

CONTENTS

Foreword	ii
Abstract	iv
Figures	vii
Tables	ix
Acknowledgement	xi
1. Overview	1
1.1 Objectives	1
1.2 Observation Items	1
1.3 Sampling Locations	2
1.4 Periods and Sample Size	3
1.5 Conference and Implementation Organization	3
2. Methods	4
2.1 Sample Containers	4
2.2 Sample Collection	4
2.3 Calibration Gas	5
2.4 Analytical Method	6
2.5 Automatic Monitoring in Urban Area	9
3. Results	11
3.1 Results in Background Area	11
3.1.1 Sampling Conditions	11
3.1.2 Concentrations of Measured Substances in Background Area	15
3.2 Results in Urban Area	18
3.2.1 Sampling Conditions	18
3.2.2 Concentrations of Measured Substances in Urban Area	18
4. Discussion	57
4.1 Results in Background Area	57
4.2 Results in Urban Area	91
5. References	106
6. Appendices	107
A. Measurement Methods	107
B. HCFCs Automatic Measuring Apparatus	121
C. Chromatograms	124

FIGURES

1.1	Sampling locations	2
2.1	2L container	4
2.2	12L container	4
2.5	Calibration gas dilution system	5
3.1	Sampling locations in Wakkanai Hokkaido	12
3.2	Sampling locations in Nemuro Hokkaido	12
3.3.1	Weather maps (summer season)	13
3.3.2	Weather maps (winter season)	14
3.4	Sampling location in urban area	18
3.5.1	Monthly wind-rose observed at JESC (March 2007 - August 2007)	19
3.5.2	Monthly wind-rose observed at JESC (September 2007 - February 2008)	20
3.6	Atmospheric concentrations of the measured substances in Kawasaki	21
4.1.1	Atmospheric concentrations of CFC-11 in Hokkaido since 1989	71
4.1.2	Atmospheric concentrations of CFC-12 in Hokkaido since 1989	71
4.1.3	Atmospheric concentrations of CFC-113 in Hokkaido since 1989	72
4.1.4	Atmospheric concentrations of CFC-114 and CFC-114a in Hokkaido since 1989	72
4.1.5	Atmospheric concentrations of CFC-115 in Hokkaido since 1989	73
4.1.6	Atmospheric concentrations of halon-1211 and halon-1301 in Hokkaido since 1989	73
4.1.7	Atmospheric concentrations of halon-2402 in Hokkaido since 1989	74
4.1.8	Atmospheric concentrations of Carbon tetrachloride in Hokkaido since 1989	74
4.1.9	Atmospheric concentrations of 1,1,1-Trichloroethane in Hokkaido since 1989	75
4.1.10	Atmospheric concentrations of HCFC-22 in Hokkaido since 1992	75
4.1.11	Atmospheric concentrations of HCFC-141b in Hokkaido since 2000	76
4.1.12	Atmospheric concentrations of HCFC-142b in Hokkaido since 1992	76
4.1.13	Atmospheric concentrations of methyl bromide in Hokkaido since 1998	77
4.1.14	Atmospheric concentrations of HFC-134a in Hokkaido since 2000	77
4.2.1	Long-term trend in CFC-11 concentrations in Hokkaido fitted with a regression line	82
4.2.2	Long-term trend in CFC-12 concentrations in Hokkaido fitted with a regression line	82
4.2.3	Long-term trend in CFC-113 concentrations in Hokkaido fitted with a regression line	83

4.2.4	Long-term trend in CFC-114 concentrations in Hokkaido fitted with a regression line	83
4.2.5	Long-term trend in CFC-115 concentrations in Hokkaido fitted with a regression line	84
4.2.6	Long-term trend in halon-1211 concentrations in Hokkaido fitted with a regression line	84
4.2.7	Long-term trend in halon-1301 concentrations in Hokkaido fitted with a regression line	85
4.2.8	Long-term trend in halon-2402 concentrations in Hokkaido fitted with a regression line	85
4.2.9	Long-term trend in carbon tetrachloride concentrations in Hokkaido fitted with a regression line	86
4.2.10	Long-term trend in 1,1,1-trichloroethane concentrations in Hokkaido fitted with a regression line	86
4.2.11	Long-term trend in HCFC-22 concentrations in Hokkaido fitted with a regression line	87
4.2.12	Long-term trend in HCFC-141b concentrations in Hokkaido fitted with a regression line	87
4.2.13	Long-term trend in HCFC-142b concentrations in Hokkaido fitted with a regression line	88
4.2.14	Long-term trend in methyl bromide concentrations in Hokkaido fitted with a regression line	88
4.2.15	Long-term trend in HFC-134a concentrations in Hokkaido fitted with a regression line	89
4.3	Plots of CFC-11 equivalent concentrations of the measured substances (1989 - 2008)	90
4.4.1	Monthly concentrations of CFC-11 and CFC-12 in urban air (Kawasaki)	98
4.4.2	Monthly concentrations of HCFC-22, HCFC-141b, HCFC-142b, methyl bromide, and HFC-134a in urban air (Kawasaki)	99
4.5.	The atmospheric concentration-distributions of the measured substances in the urban area according to wind direction (mean values, March 2007-February 2008)	101
4.6.	Diurnal variations of the atmospheric concentrations of the measured substances in the urban area (medians, March 2007-February 2008)	103
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)	105

TABLES

2.1	Grouping of CFCs and other halocarbons, and analytical methods	7
2.2	Grouping of HCFCs, methyl bromide, and HFC-134a and analytical methods	8
2.3	Detection limits of subject substances measured using manual analytical methods	8
2.4	Detection limits of subject substances measured using automatic measuring apparatus	10
3.1	Sampling date and location in Hokkaido	11
3.2	Concentrations of the measured substances in the background area. Summer season in FY2007	16
3.3	Concentrations of the measured substances in the background area. Winter season in FY2007	17
3.4	Daily summaries of the atmospheric concentrations of the measured substances in Kawasaki (mean, maximum, minimum, number of valid results)	45
4.1	Means and standard deviations calculated from the results in Wakkanai and Nemuro August 2007 and January 2008	57
4.2	Means and standard deviations calculated from results in the background area.	58
4.3	Atmospheric concentrations of the measured substances in the background area (1) CFC-11, CFC-12, CFC-113	60
4.3	Atmospheric concentrations of the measured substances in the background area (2) CFC-114, CFC-114a	62
4.3	Atmospheric concentrations of the measured substances in the background area (3) CFC-115, halon-1211, halon-1301	64
4.3	Atmospheric concentrations of the measured substances in the background area (4) Halon-2402, CCl ₄ , CH ₃ CCl ₃	66
4.3	Atmospheric concentrations of the measured substances in the background area (5) HCFC-22, HCFC-141b, HCFC-142b	68
4.3	Atmospheric concentrations of the measured substances in the background area (6) Methyl bromide, HFC-134a	70
4.4	Trends in the atmospheric concentrations of measured substances in the background area	80
4.5	Products between concentrations and ODP values of measured substances (Comparisons between January 1993 and January 2008)	91
4.6.1	Statistical summaries of concentrations of the measured substances in air of urban area obtained through the automatic measurements (CFC-11)	92
4.6.2	Statistical summaries of concentrations of the measured substances in air of urban area obtained through the automatic measurements (CFC-12)	93
4.6.3	Statistical summaries of concentrations of the measured substances in air of urban area obtained through the automatic measurements (HCFC-22)	93

4.6.4	Statistical summaries of concentrations of the measured substances in air of urban area obtained through the automatic measurements (HCFC-141b)	94
4.6.5	Statistical summaries of concentrations of the measured substances in air of urban area obtained through the automatic measurements (HCFC-142b)	94
4.6.6	Statistical summaries of concentrations of the measured substances in air of the urban area obtained through the automatic measurements (methyl bromide)	95
4.6.7	Statistical summaries of concentrations of the measured substances in air of urban area obtained through the automatic measurements (HFC-134a)	95
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)	96
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)	97