	0.58	0.57	5	0.53	0.74	0.40	5	0.057	0.085	0.044	5	0.029	0.036	0.024	5	0.010	0.012	0.008	5	0.094	0.135	0.070	5
10 22 SAT	N 21	1.8	24	0.30	0.32	0.23	4	0.59	0.60	0.57	4	0.53	0.79	0.31	4	0.090	0.152	0.054	4	0.039	0.054	0.026	4	0.013	0.015	0.011	4	0.188	0.260	0.124	4
10 23 SUN	N 33	2.1	24	0.28	0.30	0.27	5	0.59	0.61	0.56	5	0.65	0.94	0.42	5	0.101	0.147	0.059	5	0.038	0.052	0.027	5	0.014	0.020	0.010	5	0.290	0.490	0.189	5
10 24 MON	N 29	2.1	24	0.27	0.28	0.23	5	0.56	0.57	0.56	5	0.59	0.69	0.43	5	0.098	0.179	0.044	5	0.029	0.038	0.024	5	0.013	0.016	0.010	5	0.131	0.180	0.100	5
10 25 TUE	NE 33	1.3	24	0.29	0.34	0.27	5	0.58	0.60	0.57	5	0.67	0.84	0.58	5	0.570	2.200	0.084	5	0.042	0.061	0.029	5	0.017	0.024	0.013	5	0.250	0.490	0.125	5
10 26 WED	N 50	2.0	24	0.28	0.30	0.23	5	0.59	0.62	0.56	5	0.75	0.93	0.61	5	0.144	0.210	0.109	5	0.040	0.047	0.034	5	0.021	0.027	0.016	5	0.300	0.430	0.176	5
10 27 THU	N 58	3.7	24	0.29	0.31	0.23	4	0.59	0.61	0.58	4	1.01	1.60	0.69	4	0.162	0.260	0.105	4	0.041	0.058	0.029	4	0.016	0.021	0.012	4	0.172	0.250	0.109	4
10 28 FRI	S 17	2.1	24	0.33	0.34	0.32	5	0.59	0.61	0.58	5	2.10	3.30	1.18	5	0.320	0.440	0.147	5	0.044	0.065	0.034	5	0.017	0.040	0.010	5	0.350	1.000	0.104	5
10 29 SAT	WSW 46	3.8	24	0.32	0.33	0.31	5	0.59	0.61	0.57	5	0.78	1.09	0.52	5	0.107	0.192	0.046	5	0.032	0.036	0.030	5	0.039	0.071	0.023	5	0.560	1.540	0.196	5
10 30 SUN	ENE 29	2.4	24	0.32	0.34	0.23	5	0.59	0.60	0.57	5	1.60	2.50	0.58	5	0.330	0.510	0.084	5	0.046	0.060	0.028	5	0.018	0.028	0.015	5	0.310	0.750	0.111	5
10 31 MON	ENE 46	1.9	24	0.32	0.34	0.30	5	0.58	0.59	0.58	5	2.70	3.80	1.89	5	0.370	0.460	0.210	5	0.043	0.054	0.033	5	0.017	0.027	0.012	5	0.141	0.152	0.129	5

* - means absence of the result

Table 3.4. Daily summaries of the atmospheric concentrations of the specified substances in Kawasaki (Mean, Maximum, Minimum, Number of valid results) (November, 2007. Concentration unit: ppbv)

Date	Main Wind Direc.	Wind (%)	Weather		CFC-11			CFC-12			HCFC-22			HCFC-141b			HCFC-142b			Methyl bromide			HFC-134a										
			Rate	Wind speed (m/s)	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n					
11 1	TUE	N	29	1.5	24	0.35	0.39	0.32	4	0.60	0.61	0.59	4	3.30	3.80	2.70	4	0.360	0.570	0.230	4	0.054	0.071	0.046	4	0.021	0.032	0.014	4	0.220	0.250	0.173	4
11 2	WED	NNW	33	1.8	24	0.33	0.37	0.28	5	0.61	0.66	0.57	5	3.50	5.80	-2.9	5	0.360	0.710	0.110	5	0.063	0.081	0.031	5	0.018	0.031	0.010	5	0.440	0.760	0.220	5
11 3	THU	N	50	1.6	24	0.33	0.36	0.32	5	0.58	0.68	0.57	5	3.30	4.00	2.90	5	0.270	0.360	0.210	5	0.044	0.050	0.038	5	0.012	0.013	0.012	5	0.167	0.192	0.150	5
11 4	FRI	N	25	1.9	24	0.32	0.35	0.31	5	0.58	0.62	0.56	5	3.80	4.40	3.10	5	0.390	0.440	0.330	5	0.061	0.074	0.036	5	0.015	0.021	0.010	5	0.210	0.350	0.109	5
11 5	SAT	N	25	1.9	24	0.32	0.34	0.28	5	0.57	0.60	0.56	5	2.90	3.90	-4.9	5	0.300	0.390	0.129	5	0.040	0.054	0.029	5	0.012	0.014	0.010	5	0.270	0.560	0.180	5
11 6	SUN	N	38	1.4	24	0.31	0.33	0.26	4	0.60	0.61	0.59	4	3.30	3.70	2.80	4	0.310	0.450	0.160	4	0.045	0.055	0.033	4	0.020	0.031	0.013	4	0.510	1.240	0.230	4
11 7	MON	NE	46	1.5	24	0.30	0.31	0.28	5	0.57	0.69	0.56	5	2.40	3.40	-8.0	5	0.210	0.290	0.146	5	0.037	0.043	0.030	5	0.013	0.015	0.011	5	0.138	0.165	0.100	5
11 8	TUE	N	25	1.4	24	0.32	0.33	0.31	5	0.58	0.60	0.57	5	3.30	3.90	2.70	5	0.290	0.400	0.195	5	0.040	0.052	0.028	5	0.017	0.022	0.011	5	0.320	0.530	0.220	5
11 9	WED	NE	38	1.8	24	0.35	0.39	0.31	5	0.59	0.61	0.58	5	3.00	3.70	2.10	5	0.280	0.430	0.143	5	0.043	0.056	0.033	5	0.016	0.020	0.012	5	0.270	0.360	0.163	5
11 10	THU	NNE	42	2.3	24	0.33	0.35	0.32	5	0.57	0.68	0.56	5	2.70	2.80	2.40	5	0.300	0.330	0.270	5	0.037	0.039	0.035	5	0.011	0.012	0.010	5	0.146	0.167	0.129	5
11 11	FRI	N	63	2.4	24	0.33	0.34	0.32	4	0.57	0.68	0.57	4	2.60	3.10	2.20	4	0.290	0.320	0.270	4	0.039	0.041	0.038	4	0.013	0.014	0.012	4	0.153	0.169	0.136	4
11 12	SAT	SSW	25	1.7	24	0.33	0.36	0.31	5	0.58	0.61	0.55	5	2.70	3.70	-7.3	5	0.230	0.290	0.109	5	0.043	0.051	0.032	5	0.011	0.013	0.010	5	0.230	0.520	0.095	5
11 13	SUN	NNE	21	2.0	24	0.31	0.37	0.27	5	0.57	0.69	0.56	5	3.20	4.30	-6.8	5	0.220	0.320	0.107	5	0.037	0.045	0.026	5	0.012	0.020	0.009	5	0.240	0.550	0.099	5
11 14	MON	NNW	25	1.8	24	0.35	0.38	0.31	5	0.60	0.67	0.58	5	3.20	4.10	2.50	5	0.290	0.390	0.189	5	0.054	0.083	0.035	5	0.015	0.017	0.012	5	0.310	0.610	0.194	5
11 15	TUE	NNW	29	1.8	24	0.36	0.39	0.35	5	0.62	0.68	0.59	5	4.60	7.00	3.70	5	0.320	0.420	0.220	5	0.054	0.077	0.044	5	0.118	0.460	0.013	5	0.67	1.13	0.290	5
11 16	WED	ENE	46	1.5	24	0.31	0.32	0.30	4	0.66	0.69	0.57	4	2.50	3.60	-5.6	4	0.188	0.300	0.117	4	0.033	0.036	0.029	4	0.016	0.023	0.010	4	0.13	0.19	0.107	4
11 17	THU	NNW	42	1.6	24	0.33	0.35	0.32	5	0.58	0.60	0.57	5	2.40	3.80	-8.3	5	0.290	0.330	0.260	5	0.044	0.048	0.035	5	0.015	0.018	0.014	5	0.260	0.440	0.114	5
11 18	FRI	N	29	3.4	24	0.33	0.37	0.29	5	0.59	0.65	0.54	5	2.20	3.40	0.86	5	0.230	0.360	0.076	5	0.050	0.071	0.029	5	0.013	0.014	0.011	5	0.210	0.370	0.085	5
11 19	SAT	N	46	3.8	24	0.29	0.30	0.29	5	0.59	0.69	0.56	5	1.87	2.40	-4.8	5	0.169	0.210	0.146	5	0.028	0.032	0.027	5	0.011	0.016	0.009	5	0.193	0.360	0.086	5
11 20	SUN	N	21	2.5	24	0.34	0.42	0.30	5	0.59	0.63	0.56	5	2.20	3.60	-6.9	5	0.230	0.370	0.115	5	0.037	0.058	0.030	5	0.016	0.018	0.010	5	0.22	0.43	0.127	5
11 21	MON	N	25	2.1	24	0.34	0.37	0.29	4	0.61	0.65	0.58	4	2.80	3.90	-7.7	4	0.250	0.370	0.122	4	0.046	0.067	0.030	4	0.015	0.018	0.012	4	0.43	0.97	0.122	4
11 22	TUE	N	42	2.5	24	0.29	0.30	0.27	5	0.56	0.68	0.55	5	2.00	2.40	-8.5	5	0.172	0.210	0.142	5	0.029	0.030	0.028	5	0.013	0.020	0.010	5	8.4	38.0	0.116	5
11 23	WED	N	42	3.6	24	0.31	0.33	0.29	5	0.56	0.68	0.55	5	1.70	2.20	-2.4	5	0.183	0.200	0.166	5	0.030	0.033	0.028	5	0.010	0.013	0.009	5	0.35	0.79	0.210	5
11 24	THU	NNW	46	1.5	24	0.33	0.36	0.30	5	0.59	0.62	0.57	5	2.10	3.20	-3.0	5	0.210	0.330	0.160	5	0.041	0.058	0.036	5	0.015	0.021	0.011	5	0.26	0.37	0.200	5
11 25	FRI	NNW	29	1.1	24	0.34	0.37	0.32	5	0.60	0.62	0.58	5	2.90	3.60	2.10	5	0.290	0.340	0.260	5	0.057	0.071	0.042	5	0.016	0.018	0.015	5	0.31	0.39	0.220	5
11 26	SAT	NNW	46	1.0	24	0.33	0.35	0.31	4	0.61	0.66	0.59	4	3.80	5.60	2.40	4	0.300	0.360	0.210	4	0.062	0.074	0.042	4	0.019	0.021	0.017	4	0.45	0.88	0.340	4
11 27	SUN	N	50	1.5	24	0.33	0.38	0.30	5	0.60	0.67	0.56	5	4.00	5.20	3.00	5	0.390	0.620	0.200	5	0.058	0.084	0.036	5	0.019	0.025	0.014	5	0.78	1.55	0.280	5
11 28	MON	NE	67	1.6	24	0.32	0.35	0.30	5	0.57	0.69	0.56	5	2.60	3.20	2.20	5	0.250	0.280	0.220	5	0.037	0.042	0.032	5	0.015	0.018	0.012	5	0.54	1.55	0.186	5
11 29	TUE	NNE	42	2.9	24	0.30	0.32	0.29	5	0.60	0.74	0.56	5	2.50	3.10	2.30	5	0.175	0.200	0.154	5	0.032	0.033	0.030	5	0.014	0.020	0.011	5	2.80	9.80	0.118	5
11 30	WED	N	58	2.3	24	0.30	0.33	0.28	4	0.56	0.68	0.56	4	2.60	3.30	2.10	4	0.220	0.240	0.200	4	0.036	0.040	0.031	4	0.013	0.015	0.012	4	1.13	1.63	0.610	4

“-” means absence of the result

Table 3.4. Daily summaries of the atmospheric concentrations of the specified substances in Kawasaki (Mean, Maximum, Minimum, Number of valid results) (December, 2007. Concentration unit: ppbv)

Date	Weather		CFC-11			CFC-12			HCFC-22			HCFC-141b			HCFC-142b			Methyl bromide			HFC-134a			
	Main Wind Direc.	Rate (%)	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n		
	(m/s)	Wind speed																						
12 1 THU	N	33	1.5	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
12 2 FRI	WSW	17	1.3	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
12 3 SAT	W	21	1.7	24	3.36	0.36	0.61	1	4.00	4.00	4.00	1	0.370	0.370	0.370	1	0.062	0.062	0.062	1	0.025	0.025	1	
12 4 SUN	NE	33	1.3	24	3.32	0.33	0.30	5	3.00	4.20	1.80	5	0.220	0.280	0.184	5	0.042	0.055	0.035	5	0.015	0.018	0.012	5
12 5 MON	N	25	1.3	24	3.31	0.32	0.30	5	2.30	3.10	1.43	5	0.185	0.210	0.167	5	0.035	0.038	0.033	5	0.013	0.017	0.011	5
12 6 TUE	NNW	29	1.7	24	3.32	0.34	0.30	4	2.70	3.20	2.40	4	0.189	0.210	0.170	4	0.041	0.046	0.035	4	0.013	0.015	0.011	4
12 7 WED	NNW	21	1.2	24	3.33	0.37	0.27	5	2.70	4.90	0.80	5	0.220	0.370	0.070	5	0.046	0.060	0.028	5	0.022	0.032	0.014	5
12 8 THU	NNW	25	2.3	24	3.27	0.29	0.26	5	0.66	1.00	0.42	5	0.096	0.158	0.034	5	0.035	0.053	0.023	5	0.017	0.025	0.012	5
12 9 FRI	N	54	2.9	24	3.28	0.27	0.25	5	0.43	0.55	0.28	5	0.050	0.078	0.029	5	0.029	0.042	0.021	5	0.012	0.015	0.010	5
12 10 SAT	N	38	2.5	24	3.25	0.29	0.24	5	0.69	1.84	0.32	5	0.088	0.166	0.031	5	0.028	0.042	0.020	5	0.013	0.019	0.009	5
12 11 SUN	NNW	42	1.4	24	3.28	0.35	0.24	4	0.86	1.16	0.50	4	0.177	0.370	0.062	4	0.034	0.043	0.027	4	0.027	0.039	0.017	4
12 12 MON	ENE	33	1.9	24	3.29	0.38	0.24	5	0.59	0.63	0.55	5	0.129	0.300	0.048	5	0.038	0.054	0.025	5	0.024	0.034	0.018	5
12 13 TUE	N	38	2.1	24	3.28	0.29	0.26	5	0.55	0.89	0.39	5	0.091	0.137	0.050	5	0.036	0.041	0.032	5	0.019	0.040	0.012	5
12 14 WED	N	42	2.8	24	3.27	0.29	0.24	5	0.65	1.39	0.31	5	0.074	0.151	0.035	5	0.035	0.068	0.022	5	0.012	0.016	0.010	5
12 15 THU	N	29	1.3	24	3.26	0.33	0.22	5	0.66	1.01	0.47	5	0.072	0.098	0.046	5	0.032	0.037	0.023	5	0.014	0.023	0.011	5
12 16 FRI	N	58	3.7	24	3.24	0.25	0.24	4	0.36	0.58	0.27	4	0.045	0.090	0.026	4	0.028	0.046	0.021	4	0.010	0.013	0.009	4
12 17 SAT	N	29	1.4	24	3.26	0.28	0.24	5	0.65	1.50	0.29	5	0.090	0.230	0.030	5	0.031	0.051	0.022	5	0.011	0.013	0.009	5
12 18 SUN	N	29	1.6	24	3.29	0.33	0.26	5	1.06	1.46	0.54	5	0.116	0.168	0.057	5	0.041	0.054	0.028	5	0.022	0.042	0.013	5
12 19 MON	NE	63	1.2	24	3.30	0.41	0.25	5	0.62	0.91	0.44	5	0.230	0.770	0.057	5	0.027	0.034	0.023	5	0.013	0.022	0.010	5
12 20 TUE	NNW	38	1.4	24	3.28	0.28	0.26	5	0.58	0.60	0.57	5	0.110	0.152	0.090	5	0.037	0.053	0.029	5	0.018	0.021	0.016	5
12 21 WED	N	46	1.7	24	3.28	0.30	0.26	4	0.88	1.77	0.42	4	0.093	0.176	0.035	4	0.039	0.065	0.024	4	0.015	0.019	0.013	4
12 22 THU	N	46	2.2	24	3.27	0.28	0.26	5	0.57	0.58	0.57	5	0.104	0.280	0.052	5	0.027	0.030	0.025	5	0.012	0.014	0.010	5
12 23 FRI	N	67	3.6	24	3.26	0.27	0.25	5	0.55	0.56	0.54	5	0.040	0.047	0.033	5	0.026	0.032	0.023	5	-	-	-	-
12 24 SAT	N	50	3.0	24	3.29	0.29	0.28	4	0.53	0.56	0.51	5	0.064	0.103	0.033	4	0.031	0.048	0.019	5	-	-	-	-
12 25 SUN	NE	33	1.7	24	3.61	1.68	0.18	4	0.91	2.20	0.60	5	0.129	0.178	0.040	4	0.049	0.134	0.024	5	0.013	0.021	0.009	3
12 26 MON	NE	29	1.7	24	3.30	0.31	0.29	4	0.62	0.88	0.39	4	0.107	0.148	0.065	4	0.032	0.042	0.028	4	0.013	0.016	0.011	4
12 27 TUE	NNW	42	1.4	24	3.34	0.47	0.30	5	0.65	0.68	0.63	5	0.168	0.430	0.045	5	0.036	0.052	0.028	5	1.360	6.700	0.015	5
12 28 WED	NNW	29	1.6	24	3.31	0.38	0.28	5	0.63	0.66	0.59	5	0.171	0.240	0.136	5	0.042	0.053	0.035	5	0.036	0.085	0.017	5
12 29 THU	NNW	21	1.6	24	3.29	0.36	0.28	5	0.58	0.61	0.56	5	0.102	0.173	0.048	5	0.040	0.056	0.029	5	0.017	0.022	0.013	5
12 30 FRI	NNW	21	3.2	24	3.27	0.30	0.25	5	0.56	0.56	0.56	5	0.037	0.055	0.029	5	0.026	0.029	0.023	5	0.013	0.018	0.011	5
12 31 SAT	WSW	46	4.2	24	3.26	0.26	0.25	4	0.56	0.58	0.55	4	0.028	0.033	0.024	4	0.024	0.027	0.022	4	0.010	0.010	0.010	4

"-" means absence of the result

Table 3.4. Daily summaries of the atmospheric concentrations of the specified substances in Kawasaki (Mean, Maximum, Minimum, Number of valid results) (January, 2008. Concentration unit: ppbv)

Date	Weather		CFC-11			CFC-12			HCFC-22			HCFC-141b			HCFC-142b			Methyl bromide			HFC-134a							
	Main Wind Direc.	Rate (%)	Wind speed (m/s)	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n				
	1 1 SUN N	33	2.5	24	0.26	0.26	0.56	0.55	5	0.27	0.29	0.23	5	0.028	0.031	0.024	5	0.023	0.025	0.021	5	0.010	0.010	0.009	5	0.076	0.103	0.061
1 2 MON N	42	2.1	24	0.29	0.39	0.58	0.55	5	0.41	0.63	0.28	5	0.037	0.062	0.026	5	0.028	0.043	0.021	5	0.010	0.010	0.009	5	0.103	0.167	0.066	5
1 3 TUE NNW	46	1.4	24	0.26	0.27	0.55	0.55	5	0.52	0.74	0.38	5	0.049	0.075	0.032	5	0.034	0.049	0.023	5	0.011	0.012	0.010	5	0.161	0.330	0.081	5
1 4 WED N	33	1.8	24	0.25	0.26	0.57	0.55	5	0.47	0.83	0.34	5	0.039	0.059	0.029	5	0.029	0.044	0.022	5	0.010	0.011	0.009	5	0.107	0.173	0.070	5
1 5 THU NNW	25	1.6	24	0.27	0.30	0.55	0.55	4	0.47	0.55	0.34	4	0.052	0.065	0.031	4	0.029	0.033	0.024	4	0.011	0.012	0.010	4	0.124	0.164	0.078	4
1 6 FRI NW	21	1.5	24	0.27	0.28	0.55	0.56	5	0.81	1.31	0.38	5	0.080	0.116	0.067	5	0.045	0.062	0.024	5	0.012	0.015	0.010	5	0.540	1.950	0.079	5
1 7 SAT NE	17	1.3	24	0.27	0.28	0.58	0.57	5	0.80	1.05	0.51	5	0.091	0.130	0.037	5	0.043	0.057	0.024	5	0.014	0.017	0.012	5	0.270	0.520	0.107	5
1 8 SUN NNW	21	1.3	24	0.30	0.32	0.63	0.58	5	0.87	1.39	0.51	5	0.139	0.172	0.120	5	0.046	0.061	0.029	5	0.017	0.020	0.014	5	0.320	0.440	0.107	5
1 9 MON NNW	29	1.4	24	0.27	0.27	0.58	0.58	5	0.60	0.88	0.48	5	0.086	0.106	0.068	5	0.033	0.042	0.026	5	0.014	0.016	0.012	5	0.126	0.158	0.082	5
1 10 TUE NE	29	1.6	24	0.27	0.29	0.58	0.58	4	0.57	0.87	0.44	4	0.125	0.195	0.059	4	0.031	0.038	0.025	4	0.012	0.013	0.011	4	0.320	0.580	0.087	4
1 11 WED N	21	1.1	24	0.47	0.88	0.28	0.59	5	1.05	1.59	0.79	5	0.167	0.290	0.107	5	0.049	0.079	0.035	5	0.023	0.046	0.016	5	1.080	4.300	0.174	5
1 12 THU NNE	38	2.4	24	0.28	0.32	0.58	0.57	5	0.79	1.43	0.43	5	0.088	0.220	0.033	5	0.038	0.048	0.027	5	0.017	0.025	0.011	5	0.150	0.360	0.074	5
1 13 FRI N	88	4.8	24	0.27	0.27	0.58	0.57	5	0.45	0.48	0.39	5	0.028	0.030	0.027	5	0.022	0.023	0.021	5	0.010	0.010	0.009	5	0.088	0.077	0.080	5
1 14 SAT NE	42	1.9	24	0.26	0.27	0.58	0.56	5	0.52	0.83	0.41	5	0.036	0.051	0.026	5	0.024	0.028	0.022	5	0.012	0.017	0.009	5	0.093	0.152	0.068	5
1 15 SUN N	42	2.2	24	0.26	0.27	0.58	0.56	4	0.61	0.71	0.56	4	0.058	0.084	0.027	4	0.023	0.024	0.022	4	0.010	0.012	0.009	4	0.194	0.500	0.072	4
1 16 MON NNE	29	1.5	24	0.27	0.28	0.58	0.58	5	0.81	1.17	0.50	5	0.100	0.142	0.039	5	0.030	0.036	0.026	5	0.017	0.028	0.010	5	0.230	0.520	0.081	5
1 17 TUE NNE	42	2.9	24	0.26	0.27	0.58	0.57	5	0.50	0.81	0.44	5	0.046	0.068	0.033	5	0.023	0.025	0.022	5	0.010	0.010	0.009	5	0.078	0.092	0.068	5
1 18 WED N	58	1.9	24	0.27	0.29	0.58	0.57	5	0.60	0.94	0.42	5	0.046	0.066	0.034	5	0.023	0.026	0.022	5	0.011	0.012	0.010	5	0.171	0.460	0.070	5
1 19 THU N	54	3.0	24	0.27	0.27	0.58	0.57	5	0.57	0.81	0.37	5	0.035	0.046	0.027	5	0.024	0.030	0.022	5	0.011	0.014	0.009	5	0.137	0.330	0.066	5
1 20 FRI NNW	38	1.5	24	0.27	0.27	0.58	0.57	4	0.65	0.79	0.54	4	0.044	0.058	0.035	4	0.026	0.029	0.025	4	0.011	0.012	0.009	4	0.107	0.124	0.094	4
1 21 SAT NE	46	2.2	24	0.27	0.28	0.58	0.58	5	0.69	1.58	0.34	5	0.073	0.129	0.027	5	0.024	0.026	0.022	5	0.010	0.010	0.009	5	0.158	0.460	0.080	5
1 22 SUN NE	48	1.1	21	0.27	0.28	0.55	0.55	5	0.86	2.60	0.33	5	0.071	0.131	0.042	5	0.025	0.027	0.022	5	0.011	0.012	0.010	5	0.134	0.167	0.080	5
1 23 MON NNW	64	3.8	22	0.28	0.31	0.58	0.58	5	0.50	0.79	0.36	5	0.078	0.116	0.048	5	0.029	0.035	0.027	5	0.014	0.018	0.012	5	0.220	0.460	0.101	5
1 24 TUE NNW	56	1.6	9	0.27	0.28	0.58	0.57	5	0.73	1.28	0.34	5	0.053	0.083	0.035	5	0.028	0.035	0.022	5	0.012	0.016	0.009	5	0.090	0.125	0.066	5
1 25 WED N	100	3.9	6	0.28	0.28	0.58	0.58	4	0.54	0.86	0.32	4	0.038	0.047	0.029	4	0.023	0.023	0.022	4	0.010	0.010	0.009	4	0.086	0.111	0.063	4
1 26 THU N	71	3.5	24	0.27	0.27	0.58	0.57	5	0.69	1.53	0.38	5	0.031	0.034	0.028	5	0.023	0.023	0.022	5	0.010	0.011	0.010	5	0.087	0.105	0.071	5
1 27 FRI N	71	3.9	24	0.27	0.27	0.58	0.57	5	0.63	0.74	0.48	5	0.028	0.029	0.025	5	0.023	0.023	0.022	5	0.010	0.010	0.009	5	0.077	0.064	0.069	5
1 28 SAT N	25	1.6	24	0.28	0.30	0.58	0.58	5	0.94	1.78	0.47	5	0.074	0.147	0.030	5	0.028	0.037	0.024	5	0.024	0.056	0.010	5	0.146	0.230	0.082	5
1 29 SUN N	47	1.8	17	0.30	0.38	0.27	0.59	5	0.82	1.37	0.41	5	0.091	0.119	0.067	5	0.029	0.032	0.026	5	0.014	0.017	0.012	5	0.168	0.220	0.128	5
1 30 MON N	29	1.6	21	0.29	0.29	0.58	0.58	4	1.35	3.30	0.65	4	0.063	0.081	0.053	4	0.030	0.036	0.025	4	0.013	0.014	0.012	4	0.135	0.147	0.107	4
1 31 TUE N	42	3.1	24	0.29	0.31	0.58	0.60	5	1.00	2.30	0.52	5	0.085	0.163	0.088	5	0.031	0.048	0.023	5	0.014	0.018	0.011	5	0.171	0.400	0.088	5

-, means absence of the result

Table 3.4. Daily summaries of the atmospheric concentrations of the specified substances in Kawasaki (Mean,Maximum,Minimum,Number of valid results) (February,2008, Concentration unit:ppbv)

Date	Weather		CFC-11			CFC-12			HCFC-22			HCFC-141b			HCFC-142b			Methyl bromide			HFC-134a			
	Main Wind Direc.	Rate (%)	Wind speed (m/s)	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n	Mean	Max.	Min.	n
	2 1 WED	87	2.7	23	0.28	0.28	0.61	0.60	5	0.044	0.085	0.031	5	0.024	0.027	0.023	5	0.011	0.011	0.010	5	0.092	0.093	0.082
2 2 THU	NNE	42	1.8	24	0.28	0.29	0.60	5	0.64	1.06	0.46	5	0.050	0.081	0.030	5	0.011	0.012	0.010	5	0.068	0.069	0.073	5
2 3 FRI	N	88	3.7	24	0.30	0.27	0.64	5	3.50	8.10	0.44	5	0.072	0.117	0.044	5	0.029	0.034	0.026	5	0.124	0.150	0.099	5
2 4 SAT	NNE	21	1.4	24	0.33	0.32	0.66	4	12.1	19.2	9.10	4	0.157	0.193	0.127	4	0.040	0.047	0.036	4	0.330	0.483	0.143	4
2 5 SUN	NW	25	1.6	24	0.32	0.33	0.51	5	0.67	0.69	0.66	5	0.176	0.220	0.159	5	0.038	0.041	0.032	5	0.380	0.793	0.230	5
2 6 MON	N	54	2.2	24	0.31	0.32	0.50	5	1.43	19.7	8.30	5	0.157	0.185	0.186	5	0.038	0.042	0.031	5	0.360	1.173	0.151	5
2 7 TUE	N	63	2.9	24	0.31	0.33	0.50	5	0.64	0.65	0.61	5	0.22.0	29.0	29.0	5	0.033	0.037	0.029	5	0.360	0.853	0.150	5
2 8 WED	N	42	2.3	24	0.32	0.33	0.51	5	0.69	0.66	0.63	5	27.0	36.0	36.0	5	0.034	0.035	0.032	5	0.260	0.613	0.143	5
2 9 THU	NW	46	3.0	24	0.32	0.33	0.51	4	0.65	0.66	0.63	4	24.0	28.0	28.0	4	0.039	0.041	0.038	4	0.176	0.193	0.155	4
2 10 FRI	N	46	3.0	24	0.32	0.32	0.51	4	0.67	0.72	0.65	4	11.8	19.8	19.8	4	0.034	0.037	0.032	4	0.138	0.191	0.117	4
2 11 SAT	NE	25	2.1	24	0.32	0.33	0.51	5	0.65	0.67	0.63	5	20.0	33.0	33.0	5	0.034	0.036	0.031	5	0.113	0.143	0.090	5
2 12 SUN	N	17	1.8	24	0.33	0.34	0.52	5	0.68	0.71	0.66	5	27.0	35.0	35.0	5	0.045	0.054	0.037	5	0.210	0.240	0.166	5
2 13 MON	N	63	5.1	24	0.31	0.32	0.50	5	0.63	0.64	0.63	5	31.0	38.0	38.0	5	0.030	0.032	0.029	5	0.500	1.903	0.097	5
2 14 TUE	N	29	2.4	24	0.32	0.33	0.51	4	0.68	0.69	0.67	4	16.2	25.0	25.0	4	0.037	0.040	0.031	4	2.200	8.303	0.128	4
2 15 WED	NW	33	2.4	24	0.32	0.34	0.51	5	0.79	1.35	0.63	5	30.0	46.0	46.0	5	0.034	0.039	0.029	5	0.450	0.913	0.140	5
2 16 THU	N	46	2.8	24	0.32	0.33	0.52	5	0.67	0.70	0.64	5	31.0	47.0	47.0	5	0.032	0.035	0.030	5	0.175	0.363	0.117	5
2 17 FRI	N	58	2.6	24	0.31	0.32	0.51	5	0.65	0.66	0.63	5	25.0	31.0	31.0	5	0.031	0.032	0.030	5	0.109	0.117	0.098	5
2 18 SAT	NW	46	3.2	24	0.31	0.32	0.50	5	0.66	0.71	0.63	5	22.0	36.0	36.0	5	0.031	0.033	0.029	5	1.030	4.303	0.102	5
2 19 SUN	N	29	1.7	24	0.32	0.32	0.51	4	0.65	0.66	0.64	4	27.0	34.0	34.0	4	0.034	0.035	0.032	4	0.280	0.423	0.176	4
2 20 MON	N	21	2.1	24	0.32	0.33	0.51	4	0.64	0.66	0.63	4	22.0	47.0	47.0	4	0.039	0.047	0.032	4	0.290	0.563	0.142	4
2 21 TUE	N	38	3.0	24	0.32	0.32	0.52	5	0.64	0.65	0.63	5	25.0	38.0	38.0	5	0.032	0.036	0.029	5	1.670	5.900	0.115	5
2 22 WED	NW	29	1.6	24	0.34	0.41	0.53	5	0.66	0.71	0.65	5	25.0	40.0	40.0	5	0.044	0.063	0.039	5	0.530	0.973	0.168	5
2 23 THU	NW	46	5.3	24	0.34	0.36	0.53	5	0.67	0.68	0.64	5	19.7	34.0	34.0	5	0.043	0.060	0.032	5	0.187	0.353	0.104	5
2 24 FRI	NW	54	6.7	24	0.33	0.34	0.52	4	0.67	0.68	0.65	4	29.0	43.0	43.0	4	0.032	0.035	0.031	4	0.101	0.107	0.092	4
2 25 SAT	N	54	3.8	24	0.31	0.32	0.29	5	0.66	0.69	0.65	5	10.6	20.0	20.0	5	0.029	0.032	0.026	5	0.430	1.743	0.077	5
2 26 SUN	SW	42	4.3	24	0.30	0.31	0.29	5	0.64	0.67	0.63	5	0.38	0.48	0.30	5	0.025	0.029	0.024	5	0.428	0.068	0.017	5
2 27 MON	N	75	6.1	24	0.31	0.31	0.50	5	0.66	0.68	0.65	5	1.40	2.70	0.77	5	0.026	0.027	0.024	5	0.012	0.013	0.011	5
2 28 TUE	NW	33	3.2	24	0.31	0.32	0.50	5	0.68	0.70	0.67	5	1.12	1.85	0.45	5	0.028	0.029	0.026	5	0.011	0.013	0.011	5
2 29 WED	NW	56	1.4	9	0.33	0.34	0.52	4	0.70	0.71	0.69	4	0.79	1.09	0.53	4	0.032	0.036	0.029	4	0.043	0.132	0.012	4

"-" means absence of the result

4. DISCUSSION

4.1. RESULTS IN BACKGROUND AREA

(1) Comparisons of Results in the Two Areas

The means and the standard deviations according to the sampling locations calculated from the results of measurements in August 2007 and January 2008 in Wakkanai and Nemuro are shown in **Table 4.1**. The means for CFC-11, CFC-12, and methyl bromide in Wakkanai are higher than in Nemuro out of the standard deviation ranges. The difference in these three substances between the two areas is quite small. The concentrations of the other substances in both areas agree within the standard deviation ranges. Therefore, the concentrations obtained from both areas were merged into a single set of data, and were handled in the same way as in the previous surveys.

Table 4.1. Means and standard deviations calculated from the results in Wakkanai and Nemuro August 2007 and January 2008 (Unit: pptv)

Substance	Sampling Locations	Wakkanai			Nemuro		
		Mean	SD	n	Mean	SD	n
CFC-11		243	1.7	7	240	0.5	5
CFC-12		546	1.5	7	543	1.1	5
CFC-113		76.8	0.6	7	76.3	0.9	5
CFC-114		14.9	0.28	7	14.8	0.25	5
CFC-114a		1.02	0.024	7	1.01	0.024	5
CFC-115		9.02	0.14	7	9.08	0.13	5
Halon-1211		4.65	0.055	7	4.68	0.078	5
Halon-1301		3.35	0.026	7	3.36	0.011	5
Halon-2402		0.47	0.014	7	0.47	0.016	5
Carbon tetrachloride		95.9	0.76	7	95.6	0.61	5
1,1,1-Trichloroethane		14.4	0.16	7	14.5	0.38	5
HCFC-22		198	1.8	6	201	2.6	5
HCFC-141b		22.1	1.6	7	20.7	0.69	5
HCFC-142b		20.1	0.51	7	19.9	0.35	5
Methyl bromide		9.90	0.62	7	9.15	0.10	5
HFC-134a		51.2	1.1	6	51.2	1.7	5

Note 1) "n" means the number of the data sets. "SD" means the standard deviation.

Note 2) Not all the figures mean significant figures.

(2) Time-dependent calculation

Results both in Wakkanai and Nemuro were merged and calculated into averages. The means and standard deviations are shown in **Table 4.2**.

Table 4.2. Means and standard deviations calculated from results in the background area
(Unit : pptv)

Substance	Date	August 2007			January 2008		
		Mean	SD	n	Mean	SD	n
CFC-11		243	2.3	6	241	0.6	6
CFC-12		545	1.7	6	544	2.2	6
CFC-113		76.1	0.55	6	77.1	0.52	6
CFC-114		14.8	0.25	6	14.9	0.31	6
CFC-114a		1.00	0.019	6	1.02	0.023	6
CFC-115		9.02	0.11	6	9.09	0.16	6
Halon-1211		4.65	0.038	6	4.68	0.085	6
Halon-1301		3.35	0.030	6	3.36	0.006	6
Halon-2402		0.48	0.008	6	0.46	0.014	6
Carbon tetrachloride		96.0	0.79	6	95.6	0.58	6
1,1,1-Trichloroethane		14.4	0.25	6	14.5	0.28	6
HCFC-22		200	1.9	5	198	3.0	6
HCFC-141b		22.3	1.7	6	20.7	0.52	6
HCFC-142b		20.3	0.46	6	19.7	0.23	6
Methyl bromide		9.8	0.69	6	9.4	0.49	6
HFC-134a		50.5	0.37	5	51.8	1.60	6

Note 1) "n" means the number of the data set. "SD" means the standard deviation.

Note 2) Not all the figures mean significant figures.

(3) Long-Term Variations in the Concentrations of the Measured Substances

The means for the atmospheric concentrations of the measured substances (CFC-11, CFC-12, CFC-113, CFC-114, halon-1211, halon-1301, halon-2402, carbon tetrachloride, 1,1,1-trichloroethane, HCFC-22, HCFC-141b, HCFC-142b, methyl bromide, and HFC-134a) calculated from the results of each surveys from January 1989 to the present are shown in **Table 4.3** (see Note 1- Note 3). The plots of the concentrations of the substances are shown in **Figure 4.1.1 – Figure 4.1.14**. CFC-114 and CFC-114a, halon-1211 and halon-1301 are shown in the same graph, respectively. Other substances are shown in distinct graphs for ease of viewing.

Note 1) The results for CFC-114, CFC-114a, CFC-115, halon-1211, halon-1301, halon-2402, and HCFC-142b before 1999 were obtained during 1999-2000 by measurements of the samples that had been preserved in containers (9).

Note 2) Results for methyl bromide before 1998 are absent due to the problems with its stability in the containers. The stability of methyl bromide in stainless steel containers is rather poor and this is one of the factors in the increase the variability of the measurement results for this substance. The problems in the measurement of methyl bromide have been resolved since March 1998 through improvements to the process of cleaning the container and a reduction in the time taken between sampling and analysis.

Note 3) HFC-134a was added to the program in 2001. The concentrations of HFC-134a during August 2000 - March 2001 were obtained in 2003 by measurement of the preserved samples.

Note 4) HCFC-141b was added to the program in 2002. The concentrations of HCFC-141b during August 2001 - March 2002 were obtained in 2006 by measurement of the preserved samples.

Table 4.3. Atmospheric concentrations of the measured substances in the background area (1)
CFC-11, CFC-12, CFC-113 (Unit : pptv)

Sampling Time	CFC-11			CFC-12			CFC-113		
	Mean	SD	n	Mean	SD	n	Mean	SD	n
January 1989	246	4	6	486	3	6	69.8	2.2	4
March 1989	247	2	6	487	4	6	69.6	2.4	4
November 1989	254	6	6	499	9	6	73.1	2.3	4
January 1990	255	3	6	504	4	6	75.3	2.1	4
March 1990	252	3	6	503	3	6	75.4	1.4	4
October 1990	264	6	6	509	2	6	79.0	0.7	4
January 1991	264	4	6	510	2	6	78.6	1.1	4
March 1991	264	3	6	511	4	6	80.8	1.3	4
August 1991	262	2	6	516	5	6	80.0	1.0	4
January 1992	266	5	6	520	3	6	83.8	1.2	5
March 1992	267	2	6	519	5	6	84.7	1.7	4
August 1992	270	4	6	525	2	6	87.0	-	2
January 1993	271	6	6	530	3	6	84.6	0.8	3
March 1993	264	2	6	526	6	6	85.5	1.2	4
August 1993	264	2	6	529	3	6	84.8	0.8	4
January 1994	269	3	6	537	5	6	86.1	-	2
March 1994	266	6	6	534	3	6	86.3	0.9	3
July 1994	266	7	6	539	4	6	85.5	1.7	6
January 1995	266	2	6	541	5	6	86.2	1.5	4
March 1995	265	3	6	543	4	6	86.0	2.0	4
August 1995	262	4	6	543	5	6	86.2	1.4	4
January 1996	262	1	6	541	4	6	84.5	1.2	4
March 1996	262	2	6	541	4	6	85.4	1.1	4
August 1996	265	3	6	542	4	6	84.4	2.1	5
January 1997	261	1	6	549	3	6	84.9	1.6	4
March 1997	261	2	6	548	3	6	84.1	0.6	4
August 1997	263	3	6	552	6	6	84.5	1.2	4

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Table 4.3. Atmospheric concentrations of the measured substances in the background area (1)
CFC-11, CFC-12, CFC-113 (Continued) (Unit: pptv)

Sampling Time	CFC-11			CFC-12			CFC-113		
	Mean	SD	n	Mean	SD	n	Mean	SD	n
January 1998	257	3	6	548	4	6	84.6	0.7	4
March 1998	256	1	6	547	4	6	84.6	0.4	4
November 1998	260	4	6	552	2	6	83.6	1.1	6
January 1999	256	3	6	546	1	6	82.6	0.9	6
March 1999	256	3	6	548	4	6	83.4	2.1	6
October 1999	258	4	6	547	3	6	83.3	0.7	6
January 2000	251	2	6	551	4	6	82.7	1.4	6
March 2000	253	3	6	550	2	6	82.9	1.3	6
August 2000	255	2	6	551	2	6	81.3	0.6	6
January 2001	255	2	6	551	4	6	82.4	0.7	6
March 2001	253	2	6	549	3	6	82.5	0.7	6
August 2001	254	1	6	549	2	6	81.4	0.7	6
January 2002	253	1	6	550	2	6	80.5	0.5	6
March 2002	252	1	6	550	2	6	80.8	0.2	6
August 2002	251	1	6	551	1	6	80.8	1.1	6
January 2003	250	1	6	551	4	6	79.6	0.7	6
March 2003	249	2	6	549	2	6	80.6	0.5	6
July 2003	247	1	6	554	2	6	79.7	0.2	6
January 2004	247	2	6	550	2	6	79.3	0.4	6
March 2004	247	1	6	550	3	6	79.7	0.4	6
August 2004	246	1	6	548	4	6	79.4	0.4	6
January 2005	246	1	6	549	1	6	78.8	0.5	6
March 2005	246	1	6	549	1	6	79.0	0.4	6
August 2005	244	1	6	549	2	6	78.9	0.3	6
January 2006	244	1	6	548	2	6	78.3	0.3	6
March 2006	244	1	6	549	1	6	78.7	0.6	6
August 2006	242	1	6	549	3	6	78.1	0.5	6
January 2007	244	2	6	549	4	6	76.4	0.4	6
August 2007	243	2	6	545	2	6	76.1	0.6	6
January 2008	241	1	6	544	2	6	77.1	0.5	6

Note 1) "SD" means standard deviation. The means and standard deviations are calculated from the results of each month (hereafter the same).

Note 2) Not all the figures mean significant figures (hereafter the same).

Table 4.3. Atmospheric concentrations of the measured substances in the background area (2)
CFC-114, CFC-114a (Unit : pptv)

Sampling Time	CFC-114			CFC-114a			CFC-114+CFC-114	
	Mean	SD	n	Mean	SD	n	Mean	n
January 1989	14.3	0.33	5	0.91	0.018	5	15.2	5
March 1989	14.3	0.25	4	0.91	0.026	4	15.2	4
November 1989	14.6	0.23	4	0.92	0.014	4	15.5	4
January 1990	14.7	0.24	4	0.94	0.019	4	15.6	4
March 1990	14.8	0.12	4	0.96	0.032	4	15.8	4
October 1990	14.8	0.09	4	0.94	0.009	4	15.7	4
January 1991	14.8	0.10	4	0.97	0.024	4	15.8	4
March 1991	14.9	0.33	4	0.95	0.015	4	15.8	4
August 1991	14.7	0.11	4	0.94	0.008	4	15.6	4
January 1992	14.9	0.26	4	1.00	0.037	4	15.9	4
March 1992	15.1	0.14	5	0.97	0.017	5	16.1	5
August 1992	15.0	0.10	5	0.98	0.023	5	16.0	5
January 1993	14.9	0.15	4	1.01	0.060	4	15.9	4
March 1993	15.0	0.27	4	1.00	0.021	4	16.0	4
August 1993	15.0	0.10	4	1.01	0.028	4	16.0	4
January 1994	15.1	0.22	4	1.02	0.025	4	16.1	4
March 1994	15.1	0.32	4	1.04	0.008	4	16.1	4
July 1994	15.1	0.25	5	1.04	0.026	5	16.1	5
January 1995	15.0	0.20	5	1.02	0.018	5	16.0	5
March 1995	15.1	0.35	6	1.04	0.031	6	16.1	6
August 1995	15.0	0.20	4	1.01	0.020	4	16.0	4
January 1996	15.2	0.16	4	1.00	0.031	4	16.2	4
March 1996	15.2	0.16	4	1.02	0.014	4	16.2	4
August 1996	15.0	0.21	6	1.03	0.035	6	16.0	6
January 1997	15.2	0.12	6	1.04	0.021	6	16.2	6
March 1997	15.2	0.21	6	1.04	0.024	6	16.2	6
August 1997	15.0	0.34	6	1.02	0.026	6	16.0	6

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Table 4.3. Atmospheric concentrations of the measured substances in the background area (2)
CFC-114, CFC-14a (Continued) (Unit : pptv)

Sampling Time	CFC-114			CFC-114a			CFC-114+CFC-114	
	Mean	SD	n	Mean	SD	n	Mean	n
January 1998	15.2	0.11	6	1.03	0.009	6	16.2	6
March 1998	15.2	0.22	6	1.04	0.018	6	16.2	6
November 1998	15.3	0.21	6	1.04	0.030	6	16.3	6
January 1999	15.1	0.16	6	1.05	0.026	6	16.2	6
March 1999	15.2	0.26	6	1.02	0.010	6	16.2	6
October 1999	15.2	0.26	6	1.02	0.020	6	16.2	6
January 2000	15.2	0.10	6	1.02	0.005	6	16.2	6
March 2000	15.2	0.15	6	1.03	0.012	6	16.3	6
August 2000	15.0	0.10	6	1.05	0.024	6	16.0	6
January 2001	15.1	0.15	6	1.05	0.021	6	16.2	6
March 2001	15.2	0.10	6	1.06	0.016	6	16.3	6
August 2001	15.1	0.21	6	1.04	0.021	6	16.1	6
January 2002	15.2	0.25	6	1.02	0.016	6	16.2	6
March 2002	15.0	0.16	6	1.02	0.015	6	16.0	6
August 2002	15.1	0.19	6	1.04	0.009	6	16.2	6
January 2003	15.2	0.19	6	1.05	0.020	6	16.2	6
March 2003	15.2	0.14	6	1.05	0.021	6	16.2	6
July 2003	15.1	0.15	6	1.05	0.015	6	16.2	6
January 2004	14.9	0.08	6	1.04	0.008	6	15.9	6
March 2004	15.0	0.06	6	1.03	0.008	6	16.0	6
August 2004	14.9	0.18	6	1.02	0.008	6	15.9	6
January 2005	14.9	0.23	6	1.03	0.020	6	15.9	6
March 2005	15.0	0.08	6	1.05	0.008	6	16.0	6
August 2005	15.0	0.10	6	1.04	0.010	6	16.0	6
January 2006	15.1	0.10	6	1.04	0.010	6	16.1	6
March 2006	15.0	0.04	6	1.04	0.005	6	16.0	6
August 2006	15.0	0.18	6	1.04	0.008	6	16.0	6
January 2007	15.1	0.12	6	1.04	0.026	6	16.1	6
August 2007	14.8	0.25	6	1.00	0.019	6	15.8	6
January 2008	14.9	0.31	6	1.02	0.023	6	15.9	6

Table 4.3. Atmospheric concentrations of the measured substances in the background area (3)
CFC-115, halon-1211, halon-1301 (Unit : pptv)

Sampling Time	CFC-115			Halon-1211			Halon-1301		
	Mean	SD	n	Mean	SD	n	Mean	SD	n
January 1989	5.32	0.07	3	2.45	0.087	5	1.89	0.034	4
March 1989	5.81	0.13	3	2.51	0.14	4	1.91	0.049	4
November 1989	5.67	0.34	4	2.72	0.066	6	2.04	0.10	4
January 1990	5.98	0.31	2	2.73	0.043	5	2.06	0.057	6
March 1990	5.93	0.12	3	2.76	0.011	5	2.14	0.022	4
October 1990	6.17	0.28	3	2.81	0.043	4	2.21	0.044	4
January 1991	6.23	0.49	3	2.93	0.085	5	2.25	0.033	4
March 1991	6.26	0.33	3	2.94	0.046	6	2.33	0.047	5
August 1991	6.40	0.04	3	2.91	0.052	4	2.25	0.021	4
January 1992	6.59	0.24	3	3.14	0.082	5	2.42	0.022	4
March 1992	6.53	0.11	3	3.20	0.099	4	2.44	0.059	4
August 1992	7.14	0.37	4	3.15	0.032	5	2.41	0.068	4
January 1993	7.02	0.20	4	3.38	0.070	4	2.56	0.030	4
March 1993	7.13	0.14	3	3.39	0.075	6	2.55	0.064	4
August 1993	7.17	0.30	3	3.34	0.026	4	2.58	0.015	6
January 1994	7.58	0.37	6	3.52	0.12	6	2.70	0.014	4
March 1994	7.51	0.40	3	3.54	0.041	6	2.64	0.062	5
July 1994	7.57	0.24	4	3.58	0.074	4	2.68	0.051	4
January 1995	7.61	0.23	4	3.67	0.080	6	2.72	0.050	5
March 1995	7.67	0.19	4	3.75	0.054	6	2.74	0.045	4
August 1995	7.76	0.11	3	3.78	0.10	4	2.74	0.089	4
January 1996	7.89	0.09	3	3.88	0.042	6	2.80	0.071	4
March 1996	8.04	0.29	3	3.87	0.090	6	2.82	0.058	4
August 1996	8.04	0.18	4	3.91	0.083	6	2.79	0.019	4
January 1997	8.38	0.08	4	4.02	0.099	4	2.86	0.039	4
March 1997	8.32	0.07	4	4.00	0.044	6	2.83	0.031	5
August 1997	8.33	0.03	6	4.08	0.094	6	2.87	0.046	6

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Table 4.3. Atmospheric concentrations of the measured substances in the background area (3)
CFC-115, halon-1211, halon-1301 (Continued) (Unit : pptv)

Sampling Time	CFC-115			Halon-1211			Halon-1301		
	Mean	SD	n	Mean	SD	n	Mean	SD	n
January 1998	8.27	0.39	4	4.20	0.050	6	2.94	0.077	6
March 1998	8.56	0.12	5	4.25	0.079	6	2.96	0.069	6
November 1998	8.64	0.19	6	4.20	0.048	6	2.86	0.048	6
January 1999	8.36	0.29	6	4.34	0.030	6	2.94	0.064	6
March 1999	8.56	0.48	6	4.26	0.058	6	2.90	0.043	6
October 1999	8.55	0.13	6	4.31	0.025	6	2.90	0.034	6
January 2000	8.48	0.13	6	4.43	0.056	6	2.93	0.032	6
March 2000	8.58	0.25	6	4.40	0.073	6	2.94	0.058	6
August 2000	8.44	0.10	6	4.51	0.029	6	2.99	0.036	6
January 2001	8.56	0.22	6	4.60	0.047	6	3.04	0.024	6
March 2001	8.48	0.16	6	4.56	0.059	6	3.03	0.034	6
August 2001	8.65	0.17	6	4.58	0.077	6	3.08	0.034	6
January 2002	8.72	0.16	6	4.62	0.039	6	3.12	0.010	6
March 2002	8.70	0.12	6	4.68	0.026	6	3.11	0.062	6
August 2002	8.79	0.22	6	4.60	0.061	6	3.12	0.048	6
January 2003	8.83	0.23	6	4.73	0.061	6	3.16	0.021	6
March 2003	8.79	0.25	6	4.69	0.052	6	3.18	0.028	6
July 2003	8.90	0.20	6	4.68	0.015	6	3.22	0.025	6
January 2004	8.82	0.23	6	4.71	0.058	6	3.26	0.027	6
March 2004	8.87	0.19	6	4.69	0.022	6	3.27	0.013	6
August 2004	8.85	0.24	6	4.70	0.029	6	3.26	0.016	6
January 2005	8.86	0.16	6	4.74	0.029	6	3.30	0.022	6
March 2005	8.87	0.23	6	4.78	0.020	6	3.30	0.018	6
August 2005	8.89	0.13	6	4.73	0.010	6	3.29	0.021	6
January 2006	8.93	0.11	6	4.76	0.031	6	3.32	0.018	6
March 2006	8.92	0.08	6	4.77	0.028	6	3.32	0.013	6
August 2006	8.92	0.13	6	4.75	0.069	6	3.33	0.020	6
January 2007	8.91	0.08	6	4.71	0.024	6	3.34	0.044	6
August 2007	9.02	0.11	6	4.65	0.038	6	3.35	0.030	6
January 2008	9.09	0.16	6	4.68	0.085	6	3.36	0.006	6

Table 4.3. Atmospheric concentrations of the measured substances in the background area (4)
Halon-2402, CCl₄, CH₃CCl₃ (Unit : pptv)

Sampling Time	Halon-2402			Carbon tetrachloride			1,1,1-Trichloroethane		
	Mean	SD	n	Mean	SD	n	Mean	SD	n
January 1989	0.45	0.024	3	108	3	6	165	2	6
March 1989	0.47	0.012	3	104	1	6	166	4	6
November 1989	0.46	0.008	3	114	4	6	178	13	6
January 1990	0.47	0.034	3	112	5	6	176	6	6
March 1990	0.48	0.023	3	106	1	6	175	2	6
October 1990	0.50	0.024	3	111	4	6	179	12	6
January 1991	0.49	0.015	3	111	1	6	176	2	6
March 1991	0.48	0.025	3	108	1	6	177	2	6
August 1991	0.48	0.008	3	116	4	6	172	8	6
January 1992	0.51	0.017	3	113	3	6	177	3	6
March 1992	0.52	0.015	3	111	1	6	177	1	6
August 1992	0.52	0.025	3	116	2	6	177	4	6
January 1993	0.51	0.010	3	110	2	6	177	10	6
March 1993	0.54	-	2	113	4	6	174	9	6
August 1993	0.50	0.011	3	110	5	6	146	4	6
January 1994	0.52	0.023	5	105	2	2	147	6	6
March 1994	0.51	0.028	3	109	2	6	143	2	6
July 1994	0.53	0.012	3	108	2	6	144	11	6
January 1995	0.54	0.006	3	104	3	6	129	2	6
March 1995	0.53	0.015	4	105	3	6	130	2	6
August 1995	0.54	-	2	-	-	0	120	2	6
January 1996	0.54	-	2	-	-	0	112	1	6
March 1996	0.54	0.013	3	-	-	0	111	2	6
August 1996	0.53	0.013	3	104	1	2	102	7	6
January 1997	0.53	-	2	-	-	0	95.6	0.7	6
March 1997	0.54	-	2	107	1	2	95.4	0.4	6
August 1997	0.54	0.016	3	110	5	6	88.3	4.3	6

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Table 4.3. Atmospheric concentrations of the measured substances in the background area (4)
 Halon-2402, CCl₄, CH₃CCl₃ (Continued) (Unit : pptv)

Sampling Time	Halon-2402			Carbon tetrachloride			1,1,1-Trichloroethane		
	Mean	SD	n	Mean	SD	n	Mean	SD	n
January 1998	0.53	-	1	106	4	6	78.1	1.8	6
March 1998	0.52	0.012	3	106	3	6	76.0	1.5	6
November 1998	0.53	0.029	6	108	2	6	76.5	1.5	6
January 1999	-	-	0	103	1	6	70.1	1.6	6
March 1999	0.53	0.036	6	108	3	6	71.5	1.6	6
October 1999	0.52	0.020	6	110	4	6	64.2	0.8	6
January 2000	0.53	0.018	6	103	2	6	58.7	0.7	6
March 2000	0.51	0.018	6	106	1	6	57.5	1.9	6
August 2000	0.52	0.021	6	108	1.3	6	50.1	1.5	6
January 2001	0.51	0.028	6	105	0.5	6	50.4	0.5	6
March 2001	0.51	0.018	6	105	1.4	6	50.7	0.5	6
August 2001	0.50	0.013	6	105	0.8	6	43.0	0.7	6
January 2002	0.50	0.028	6	104	0.8	6	37.6	0.1	6
March 2002	0.51	0.026	6	104	0.8	6	37.1	0.2	6
August 2002	0.50	0.027	6	106	1.0	6	35.7	0.6	6
January 2003	0.51	0.020	6	104	2.1	6	32.5	0.4	6
March 2003	0.50	0.012	6	103	0.4	6	31.8	0.8	6
July 2003	0.50	0.018	6	100	0.7	6	28.4	0.4	6
January 2004	0.50	0.004	6	99.5	0.8	6	26.6	0.3	6
March 2004	0.50	0.024	6	99.3	0.8	6	26.6	0.4	6
August 2004	0.49	0.013	6	99.0	0.7	6	23.8	0.6	6
January 2005	0.50	0.008	6	98.0	0.7	6	21.9	0.3	6
March 2005	0.50	0.008	6	99.4	0.7	6	21.9	0.9	6
August 2005	0.49	0.010	6	97.5	0.7	6	20.8	0.3	6
January 2006	0.49	0.019	6	96.7	0.4	6	19.2	0.2	6
March 2006	0.50	0.021	6	96.0	1.1	6	18.6	0.3	6
August 2006	0.48	0.006	6	97.0	0.6	6	16.2	0.4	6
January 2007	0.48	0.021	6	96.5	0.4	6	16.2	0.1	6
August 2007	0.48	0.008	6	96.0	0.8	6	14.4	0.2	6
January 2008	0.46	0.014	6	95.6	0.6	6	14.5	0.3	6

Table 4.3. Atmospheric concentrations of the measured substances in the background area (5)
 HCFC-22, HCFC-141b, HCFC-142b (Unit : pptv)

Sampling Time	HCFC-22			HCFC-141b			HCFC-142b		
	Mean	SD	n	Mean	SD	n	Mean	SD	n
August 1992	111	2	5	-	-	--	4.54	0.75	3
January 1993	112	6	5	-	-	-	5.35	0.37	4
March 1993	114	7	5	-	-	-	5.37	0.44	2
August 1993	114	5	6	-	-	-	6.27	0.70	3
January 1994	120	5	4	-	-	-	7.00	0.54	4
March 1994	121	2	5	-	-	-	6.61	0.27	4
July 1994	120	3	6	-	-	-	7.45	1.1	4
January 1995	123	4	6	-	-	-	7.78	0.68	4
March 1995	124	2	6	-	-	-	7.68	0.38	5
August 1995	125	4	5	-	-	-	8.52	0.64	6
January 1996	128	3	6	-	-	-	8.94	0.96	4
March 1996	127	5	6	-	-	-	9.60	0.43	4
August 1996	133	5	5	-	-	-	9.94	0.86	5
January 1997	134	3	6	-	-	-	9.88	0.40	6
March 1997	133	5	6	-	-	-	10.0	1.1	6
August 1997	137	3	6	-	-	-	10.4	2.1	5
January 1998	136	2	5	-	-	-	11.2	0.59	4
March 1998	138	3	6	-	-	-	10.8	1.1	6
November 1998	142	3	6	-	-	-	11.6	0.57	4
January 1999	150	2	6	-	-	-	12.0	0.43	6
March 1999	150	2	6	-	-	-	12.2	0.59	3
October 1999	149	7	6	-	-	-	11.5	0.45	5
January 2000	150	3	6	-	-	-	13.2	0.39	6
March 2000	150	1	6	-	-	-	12.8	1.1	6
August 2000	153	2	6	-	-	-	13.4	0.64	6

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Table 4.3. Atmospheric concentrations of the measured substances in the background area (5)
 HCFC-22, HCFC-141b, HCFC-142b (Continued) (Unit : pptv)

Sampling Time	HCFC-22			HCFC-141b			HCFC-142b		
	Mean	SD	n	Mean	SD	n	Mean	SD	n
January 2001	157	2	6	-	-	-	14.4	0.26	6
March 2001	158	2	6	-	-	-	14.1	0.55	6
August 2001	157	3	6	17.2	0.54	6	14.1	0.17	6
January 2002	158	2	6	17.7	0.37	6	15.3	0.47	6
March 2002	158	2	6	18.1	0.28	6	15.4	0.47	6
August 2002	163	2	6	19.0	0.28	6	15.2	0.59	6
January 2003	166	1	6	18.6	0.12	6	15.4	0.64	6
March 2003	163	1	6	19.1	0.18	6	15.9	0.58	6
July 2003	168	3	6	20.2	0.71	6	15.5	0.64	6
January 2004	168	1	6	20.0	0.63	6	15.9	0.44	6
March 2004	169	1	6	20.0	0.42	6	16.5	0.32	6
August 2004	171	2	6	19.6	0.20	6	16.6	0.18	6
January 2005	174	2	6	19.6	0.11	6	16.4	0.08	6
March 2005	174	1	6	20.1	0.78	6	16.6	0.20	6
August 2005	179	3	6	20.2	0.29	6	17.1	0.26	6
January 2006	179	2	6	20.2	0.11	6	17.4	0.23	6
March 2006	183	1	6	20.4	0.29	6	17.2	0.26	6
August 2006	186	2	5	20.8	0.55	6	17.6	0.35	6
January 2007	190	2	6	21.0	0.54	6	18.4	0.18	6
August 2007	200	2	5	22.3	1.7	6	20.3	0.46	6
January 2008	198	3	6	20.7	0.52	6	19.7	0.23	6

Note 3) The observations of HCFC-22, HCFC-141b, and HCFC-142b began August 1992, August 2002, and August 1992, respectively.

Note 4) The concentrations of HCFC-141b before August 2002 were obtained through the measurements of the preserved samples in 2006.

Table 4.3. Atmospheric concentrations of the measured substances in the background area (6)
Methyl bromide, HFC-134a (Unit : pptv)

Sampling Time	Methyl bromide			HFC-134a		
	Mean	SD	n	Mean	SD	n
March 1998	11.2	0.52	6	-	-	-
November 1998	11.7	0.55	3	-	-	-
January 1999	11.2	0.59	6	-	-	-
March 1999	10.6	0.00	3	-	-	-
October 1999	10.4	0.68	6	-	-	-
January 2000	9.4	0.35	6	-	-	-
March 2000	9.5	0.78	6	-	-	-
August 2000	10.0	0.65	6	17.0	0.45	5
January 2001	9.2	0.39	6	20.1	1.0	4
March 2001	10.2	0.90	6	19.5	1.2	4
August 2001	9.4	0.99	6	21.3	0.60	6
January 2002	9.5	0.52	6	24.1	0.98	6
March 2002	8.9	0.33	6	24.4	1.3	6
August 2002	10.0	0.56	6	25.8	0.42	6
January 2003	9.5	0.11	6	29.4	0.84	6
March 2003	9.5	0.28	6	28.9	2.0	6
July 2003	9.6	0.80	6	30.7	1.0	6
January 2004	10.3	0.62	6	32.3	1.1	6
March 2004	9.6	0.51	6	33.1	0.58	6
August 2004	9.4	0.39	6	34.8	1.4	6
January 2005	9.4	0.38	6	36.9	1.0	6
March 2005	9.8	0.29	6	37.5	1.2	6
August 2005	10.2	0.45	6	40.0	1.5	6
January 2006	9.1	0.15	6	41.8	1.0	6
March 2006	9.5	0.21	6	43.5	1.4	6
August 2006	9.5	0.17	5	44.8	0.85	6
January 2007	9.4	0.42	6	46.8	0.91	6
August 2007	9.8	0.69	6	50.5	0.37	6
January 2008	9.4	0.49	6	51.8	1.6	6

Note 5) Methyl Bromide was added to the program in 1993. Reliable results for this substance have been obtained since March 1998 due to the problems in the measurement.

Note 6) HFC-134a was added to the program in 2001. The concentrations of HFC-134a before August 2001 shown in this table were obtained through the measurements of preserved samples in 2003.

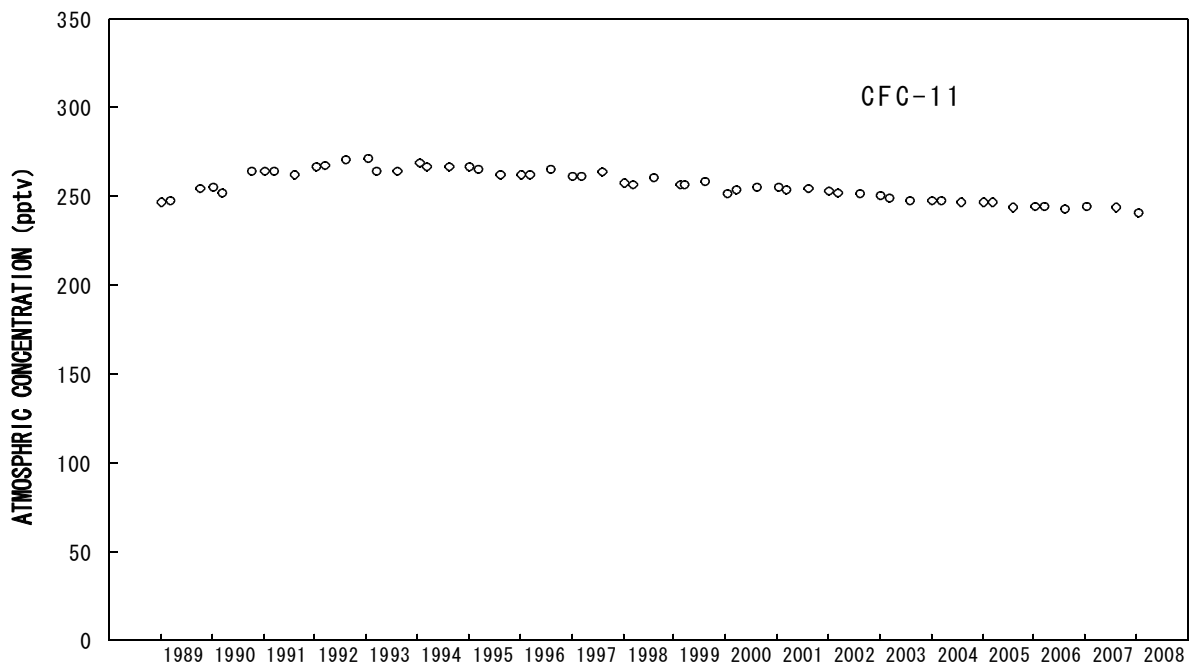


Figure 4.1.1. Atmospheric concentrations of CFC-11 in Hokkaido since 1989
Circles represent the means for 6 samples.

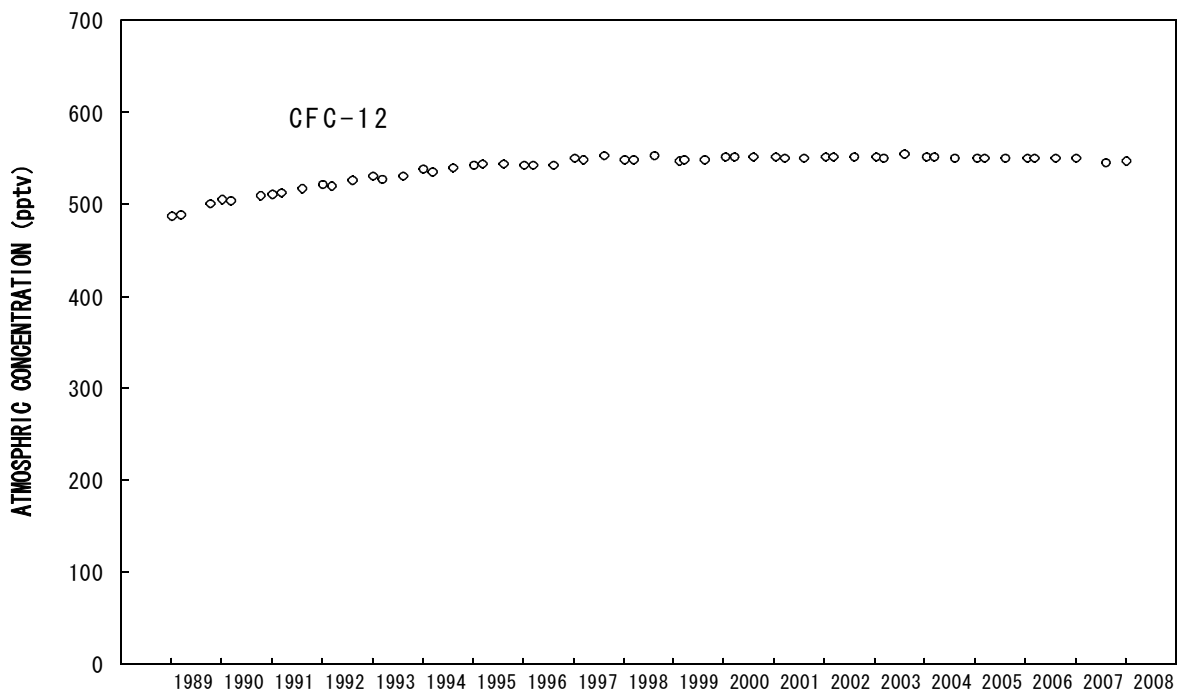


Figure 4.1.2. Atmospheric concentrations of CFC-12 in Hokkaido since 1989
Circles represent the means for 6 samples.

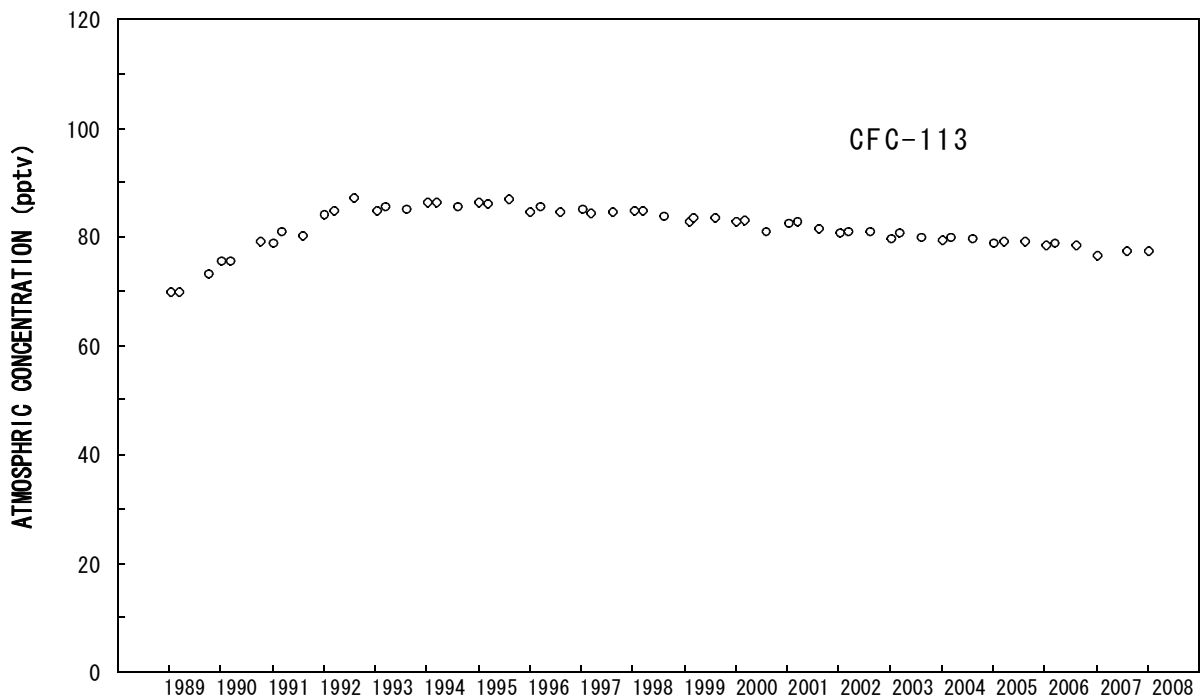


Figure 4.1.3. Atmospheric concentrations of CFC-113 in Hokkaido since 1989
 Circles represent the means for 2-6 samples.

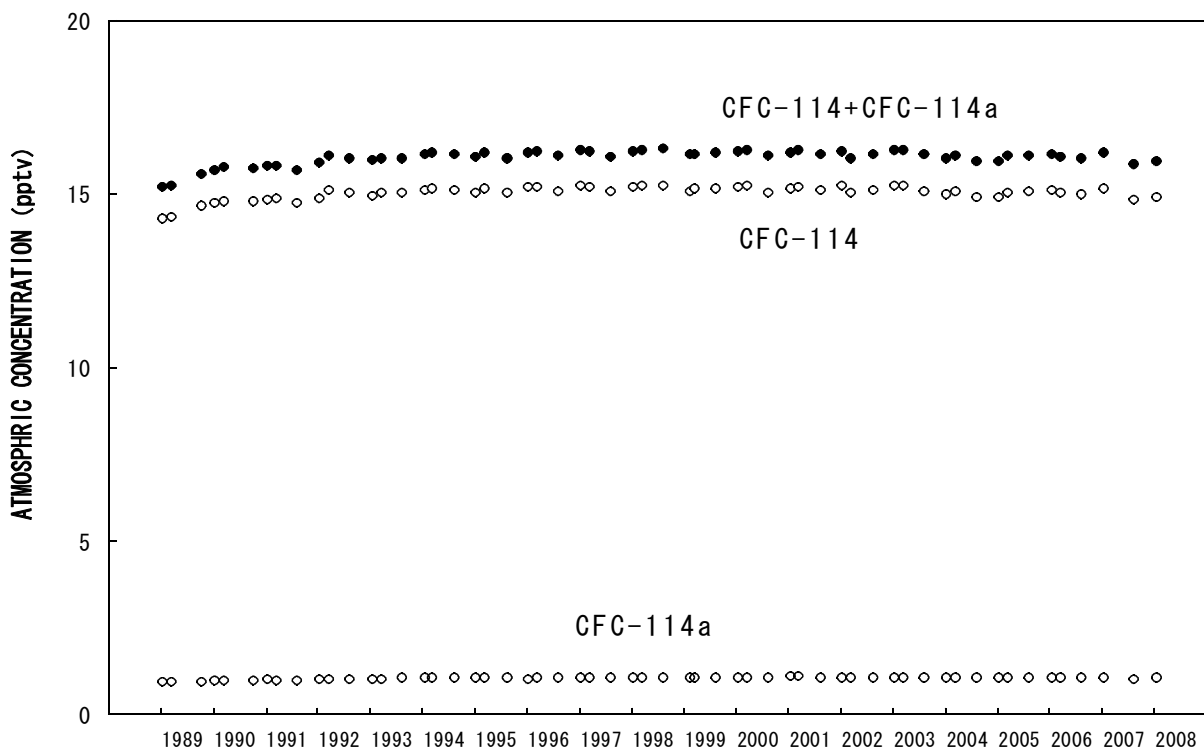


Figure 4.1.4. Atmospheric concentrations of CFC-114 and CFC-114a in Hokkaido since 1989
 Open circles represent the means of each substance both for 4-6 samples.
 Solid circles represent the sums of CFC-114 and CFC-114a.

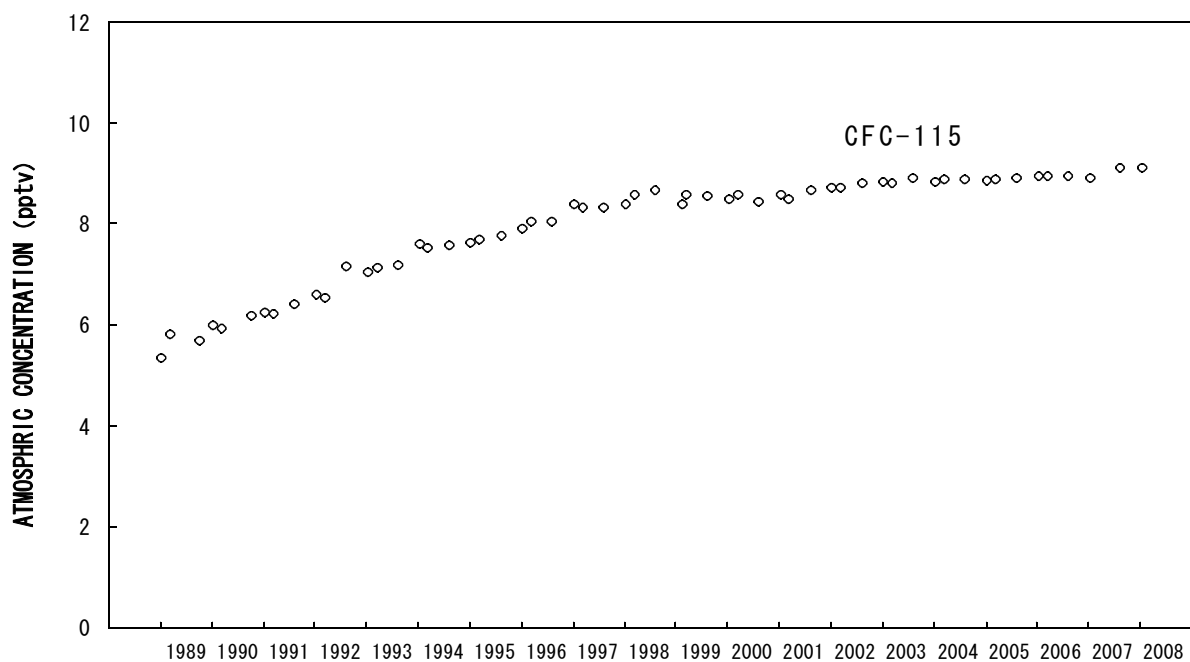


Figure 4.1.5. Atmospheric concentrations of CFC-115 in Hokkaido since 1989
Circles represent the means for 2-6 samples.

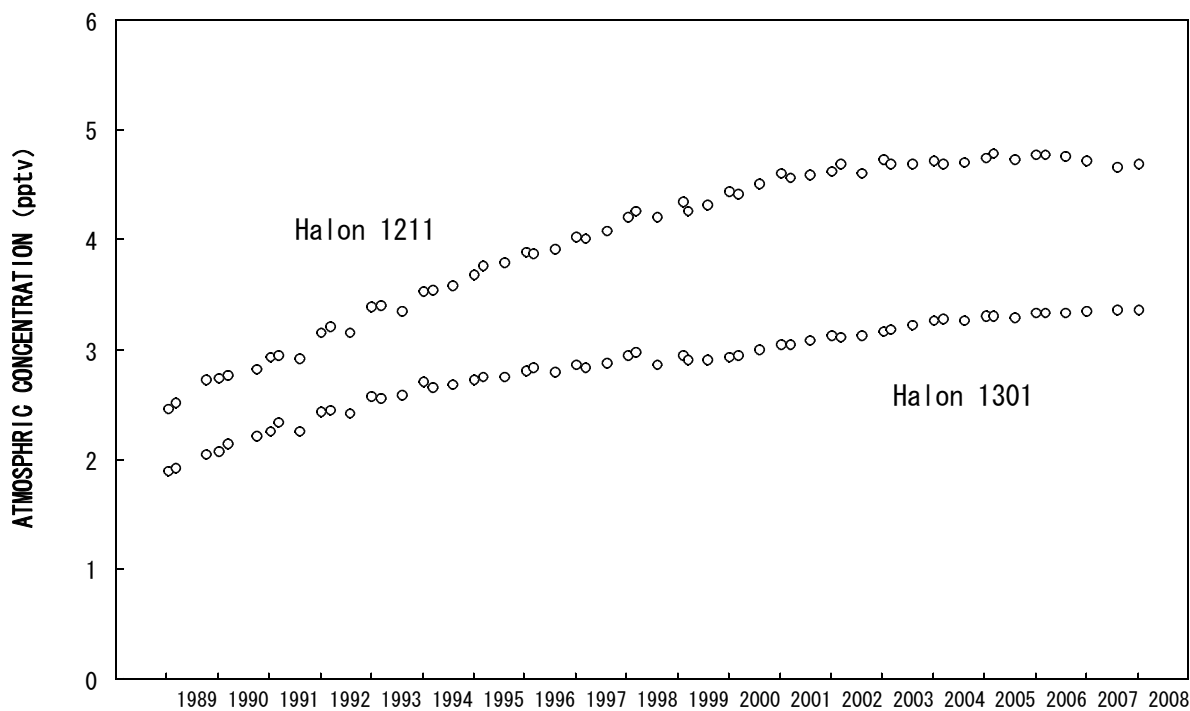


Figure 4.1.6. Atmospheric concentrations of halon-1211 and halon-1301 in Hokkaido since 1989
Circles represent the means for 4-6 samples.

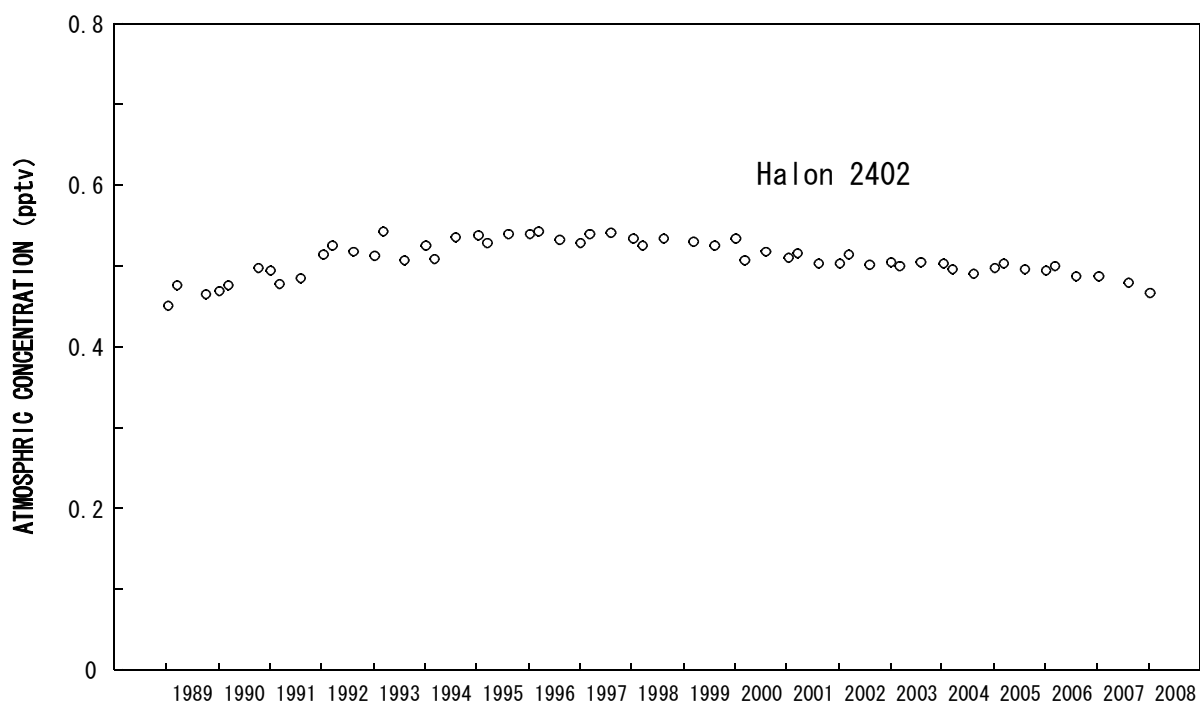


Figure 4.1.7. Atmospheric concentrations of halon-2402 in Hokkaido since 1989
Circles represent the means for 1-6 samples.



Figure 4.1.8. Atmospheric concentrations of carbon tetrachloride in Hokkaido since 1989
Circles represent the means for 2-6 samples.

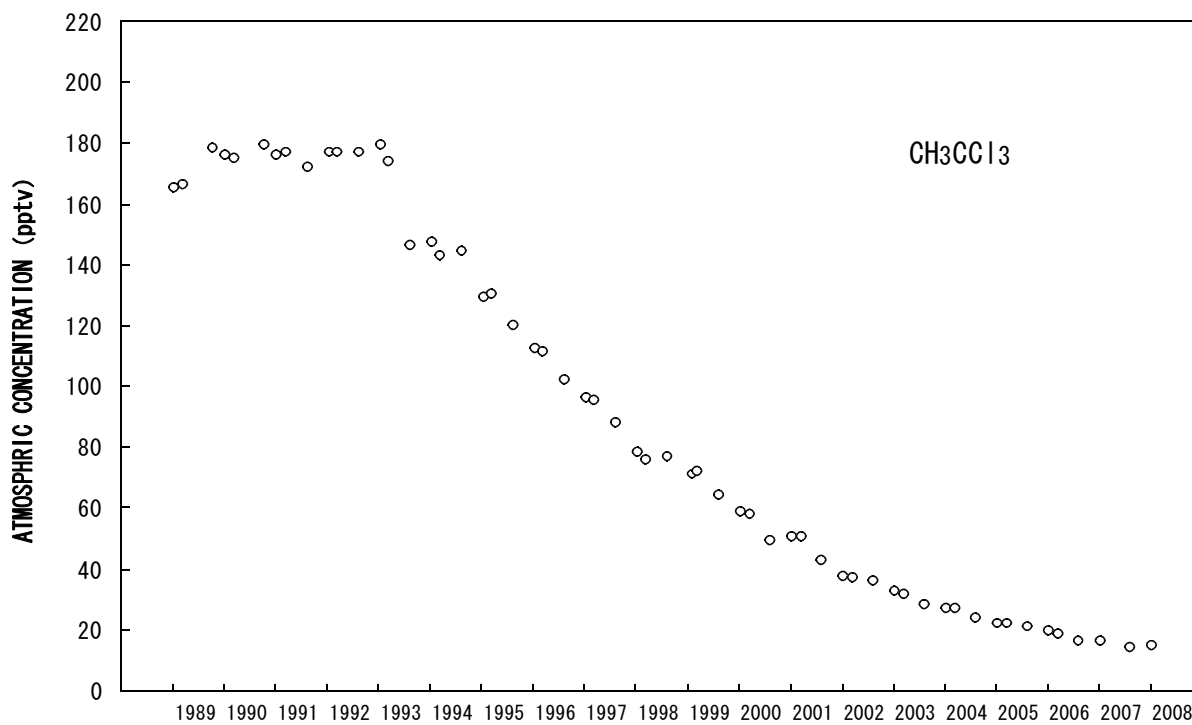


Figure 4.1.9. Atmospheric concentrations of 1,1,1-trichloroethane in Hokkaido since 1989
Circles represent the means for 6 samples.

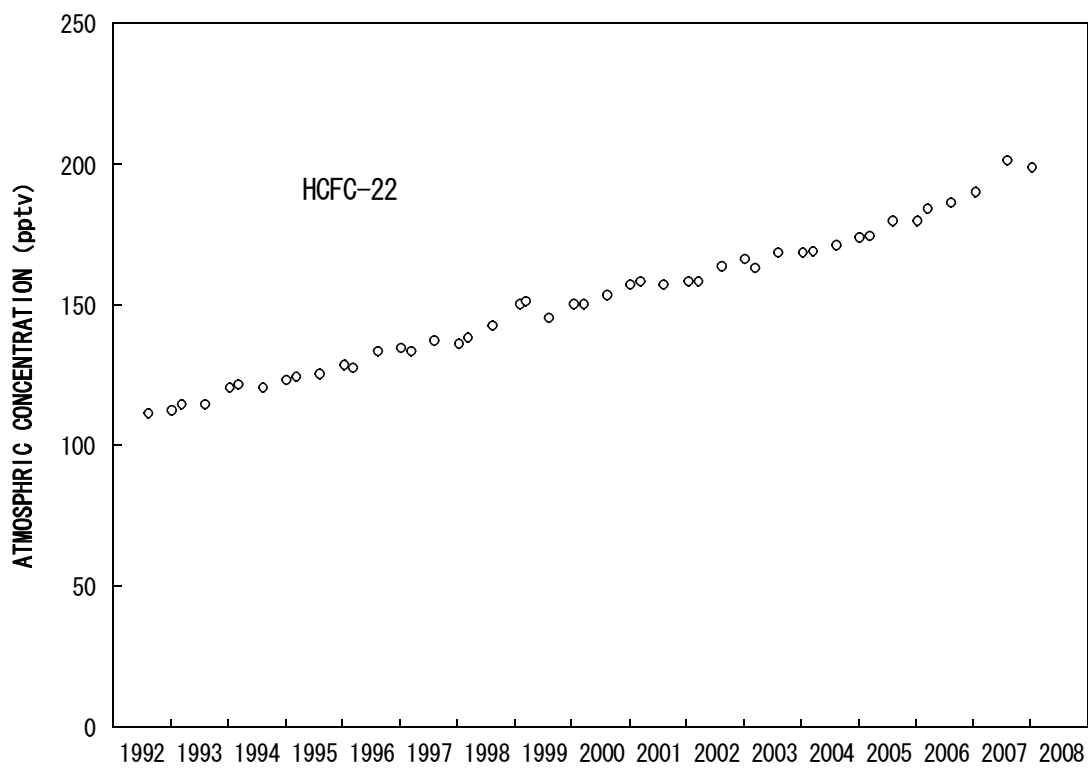


Figure 4.1.10. Atmospheric concentrations of HCFC-22 in Hokkaido since 1992
Circles represent the means for 4-6 samples.

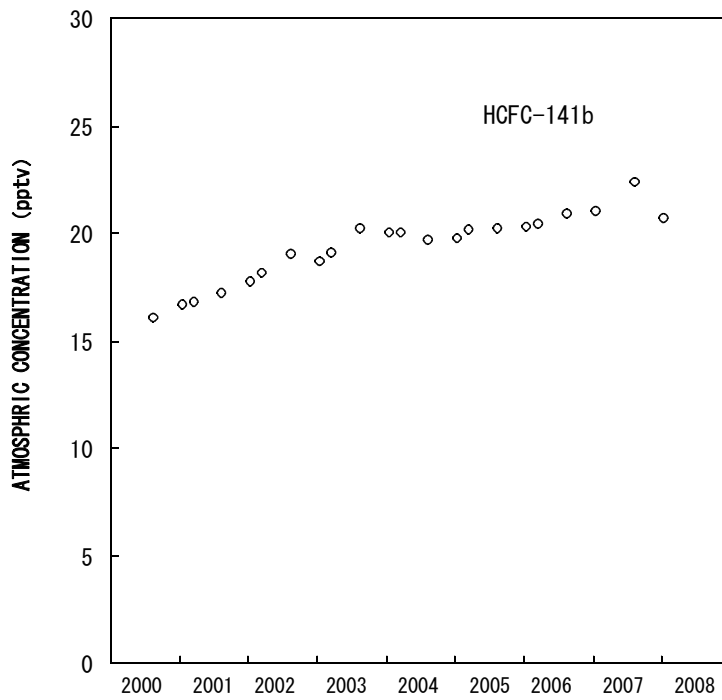


Figure 4.1.11. Atmospheric concentrations of HCFC-141b in Hokkaido since 2000
Circles represent the means for 6 samples.

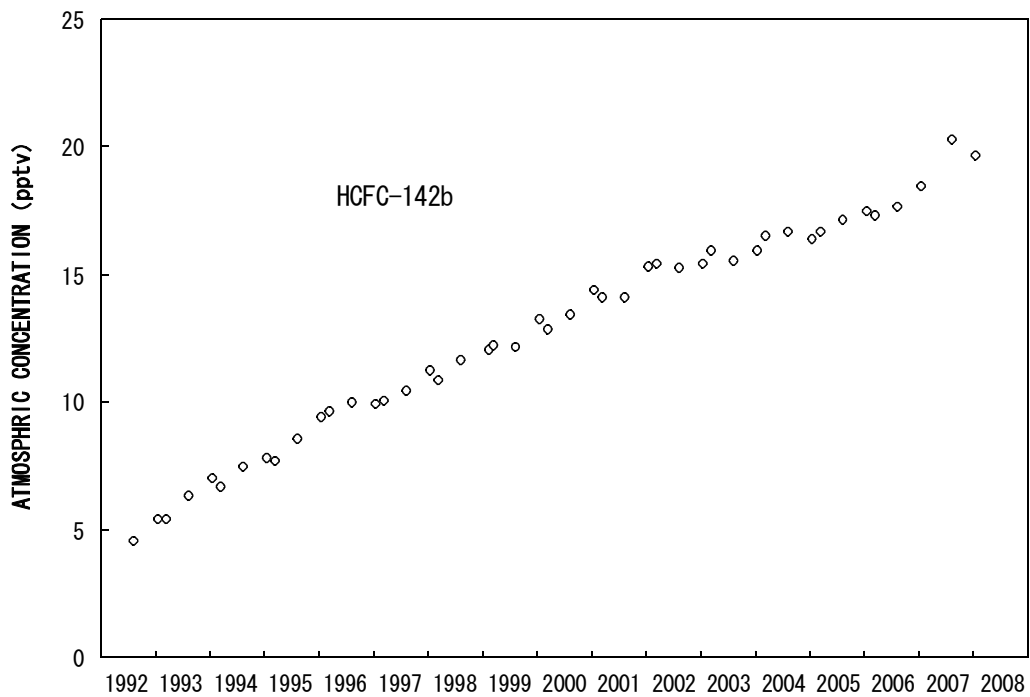


Figure 4.1.12. Atmospheric concentrations of HCFC-142b in Hokkaido since 1992
Circles represent the means for 2-6 samples.

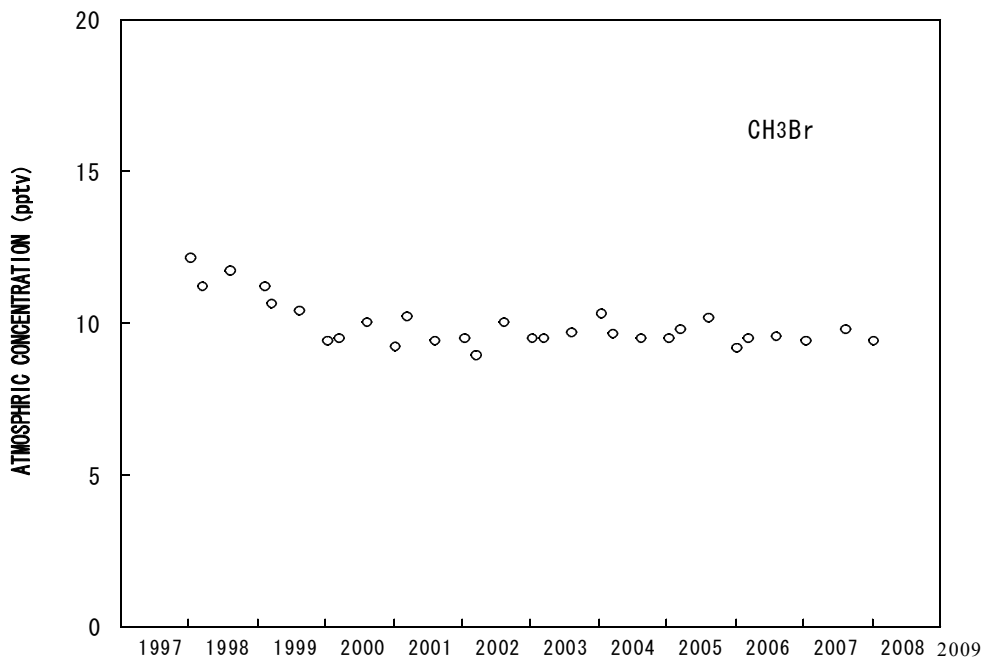


Figure 4.1.13. Atmospheric concentrations of methyl bromide in Hokkaido since 1997
Circles represent the means for 3-6 samples.

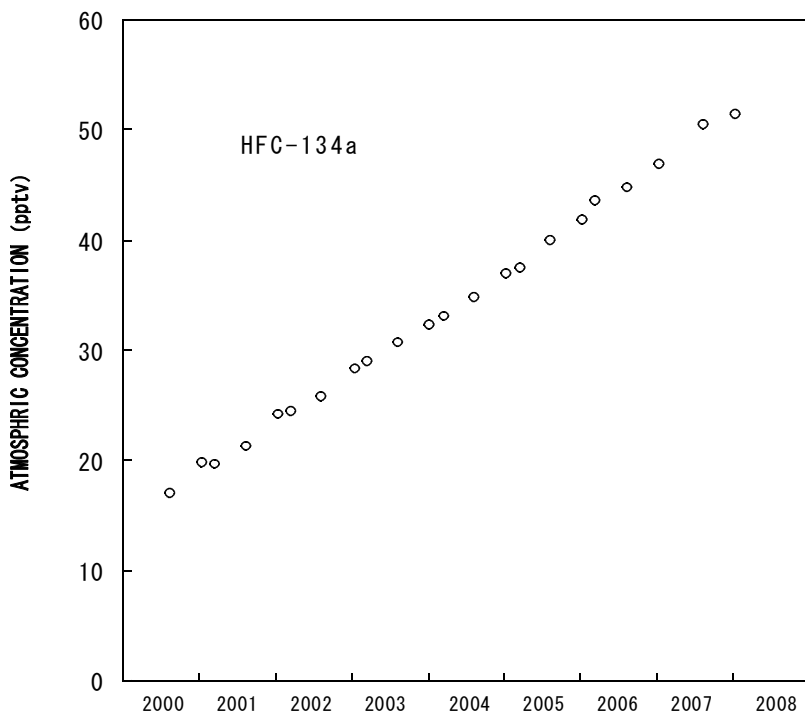


Figure 4.1.14. Atmospheric concentrations of HFC-134a in Hokkaido since 2000
Circles represent the means for 4-6 samples.

(4) Rate of Change in the Concentrations of Measured Substances

The results from a series of the surveys in the background area were statistically evaluated to obtain the recent trends in the atmospheric concentrations. The evaluation method used was as follows.

(A) Evaluation Period

The period of the evaluation was principally about 12 years, from January 1996 to the present (January 2008). On January 1, 1996, the manufacture of the major CFCs (group I of Annex A of the Montreal Protocol) was prohibited in developed countries. Although the manufacture of halons (group II of Annex A of the Protocol) in developed countries was already prohibited in January 1994, the evaluation periods of these substances was taken as the same for convenience. Since trends in the atmospheric concentrations of many substances do not obviously appear to change markedly over this period, it is possible to assume that the trends in concentrations of many substances were constant over the period (**Figure 4.1.1 - Figure 4.1.15**). The evaluation periods for several substances were nevertheless reduced as follows.

- i) The evaluation period for CFC-12 was reduced to be from January 1997, because the trend in the concentrations changed around 1996 (see **Figure 4.1.2**).
- ii) The evaluation period for CFC-115 was reduced to be from January 1998, because the trend in the concentrations changed around 1997 (see **Figure 4.1.5**).
- iii) The evaluation period for halon-1211 was reduced to be from January 2001, because the trend in the concentrations changed around 2000 (see **Figure 4.1.6**).
- iv) The evaluation period for carbon tetrachloride was reduced to be from August 1996 due to the lack of the results for early 1996.
- v) Since the rate of decline in the concentrations of 1,1,1-trichloroethane has steadily changed, it is difficult to determine a long evaluation period for this substance. The evaluation period was limited to that from August 2002 to the present. It is possible to assume that the trend was approximately straight for this period (see **Figure 4.1.9**).
- vi) The evaluation period for HCFC-141b was reduced to be from January 2003, because the trend in the concentrations changed around 2000 (see **Figure 4.1.11**).
- vii) The evaluation period for methyl bromide was reduced to be from January 2000, because the trend in the concentrations changed around 1999 (see **Figure 4.1.13**).
- viii) The evaluation period for HFC-134a was from 2000 since the measurement of HFC-134a began in this year.

(B) Method of Analysis

The statistical analysis was carried out under following conditions.

- i) The analysis used the raw results of the measurements instead of averaged values.
- ii) The analysis calculated a straight-line regression with the assumption that the change in the trend in concentrations over the evaluation period was constant.
- iii) The analysis calculated 95% confidence intervals for the inclinations of the regression.
- iv) The analysis calculated the rates of change in the concentrations per year (annual growth rates) using the present (January 2008) concentrations calculated from the regressions and the inclinations of the regression.

(C) Results of Analysis

The calculated annual growth rates (pptv per year) and 95% confidence intervals are shown in **Table 4.4**. The plots of each substance are also shown in **Figure 4.2.1 – Figure 4.2.15**. Each figure is based on the results of measurements that are the same as those in **Figure 4.1.1 - Figure 4.1.15**. The ordinates (concentration) of almost all the graphs are magnified for ease of detecting changes in the concentrations. To display the variability of the measurements, a standard deviation range (1σ , short cross-bars) is plotted above and below of each average. A regression line is also shown as a solid line. The means that are within the evaluation period are shown by solid circles (●) and those that are out of the period are shown by open circles (○).

Table 4.4. Trends in the atmospheric concentrations of measured substances in the background area
Evaluation periods are principally from January 1996 to January 2008

Substance	Annual Growth		Period of Evaluation ~ Jan 2008 (Note 1)	Concentration at Jan 2008 (Note 2) (pptv)	Annual Growth Rate (%) (Note 3)
	pptv/year	95 % Confidence Intervals (pptv)			
CFC-11	-1.9	± 0.1	Jan 1996~	240	-0.8
CFC-12	-0.1	± 0.2	Jan 1997~ (Note4)	549	0.0
CFC-113	-0.73	± 0.04	Jan 1996~	77	-0.9
CFC-114	-0.02	± 0.008	Jan 1996~	15.0	-0.1
CFC-115	0.06	± 0.01	Jan 1998~ (Note4)	9.1	0.7
Halon-1211	0.02	± 0.005	Jan 2001~	4.8	0.4
Halon-1301	0.05	± 0.002	Jan 1996~	3.4	1.5
Halon-2402	-0.005	± 0.001	Jan 1996~	0.48	-1.0
Carbon tetrachloride	-1.3	± 0.1	Aug 1996~ (Note5)	96	-1.4
1,1,1-Trichloroethane	-3.9	± 0.2	Aug 2001~ (Note4)	12	-32
HCFC-22	5.4	± 0.1	Jan 1996~	193	2.8
HCFC-141b	0.44	± 0.1	Jan 2003~ (Note4)	21	2.1
HCFC-142b	0.84	± 0.03	Jan 1996~	20.0	4.2
Methyl bromide	-0.02	± 0.06	Jan 2000~ (Note4)	9.4	-0.2
HFC-134a	4.7	± 0.2	Aug 2000~ (Note6)	52	9.0

Note 1) The results in this table are calculated from the results of measurements of previous 12 years (January 1996 - January 2008). See Note 4 ~ Note 6 for the periods of evaluation of CFC-12, halon-1211, carbon tetrachloride, 1,1,1-trichloroethane, HCFC-141b, methyl bromide, and HFC-134a.

Note 2) The concentrations at January 2008 were calculated from the regression equations. Thus, these are not the measured values.

Note 3) The annual growth rates are based on the concentrations at the present.

Note 4) The evaluation periods for CFC-12, CFC-115, halon-1211, 1,1,1-trichloroethane, HCFC-141b, and methyl bromide are from January 1997, January 1998, January 2001, August 2002, January 2003, and January 2000 to the present, respectively.

Note 5) The evaluation period for carbon tetrachloride is from August 1996 to the present due to the lack of the results in January 1996 and March 1996.

Note 6) The evaluation period for HFC-134a was from 2000 since the measurement of HFC-134a began in this year.

(D) Evaluation of the Results of the Analysis

The conclusions for the trends in the concentrations of the measured substances in the background area are as follows according to **Table 4.4**, and **Figure 4.2.1 - Figure 4.2.15**.

- (i) The atmospheric concentrations of CFC-115, halon-1301, HCFC-22, HCFC-141b, HCFC-142b, and HFC-134a have continued to increase since the observation program began. The rate of increase in the concentrations of HFC-134a is the highest of these substances.
- (ii) The atmospheric concentrations of CFC-12 and CFC-114 were increasing until the first half of the 1990s, however, they have been almost stable since then.
- (iii) The concentrations of halon-1211 were increasing until about 2005, but no significant change has been observed since then.
- (iv) The atmospheric concentrations of CFC-11, CFC-113, halon-2402, carbon tetrachloride, and 1,1,1-trichloroethane were increasing for several years from the beginning of the observation, but they have been declining for the past 10 or more years. The rate of decline in the concentrations of 1,1,1-trichloroethane is the highest of these substances.
- (v) No significant change has been observed in the concentrations of methyl bromide in recent years.

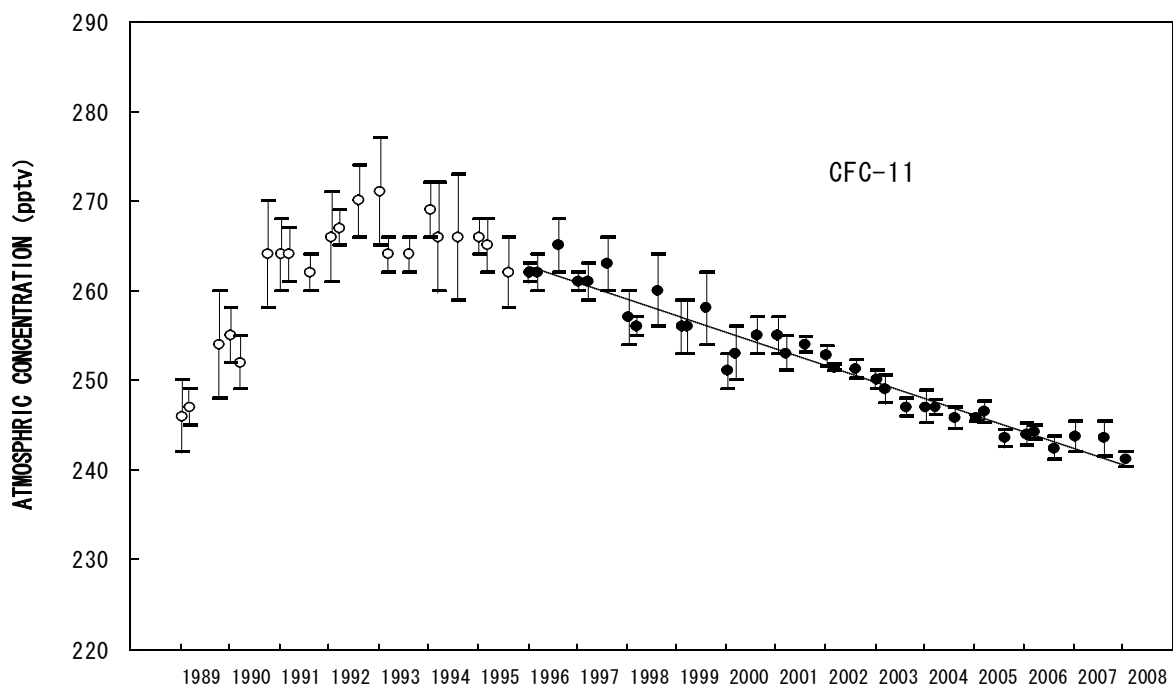


Figure 4.2.1. Long-term trend in CFC-11 concentrations in Hokkaido fitted with a regression line. Circles represent means for 6 samples (solid circles "●" represent the means within the evaluation period, open circles "○" represent the means out of the period), error bars represent ranges of the standard deviation.

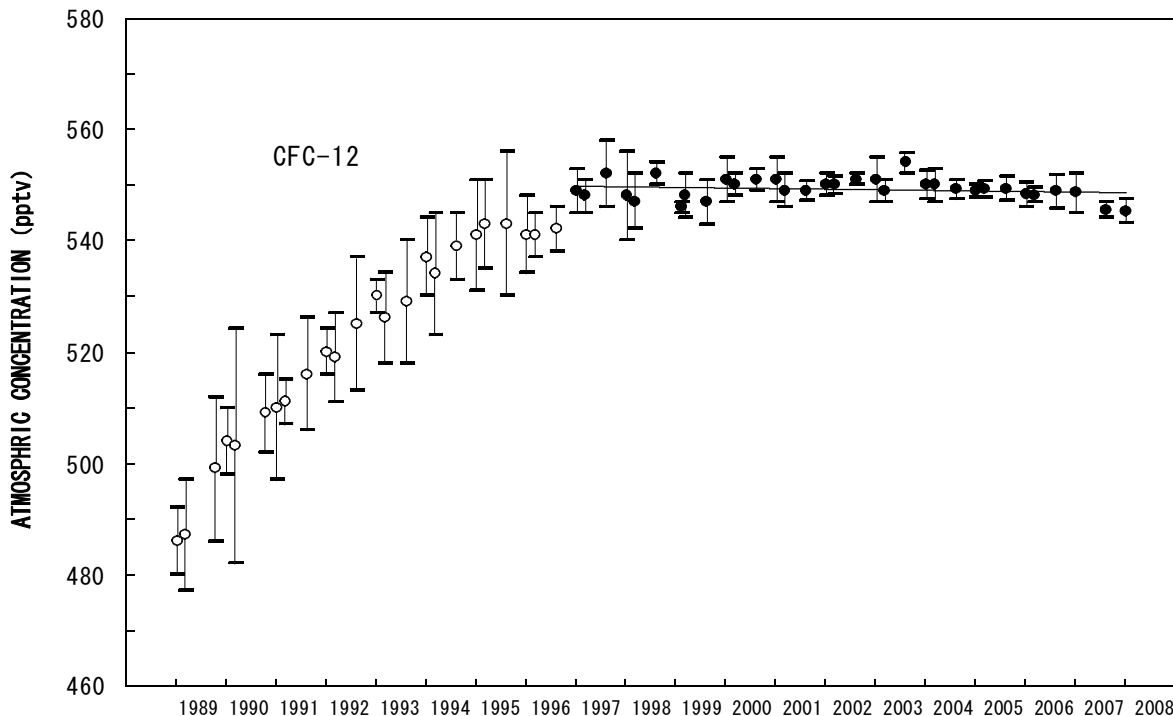


Figure 4.2.2. Long-term trend in CFC-12 concentrations in Hokkaido fitted with a regression line. Circles represent means for 6 samples (solid circles "●" represent the means within the evaluation period, open circles "○" represent the means out of the period), error bars represent ranges of the standard deviation.

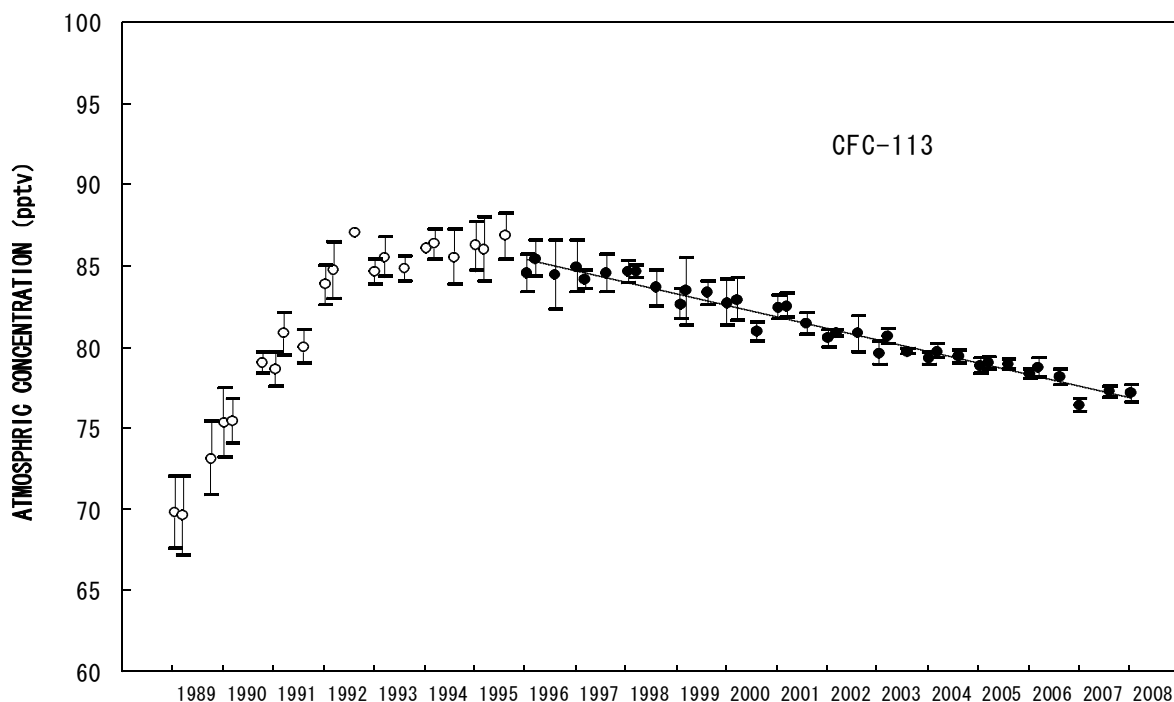


Figure 4.2.3. Long-term trend in CFC-113 concentrations in Hokkaido fitted with a regression line
 Circles represent means for 2-6 samples (solid circles "●" represent the means within the evaluation period, open circles "○" represent the means out of the period), error bars represent ranges of the standard deviation.

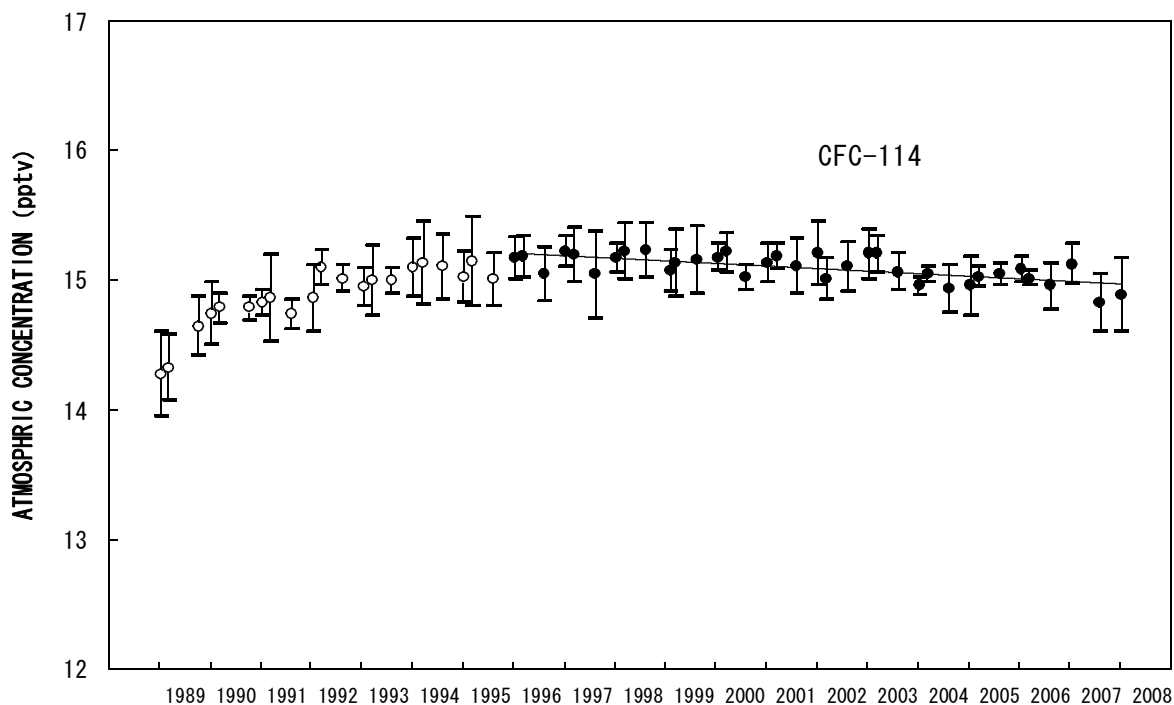


Figure 4.2.4. Long-term trend in CFC-114 concentrations in Hokkaido fitted with a regression line
 Circles represent means for 4-6 samples (solid circles "●" represent the means within the evaluation period, open circles "○" represent the means out of the period), error bars represent ranges of the standard deviation.

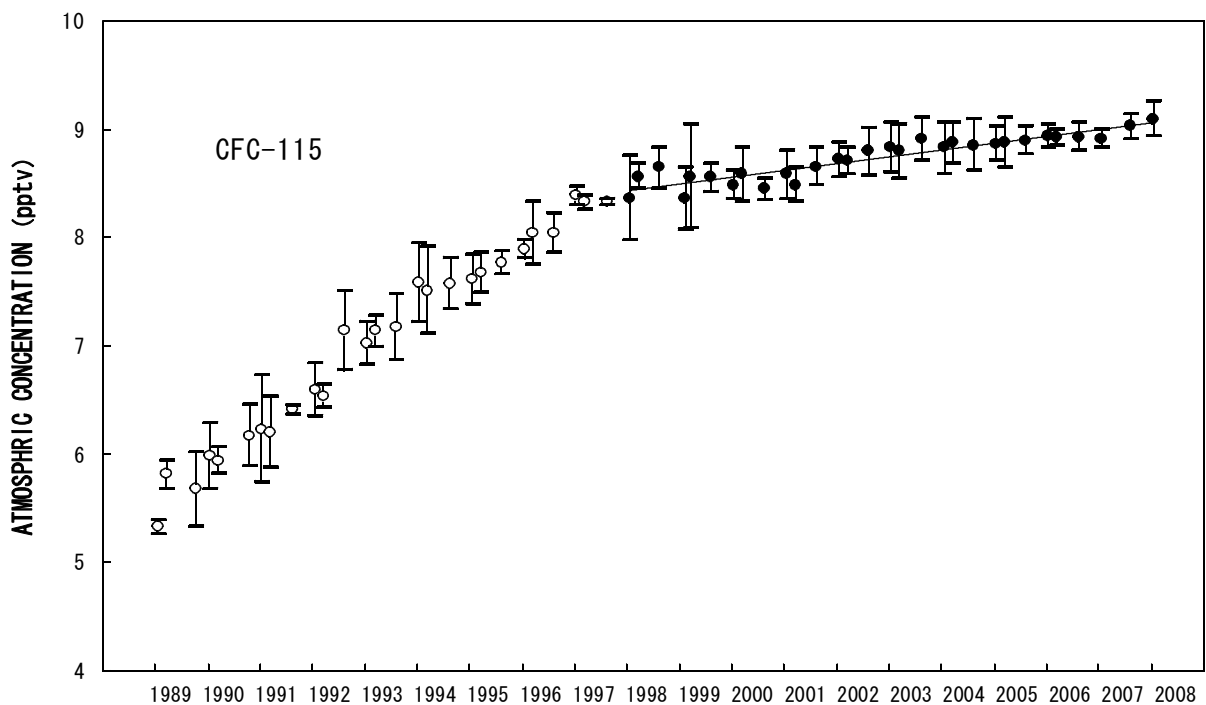


Figure 4.2.5. Long-term trend in CFC-115 concentrations in Hokkaido fitted with a regression line
 Circles represent means for 2-6 samples (solid circles "●" represent the means within the evaluation period, open circles "○" represent the means out of the period), error bars represent ranges of the standard deviation.

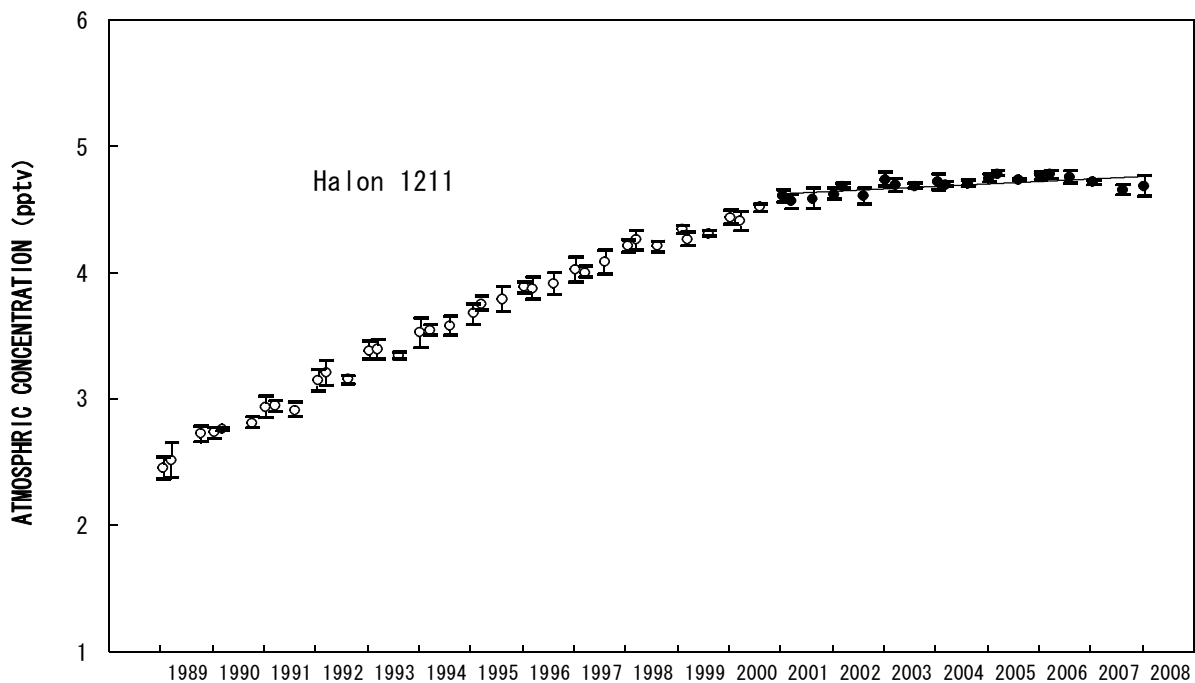


Figure 4.2.6. Long-term trend in halon-1211 concentrations in Hokkaido fitted with a regression line
 Circles represent means for 4-6 samples (solid circles "●" represent the means within the evaluation period, open circles "○" represent the means out of the period), error bars represent ranges of the standard deviation.

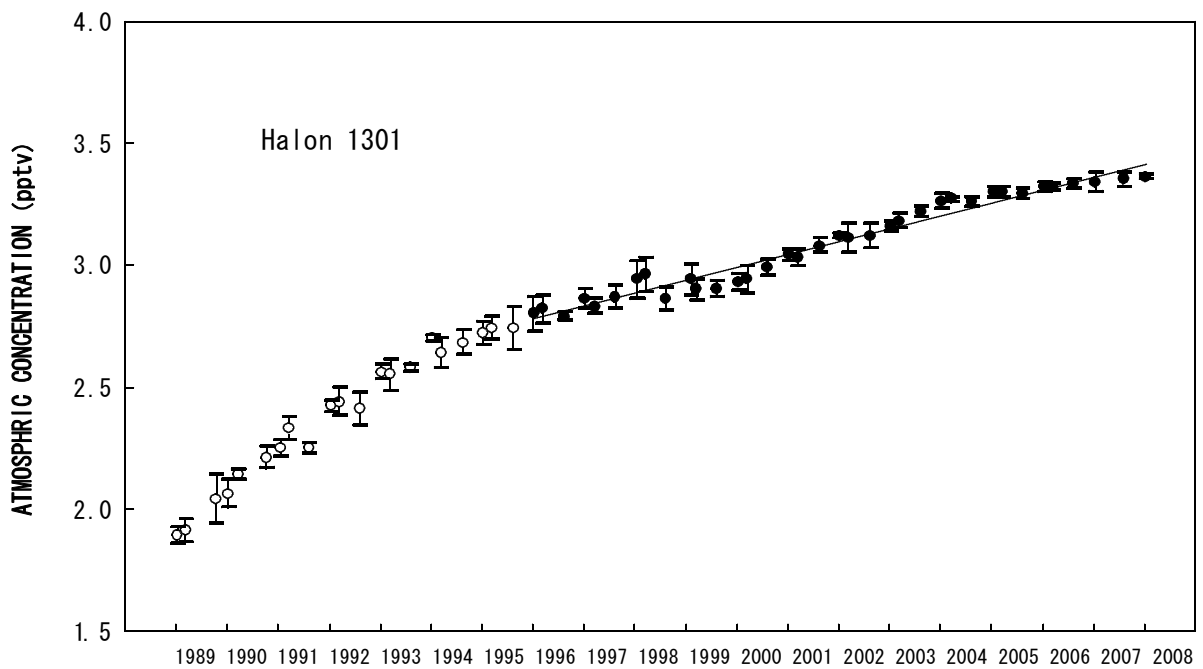


Figure 4.2.7. Long-term trend in halon-1301 concentrations in Hokkaido fitted with a regression line. Circles represent means for 4-6 samples (solid circles "●" represent the means within the evaluation period, open circles "○" represent the means out of the period), error bars represent ranges of the standard deviation.

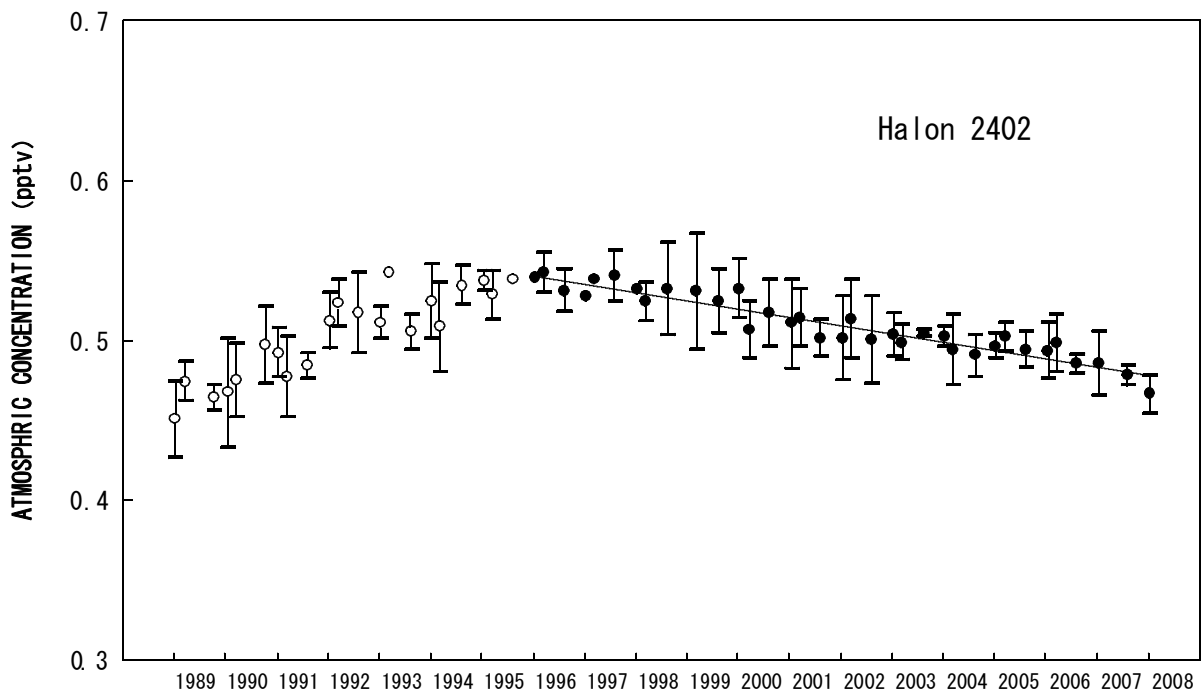


Figure 4.2.8. Long-term trend in halon-2402 concentrations in Hokkaido fitted with a regression line. Circles represent means for 1-6 samples (solid circles "●" represent the means within the evaluation period, open circles "○" represent the means out of the period), error bars represent ranges of the standard deviation.

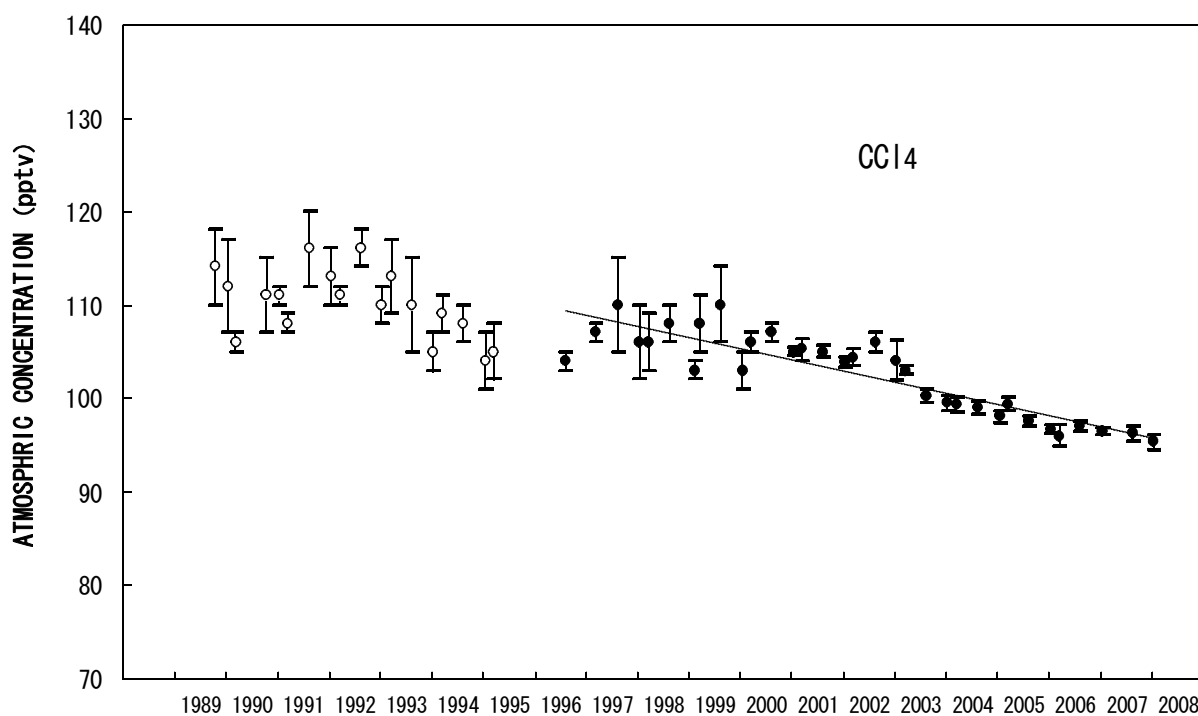


Figure 4.2.9. Long-term trend in carbon tetrachloride concentrations in Hokkaido fitted with a regression line
 Circles represent means for 2-6 samples (solid circles "●" represent the means within the evaluation period, open circles "○" represent the means out of the period), error bars represent ranges of the standard deviation.

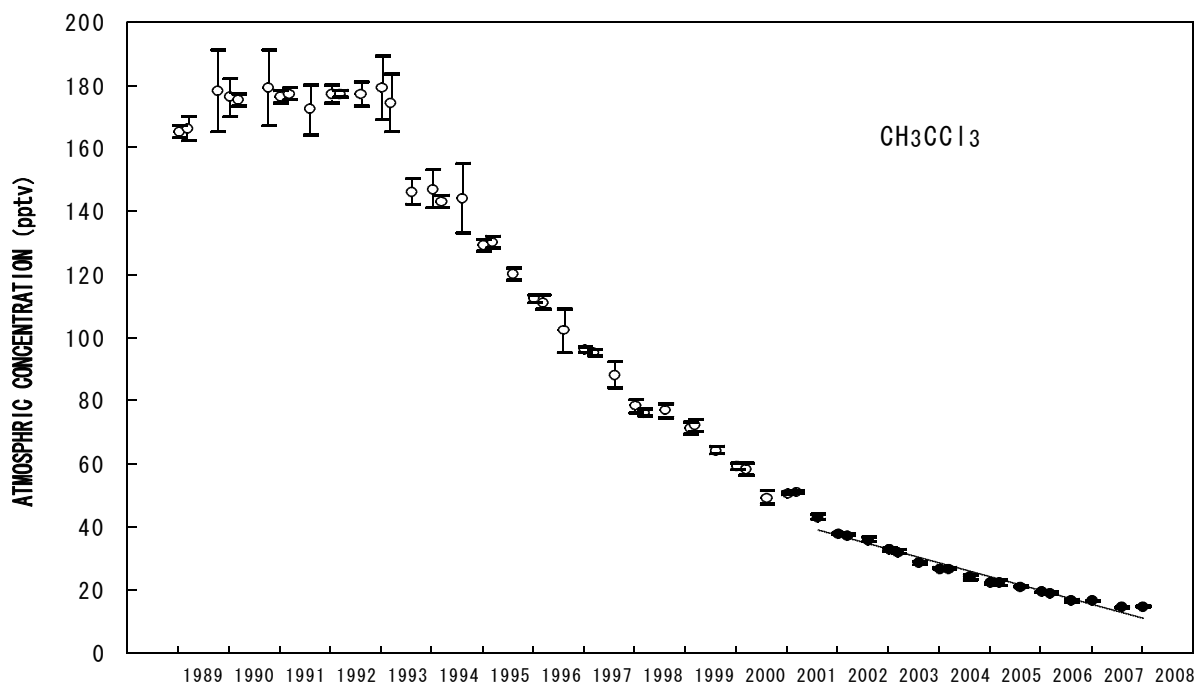


Figure 4.2.10. Long-term trend in 1,1,1-trichloroethane concentrations in Hokkaido fitted with a regression line
 Circles represent means for 6 samples (solid circles "●" represent the means within the evaluation period, open circles "○" represent the means out of the period), error bars represent ranges of the standard deviation.

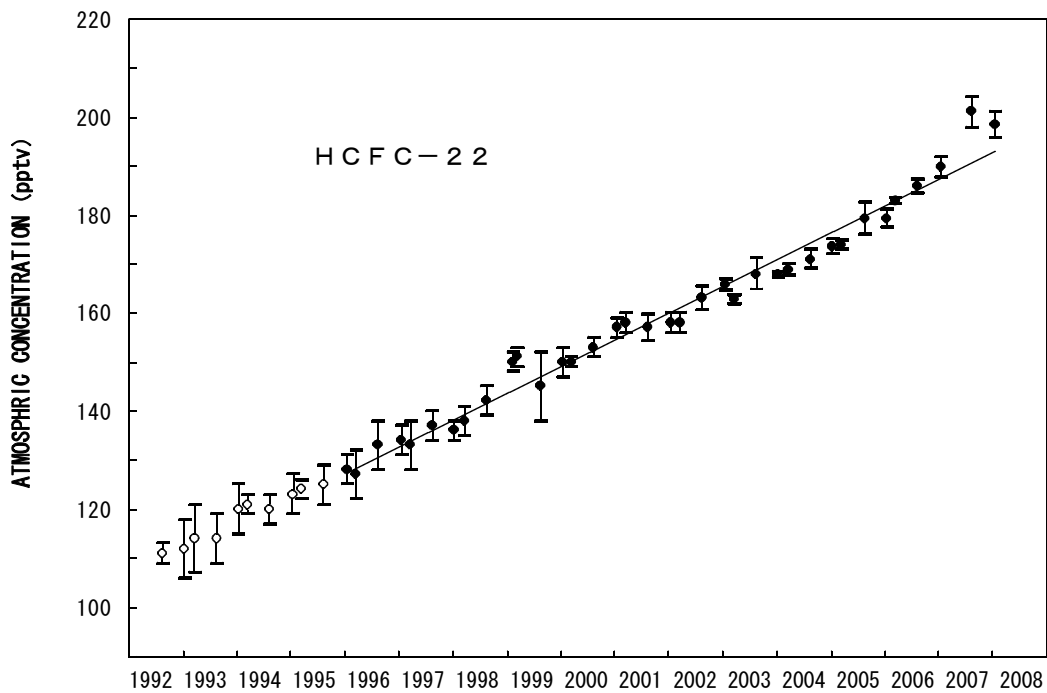


Figure 4.2.11. Long-term trend in HCFC-22 concentrations in Hokkaido fitted with a regression line
 Circles represent means for 4-6 samples (solid circles "●" represent the means within the evaluation period, open circles "○" represent the means out of the period), error bars represent ranges of the standard deviation.

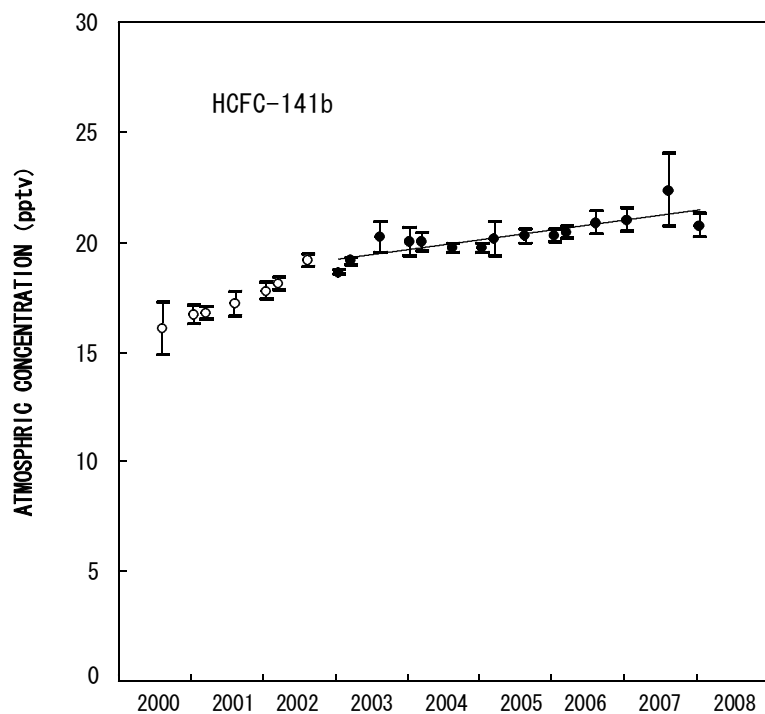


Figure 4.2.12. Long-term trend in HCFC-141b concentrations in Hokkaido fitted with a regression line
 Circles represent means for 6 samples (solid circles "●" represent the means within the evaluation period, open circles "○" represent the means out of the period), error bars represent ranges of the standard deviation.

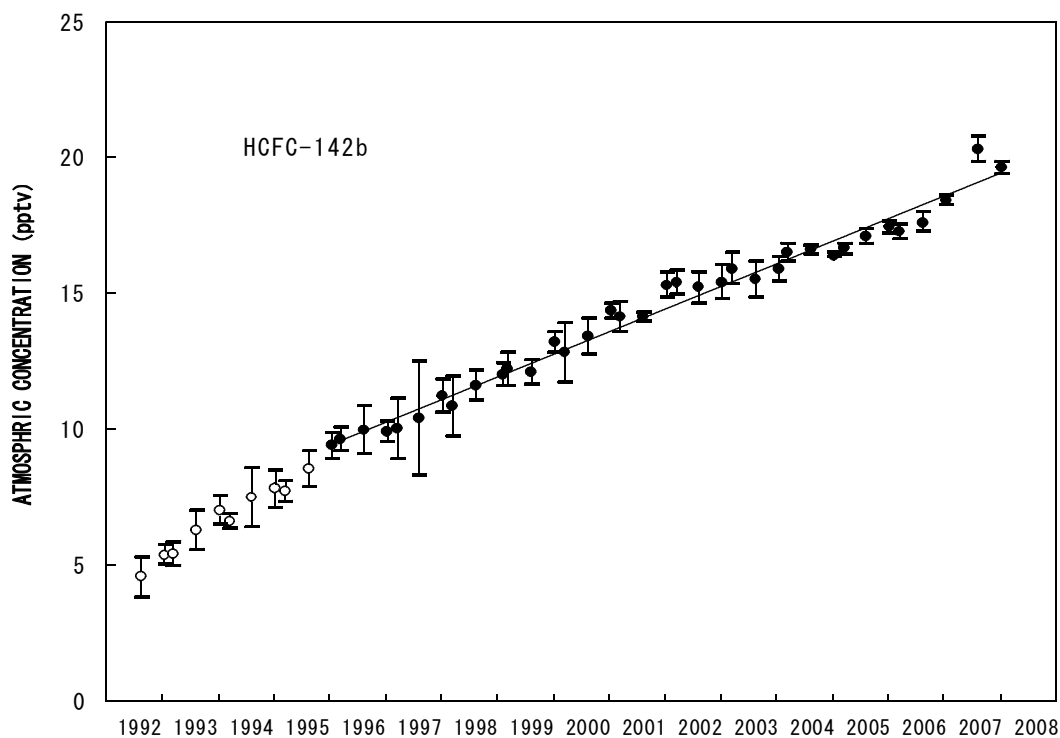


Figure 4.2.13. Long-term trend in HCFC-142b concentrations in Hokkaido fitted with a regression line
 Circles represent means for 2-6 samples (solid circles "●" represent the means within the evaluation period, open circles "○" represent the means out of the period), error bars represent ranges of the standard deviation.

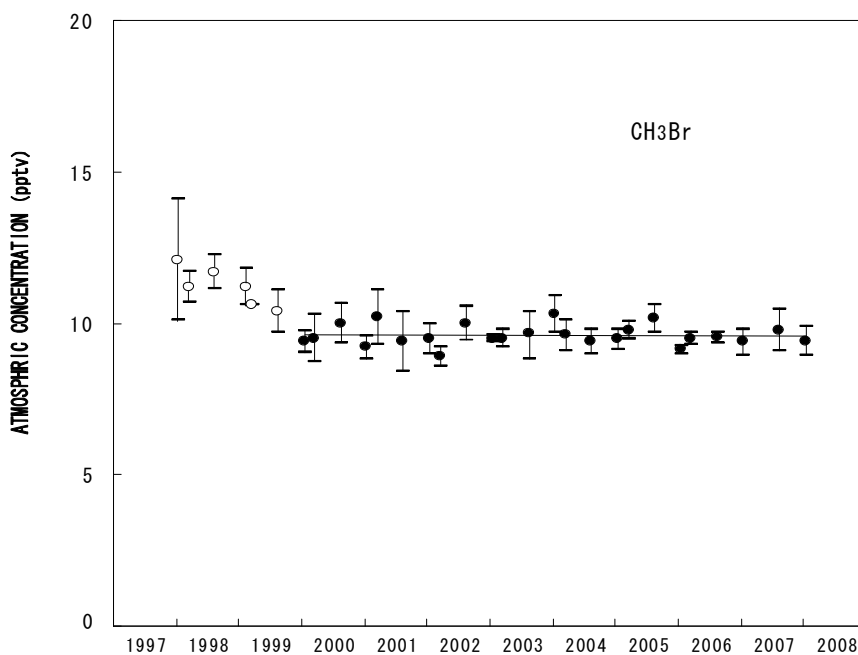


Figure 4.2.14. Long-term trend in methyl bromide concentrations in Hokkaido fitted with a regression line
 Circles represent means for 3-6 samples (solid circles "●" represent the means within the evaluation period, open circles "○" represent the means out of the period), error bars represent ranges of the standard deviation.

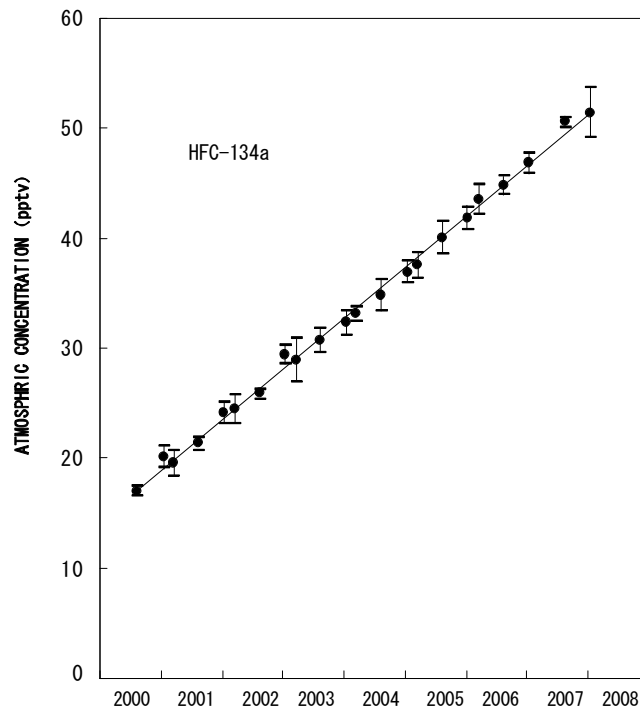


Figure 4.2.15. Long-term trend in HFC-134a concentrations in Hokkaido fitted with a regression line
 Circles represent means for 4-6 samples (solid circles "●" represent the means within the evaluation period, open circles "○" represent the means out of the period), error bars represent ranges of the standard deviation.

(5) Estimation of the Impact of the Measured Substances on the Ozone Layer

To estimate the effect of the measured substances on the ozone layer, products between the concentrations and the ozone depleting potential of each substance (ODP values, (13)) were calculated. The product between the concentration in the background area in January 1993 and January 2007 and the ODP value of the measured substances are shown in **Table 4.5** and the plots are shown in **Figure 4.3**. Since its ODP value is estimated to be approximately 0, HFC-134a was excluded. Since methyl bromide and HFC-134a were added to the program later than August 1992, these two substances were excluded as well. The atmospheric concentrations of CFC-11, CFC-113, and 1,1,1-trichloroethane reached peaks in around 1993, and these concentrations began to decline thereafter. Although CFC-12 has not yet reached a peak, the concentration x ODP value reached a peak around 1993.

The decline in the concentrations of CFC-11, CFC-113, carbon tetrachloride, and 1,1,1-trichloroethane has reduced the sum of the concentration x ODP value, however, the growth in the concentrations of CFC-12, halons, and HCFCs has raised the sum. The decline was greater than the growth as a whole, and the sum of the concentration x ODP value has decreased at present compared to 1993 as a result.

Table 4.5. Products between concentrations and ODP values of measured substances (Comparisons between January 1993 and January 2008)

Substance	Time	Jan. 1993		Jan. 2008	
	ODP value	Concentration (pptv)	Conc. × ODP value	Concentration (pptv)	Conc. × ODP value
CFC-11	1.0	271	271	241	241
CFC-12	1.0	530	530	544	544
CFC-113	0.8	84.6	68	77.1	62
CFC-114	1.0	14.9	15	14.9	15
CFC-114a	1.0	1.00	1	1.02	1
CFC-115	0.6	7.02	4	9.01	5
Halon-1211	3.0	3.38	10	4.64	14
Halon-1301	10.0	2.56	26	3.36	34
Halon-2402	6.0	0.51	3	0.46	3
Carbon tetrachloride	1.1	110	121	95.6	105
1,1,1-Trichloroethane	0.1	177	18	14.5	1
HCFC-22	0.055	112	6	198	11
HCFC-141b	0.11	-	-	20.7	(2)
HCFC-142b	0.065	5.35	0	19.7	1
Methyl bromide	0.6	-	-	9.4	(6)
Sum of concentration × ODP value (Note)			1,073	-	1,037

Note) HCFC-141b and methyl bromide are excluded from the summation.

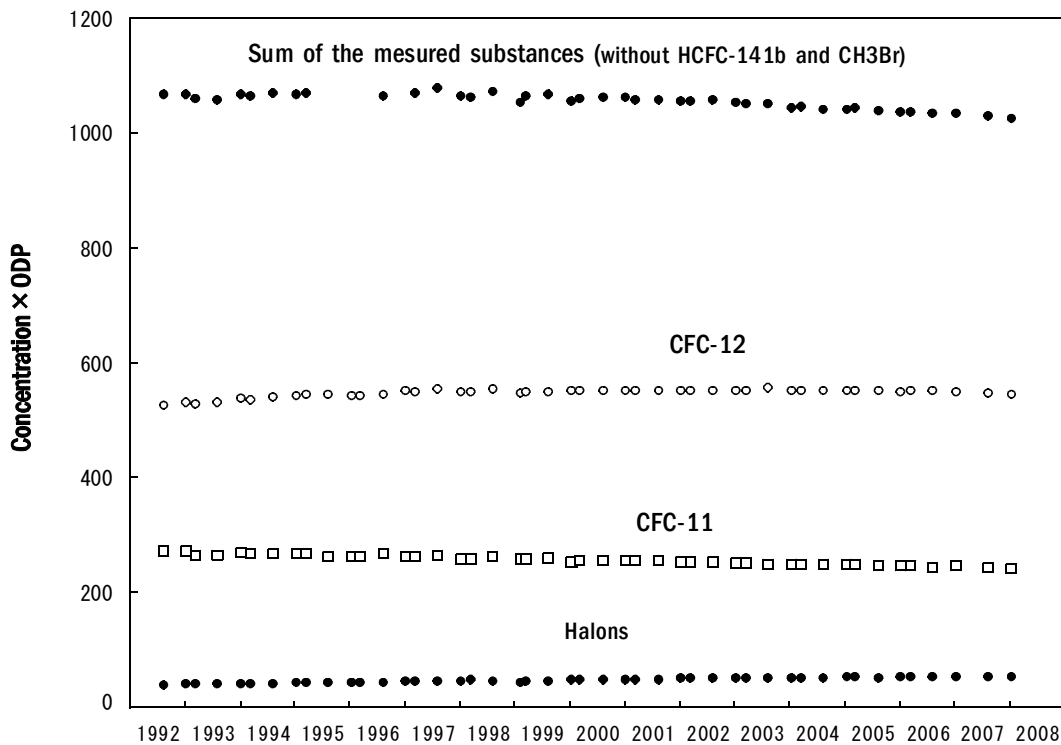


Figure 4.3. Plots of CFC-11 equivalent concentrations of the measured substances (1989 - 2008) (Product between atmospheric concentrations and the ozone depleting potentials (ODP values))

4.2. RESULTS IN URBAN AREA

(1) Results of Automatic Measurements

Monthly and annual medians, means, 20% values, 80% values, maximum values, and numbers of the valid data for CFC-11, CFC-12, HCFC-22, HCFC-141b, HCFC-142b, methyl bromide, and HFC-134a calculated from the results of the measurements achieved by the use of the automatic measuring apparatus obtained during March 2007-February 2008 are shown in **Table 4.6.1-Table 4.6.7**. The "median" is a value of the "0.5 x N"th result of the N results arranged in order of size. The "20% value" is a value of the "0.2 x N"th result and "80% value" is a value of the "0.8 x N"th results of the N results arranged in ascending order, respectively.

(A) CFC-11

The annual median, mean, and number of valid results for CFC-11 were 0.31 ppbv, 0.31 ppbv, and 1,474, respectively. The annual maximum value was 2.1 ppbv. The annual 20% value was 0.28 ppbv. The annual median and the 20% value did not differ largely from those of the previous fiscal year. The annual median and the 20% value approached the background level and this indicates that emissions of this substance into the air decreased as a whole. However, the annual 80% value was 0.33 ppbv, and this value is still large. Although not frequently, concentrations that reached several times the background level were detected. This indicates that emissions of this substance still continue.

(B) CFC-12

The annual median, mean, and number of valid results of CFC-12 was 0.59 ppbv, 0.60 ppbv, and 1,477, respectively. High concentrations which reached several ppbv were sometimes detected. This indicates that isolated emission of this substance still continues.

(C) HCFC-22

The annual median, mean, and number of valid results for HCFC-22 were 0.68 ppbv, 2.5 ppbv, and 1,477, respectively. The annual median exceeded three times the background level (= 0.2 ppbv). The annual 20% value was several times the background level. Extremely high concentrations were frequently detected. This indicates that a large amount of this substance is being discharged in the urban area.

(D) HCFC-141b

The annual median, mean, and number of valid results for HCFC-141b were 0.077 ppbv, 0.113 ppbv, and 1,474, respectively. The annual median closed to four times the background level (= 0.02 ppbv). The annual 20% value exceeded twice the background level. This indicates that a considerable amount of this substance is being discharged in the urban area.

(E) HCFC-142b

The annual median, mean, and number of valid results for HCFC-142b were 0.030 ppbv, 0.034 ppbv, and 1,477, respectively. The annual 20% value was close to the background level (= 0.02 ppbv). This indicates that this substance is being discharged in the urban area, although the amount of the emissions is little.

(F) Methyl Bromide

The annual median, mean, and number of valid results for methyl bromide were 0.013 ppbv, 0.026

ppbv, and 1,452, respectively. The annual 20% value was closed to the background level (= 0.009 ppbv). This indicates that this substance is being discharged in the urban area, although the amount of the emissions is little.

(G) HFC-134a

The annual median, mean, and number of valid results for HFC-134a were 0.14 ppbv, 0.33 ppbv, and 1,477, respectively. The annual median closed to three times the background level (= 0.05 ppbv). This indicates that a large amount of this substance is being discharged in the urban area.

Table 4.6.1. Statistical summaries of concentrations of the measured substances in air of urban area obtained through the automatic measurements (CFC-11) (Unit : ppbv)

Period of Calculation	Median	Mean	20%Value	80%Value	Maximum	n
March 2007	0.29	0.29	0.26	0.32	0.33	16
April 2007	0.29	0.29	0.28	0.30	0.34	132
May 2007	0.30	0.31	0.29	0.32	0.55	118
June 2007	0.31	0.34	0.29	0.34	0.56	100
July 2007	0.32	0.34	0.29	0.34	2.1	126
August 2007	0.32	0.35	0.29	0.36	0.90	149
September 2007	0.34	0.30	0.32	0.38	0.72	129
October 2007	0.29	0.32	0.27	0.32	0.44	142
November 2007	0.32	0.29	0.30	0.35	0.42	143
December 2007	0.28	0.28	0.26	0.31	1.7	133
January 2008	0.27	0.32	0.26	0.28	0.86	149
February 2008	0.32	0.32	0.30	0.32	0.41	137
March 2007-February 2008	0.31	0.31	0.28	0.33	2.1	1,474

Note 1) "Median" is a value of the "0.5 x N"th result of the N results arranged in order of size. The "20% value" is a value of the "0.2 x N"th result and the "80% value" is a value of the "0.8 x N"th results of the N results arranged in ascending order, respectively. (Hereafter the same.)

Note 2) "n" is the number of valid results.

Table 4.6.2. Statistical summaries of concentrations of the measured substances in air of urban area obtained through the automatic measurements (CFC-12) (Unit : ppbv)

Period of Calculation	Median	Mean	20%Value	80%Value	Maximum	n
March 2007	0.56	0.55	0.52	0.57	0.62	16
April 2007	0.56	0.56	0.54	0.57	0.60	132
May 2007	0.58	0.58	0.56	0.60	0.82	118
June 2007	0.58	0.57	0.55	0.60	0.64	91
July 2007	0.61	0.61	0.58	0.63	0.84	126
August 2007	0.59	0.60	0.58	0.61	0.77	149
September 2007	0.64	0.64	0.61	0.67	0.86	129
October 2007	0.58	0.59	0.56	0.61	0.73	142
November 2007	0.58	0.59	0.56	0.60	0.89	143
December 2007	0.58	0.59	0.56	0.61	2.2	135
January 2008	0.58	0.59	0.57	0.60	0.71	149
February 2008	0.65	0.67	0.63	0.68	1.4	137
March 2007-February 2008	0.59	0.60	0.56	0.63	2.2	1,467

Table 4.6.3. Statistical summaries of concentrations of the measured substances in air of urban area obtained through the automatic measurements (HCFC-22) (Unit : ppbv)

Period of Calculation	Median	Mean	20%Value	80%Value	Maximum	n
March 2007	0.58	0.69	0.46	0.85	1.1	16
April 2007	0.80	0.88	0.62	1.1	4.2	132
May 2007	0.72	0.86	0.47	1.1	3.7	118
June 2007	0.48	0.54	0.35	0.71	1.1	101
July 2007	0.60	0.70	0.42	0.83	4.6	126
August 2007	0.44	0.56	0.34	0.73	2.5	149
September 2007	0.51	0.67	0.35	0.80	5.5	129
October 2007	0.63	0.80	0.46	0.94	3.8	142
November 2007	2.8	2.9	2.0	3.6	7.0	143
December 2007	0.62	0.99	0.42	1.3	4.9	135
January 2008	0.54	0.68	0.41	0.83	3.3	149
February 2008	19.2	17.4	1.0	29	47	137
March 2007-February 2008	0.68	2.5	0.42	1.6	47	1,477

Table 4.6.4. Statistical summaries of concentrations of the measured substances in air of urban area obtained through the automatic measurements (HCFC-141b) (Unit : ppbv)

Period of Calculation	Median	Mean	20%Value	80%Value	Maximum	n
March 2007	0.043	0.052	0.037	0.061	0.10	16
April 2007	0.055	0.066	0.042	0.078	0.31	132
May 2007	0.066	0.091	0.046	0.105	0.81	118
June 2007	0.062	0.075	0.039	0.094	0.68	100
July 2007	0.077	0.105	0.052	0.143	0.87	126
August 2007	0.055	0.078	0.037	0.100	0.43	149
September 2007	0.071	0.100	0.044	0.114	0.89	129
October 2007	0.088	0.157	0.061	0.189	2.2	142
November 2007	0.263	0.266	0.184	0.34	0.70	143
December 2007	0.090	0.117	0.039	0.173	0.77	133
January 2008	0.050	0.067	0.031	0.096	0.29	149
February 2008	0.107	0.108	0.051	0.141	0.33	137
March 2007-February 2008	0.077	0.113	0.044	0.158	2.2	1,474

Table 4.6.5. Statistical summaries of the concentrations of the measured substances in air of urban area obtained through the automatic measurements (HCFC-142b) (Unit : ppbv)

Period of Calculation	Median	Mean	20%Value	80%Value	Maximum	n
March 2007	0.023	0.026	0.021	0.028	0.046	16
April 2007	0.024	0.025	0.022	0.027	0.051	132
May 2007	0.028	0.031	0.025	0.034	0.074	118
June 2007	0.027	0.031	0.024	0.035	0.080	101
July 2007	0.032	0.036	0.026	0.042	0.27	126
August 2007	0.031	0.036	0.026	0.043	0.111	149
September 2007	0.031	0.036	0.027	0.041	0.101	129
October 2007	0.031	0.035	0.027	0.042	0.077	142
November 2007	0.039	0.043	0.032	0.051	0.084	143
December 2007	0.033	0.035	0.024	0.043	0.134	135
January 2008	0.026	0.030	0.023	0.035	0.079	149
February 2008	0.032	0.033	0.029	0.037	0.063	137
March 2007-February 2008	0.030	0.034	0.025	0.040	0.27	1,477

Table 4.6.6. Statistical summaries of concentrations of the measured substances in air of the urban area obtained through the automatic measurements (Methyl bromide) (Unit : ppbv)

Period of Calculation	Median	Mean	20%Value	80%Value	Maximum	n
March 2007	0.017	0.025	0.012	0.024	0.096	16
April 2007	0.013	0.018	0.012	0.017	0.166	119
May 2007	0.014	0.017	0.012	0.019	0.057	118
June 2007	0.013	0.021	0.011	0.016	0.58	101
July 2007	0.015	0.066	0.012	0.022	5.8	126
August 2007	0.014	0.016	0.011	0.018	0.093	149
September 2007	0.014	0.018	0.012	0.020	0.075	129
October 2007	0.013	0.017	0.011	0.017	0.36	142
November 2007	0.014	0.018	0.011	0.018	0.46	143
December 2007	0.014	0.071	0.011	0.020	6.7	123
January 2008	0.011	0.013	0.010	0.014	0.056	149
February 2008	0.012	0.015	0.011	0.015	0.132	137
March 2007-February 2008	0.013	0.026	0.011	0.018	6.7	1,452

Table 4.6.7. Statistical summaries of concentrations of the measured substances in air of urban area obtained through the automatic measurements (HFC-134a) (Unit : ppbv)

Period of Calculation	Median	Mean	20%Value	80%Value	Maximum	n
March 2007	0.136	0.171	0.085	0.173	0.66	16
April 2007	0.111	0.47	0.079	0.26	24	132
May 2007	0.105	0.39	0.077	0.20	28	118
June 2007	0.106	0.170	0.069	0.161	3.7	101
July 2007	0.136	0.23	0.091	0.28	2.6	126
August 2007	0.130	0.184	0.081	0.25	1.12	149
September 2007	0.131	0.36	0.093	0.25	11.0	129
October 2007	0.131	0.22	0.093	0.22	4.6	142
November 2007	0.23	0.70	0.149	0.44	38	143
December 2007	0.177	0.30	0.084	0.35	3.8	135
January 2008	0.110	0.192	0.073	0.20	4.3	149
February 2008	0.154	0.40	0.100	0.36	8.3	137
March 2007-February 2008	0.136	0.33	0.086	0.28	38	1,477

(2) Changes in Concentrations of Measured Substances in Urban Area

The summarized annual results of the concentrations of measured substances in the urban area from March 1991 to February 2007 measured using an automatic measuring apparatus are shown in **Table 4.7.1 - 4.7.2**. The results shown in these tables are calculated from the measured concentrations obtained in the period of a fiscal year from March 2006 to the following February. The plots of the monthly statistics on the concentrations of CFC-11 and CFC-12 in the period mentioned above are shown in **Figure 4.4**. Among the statistical results shown in **Table 4.7.1 - 4.7.2**, the medians of CFC-11 and CFC-12 obtained in recent years approach the background levels and have been almost stable since 1993. Since other substances have been observed from the previous year, their behavior in terms of variation in the concentrations is not well known. The medians of concentrations of almost all these substances are about twice the background level.

Table 4.7.1. Annual summaries of concentrations of the measured substances in air of urban area obtained through the automatic measurements (CFC-11 and CFC-12) (Unit : ppbv)

Period	CFC-11				CFC-12			
	Median	80% Value	20% Value	n	Median	80% Value	20% Value	n
Mar 1991 - Feb 1992	0.42	0.57	0.35	3,880	0.72	1.0	0.59	3,905
Mar 1992 - Feb 1993	0.37	0.51	0.30	4,194	0.65	0.88	0.55	4,195
Mar 1993 - Feb 1994	0.32	0.39	0.29	4,297	0.56	0.76	0.54	4,296
Mar 1994 - Feb 1995	0.30	0.38	0.27	4,101	0.61	0.78	0.55	4,100
Mar 1995 - Feb 1996	0.30	0.37	0.27	4,024	0.59	0.67	0.55	4,015
Mar 1996 - Feb 1997	0.28	0.32	0.26	4,065	0.57	0.65	0.54	4,064
Mar 1997 - Feb 1998	0.28	0.30	0.26	3,718	0.60	0.72	0.54	3,727
Mar 1998 - Feb 1999	0.28	0.32	0.26	3,023	0.63	0.76	0.54	3,020
Mar 1999 - Feb 2000	0.29	0.32	0.27	4,159	0.60	0.70	0.57	4,159
Mar 2000 - Feb 2001	0.30	0.33	0.28	3,812	0.58	0.64	0.56	3,809
Mar 2001 - Feb 2002	0.29	0.33	0.28	4,220	0.62	0.68	0.58	4,219
Mar 2002 - Feb 2003	0.29	0.32	0.28	4,162	0.59	0.63	0.57	4,159
Mar 2003 - Feb 2004	0.28	0.31	0.27	4,304	0.58	0.61	0.56	4,304
Mar 2004 - Feb 2005	0.28	0.31	0.27	4,195	0.57	0.60	0.56	4,193
Mar 2005 - Feb 2006	0.28	0.30	0.27	4,012	0.57	0.59	0.55	4,009
Mar 2006 - Feb 2007	0.29	0.36	0.27	1,519	0.57	0.61	0.53	1,516
Mar 2007 - Feb 2008	0.31	0.33	0.28	1,474	0.59	0.63	0.56	1,467

Note 1) The "median" is a value of the "0.5 x N"th result of the N results arranged in order of size. The "20% value" is a value of the "0.2 x N"th result and "80% value" is a value of the "0.8 x N"th results of the N results arranged in ascending order, respectively. (Hereafter the same.)

Note 2) The "n" is the number of valid results.

Table 4.7.2. Annual summaries of concentrations of the measured substances in air of urban area obtained through the automatic measurements (HCFC-22, HCFC-141b, HCFC-142b, methyl bromide, and HFC-134a) (Unit : ppbv)

Period	HCFC-22				HCFC-141b			
	Median	80% Value	20% Value	n	Median	80% Value	20% Value	n
Mar 2006 - Feb 2007	0.65	1.1	0.42	1,519	0.075	0.14	0.047	1,519
Mar 2007 - Feb 2008	0.68	1.6	0.42	1,477	0.077	0.16	0.044	1,474

Period	HCFC-142b				Methyl bromide			
	Median	80% Value	20% Value	n	Median	80% Value	20% Value	n
Mar 2006 - Feb 2007	0.028	0.037	0.022	1,519	0.022	0.035	0.015	1,519
Mar 2007 - Feb 2008	0.030	0.040	0.025	1,477	0.013	0.018	0.011	1,452

Period	HFC-134a			
	Median	80% Value	20% Value	n
Mar 2006 - Feb 2007	0.090	0.28	0.042	1,519
Mar 2007 - Feb 2008	0.136	0.28	0.086	1,477

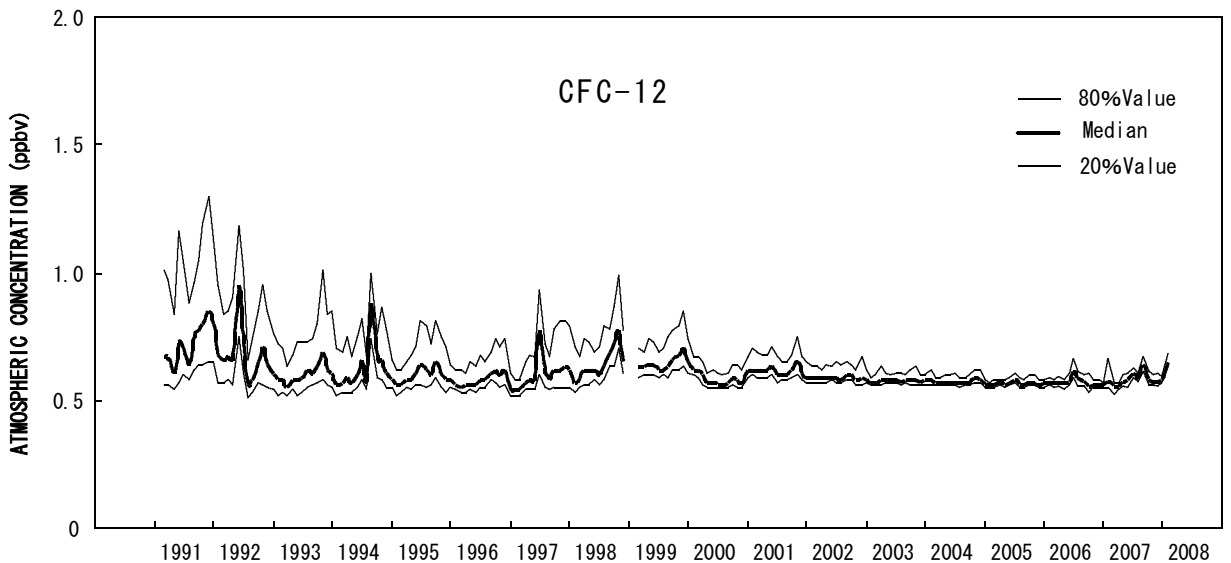
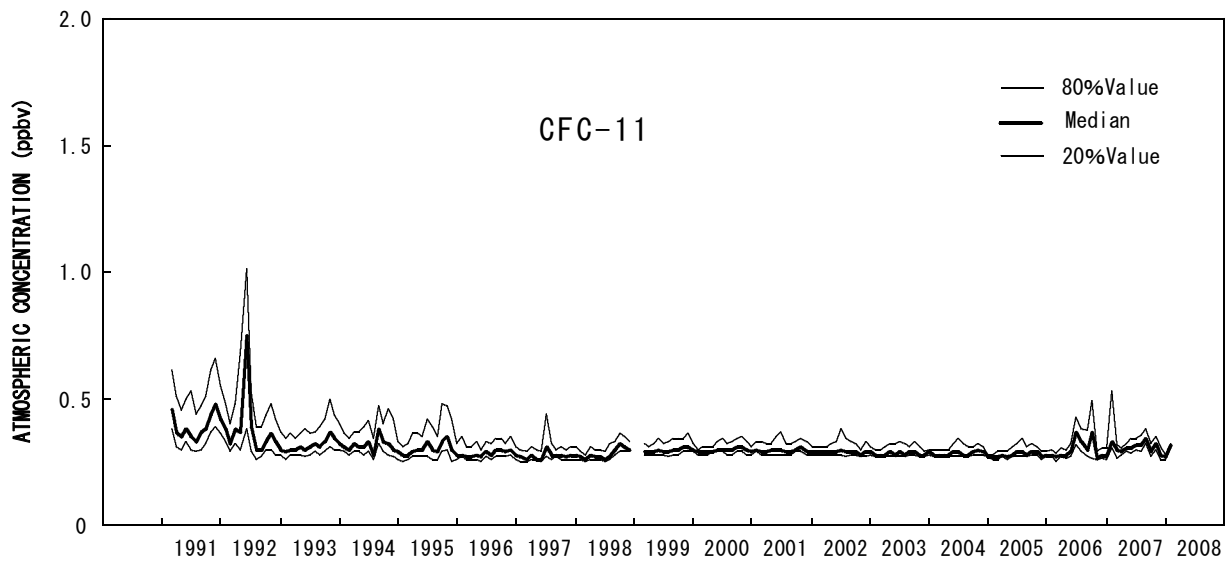


Figure 4.4.1 Monthly concentrations of CFC-11 and CFC-12 in urban air (Kawasaki) March 1991-February 2008. Solid thick line represents median, the upper and lower solid thin lines represent 60% ranges.

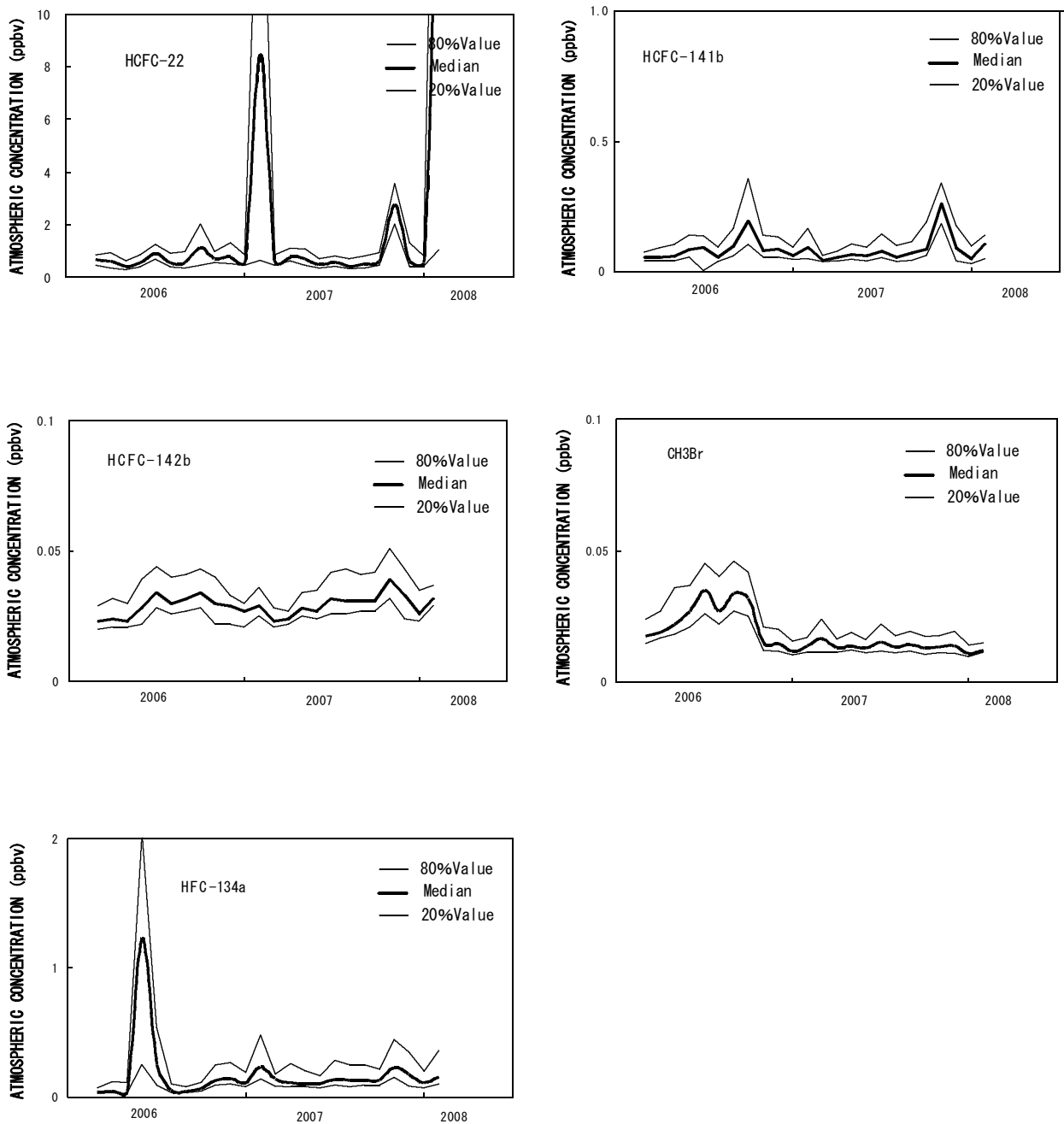


Figure 4.4.2. Monthly concentrations of HCFC-22, HCFC-141b, HCFC-142b, methyl bromide, and HFC-134a in urban air (Kawasaki) March 2006 - February 2008. Solid thick line represents median, the upper and lower solid thin lines represent 60% ranges.

(3) Relationship between the concentrations and wind direction in urban area

To examine the relationship between the atmospheric concentrations of the measured substances and the wind direction, mean concentrations according to wind direction were calculated from the one year of measurements obtained from March 2007 to February 2008 using the automatic measurement equipment. The results are plotted on the 16-point wind directions in Figure 4.5. The averages are used in the analysis because; 1) averages were used in similar analyses in the previous reports, 2) averages emphasize the differences in the variations in the concentrations more than the medians do.

The following are the results of this analysis described according to the respective substances. The concentration values described here mean the averages of the results of the measurements according to the wind direction (a typical sample number is about 100).

(CFC-11)

The figure of the concentration-wind rose for CFC-11 is almost round. This indicates that there is no significant emission source in a specific direction. The concentrations are close to the background level in any wind direction.

(CFC-12)

The figure of the concentration-wind rose for CFC-12 is almost round. This indicates that there is no significant emission source in a specific direction. The concentrations are close to the background level in any wind direction.

(HCFC-22)

The figure of the concentration-wind rose for HCFC-22 is not round. The concentrations rise higher in the northwest ~ north and southwest directions. The highest concentration exceeds 30 times the background level. In the southwest direction, the concentration is the lowest, however it is still three times the background level.

(HCFC-141b)

The figure of the concentration-wind rose for HCFC-141b is not round. The concentrations rise higher in the west ~ north and northeast ~ east directions. In the southwest direction, the concentration is the lowest, however, it is still three times the background level.

(HCFC-142b)

The atmospheric concentrations of HCFC-142b slightly rise in west ~ northwest direction. The concentrations are stable in the other directions and they are close to the background level.

(Methyl bromide)

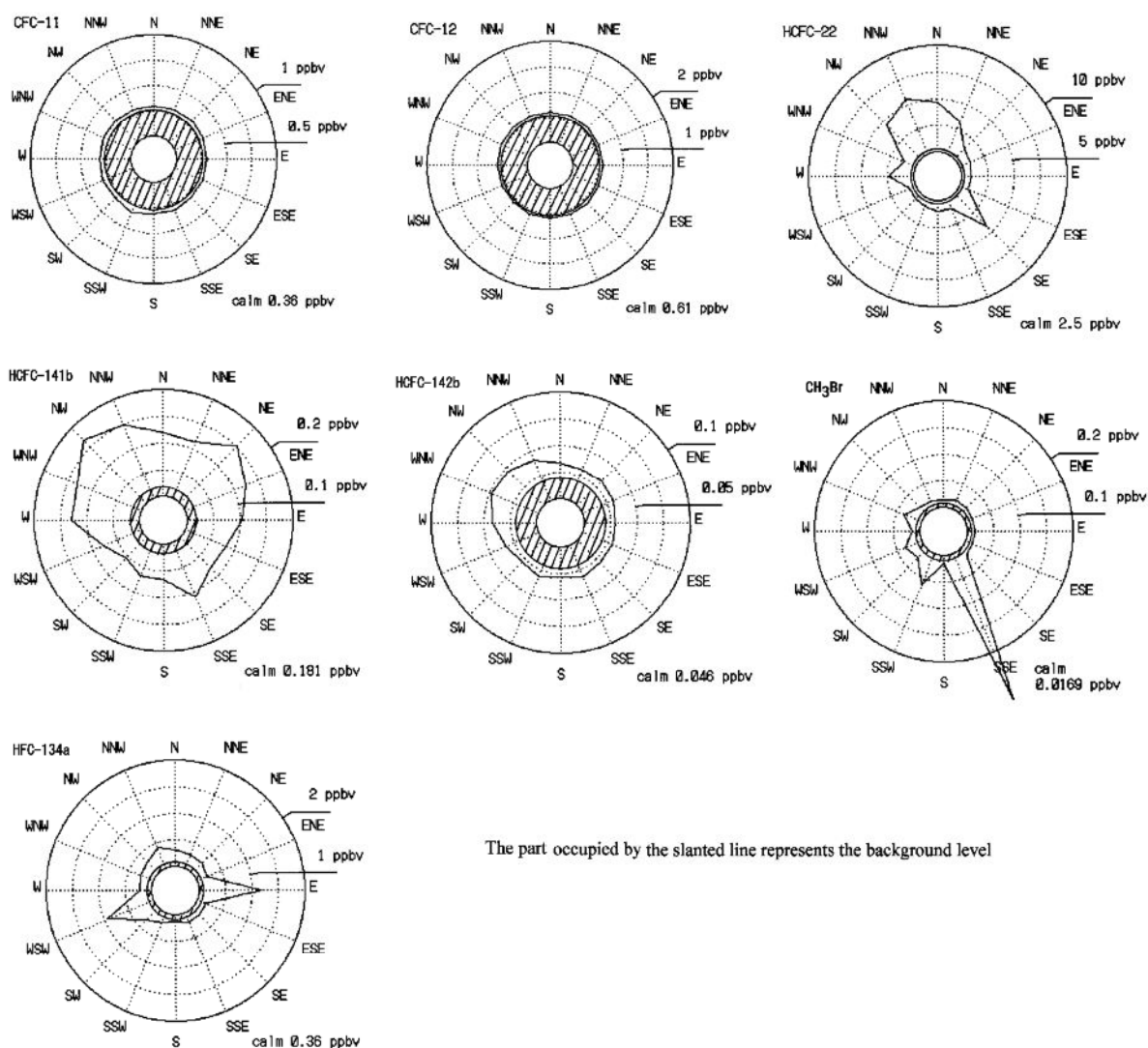
The figure of the concentration-wind rose for methyl bromide is not round. It has a sharp and high peak in the south-southeast direction. It also has some small peaks in the south-southwest ~ west-northwest direction. The concentrations are close to the background level in the other directions.

(HFC-134a)

The figure of the concentration-wind rose for HFC-134a is not round. It has sharp peaks in the east, west-southwest, and northwest directions. No significant peak is found in other directions, however, the concentrations are obviously higher than the background level.

To examine the relationship between the concentrations of the measured substances and the wind direction, the mean concentrations were calculated from the one year of measurements according to wind direction and analyzed. Almost no variation was found in the atmospheric concentrations of CFC-11 and CFC-12 depending upon the wind direction. This indicates that there is no significant emission source of these substances in this area and few emission sources that are gathered in a specific direction. The analysis

assumed that the amount of HCFC-142b being emitted in the area is not so large, but that large amounts of HCFC-22, HCFC-141b, and HFC-134a are being emitted in the area while a not so large amount of methyl bromide is being emitted from a specific and small area.



The part occupied by the slanted line represents the background level

Figure 4.5. The atmospheric concentration-distributions of the measured substances in the urban area according to wind direction (mean values, March 2007-February 2008)

(4) Relationship between the concentrations and time of day in urban area

To examine the relationship between the atmospheric concentrations of the measured substances and the time of day, the medians of the concentrations according to the hour of the day were calculated from the one year of measurements obtained from March 2007 to February 2008 using the automatic measurement equipment. The results are illustrated in Figure 4.6.

The following are the results of this analysis described according to the respective substances. The concentration values described here mean the medians of the results of the measurements according to the hour of the day (a typical sample number is about 65).

(CFC-11)

The atmospheric concentrations of CFC-11 vary slightly according to the hour of the day. The concentrations slightly decreased in the afternoons in the daytime.

(CFC-12)

No significant diurnal variation is found in the atmospheric concentrations of CFC-12.

(HCFC-22)

The atmospheric concentrations of HCFC-22 increased before noon in the daytime and decreased between the afternoons of the daytime and the nighttime.

(HCFC-141b)

Diurnal variations are found in the atmospheric concentrations of HCFC-141b. The tendency of the variation is similar to that of HCFC-22.

(HCFC-142b)

Diurnal variations are found in the atmospheric concentrations of HCFC-142b. The tendency of the variation is similar to that of HCFC-22 and of HCFC-141b as well.

(Methyl bromide)

No significant diurnal variation is found in the atmospheric concentrations of methyl bromide.

(HFC-134a)

The atmospheric concentrations of HFC-134a increased in the daytime and decreased in the nighttime. The concentrations of HCFCs showed a difference between before noon of the daytime and the afternoon of the daytime, but this substance showed no tendency like this.

To examine the relationship between the concentrations and the time of day, the medians of the concentrations according to the hour were calculated from the one year of measurements and analyzed. The diurnal variations in the atmospheric concentrations of CFC-11 and CFC-12 are small because the amounts from the emission of these substances are expected to be small in this area. The diurnal variation in the atmospheric concentrations of methyl bromide is small as well. The atmospheric concentrations of HCFCs and HFC-134a varied depending upon the hour of the day. They increased in the daytime hours and decreased in the nighttime hours. The differences in the concentrations between the daytime and nighttime hours are smaller than expected. These results must be understood as involving; 1) differences in the amounts of emissions between the daytime and nighttime hours, 2) delays in the variation of the concentrations that are described in the next section, 3) differences in meteorological conditions. The atmospheric concentrations of HCFCs showed a tendency to decrease in the afternoon of the daytimes. Since these simple hourly statistical calculations will be affected by differences in the meteorological conditions between the daytime and the nighttime, these results must be considered as involving both the emissions and the meteorological conditions.

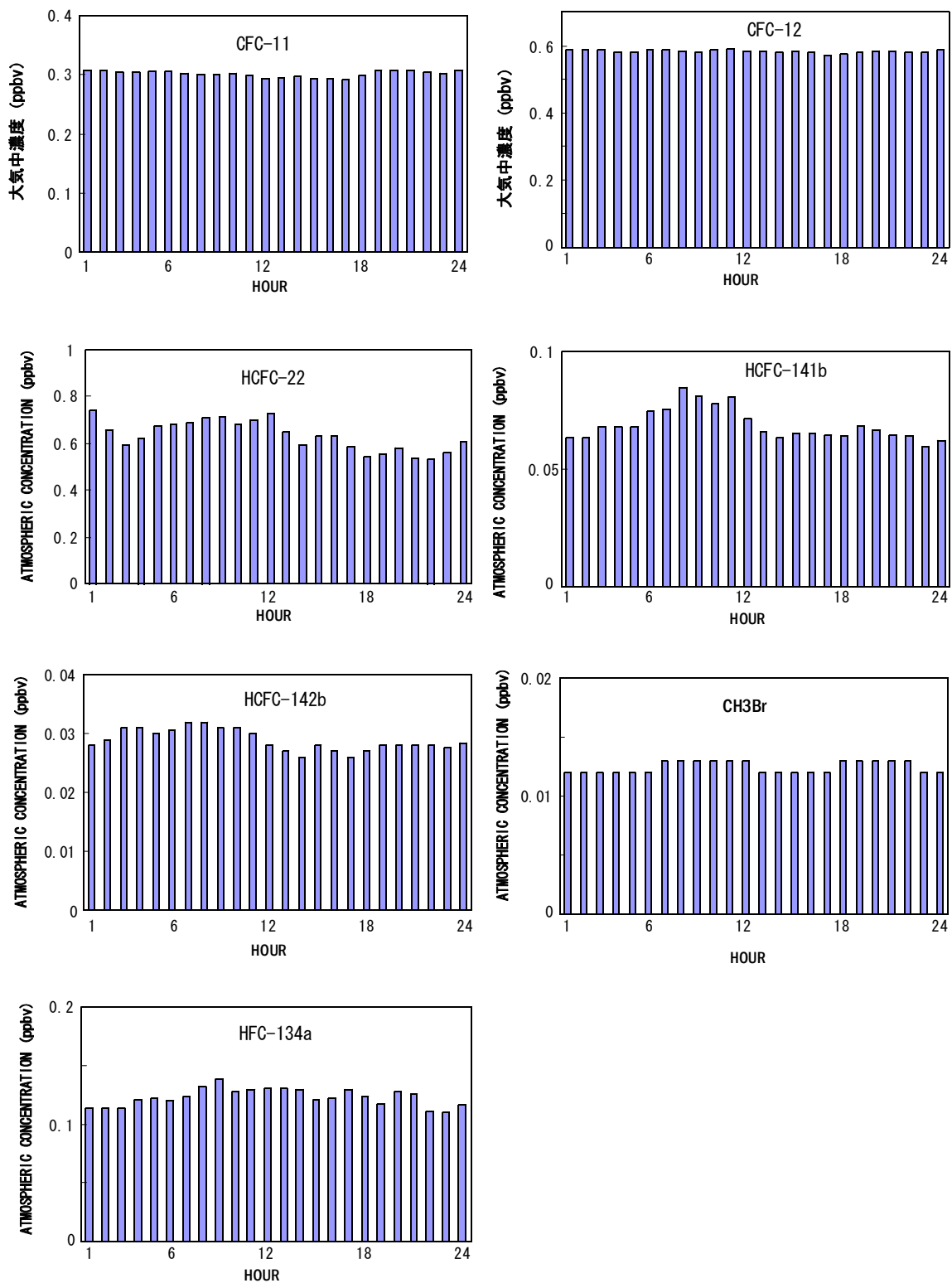


Figure 4.6. Diurnal variations of the atmospheric concentrations of the measured substances in the urban area (medians, March 2007-February 2008)

(5) Relationship between the concentrations and the days of the week in urban area

To examine the relationship between the atmospheric concentrations of the measured substances and the days of the week, the medians of the concentrations according to each day of the week are calculated from the one year of measurements obtained from March 2007 to February 2008 using the automatic measurement equipment. The results are illustrated in Figure 4.7.

The following are the results of this analysis described according to the respective substances. The concentration values described here mean the medians of the results of the measurements according to the day of the week (the typical sample number is about 220).

(CFC-11)

The atmospheric concentrations of CFC-11 slightly decreased from Sundays to Mondays, but the tendency of the variations is not obvious.

(CFC-12)

No significant variation is found in the atmospheric concentrations of CFC-12 from Sundays to Mondays.

(HCFC-22)

The atmospheric concentrations of HCFC-22 obviously decreased on Sundays.

(HCFC-141b)

The atmospheric concentrations of HCFC-141b vary over Sundays to Mondays. The tendency of the variation is similar but much more obvious compared to that of HCFC-22.

(HCFC-142b)

The atmospheric concentrations of HCFC-142b only slightly decreased from Sundays to Mondays, but the tendency of the variations is not obvious.

(Methyl bromide)

The atmospheric concentrations of methyl bromide slightly decreased from Saturdays to Mondays.

(HFC-134a)

The atmospheric concentrations of HFC-134a obviously decreased from Saturdays to Mondays.

To examine the relationship between the concentrations and the day of the week, the medians of the concentrations according to the day of the week are calculated from the one year of measurements and analyzed.

Results from the statistical calculations according to the day of the week are expected to not be affected by the meteorological conditions. It is therefore expected that the human activities in this urban area directly resulted in the variations in the atmospheric concentrations calculated according to the day of the week. The variations in the atmospheric concentrations of CFC-11 and CFC-12 from Sundays to Mondays were small. Large amounts of these substances are no longer emitted in this area, thus the results are comprehensible. The atmospheric concentrations of HCFCs, methyl bromide, and HFC-134a vary depending upon the days of the week. They have a tendency to decrease from the weekends to Mondays. These are the results of the variations in emissions according to human activities in this urban area.

The atmospheric concentrations of almost all the substances are obviously lower on Mondays than on the days from Tuesday to Friday, but are rather similar to that on Sundays. Since it is possible to presume that human activities in this urban area are constant from Mondays through to Fridays, these results show that the increased emissions on Mondays raised the concentrations to certain levels with a lag of about one day.

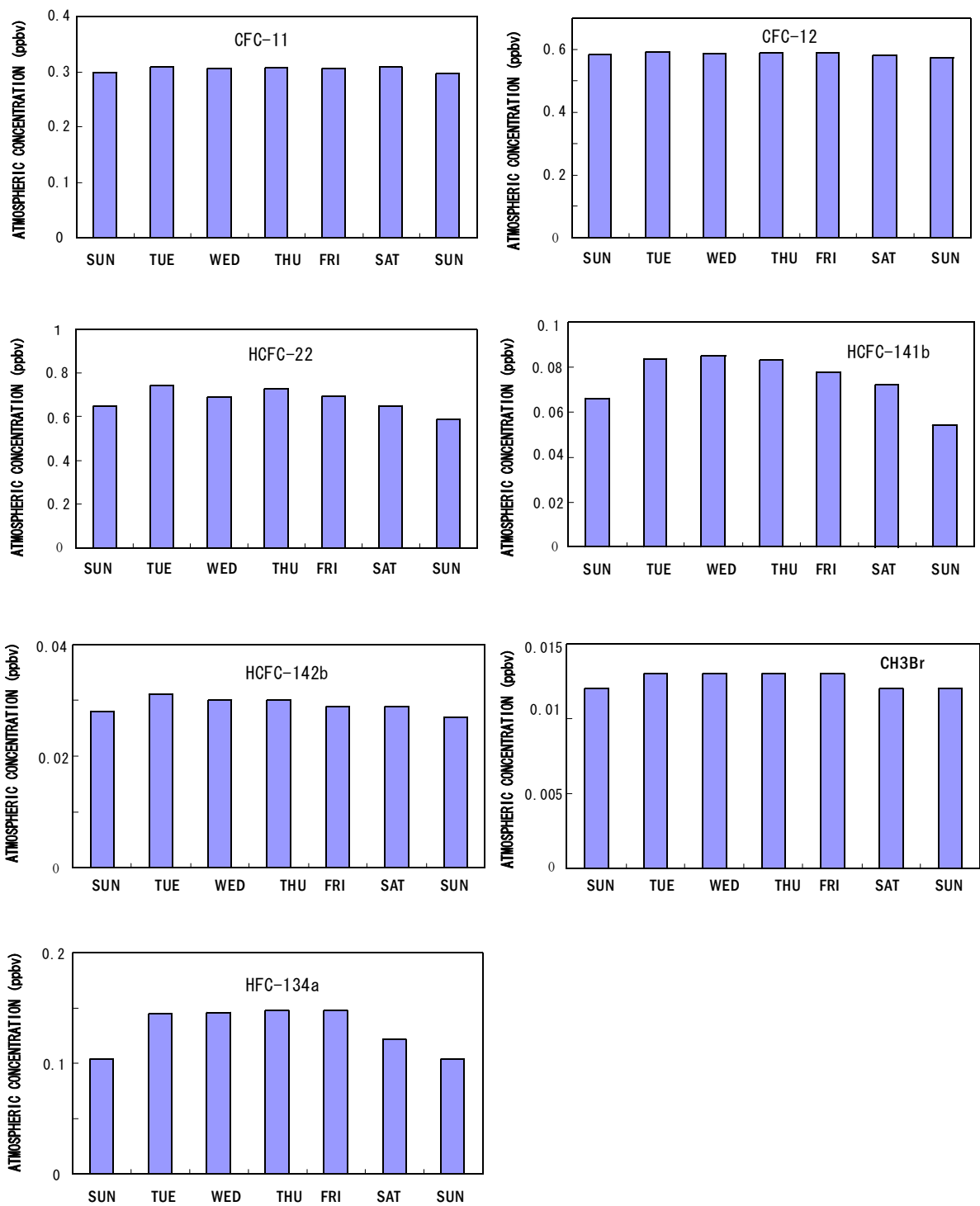


Figure 4.7. Variations of the atmospheric concentrations of the measured substances in the urban area according to the days of the week (medians, March 2007-February 2008)

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6. APPENDICES

APPENDIX A

MEASUREMENT METHODS

CONTENTS

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1. Measurement Method of CFC-11, CFC-113, Carbon tetrachloride, and 1,1,1-Trichloroethane

(GC Analytical Method 1)

(1) Analytical System

A schematic diagram of the analytical system assembled for this method is shown in Figure 1. The analytical system can be roughly divided into two sub-systems, a sample introduction system and a gas chromatograph. The sample introduction equipment is a system which introduces a certain volume of air sample from a sample container into an analytical column through a measuring loop. The sample introduction system was assembled in the JESC laboratory. The gas chromatograph is a Shimadzu GC-14A gas chromatograph equipped with an electron capture detector (ECD).

Stainless steel tubes with 1/8 inches of outside diameter (OD) connect the pressure gauges, the sampling container, the valves and other components. The measuring loop is made of approximately 4 m long glass tube with 5 mm inside diameter (ID). The volume of the measuring loop is 75.73 ml. The whole of the volume of the measuring loop associated with the measurement of sample volume including tubing and other components was estimated to be 80.0 ml. The dryer tube is a stainless steel tube with 3 mm ID, 10 cm long filled with Chromosorb W 30-60 mesh column packing coated with 5w/w% of magnesium perchlorate (Mg(ClO₄)₂). The dryer tube can be re-generated by bake-out at 150 °C for 20 min with a inert gas flow inside. The stop valves are U.S. Nupro Type SS-4H metal bellows valves.

The sample concentration tube is a U-shaped stainless steel tube with 3 mm ID, 20 cm long filled with 0.1g of Chromosorb W 60-80 mesh column packing. Four-port valve 1 is equipped to prevent degradation of the analytical column or the detector by oxygen that passed the sample concentration tube during the sample concentration procedure mentioned below.

The nitrogen carrier gas is introduced to the GC after decompressed from a cylinder and refined via the two gas purifying tubes that are respectively filled with Molecular sieve 5A and Molecular sieve 13X. The carrier gas streams which flow from the flow controllers of the GC are again refined through another two gas purifying tubes.

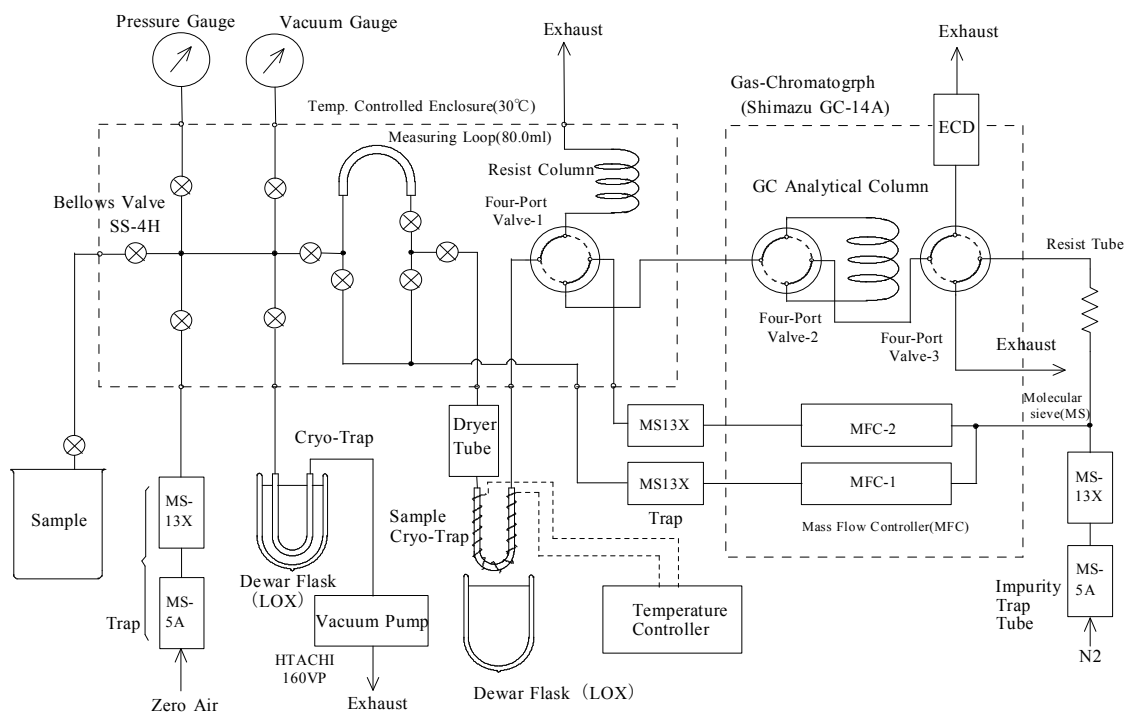


Figure 1. CFCs analytical system (SYSTEM I)

The analytical conditions for the gas chromatography are shown in **Table 1**.

Table 1. Analytical conditions of GC analytical method 1

Term	Condition
Gas chromatograph	Shimadzu GC-14A
Column	DC-550 25 %, Shimalite 101, 60-80 mesh, 3mm ID, 4 m long, stainless steel +OV-101 25%, Shimalite 101, 60-80mesh, 3mm ID, 2 m long, stainless steel
Column oven temp.	30 °C (5 min) to 90 °C, 2 °C/min
Carrier gas	N ₂ , 50 ml/min
Detector	ECD (370 MBq, Ni 63, 220 °C)
Sample volume	28.4 ml (STD)

(2) Analytical Procedures

A sample container was connected to the sample introducing port of the sample introduction equipment, and the sample introduction line and the measuring loop were evacuated to 0.1 mmHg (13 Pa) or less. Approximately 28 ml of the air sample in the sampling container was removed to the measuring loop until the pressure in the loop reached a fixed value (i.e. 300 mmHg or 40 kPa). The sample concentration tube was immersed in liquid oxygen. After the temperature of the tube reached the liquid oxygen temperature, the sample air in the measuring loop was introduced into the sample concentration tube through the operation of the valves. A period of four minutes was necessary to whole of the sample passed the concentration tube by the carrier gas flow. Four-port valve 1 was kept in the bypass position during this procedure. After the concentration procedure was completed, four-port valve 1 was changed to the analysis position and the next procedure was held till the fluctuation of the pressure in the carrier gas settled. The liquid oxygen flask was removed from the sample concentration tube, and the tube was heated to 50 °C. After the gas chromatographic analysis accomplished, the analysis system was left until tetrachloroethylene eluted from the analytical column.

(3) Calculation

A relation curve must once be created beforehand to verify the linearity in the response of the detector in an expected range that would cover a dispersion of sample concentrations. See Chapter 2. **METHOD** in the text of the report for the calibration gas, calculation method of concentrations and others.

2. Measurement Method of CFC-114 (GC Analytical Method 2)

(1) Analytical System

A schematic diagram of the analytical system assembled for this method is shown in **Figure 2**. The analytical system can be roughly divided into two sub-systems, a sample introduction system and a gas chromatograph. Several components in the sample introduction equipment are common to the measuring method of CFCs (**Figure 1**). Sample concentration tube 1, four-port valve 1, and refining of carrier gas and others are the same as GC analytical method 1.

Sample concentration tube 2 is similar to sample concentration tube 1 in the structure and the packing contained with. Four-port valve 2 ejects unnecessary compounds which have been introduced into the precolumn outside of the system by reversion of the gas flow in this column. Four-port valve 3 distributes the eluants from the precolumn into the sample concentration tube 2 or outside. The eight-port valve releases the pressure in the end of the precolumn to the ambient during the re-concentration procedure.

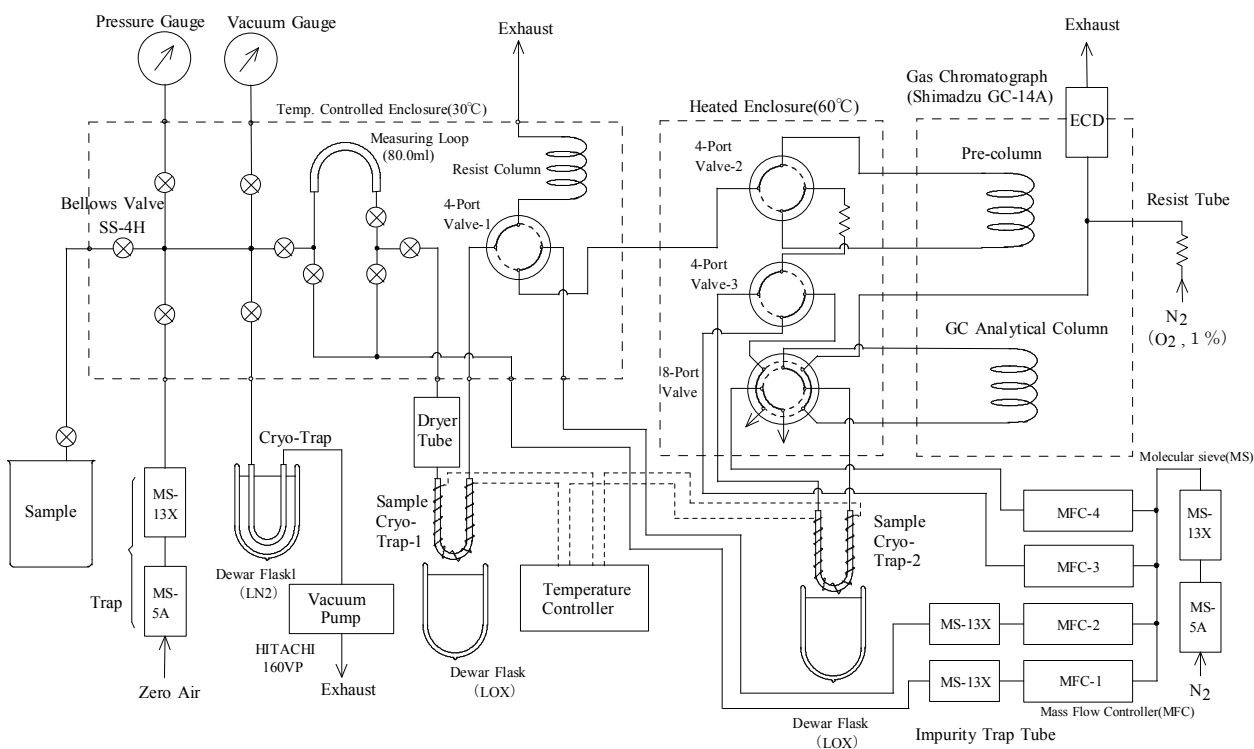


Figure 2. CFC-114 analytical system (SYSTEM II)

The analytical conditions for the gas chromatography are shown in **Table 2**.

Table 2. Analytical conditions of GC analytical method 2

Term		Condition
Pre-treatment	Precolumn	DC-550 25 %, Shimalite 101, 60-80 mesh, 3 mm ID, 4m long, stainless steel
	Column temp.	25 °C
	Carrier gas	N ₂ , 50 ml/min
	Sample volume	113.8 ml (STD)
Analysis	Gas chromatograph	Shimadzu GC-14A
	Analytical column	GS-Alumina, 0.53 mm ID, 50 m long
	Column temp.	60 °C
	Carrier gas	N ₂ , 5 ml/min
	Make-up gas	N ₂ , 45 ml/min
	Detector	ECD (370 MBq, Ni 63, 220 °C)

(2) Analytical procedures

(A) Sample Concentration Procedure

A sample container was connected to the sample introducing port of the sample introduction equipment. The sample introduction line and the measuring loop were evacuated to 0.1 mmHg (13 Pa) or less. Approximately 56 ml of volume of the air sample in the sample container was removed to the measuring loop until the pressure in the measuring loop reached a fixed value (i.e. 600 mmHg or 80 kPa). Sample concentration tube 1 was immersed in liquid oxygen. After the temperature of concentration tube 1 reached the liquid oxygen temperature, the sample air in the measuring loop was introduced into concentration tube 1 through the operation of the valves. This procedure was carried out twice to accumulate the sample volume to approximately 114 ml (STD).

(B) Re-concentration and Analysis Procedure

After the concentration procedure was accomplished, four-port valve 1 was turned to the analysis position. The liquid oxygen flask was removed from sample concentration tube 1, and the tube was heated to 25 °C. Time-check was started at the same time, and sample concentration tube 2 was immersed in the liquid oxygen. Four-port valve 3 was turned to the trapping position at the time CFC-12 finished to elute from the precolumn to again concentrate CFC-114 and CFC-114a on sample concentration tube 2. Four-port valve 3 was again turned to the ejecting position at the time CFC-114 and CFC-114a finished to elute from the precolumn. Thus the re-concentration procedure was accomplished. Approximately four minutes was necessary for the re-concentration procedure under the conditions shown in **Table 2**. The liquid oxygen flask was removed from sample concentration tube 2, and sample concentration tube 2 was heated to 25 °C and the gas chromatographic analysis was started. CFC-114 and CFC-114a were eluted at approximately 25 minutes in order of the description.

(3) Calculation

A relation curve must once be created beforehand to verify the linearity in the response of the detector in an expected range that would cover a dispersion of sample concentrations. See Chapter 2. **METHOD** in the text of the report for the calibration gas, calculation method of concentrations and others.

3. Measurement Method of CFC-115 (GC Analytical Method 3)

(1) Analytical System

Since the typical atmospheric concentration of CFC-115 is minute and ECDs have poor sensitivity for this substance, the amount of sample should be enlarged to about 500 ml or more in analysis of this substance. The measuring loop technique which was adopted in GC analytical method 1 and 2 is not adequate to handle a sample with a volume of 500 ml or more. To precisely measure a greater volume of a sample, we installed an evacuated flask to the end of the sample concentration tube which sucks the sample air to concentrate and also determines the sample volume extracted. A schematic diagram of the system is shown in **Figure 3**. (SYSTEM III). Several components and the GC are common to the analytical system used in GC analytical method 1 and 2 (SYSTEM I and SYSTEM II). The calibration gas is introduced to the GC in the similar manner of GC analytical method 2 through the measuring loop mentioned in analytical method 2.

The measuring flask which functioned as a sample suction pump and a measure for sample volume is made of stainless steel with 1,960 ml of inner volume. The whole of the volume of the measuring flask which associated with the measurement of the sample volume including tubing and other components is 1,996 ml. The measuring flask is not installed in a temperature-maintained enclosure, but the room temperature was maintained at 23 °C while the measurements was being conducted.

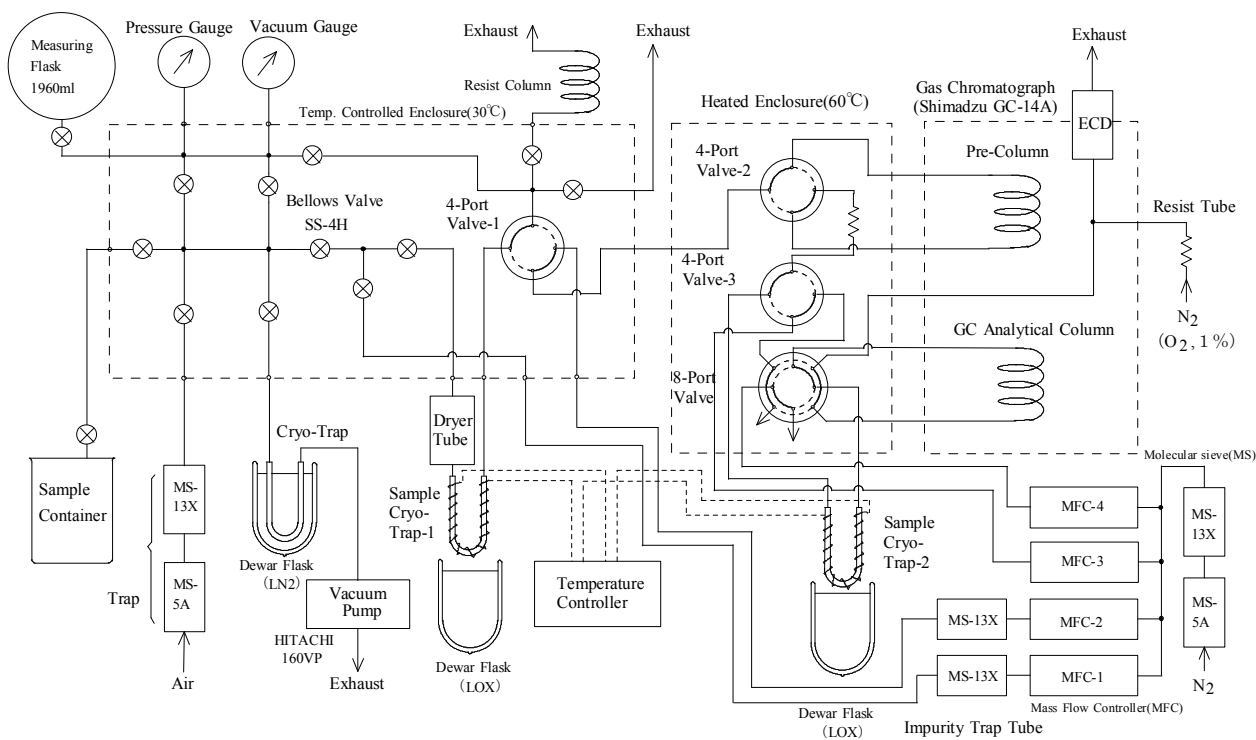


Figure 3. CFC-115 analysis system (SYSTEM III)

The analytical conditions for the gas chromatography are shown in **Table 3**.

Table 3. Analytical conditions of GC analytical method 3

Term		Condition
Pre-treatment	Precolumn	Carbopack B 1% SP1000, 60-80 mesh, 3 mm ID, 2 m long, stainless steel
	Column temp.	30 °C
	Carrier gas	N ₂ , 50 ml/min
	Sample volume	284.5 ml (STD)
Analysis	Gas chromatograph	Shimadzu GC-14A
	Analytical column	GS-Alumina, 0.53 mm ID, 50 m long
	Column temp.	30 °C
	Carrier gas	N ₂ , 5 ml/min
	Make-up gas	N ₂ , 45 ml/min
	Detector	ECD (370MBq, Ni 63, 220 °C)

(2) Analytical Procedures

(A) Sample Concentration Procedure

The measuring flask was evacuated to 0.1 mmHg (13 Pa) or less. A sample container was connected to the sample introducing port of the sample introduction equipment, and the sample introduction line was evacuated to 0.1 mmHg(13 Pa) or less. Sample concentration tube 1 was immersed in liquid oxygen. Approximately 284 ml of volume of the air sample in the sample container was removed to the measuring flask through cryo-cooled sample concentration tube 1 until the pressure in the flask reached a fixed value (i.e. 117.4 mmHg or 15.6 kPa). The calibration gas was concentrated on sample concentration tube 1 in the similar manner of GC analytical method 2.

(B) Re-concentration and Analysis Procedure

Re-concentration and analysis procedure were similar to the procedures of GC analytical method 2. CFC-115 eluted from the precolumn at approximately five minutes and eluted from the analytical column at approximately 13 minutes under the conditions shown in **Table 3**.

(3) Calculation

A relation curve must once be created beforehand to verify the linearity in the response of the detector in an expected range that would cover a dispersion of sample concentrations. See Chapter 2. **METHOD** in the text of the report for the calibration gas, calculation method of concentrations and others.

4. Measurement Method of Halon-1211 and Halon-1301 (GC Analytical Method 4)

(1) Analytical System

The analytical system was the same as described in GC analytical method 2. The analytical conditions are shown in **Table 4**.

Table 4. Analytical conditions of GC analytical method 4

Term		Condition
Pre-treatment	Precolumn	DC-550 25%, Shimalite 101, 60-80 mesh, 3mm ID, 4m long, stainless steel
	Column temp.	50 °C
	Carrier gas	N ₂ , 50 ml/min
	Sample volume	56.9 ml (STD)
Analysis	Gas chromatograph	Shimadzu GC-14A
	Analytical column	Carbopack B 1% SP1000, 60-80 mesh 3 mm ID, 2 m long, stainless steel
	Column temp.	30 °C
	Carrier gas	N ₂ , 50 ml/min
	Detector	ECD (370 MBq, Ni 63, 220 °C)

(2) Analytical Procedures

The analytical procedures were the same as described in GC analytical method 2. Halon-1211 and halon-1301 eluted from the precolumn at approximately two minutes and approximately four minutes, respectively, and eluted from the analytical column at approximately four minutes and approximately 13 minutes, respectively, under the conditions shown in **Table 4**.

(3) Calculation

A relation curve must once be created beforehand to verify the linearity in the response of the detector in an expected range that would cover a dispersion of sample concentrations. See Chapter 2. **METHOD** in the text of the report for the calibration gas, calculation method of concentrations and others.

5. Measurement Method of Halon-2402 (GC Analytical Method 5)

(1) Analytical System

The analytical system was the same as described in GC analytical method 3. The analytical conditions are shown in **Table 5**.

Table 5. Analytical conditions of GC analytical method 5

Term		Condition
Pre-treatment	Precolumn	OV-17 25%, Shimalite 101, 60-80 mesh, 3 mm ID, 5m long, stainless steel
	Column temp.	60 °C
	Carrier gas	N ₂ , 50 ml/min
	Sample volume	284.5 ml (STD)
Analysis	Gas chromatograph	Shimadzu GC-14A
	Analytical column	Carbopack B 1% SP1000, 60-80 mesh 3 mm ID, 1.5m long, stainless steel
	Column temp.	60 °C
	Carrier gas	N ₂ , 50 ml/min
	Detector	ECD (370 MBq, Ni 63, 220 °C)

(2) Analytical Procedures

The analytical procedures were the same as described in GC analytical method 3. Halon-2402 eluted from the precolumn at approximately eight minutes and eluted from the analytical column at approximately 15 minutes under the conditions shown in **Table 5**.

(3) Calculation

A relation curve must once be created beforehand to verify the linearity in the response of the detector in an expected range that would cover a dispersion of sample concentrations. See Chapter 2. **METHOD** in the text of the report for the calibration gas, calculation method of concentrations and others.

6. Measurement Method of CFC-12 and HCFC-22 (GC Analytical Method 6)

(1) Analytical System

The analytical system was the same as described in GC analytical method 2 with the exception that a branch-off between the analytical column and the ECD was installed. 0.03% of oxygen was added to the carrier gas by introducing nitrogen which contained 1% of oxygen through the branch at a flow rate of 1.5 ml/min. The analytical conditions are shown in **Table 6**.

Table 6. Analytical conditions of GC analytical method 6

Term		Condition
Pre-treatment	Precolumn	DC-550 25%, Shimalite 101, 60-80 mesh, 3 mm ID, 4m long, stainless steel
	Column temp.	30 °C
	Carrier gas	N ₂ , 50 ml/min
	Sample volume	56.9 ml (STD)
Analysis	Gas chromatograph	Shimadzu GC-14A
	Analytical column	Carbopack B 1% SP1000, 60-80 mesh 3 mm ID, 4 m long, stainless steel
	Column temp.	30 °C
	Carrier gas	N ₂ , 50 ml/min
	Detector	ECD (370 MBq, Ni 63, 220 °C, 0.03 % O ₂ doped)

(2) Analytical Procedures

The analytical procedures were the same as described in GC analytical method 2. CFC-12 and HCFC-22 eluted from the precolumn at approximately three minutes and CFC-12 eluted from the analytical column at approximately 12 minutes and HCFC-12 eluted at approximately five minutes under the conditions shown in **Table 6**.

(3) Calculation

A relation curve must once be created beforehand to verify the linearity in the response of the detector in an expected range that would cover a dispersion of sample concentrations. See Chapter 2. **METHOD** in the text of the report for the calibration gas, calculation method of concentrations and others.

7. Measurement Method of HCFC-141b (GC Analytical Method 7)

(1) Analytical System

The analytical system was the same as described in GC analytical method 3. The ECD was doped with O₂ the same as GC analytical method 6. The analytical conditions are shown in **Table 7**.

Table 7. Analytical conditions of GC analytical method 7

Term		Condition
Pre-treatment	Precolumn	DC-550 25%, Shimalite 101, 60-80 mesh, 3 mm ID, 3m long, stainless steel
	Column temp.	30 °C
	Carrier gas	N ₂ , 50ml/min
	Sample volume	284.5 ml (STD)
Analysis	Gas chromatograph	Shimadzu GC-14A
	Analytical column	Supelco Vocol, 0.53mm ID, 3um, 100 m long
	Column temp.	30 °C
	Carrier gas	N ₂ , 50 ml/min
Detector	ECD (370 MBq, Ni 63, 220 °C, 0.03 % O ₂ doped)	

(2) Analytical Procedures

The analytical procedures were the same as described in GC analytical method 3. HCFC-141b eluted from the precolumn at approximately 10 minutes and eluted from the analytical column at approximately 22 minutes under the conditions shown in **Table 7**.

(3) Calculation

A relation curve must once be created beforehand to verify the linearity in the response of the detector in an expected range that would cover a dispersion of sample concentrations. See Chapter 2. **METHOD** in the text of the report for the calibration gas, calculation method of concentrations and others.

8. Measurement Method of HCFC-142b and Methyl Bromide (GC Analytical Method 8)

(1) Analytical System

The analytical system was the same as GC analytical method 7. The analytical conditions are shown in **Table 8**.

Table 8. Analytical conditions of GC analytical method 8

Term		Condition
Pre-treatment	Precolumn	DC-550 25%, Shimalite 101, 60-80 mesh, 3 mm ID, 4m long, stainless steel
	Column temp.	30 °C
	Carrier gas	N2, 50 ml/min
	Sample volume	56.9 ml (STD)
Analysis	Gas chromatograph	Shimadzu GC-14A
	Analytical column	Carbopack B 1% SP1000, 60-80 mesh 3 mm ID, 4 m long, stainless steel
	Column temp.	30 °C
	Carrier gas	N2, 50 ml/min
	Detector	ECD (370 MBq, Ni 63, 220 °C, 0.03 % O2 doped)

(2) Analytical Procedures

The analytical procedures were the same as described in GC analytical method 3. HCFC-142b and methyl bromide eluted from the precolumn at approximately three minutes and HCFC-142b eluted from the analytical column at approximately 11 minutes and methyl bromide eluted at approximately seven minutes under the conditions shown in **Table 8**.

(3) Calculation

A relation curve must once be created beforehand to verify the linearity in the response of the detector in an expected range that would cover a dispersion of sample concentrations. See Chapter 2. **METHOD** in the text of the report for the calibration gas, calculation method of concentrations and others.

9. Measurement Method of HFC-134a (GC/MS Analytical Method)

(1) Analytical System

A schematic diagram of the analytical system for HFC-134a measurement is shown in **Figure 4**. This system can be roughly divided into two sub-systems, a sample introduction system and a gas chromatograph-mass spectrometer (GC-MS). The sample introduction equipment which was assembled for CFC-115 measurement was used for sample concentration and sample refinement. See GC analytical method 3 for the detail of the sample introduction equipment.

The GC-MS is a JEOL JMS-GCmate gas chromatograph-mass-spectrometer. The GC-MS consists of a HP-6890 gas chromatograph and a double focusing magnetic field mass-spectrometer. The sample concentration tube shown in **Figure 4** is a U-shaped stainless steel tube with 3 mm ID, 20cm long filled with Chromosorb W column packing with 30-60 mesh. The four-port valve (GL Science Type UMF-4) changes the carrier gas flow to the sample concentration tube or to the analytical column. Helium gas (Nippon Sanso, 99.9999% in purity) is introduced to a flow control device after decompressed from a cylinder and refined via an oxygen removal tube (U. S. Alltech OXY-TRAP) and a gas purifying tube filled with molecular sieve 13X (laboratory made). The helium carrier gas flow is controlled by a mechanical flow control device with stainless steel diaphragm (U.S. Porter Type VCD1000) and finally refined through an impurity trap tube immersed in liquid nitrogen.

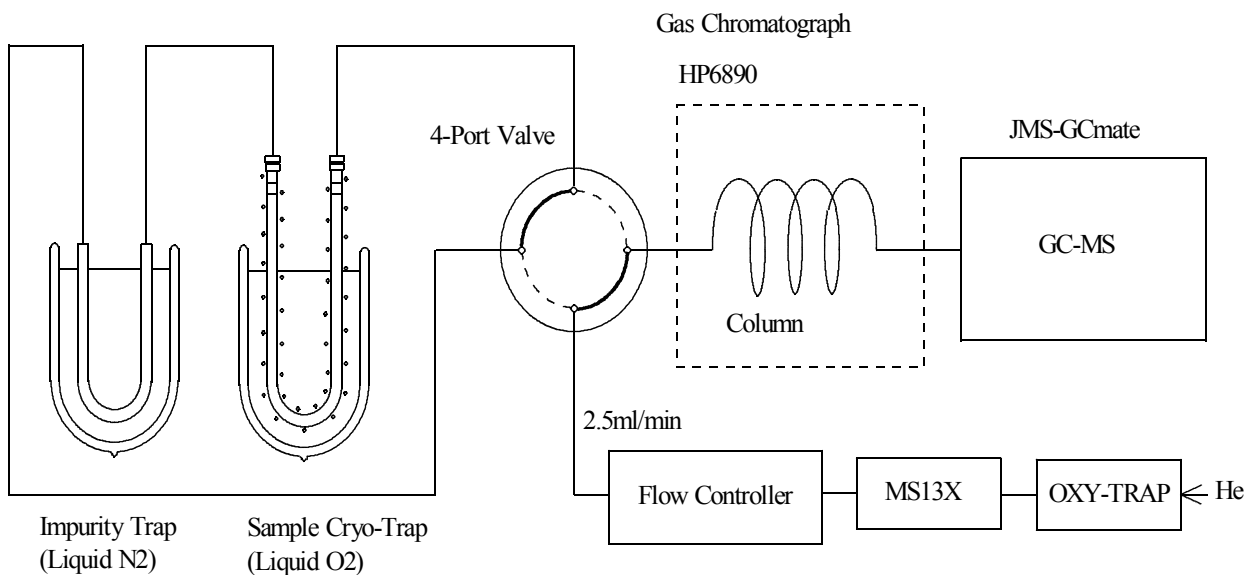


Figure 4. HFC-134 analytical system (GC/MS analysis).

The analytical conditions are shown in **Table 9**.

Table 9. Analytical conditions of GC-MS analytical method (HFC-134a)

Term		Condition
Pre-treatment	Precolumn	DC-550 25%, Shimalite 101, 60-80 mesh, 3 mm ID, 4m long, stainless steel
	Column temp.	30 °C
	Carrier gas	N ₂ , 50 ml/min
	Sample volume	300 ~ 350 ml
Analysis	Gas chromatograph	HP 6890
	Analytical column	Carbopack B (+1% SP1000) 60/80 mesh 0.8 mm ID, 3 m long
	Column temp.	30 °C
	Carrier gas	He, 2.5 ml/min
	Concentration temp.	Liquid O ₂ temp.
	Desorption temp.	25 °C
MS	Mass Spectrometer	JEOL JMS GC-Mate
	Ionization	EI (70 V, 300 uA)
	SIM	69 (m/z)

(4) Analytical Procedures

(A) Sample Concentration Procedure

The sample concentration procedure was the same as described in GC analytical method 3.

(B) Re-concentration and Analysis Procedure

The re-concentration procedure was similar to the re-concentration procedure of GC analytical method 2. HFC-134a eluted at approximately three minutes from the precolumn under the conditions shown in **Table 9**.

Sample concentration tube 2 which contained HFC-134a fraction, kept in Liquid O₂, was subsequently connected to the GC-MS, then the route of the carrier gas flow was changed to the sample concentration tube. The tube was then heated to 25 °C, and a single mass ion monitoring (SIM) analysis with a mass number of 69 amu was initiated to run. HFC-134a eluted from the analytical column at approximately seven minutes under the conditions.

(3) Calculation

A relation curve must once be created beforehand to verify the linearity in the response of the detector in an expected range that would cover a dispersion of sample concentrations. See Chapter 2. **METHOD** in the text of the report for the calibration gas, calculation method of concentrations and others.

APPENDIX B

HCFCs AUTOMATIC MEASURING APPARATUS

1. Outline of the HCFCs Automatic Measuring Apparatus

(1) HCFCs Automatic Measuring Apparatus

A schematic diagram of the HCFCs automatic measuring apparatus (hereinafter referred to as "the apparatus") is shown in **Figure 5**. The apparatus mainly consists of a sample introduction system and a GC-MS.

The sample introduction system was assembled in the JESC laboratory. The pneumatic valves (U.S. Nupro Type 6LVV) and metal bellows valves (U.S. Nupro Type SS-4H) are used in the system where the valves are exposed to the sample air. The three pneumatic rotary valves are GL Type AR-UMF-4 and Type AR-UMF-6. The electronic mass-flow controller which maintains constant sample air flow is a Kofloc Type 3650. The freezer is a Nippon Freezer Type MYBIO which has inner volume of 70 L. The nominal operation temperature of this freezer is -80°C . The cold trap tube 1 is a made of stainless steel with 3 mm ID, 200 mm long filled with 0.4 g of Carboxpack B 60-80 mesh + 1% SP-1000 (U.S. Supelco). The cold trap tube 2 is a made of stainless steel with 2 mm ID, 100 mm long filled with 0.06 g of same packing mentioned above. The dryer tube is a made of stainless steel with 3 mm ID, 200 mm long filled with 0.3 g of Chromosorb W 30-60 mesh coated with 5 w/w% of $\text{Mg}(\text{ClO}_4)_2$. The cold trap tubes and the dryer tube are equipped with heating wires and thermocouples.

The GC-MS is a Shimadzu 2010. The analytical column is a Chrompack CP-Sil 5CB (0.53 mm ID, 5 μm film thickness, 100 m long) capillary column. Helium gas (99.9999%) is used as the carrier gas at a flow rate of 5mL/min and as the purge gas at a flow rate of 20mL/min. The Shimadzu 2010 GC/MS has an

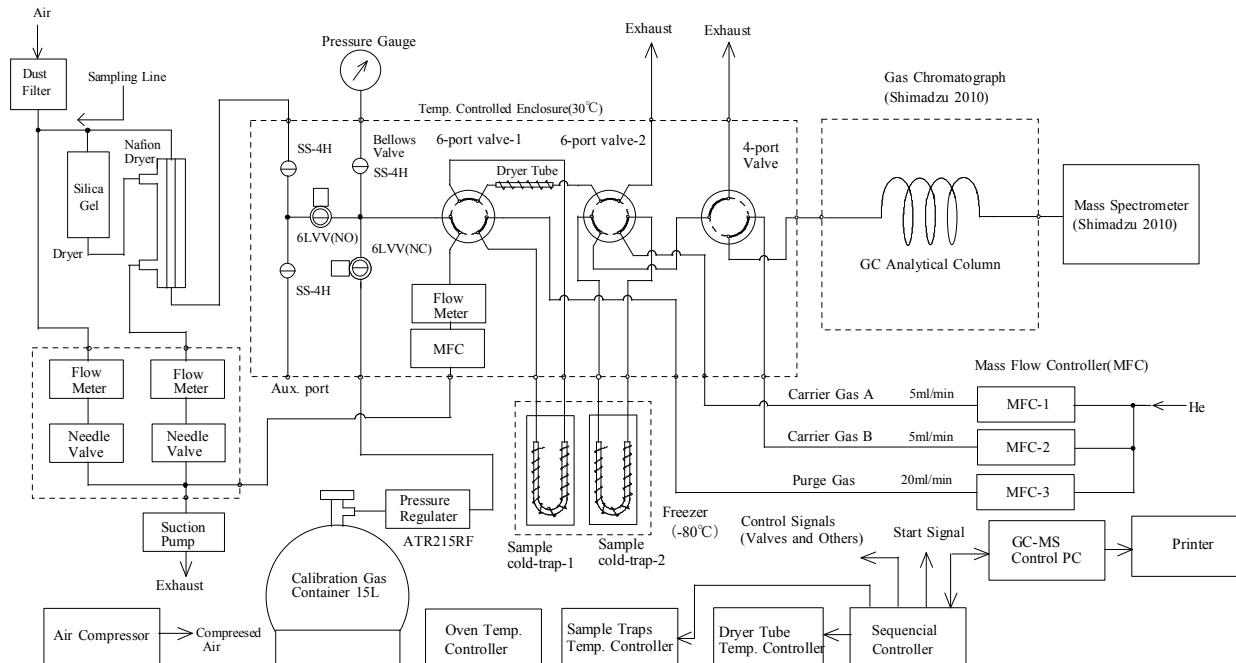


Figure 5. HCFCs automatic measuring apparatus

electric carrier gas control system designed for split/split-less injection. This flow control system is not available for this analysis because the control software of the GC-MS does not permit any carrier gas leakage that may occur during the analysis. Additional three mechanical carrier gas flow controllers therefore were required (U.S. Porter Type VCD1000 for the carrier gas and Koflock Type 2203 for the purge gas).

(2) Operation

The sample air was first dehumidified via the Nafion dryer tube (U.S. Perma Pure Type MD-110-48P-4). The sample air was passed through the sample concentration tube kept at $-80\text{ }^{\circ}\text{C}$ in the freezer. Then, the compounds are separated from the air. During the sampling procedure, the sample air was drawn at a rate of 0.1 L/min over the sampling period of 10 min. 1L of sample air was concentrated on the concentration tube as a result. Then the sample concentration tube was heated from $-80\text{ }^{\circ}\text{C}$ to $150\text{ }^{\circ}\text{C}$ in a short period of time in the helium gas flow, the compounds collected on the concentration tube packing were vaporized. The released analytes were dehumidified via the $\text{Mg}(\text{ClO}_4)_2$ dryer tube and again concentrated on the small secondary cold trap tube to enhance chromatographic resolution of the individual sample components. The secondary cryo-concentration tube was heated to $150\text{ }^{\circ}\text{C}$, then the compounds collected on the tube packing were again vaporized and carried onto the analytical column by the helium gas flow. The analytical column temperature was raised from $30\text{ }^{\circ}\text{C}$ up to $120\text{ }^{\circ}\text{C}$ at a rate of $2\text{ }^{\circ}\text{C}/\text{min}$.

(3) Concentration Procedure

Among analytical methods of CFCs or HCFCs, since these substances have low boiling temperatures, the typical concentration procedures are performed under around liquid oxygen temperature. However, a continuous feed of liquid oxygen or other cryogen to an automatic measuring apparatus would obviously take much efforts. We employed a commercial freezer instead of the cryogen. Since the nominal lowest temperature of this freezer was $-80\text{ }^{\circ}\text{C}$, a possible error may occur during the concentration cycle for the target substances that have extremely low boiling temperatures. As HCFC-22 has the lowest boiling temperature of $-40\text{ }^{\circ}\text{C}$ among the target analytes, this substance was considered to possess the greatest difficulty in concentration procedure. Therefore, we adopted a cold trap tube filled with Carbopack B 60-80 +1% SP-1000 to improve the adsorptiveness. The break through capacity of this cold trap tube for HCFC-22 was estimated to be over 10L at $-80\text{ }^{\circ}\text{C}$. As a concentration tube filled with adsorbent generally has a difficulty in the recovery of compounds which have high boiling temperatures, in the operation of this apparatus, the directions of the gas flows in the concentration tubes were replaced between the concentrating procedure and the eluting procedure to ease the elution of the compounds (back-flush).

2. Introduction of the Sample Air

A stainless steel tube with 8 mm OD, approximately 30 m long was extended from the apparatus through the wall to the sampling point at the rooftop of the JESC building. Ambient air from the sampling point was drawn through this tubing to the apparatus. The outline of the sample line is shown in **Figure 6**. The inside of the sample line was kept ventilating with an ambient air flow at a rate of 0.3L/min using a diaphragm pump.

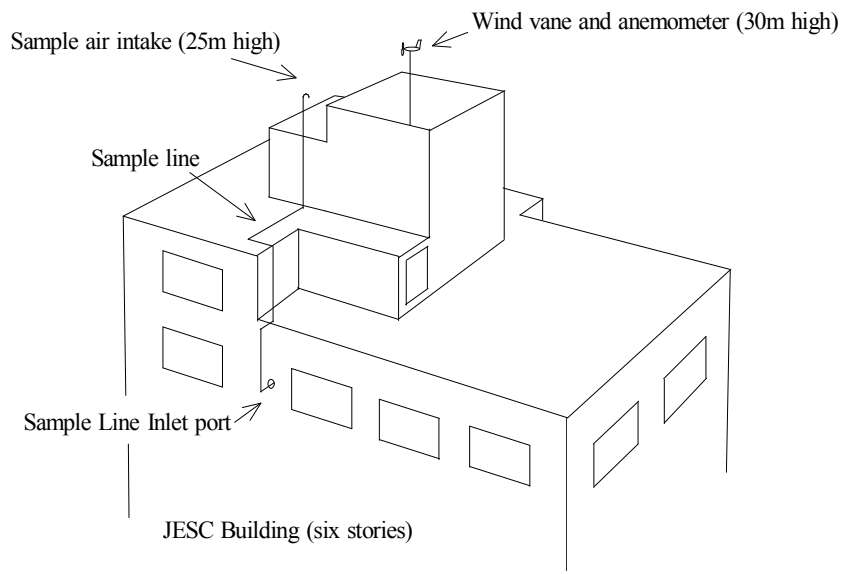


Figure 6. Sampling line for automatic measurement

APPENDIX C

CHROMATOGRAMS

Typical gas chromatograms obtained in this work are shown in **Figure 1 - Figure 9**.

Figure 1 is a typical chromatogram of CFC-11 and others / GC analytical method 1 (Nemuro, 11:00, January 18, 2007). **Figure 2** is a typical chromatogram of CFC-114 / GC analytical method 2 (Wakkanai, 15:00, January 15, 2007). **Figure 3** is a typical chromatogram of CFC-115 / GC analytical method 3 (Wakkanai, 13:00 January 15, 2007). **Figure 4** is a typical chromatogram of halon-1211 and halon-1301 / GC analytical method 4 (Wakkanai, 13:00, January 15, 2007). **Figure 5** is a typical chromatogram of halon-2402 / GC analytical method 5 (Nemuro, 11:00, January 17, 2007). **Figure 6** is a typical chromatogram of HCFC-22 / GC analytical method 6 (Nemuro, 12:00, January 17, 2007). **Figure 7** is a typical chromatogram of HCFC-141b / GC analytical method 7 (Wakkanai, 15:00, January 15, 2007). **Figure 8** is a typical chromatogram of HCFC-142b / GC analytical method 8 (Wakkanai, 13:00, January 15, 2007). **Figure 9** is a typical chromatogram of HFC-134a / GC/MS analytical method (Wakkanai, 11:00, January 16, 2007).

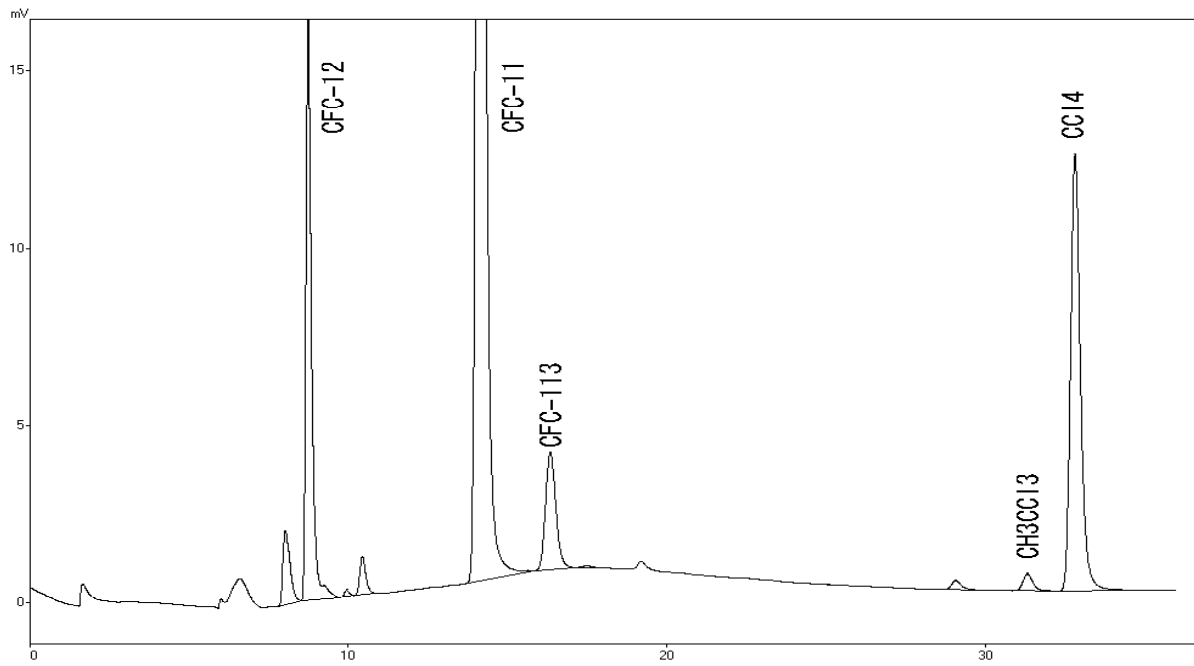


Figure 1. Typical chromatogram from GC method 1 of a sample collected in Hokkaido. CFC-11, CFC-113, CH₃CCl₃, and CCl₄ measured.

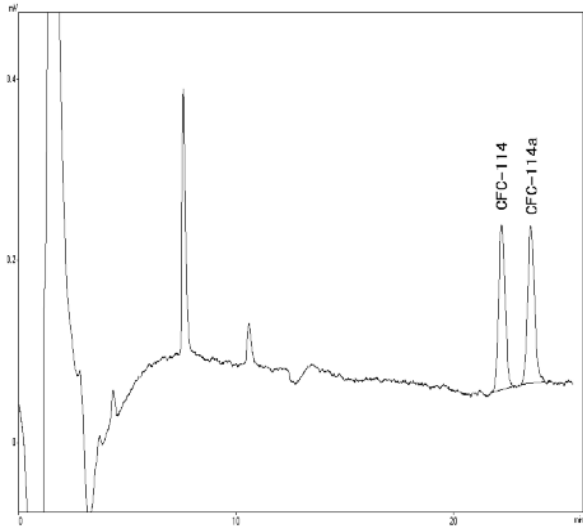


Figure 2. Typical chromatogram from GC method 2 of a sample collected in Hokkaido. CFC-114 measured.

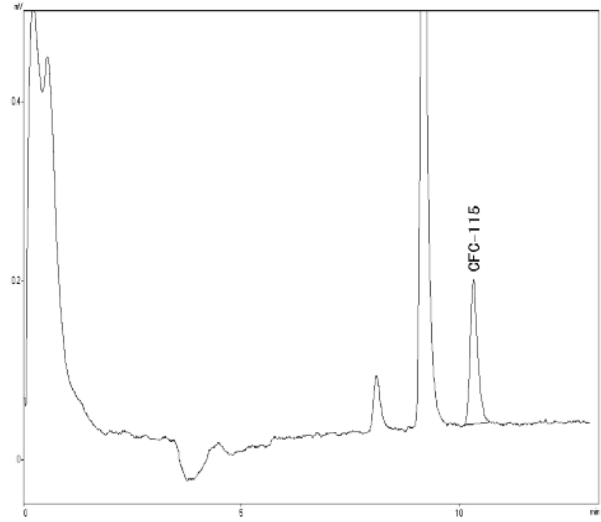


Figure 3. Typical Chromatogram from GC method 3 of a sample collected in Hokkaido. CFC-115 measured.

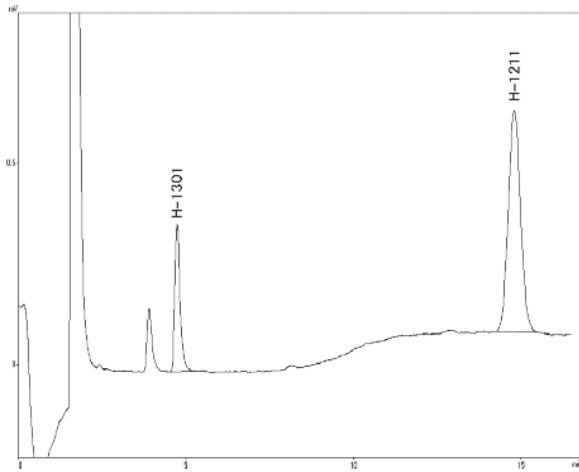


Figure 4. Typical chromatogram from GC method 4 of a sample collected in Hokkaido Halon-1211 and halon-1301 measured

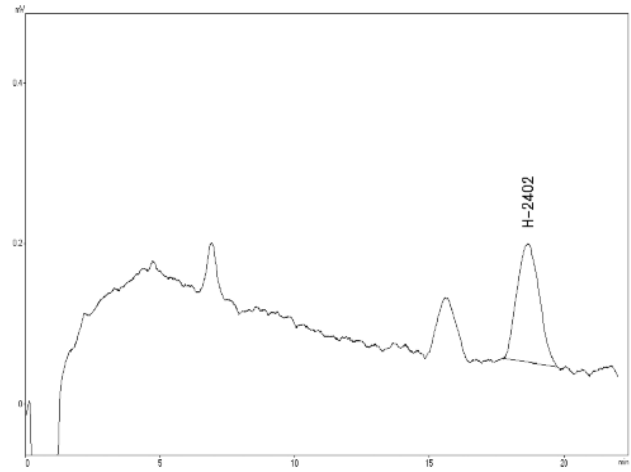


Figure 5. Typical Chromatogram from GC method 5 of a sample collected in Hokkaido Halon-2402 measured

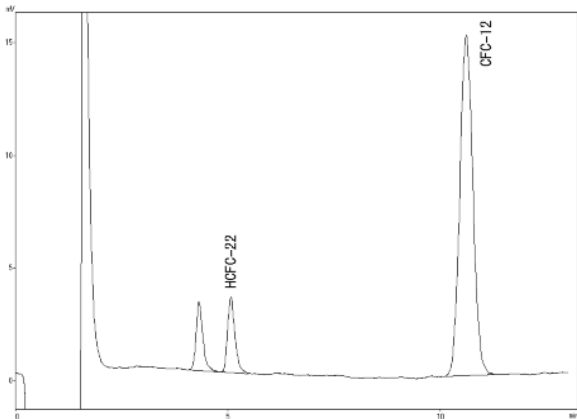


Figure 6. Typical chromatogram from GC method 6 of a sample collected in Hokkaido HCFC-22 measured

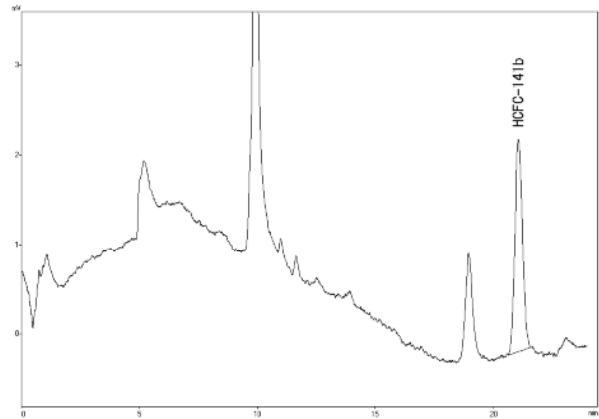


Figure 7. Typical Chromatogram from GC method 7 of a sample collected in Hokkaido HCFC-141b measured

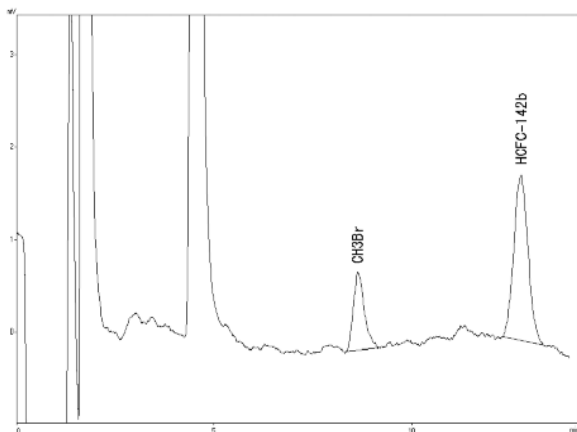


Figure 8. Typical chromatogram from GC method 8 of a sample collected in Hokkaido HCFC-142b and CH3Br measured

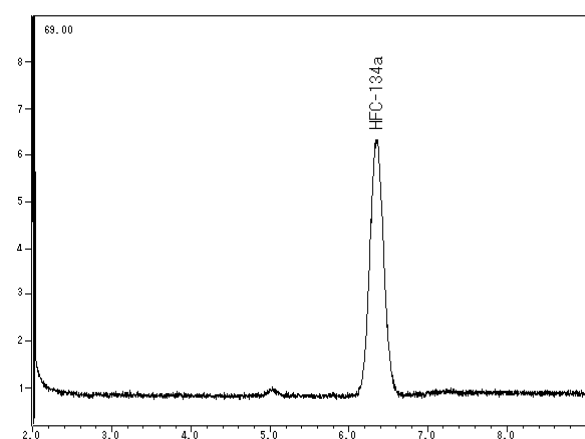


Figure 9. Typical Chromatogram from GC-MS method of a sample collected in Hokkaido HFC-134a measured

