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)	CCl_2FCClF_2
iv) Dichlorotetrafluoroethane (CFC-114)	$CClF_2CClF_2$
(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)	$C_2Br_2F_4$
ix) Carbon tetrachloride	CCl_4
x) 1,1,1-Trichloroethane	CH_3CCl_3
xi) Chlorodifuluoromethane (HCFC-22)	$CHClF_2$
xii) 1,1-Dichloro-1-fluoroethane (HCFC-141b)	CH_3CCl_2F
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".