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No. 27

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ENVIRONMENTAL IMPACT MANAGEMENT AGENCY (BAPEDAL)
THE REPUBLIC OF INDONESIA

THE STUDY
ON
THE INTEGRATED AIR QUALITY MANAGEMENT
FOR
JAKARTA METROPOLITAN AREA

FINAL REPORT

VOLUME 2

SUPPORTING REPORT

JUNE 1997

NIPPON KOEI CO., LTD.
SUURI KEIKAKU CO., LTD.

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LIST OF REPORTS

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Volume 1	Main Report
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Currency Equivalents

US$ 1.00	=	Rp. 2,321
J. Yen 1.00	=	Rp. 19.97

(As of Mid. January 1997)

SUPPORTING REPORT
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METEOROLOGY

1.1 Upper Layer Meteorology

1.1.1 Vertical Profile of Temperature and Wind Speed

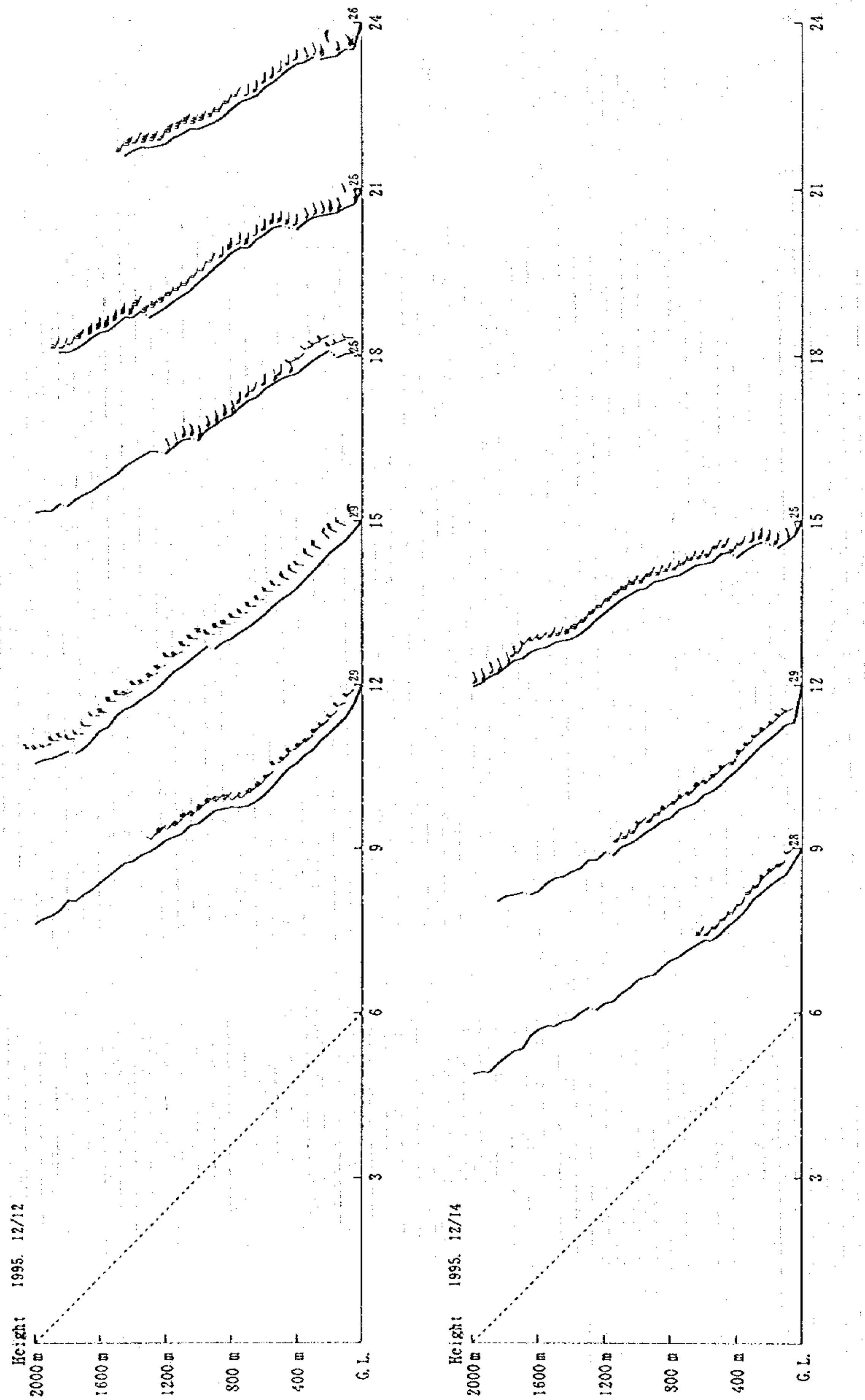


Figure Temperature and Wind Vertical Profiles at EMC

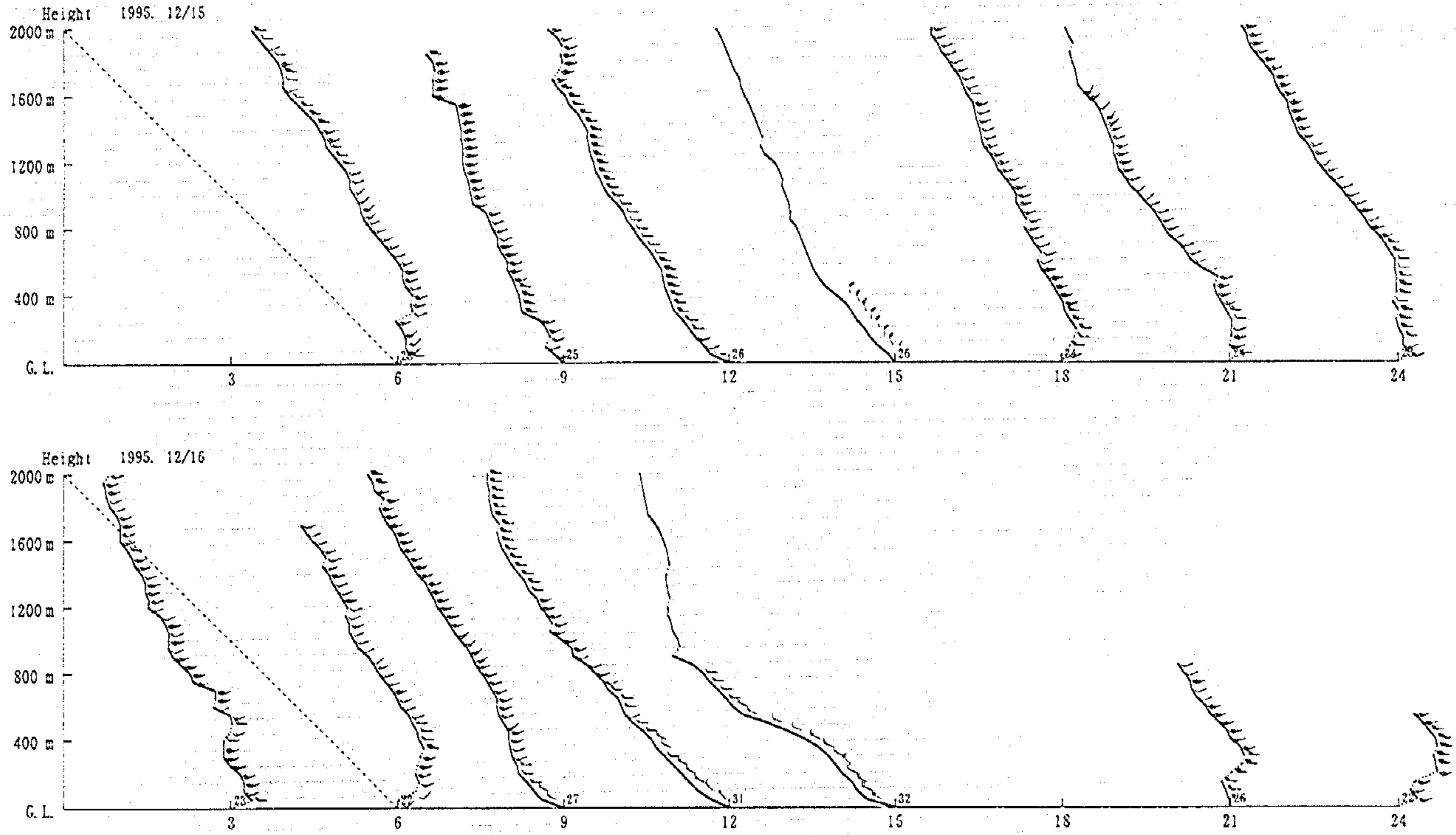
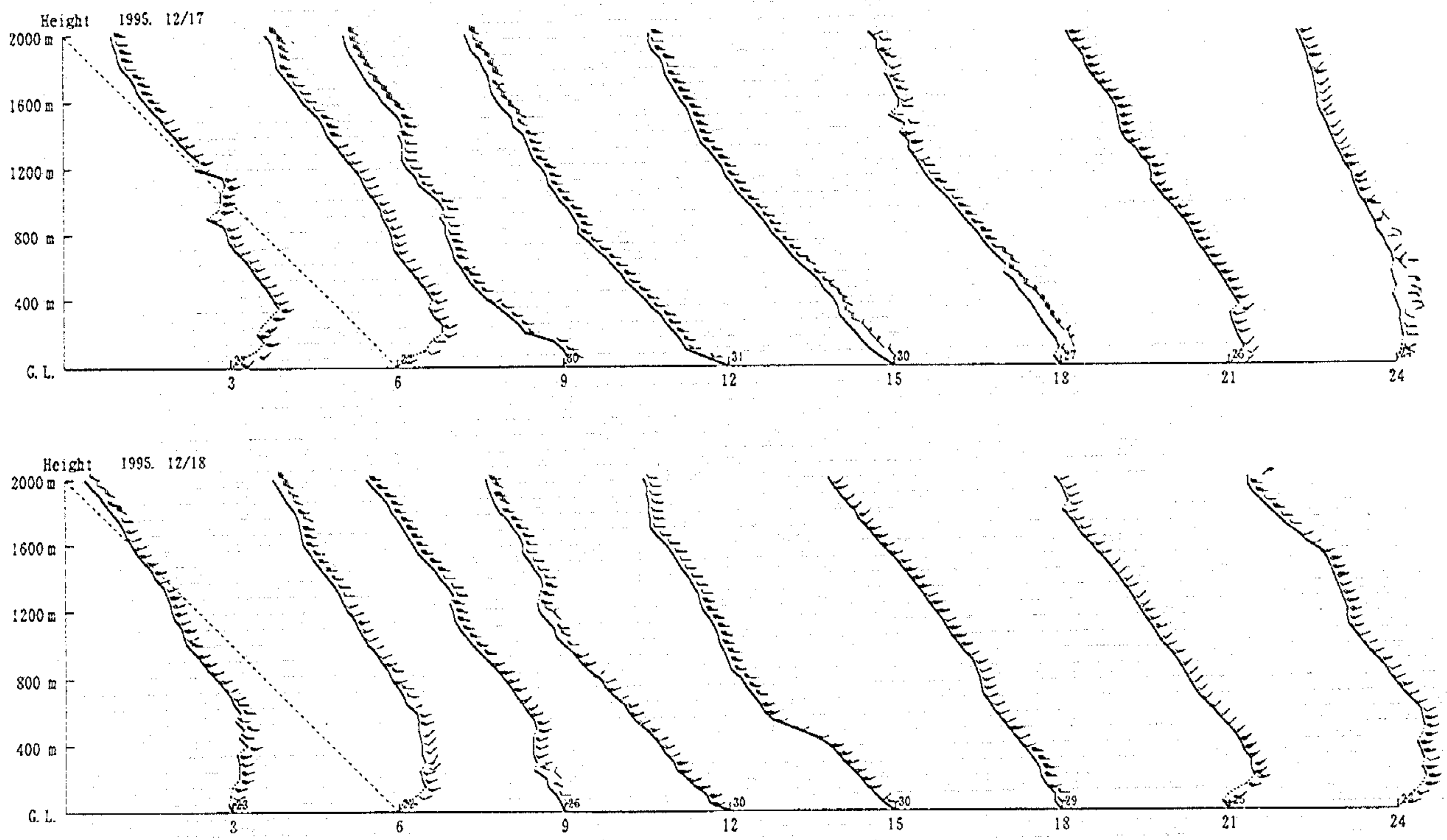


Figure Temperature and Wind Vertical Profiles at EMC ---- Dry Lapse Rate



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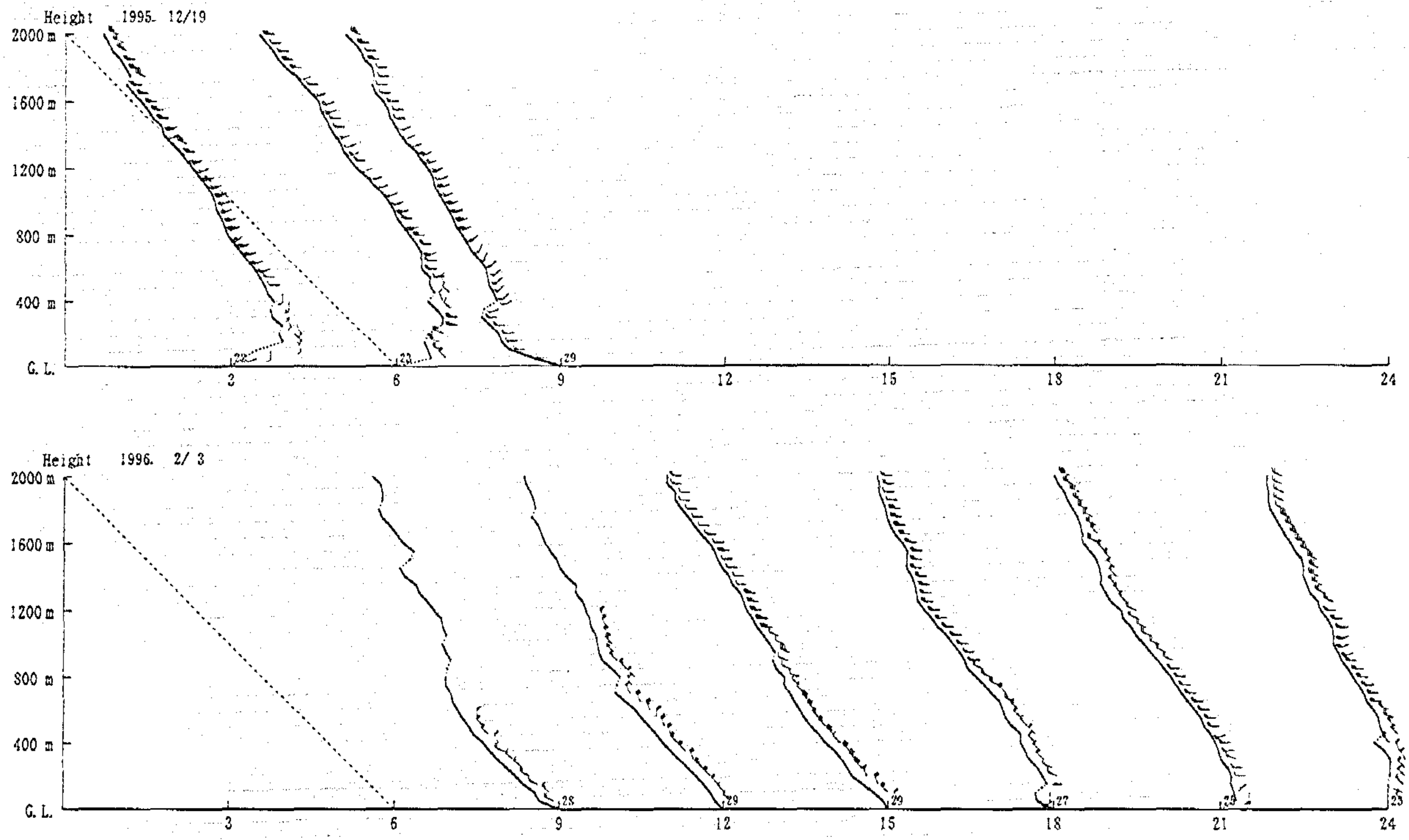

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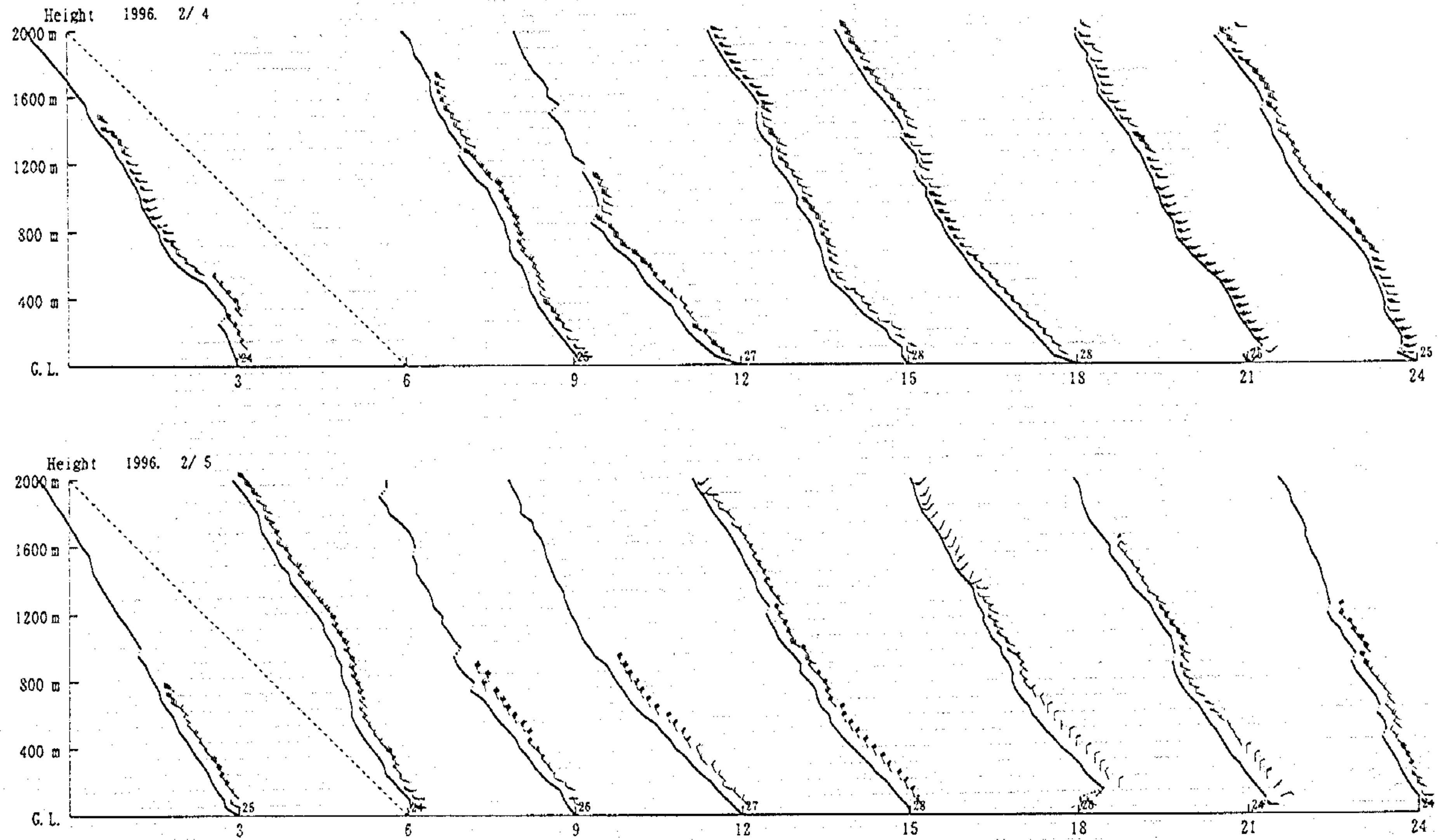

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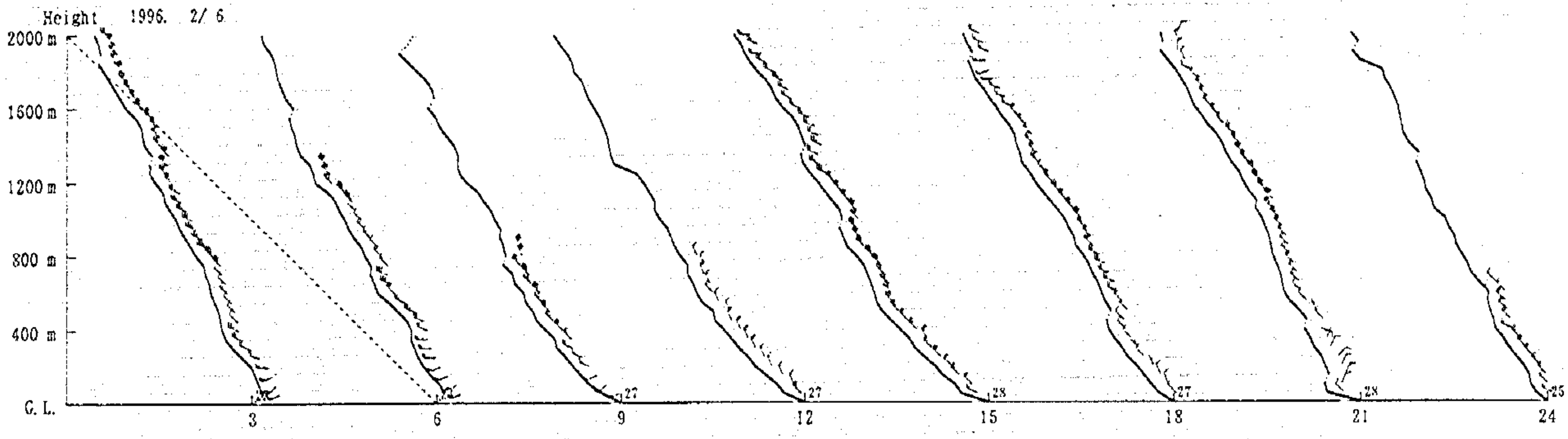

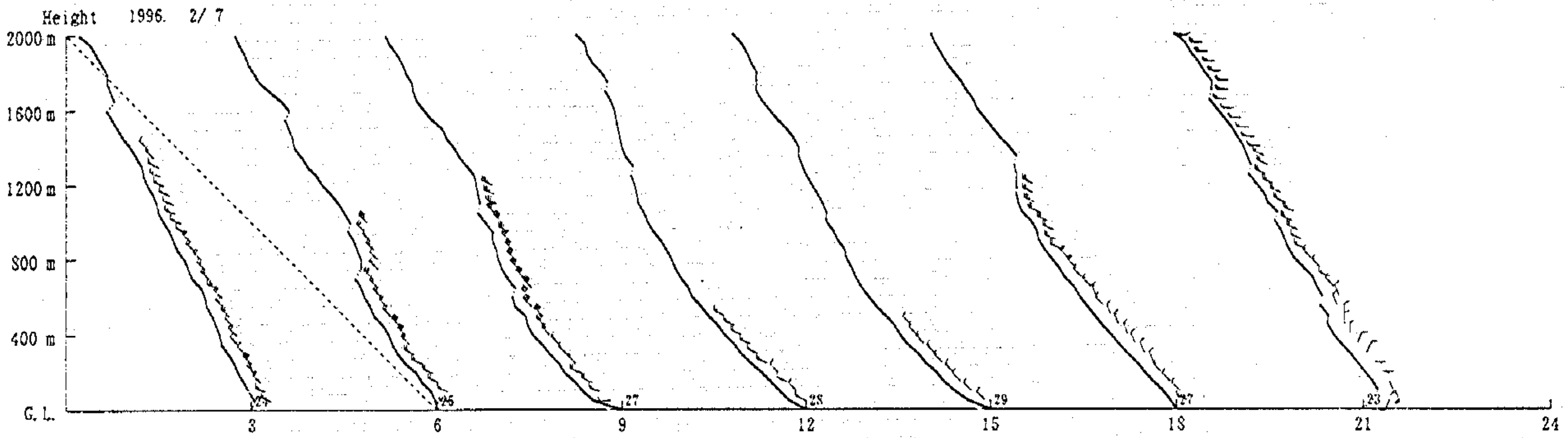

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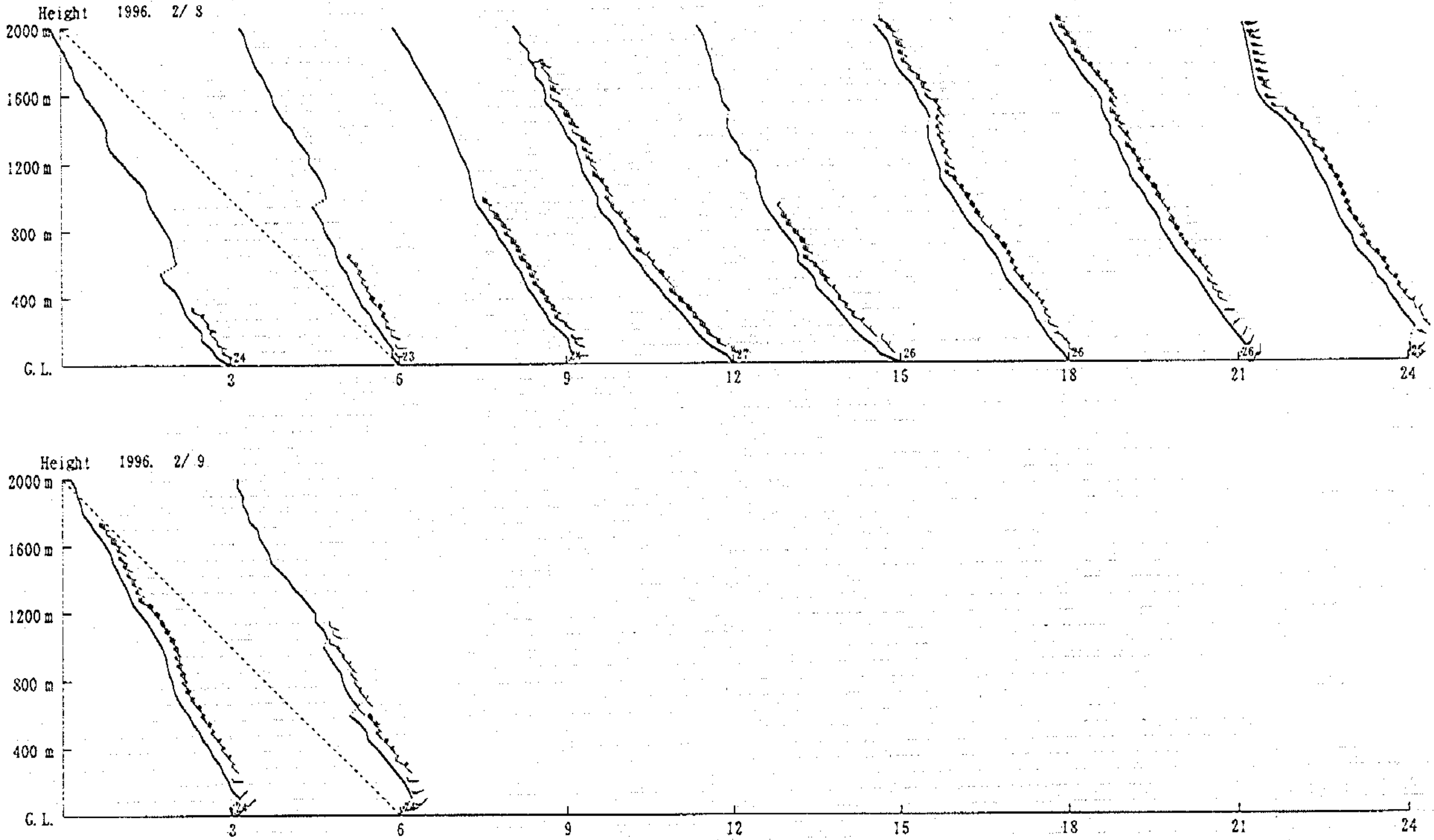


Figure Temperature and Wind Vertical Profiles at EMC ---- Dry Lapse Rate

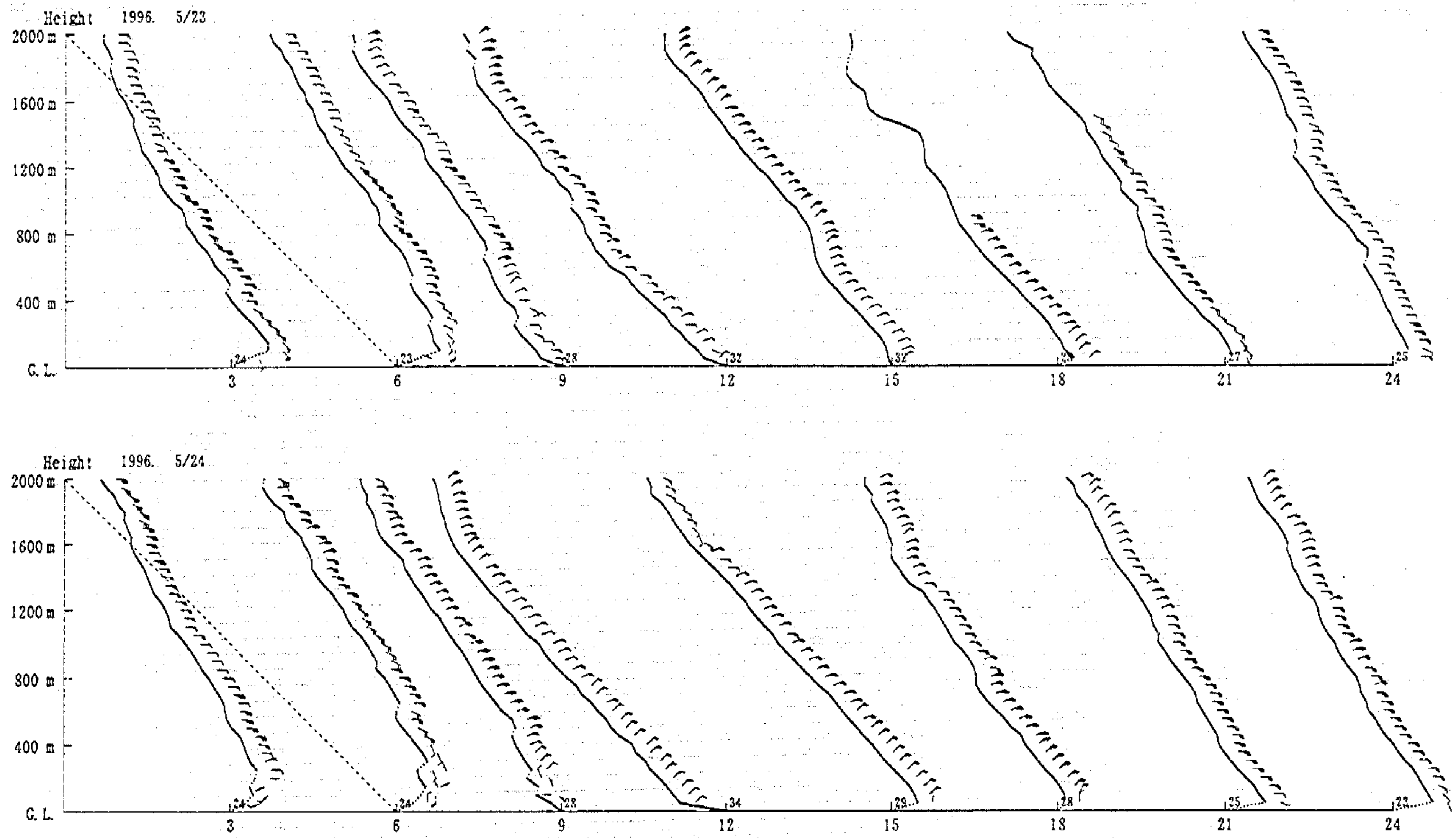


Figure Temperature and Wind Vertical Profiles at EMC ---- Dry Lapse Rate

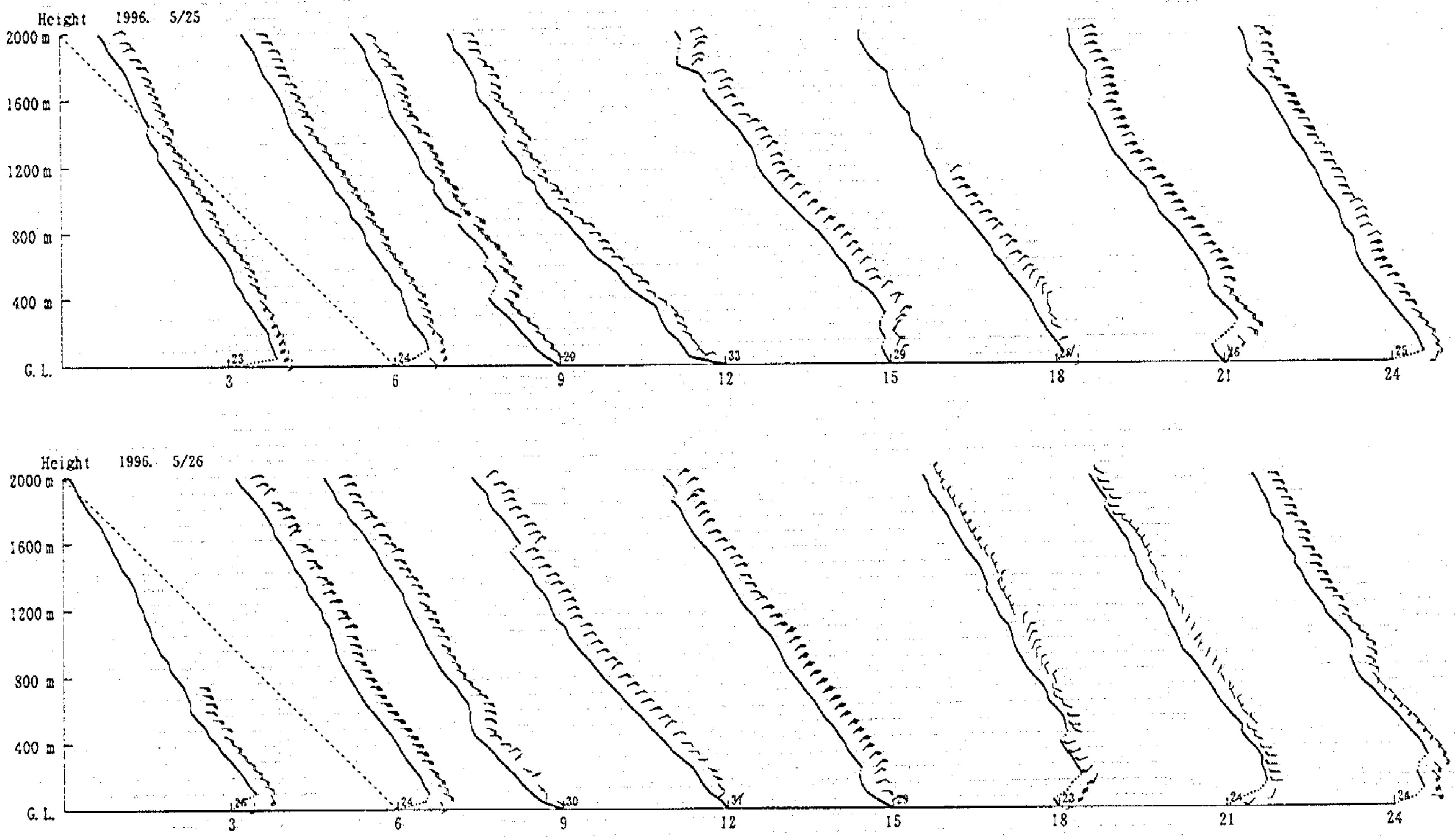
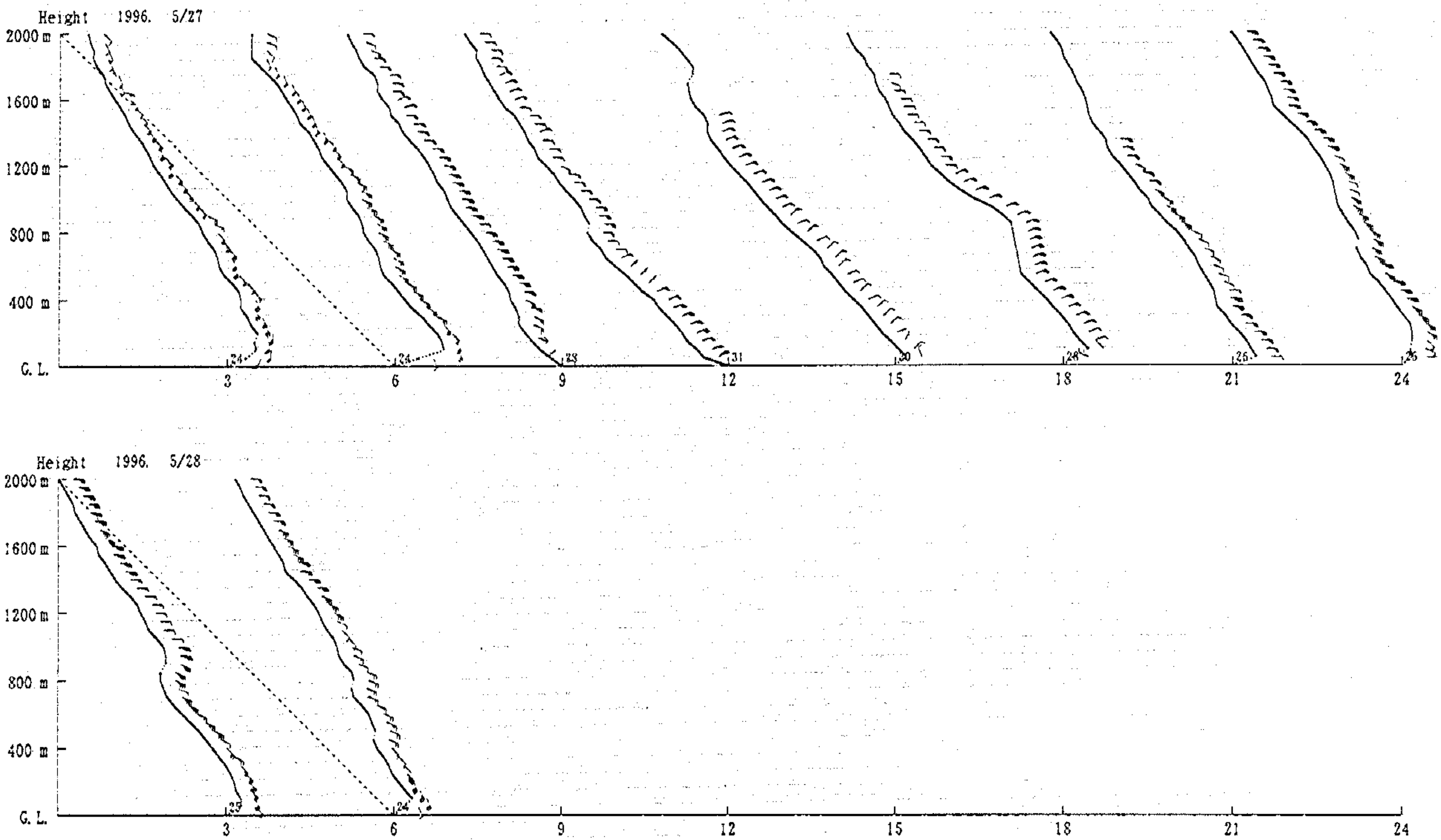


Figure Temperature and Wind Vertical Profiles at EMC

...... Dry Lapse Rate



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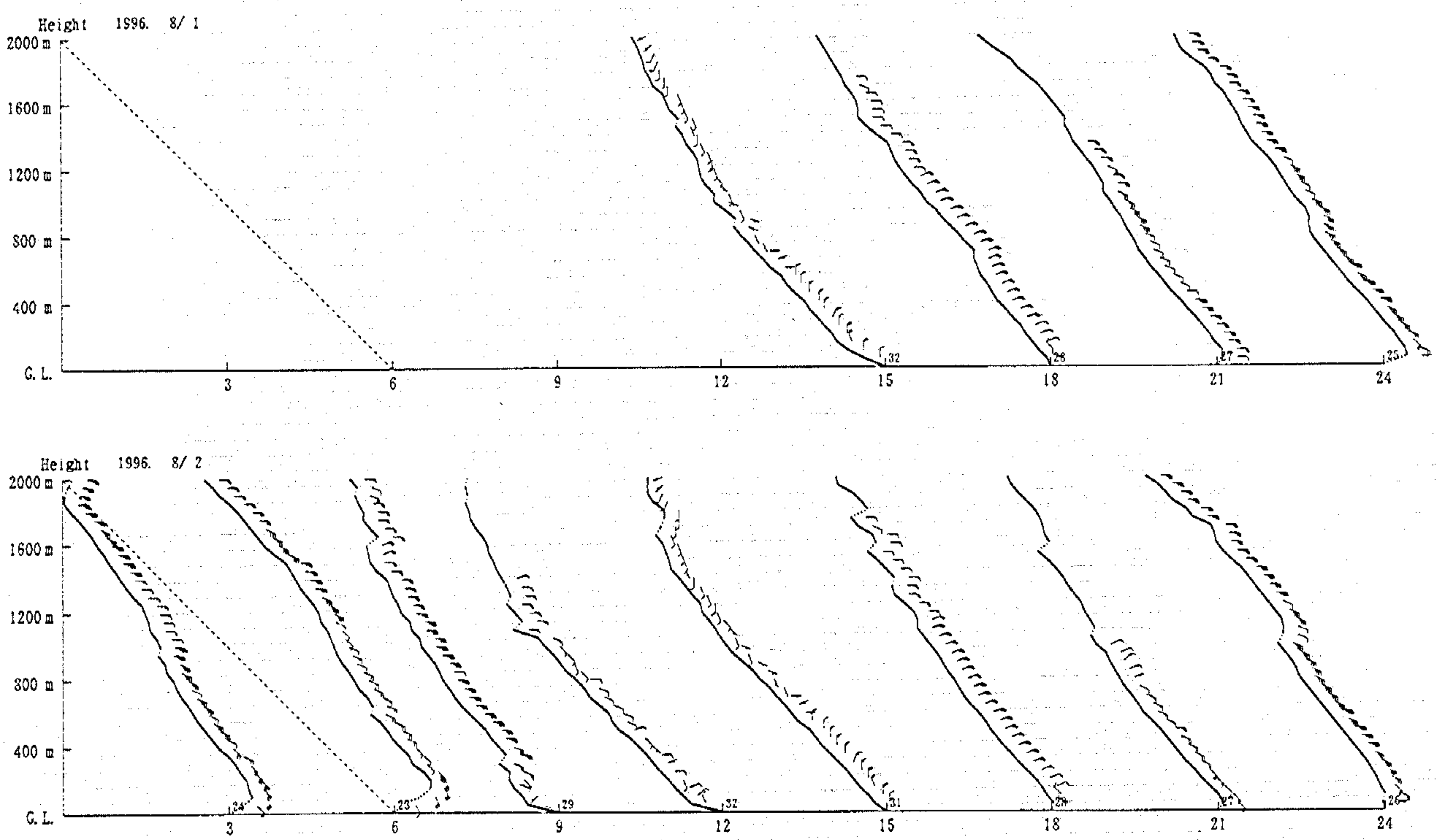

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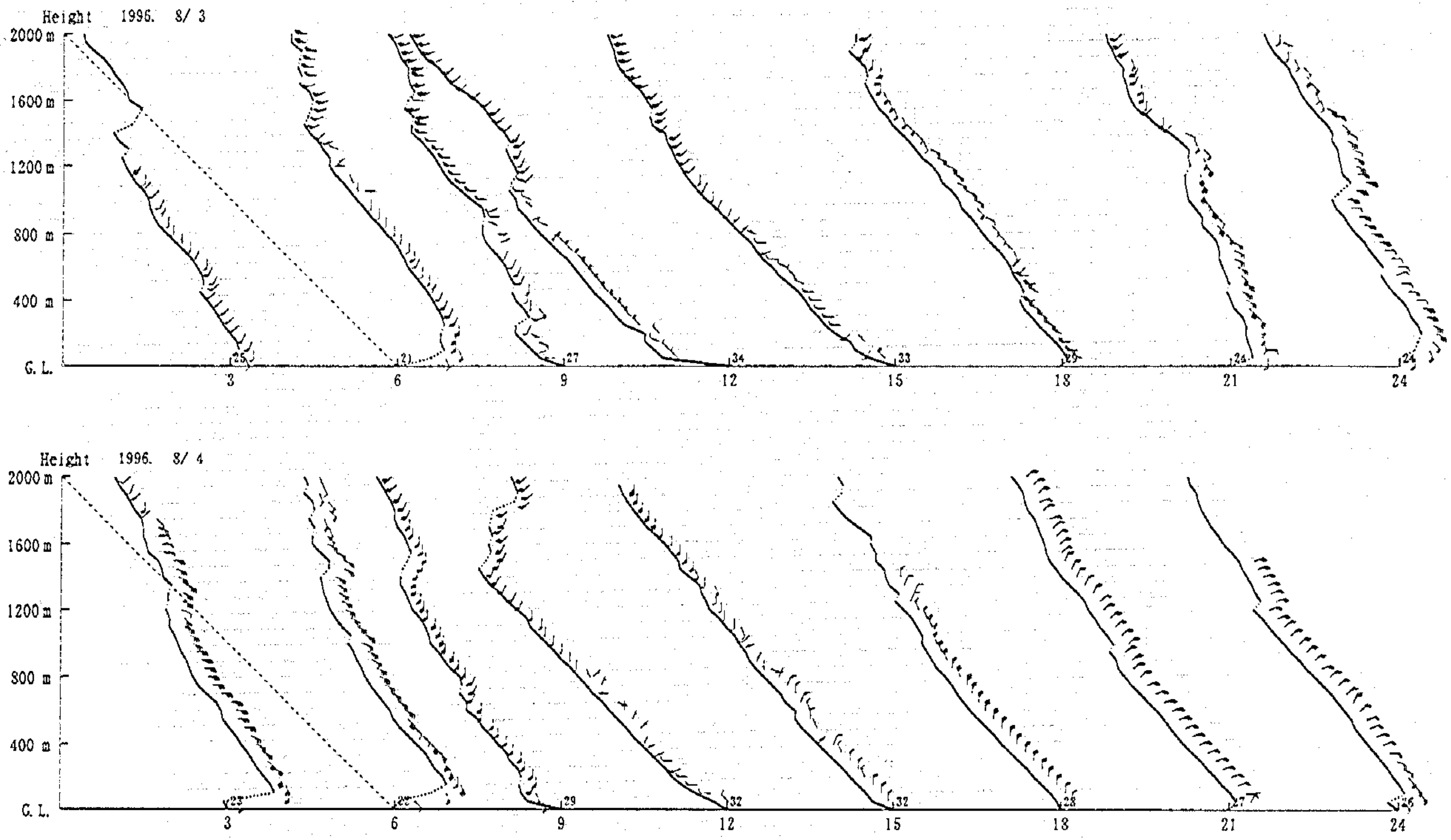

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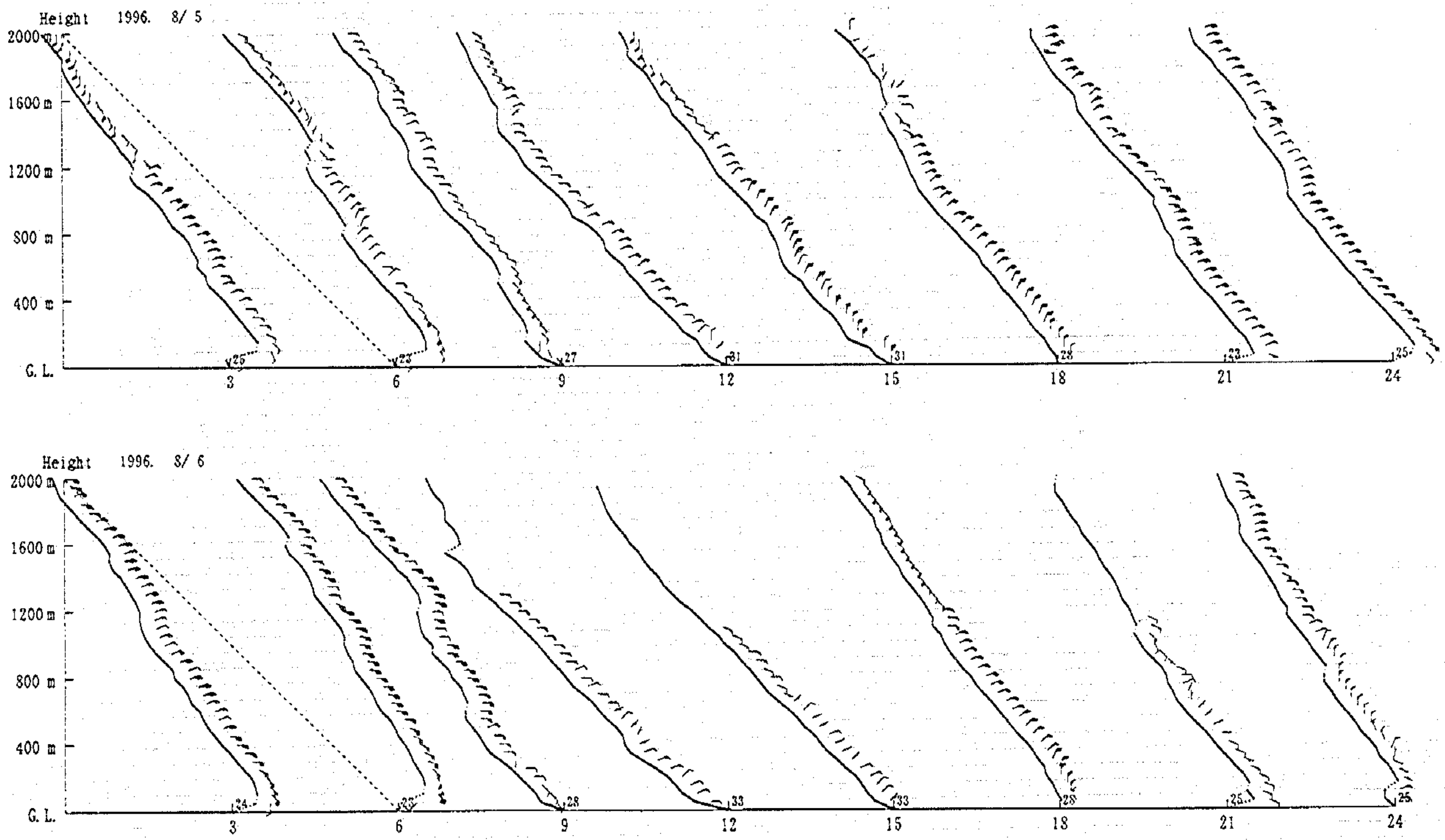

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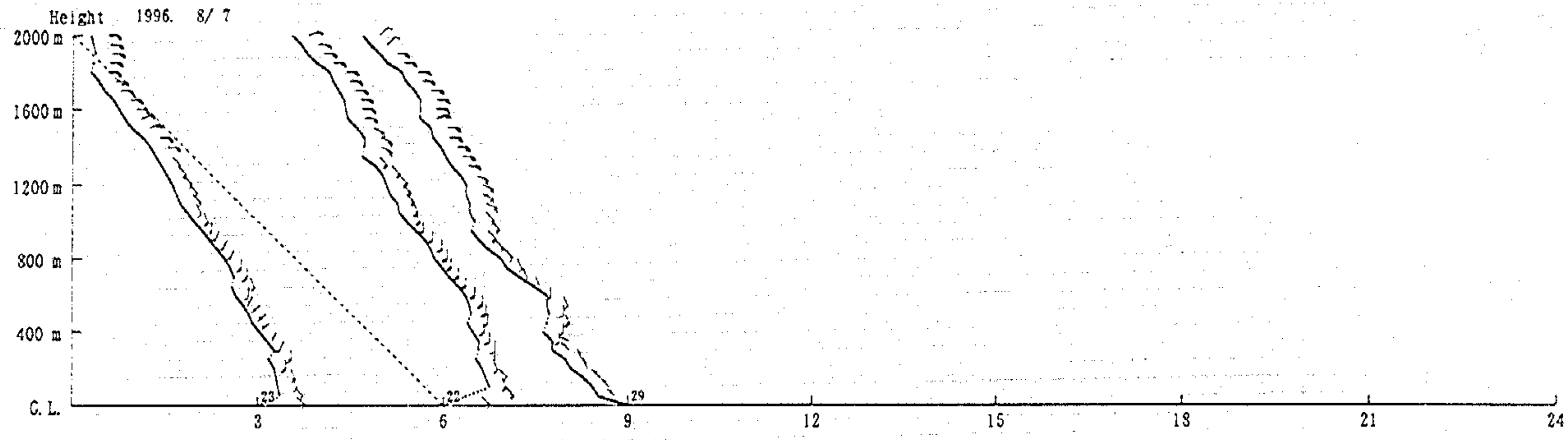


Figure Temperature and Wind Vertical Profiles at EMC ···· Dry Lapse Rate

1.1.2 Inversion Layer Frequency

Table Inversion Layer Frequency

(Target Height 450 m) Observation : EMC

Time Zone	Period / Inversion Categories	Dec Count	Dec Freq (%)	Feb Count	Feb Freq (%)	May Count	May Freq (%)	Aug Count	Aug Freq (%)	Annual Count	Annual Freq (%)
Day	None	19	86.4	21	87.5	17	85.0	22	95.7	79	88.8
	Lower (0 to 450 m)	3	13.6	0	0.0	2	10.0	0	0.0	5	5.6
	Upper (450 to 1,000 m)	0	0.0	3	12.5	0	0.0	0	0.0	3	3.4
	Target	0	0.0	0	0.0	1	5.0	1	4.3	2	2.2
Night	None	4	21.1	17	77.3	8	36.4	14	58.3	43	49.4
	Lower (0 to 450 m)	13	68.4	5	22.7	14	63.6	10	41.7	42	48.3
	Upper (450 to 1,000 m)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Target	2	10.5	0	0.0	0	0.0	0	0.0	2	2.3
All Day	None	23	56.1	38	82.6	25	59.5	36	76.6	122	69.3
	Lower (0 to 450 m)	16	39.0	5	10.9	16	38.1	10	21.3	47	26.7
	Upper (450 to 1,000 m)	0	0.0	3	6.5	0	0.0	0	0.0	3	1.7
	Target	2	4.9	0	0.0	1	2.4	1	2.1	4	2.3

NOTE : 1. An inversion is a temperature lapse rate greater than or equal to 0.1 ^{0}C/100 m, and the thickness is greater than or equal to 100 m. Significant point is not included.

2. Observation frequency is rate of observation number respect to each time zone. The observation numbers are as follows :

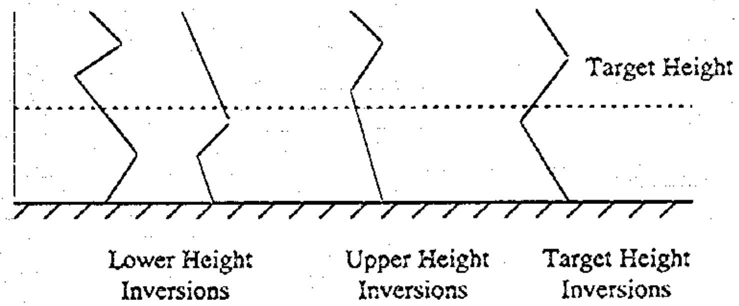
	Dec	Feb	May	Aug	Annual
Day	22	24	20	23	89
Night	19	22	22	24	87
All Day	41	46	42	47	176

3. Observation period and day and night time zones are shown below :

Dec 1995/12/12 to 12/19 Noon 7:00 to 18:00 Night 19:00 to 6:00
Feb 1996/2/3 to 2/9 Noon 7:00 to 18:00 Night 19:00 to 6:00
May 1996/5/22 to 5/28 Noon 7:00 to 18:00 Night 19:00 to 6:00
Aug 1996/8/1 to 8/7 Noon 7:00 to 18:00 Night 19:00 to 6:00

4. The frequency sum may not be 100% due to rounded off error

5. A Target Height Inversion is an inversion continuing from lower to upper layer. Relations among Target Height and 3 inversion categories are shown below :



1.1.3 Daily Maximum Lid Height

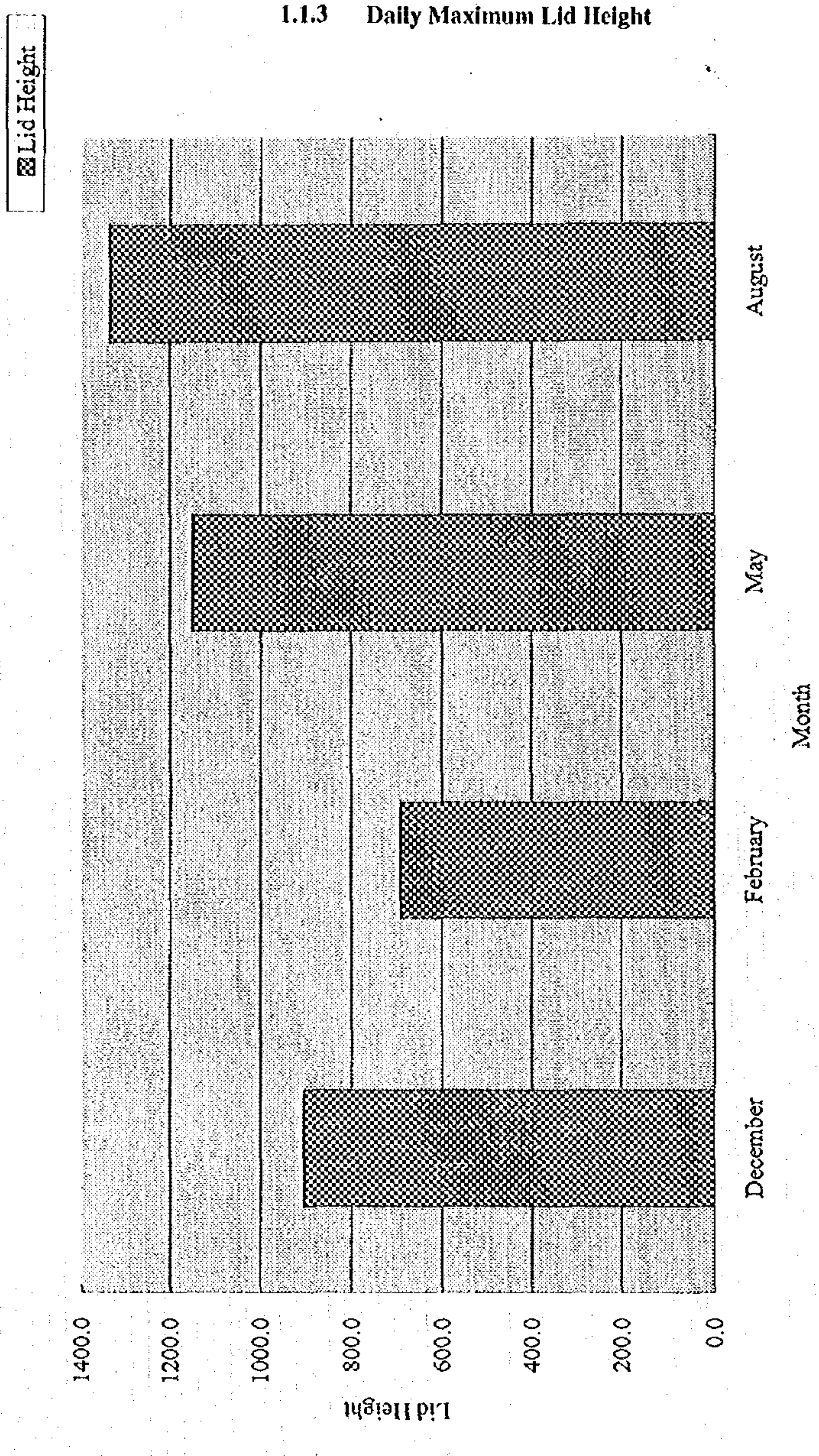


Figure Daily Maximum Lid Height

1.1.4 Intensity of Inversion Layer

Table Intensity of Inversion Layer

dt/dz (℃/100m)

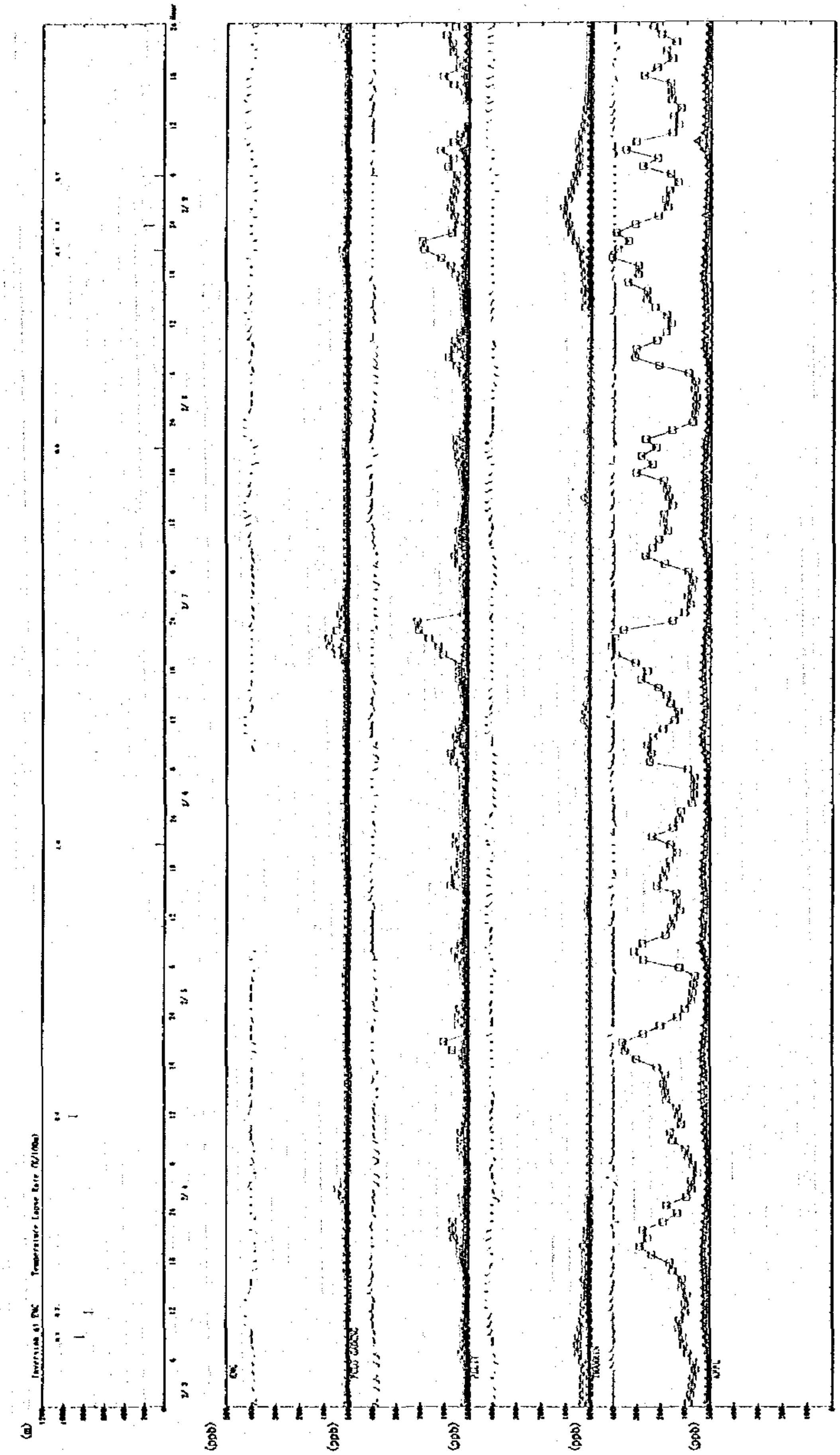
	Dec.	Feb.	May	Aug.	Total
None	23	38	25	36	122
~1.0	11	8	3	2	24
~2.0	6	0	11	6	23
~3.0	1	0	3	3	7
3.1~	0	0	0	0	0
Total	41	46	42	47	176

dt/dz (℃/100m)

	Day Time	Night Time	Total
None	79	43	122
~1.0	8	16	24
~2.0	2	21	23
~3.0	0	7	7
3.1~	0	0	0
Total	89	87	176

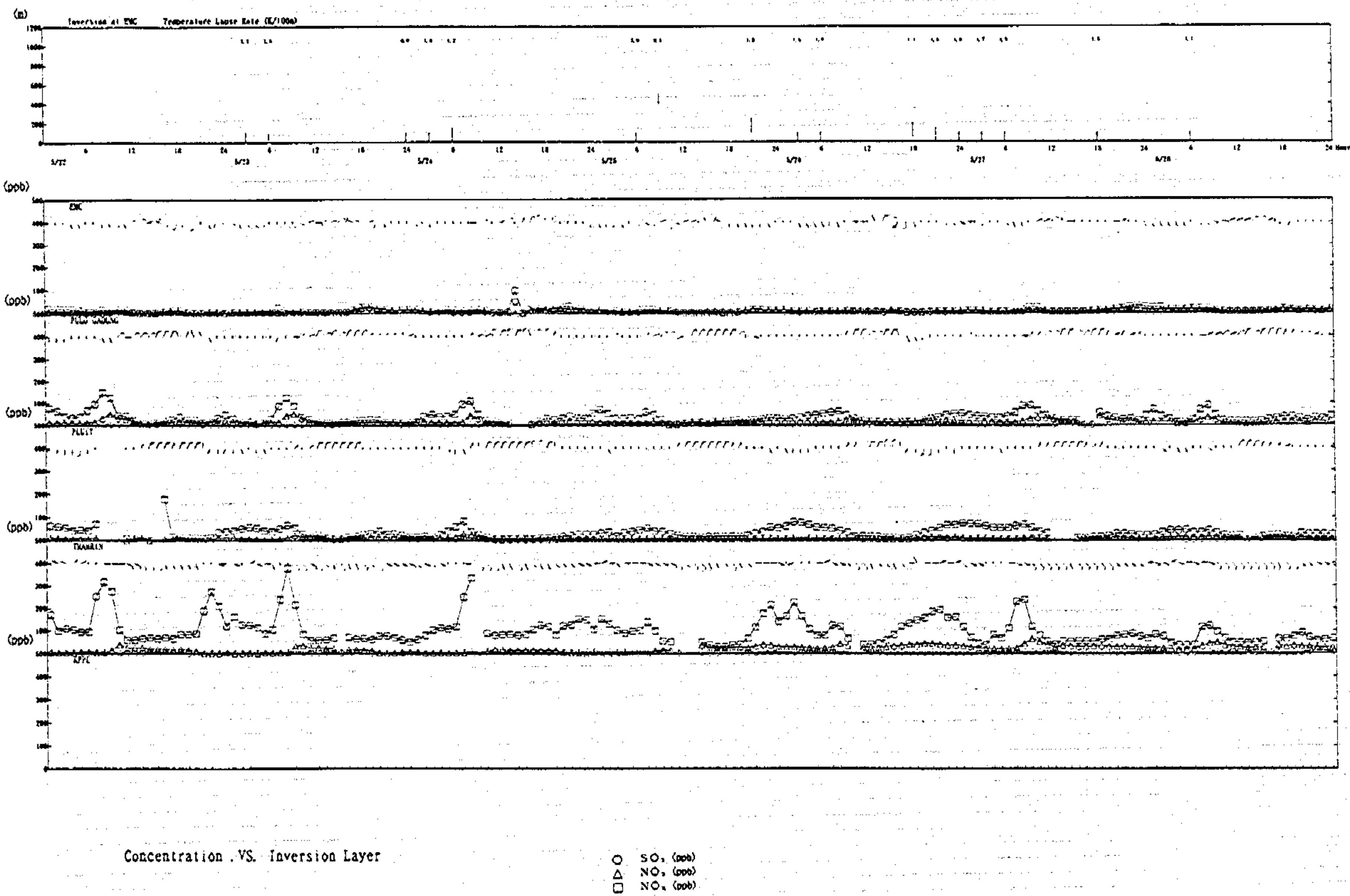
Note: Day Time is from 6:00 to 18:00
Night Time is from 18:00 to 6:00

1.1.5 Inversion Layer and Ambient Air Quality

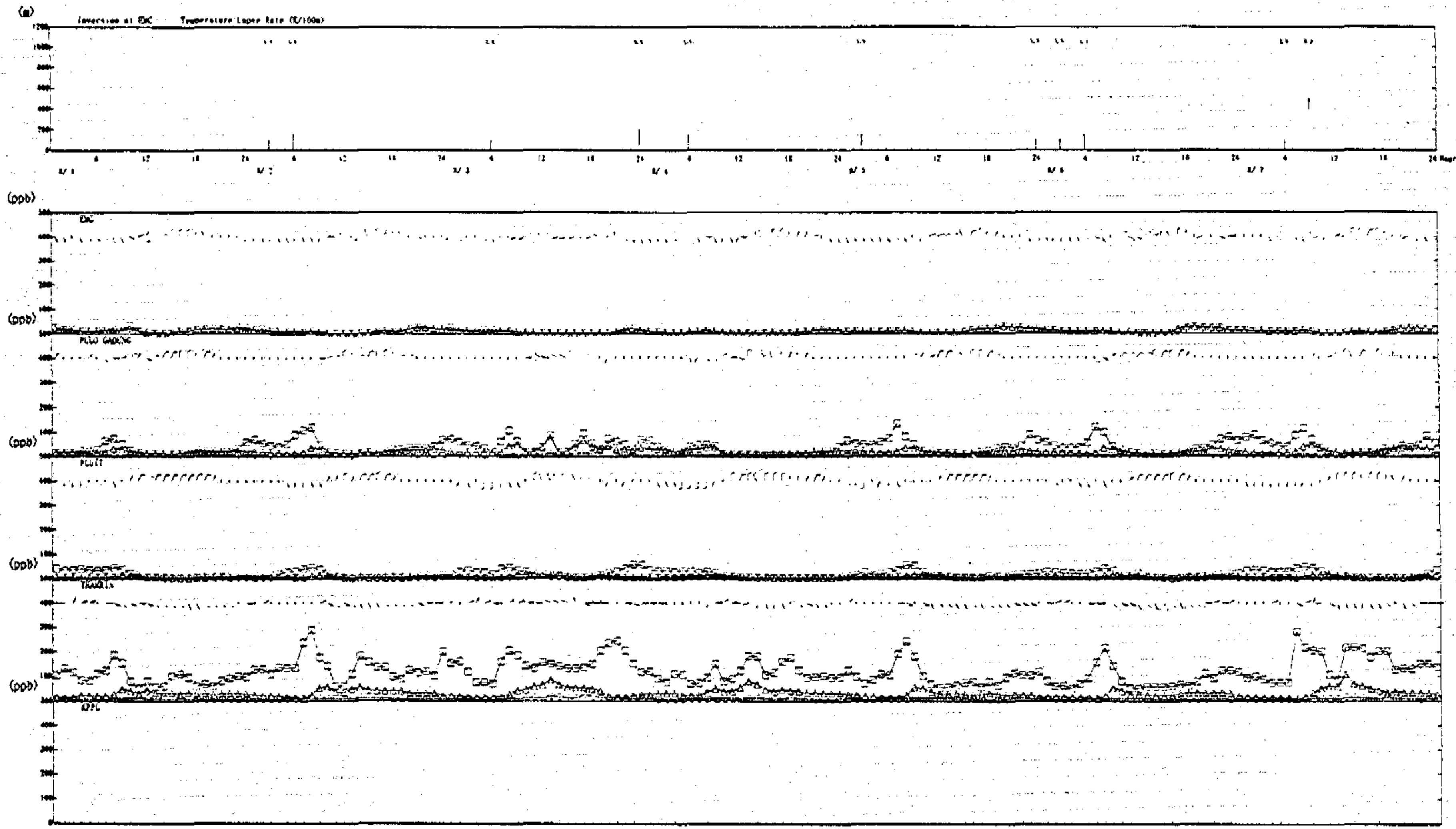


○ SO_2 (ppb)
△ NO_2 (ppb)
□ NO_x (ppb)

Concentration .VS. Inversion Layer



Concentration .VS. Inversion Layer



Concentration .VS. Inversion Layer

○ SO_2 (ppb)
△ NO_2 (ppb)
□ NO_x (ppb)

1.2 Surface Meteorology

1.2.1 Wind Speed Frequency

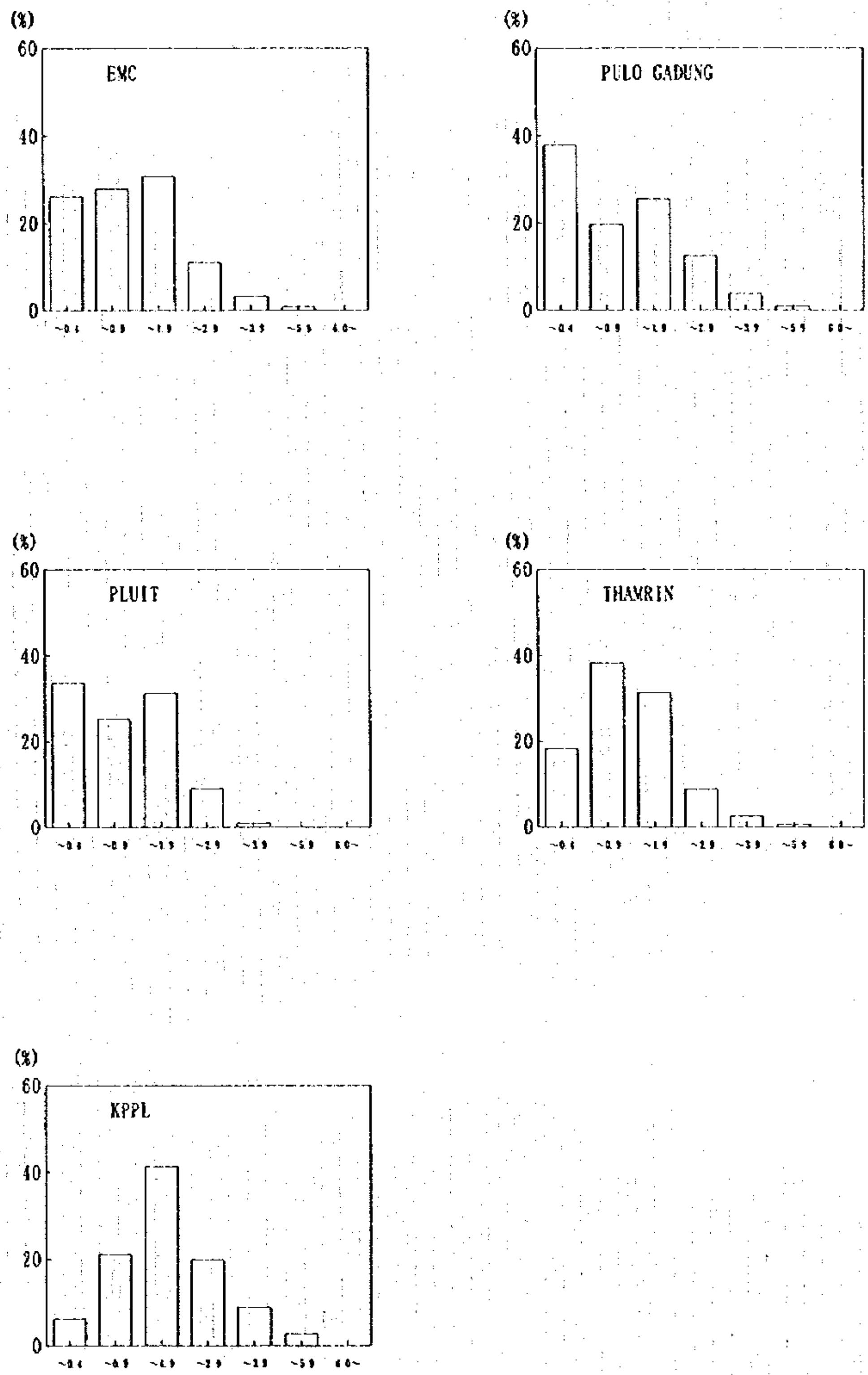


Fig. Wind Speed Frequency Year 1996 (Jan. to Dec.)

1.2.2 Diurnal Change of Wind Speed

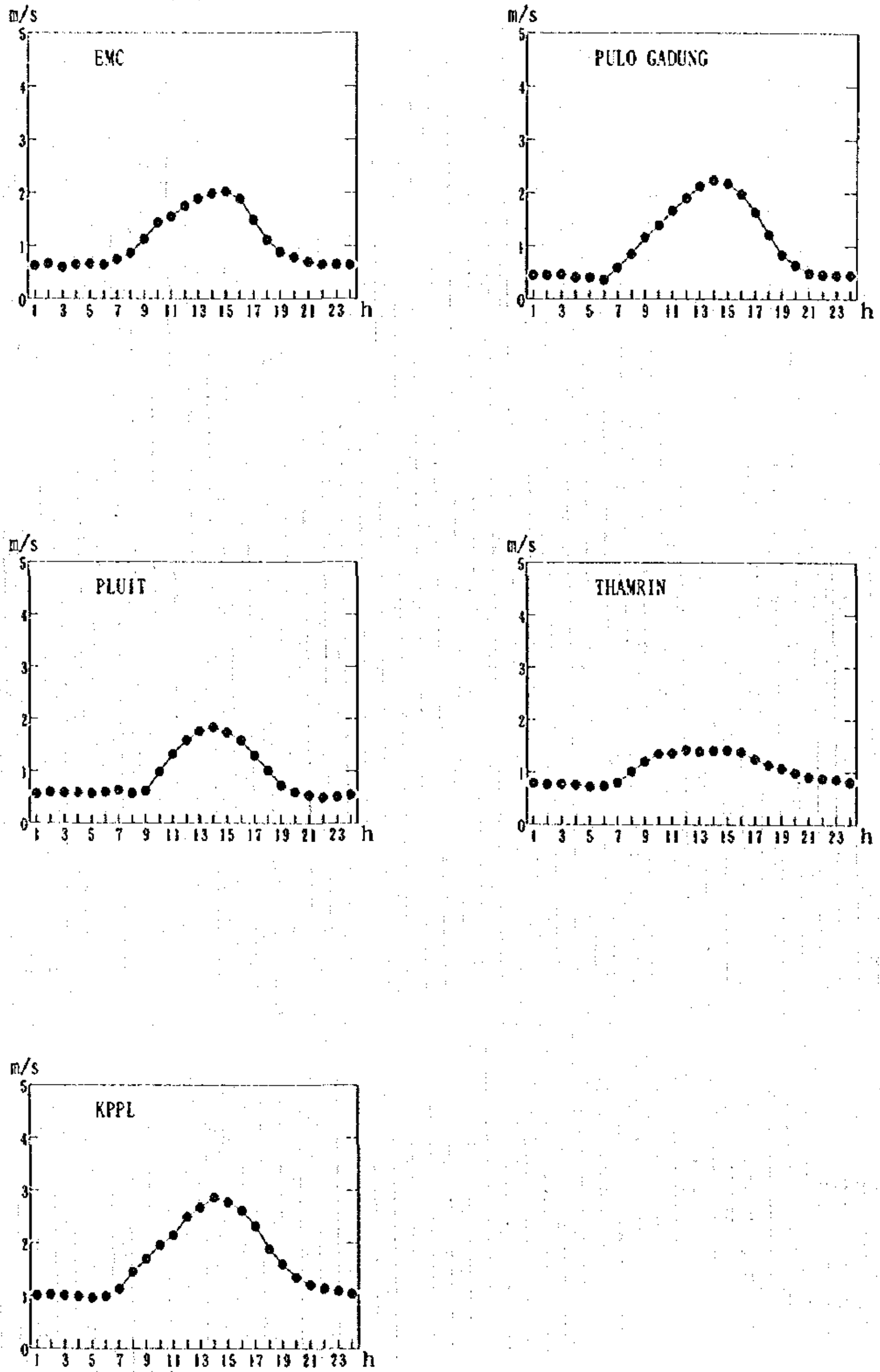
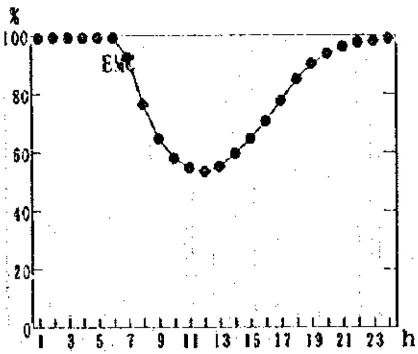
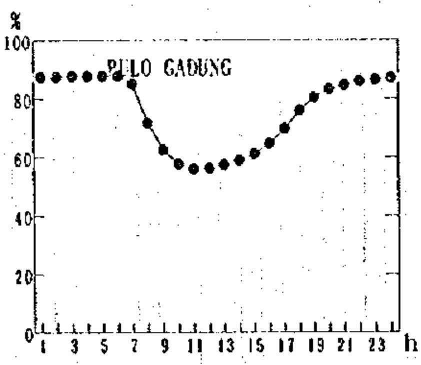


Fig. Diurnal Change of Wind Speed Year 1996 (Jan. to Dec.)

1.2.3 Diurnal Change of Humidity





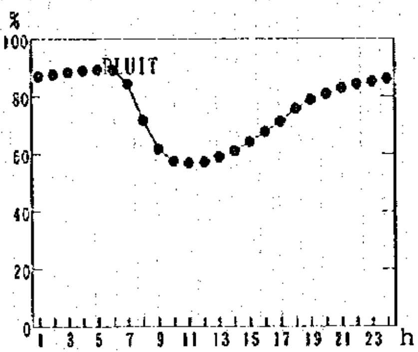


Fig. Diurnal Change of Humidity Year 1996 (Jan. to Dec.)

1.2.4 Diurnal Change of Net Radiation

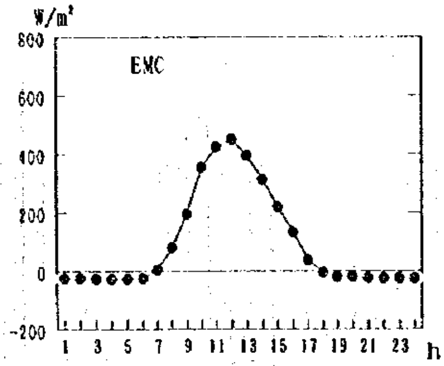
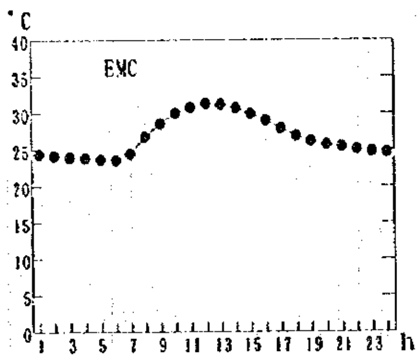
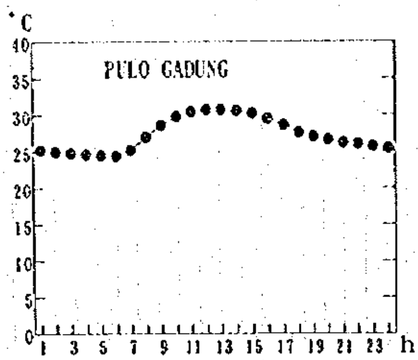


Fig. Diurnal Change of Net Radiation Year 1996 (Jan. to Dec.)

1.2.5 Diurnal Change of Temperature





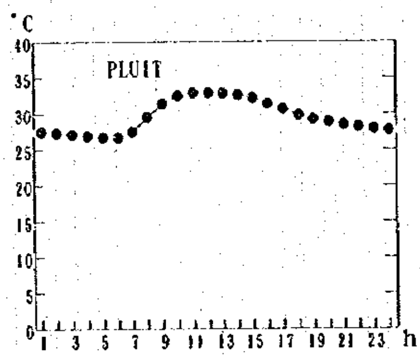


Fig. Diurnal Change of Temparature Year 1996 (Jan. to Dec.)

Appendix 2

CURRENT AIR QUALITY

2.1 Concentration Graphs

2.1.1 Cumulative Distribution

—Daily Average
—Hourly Average

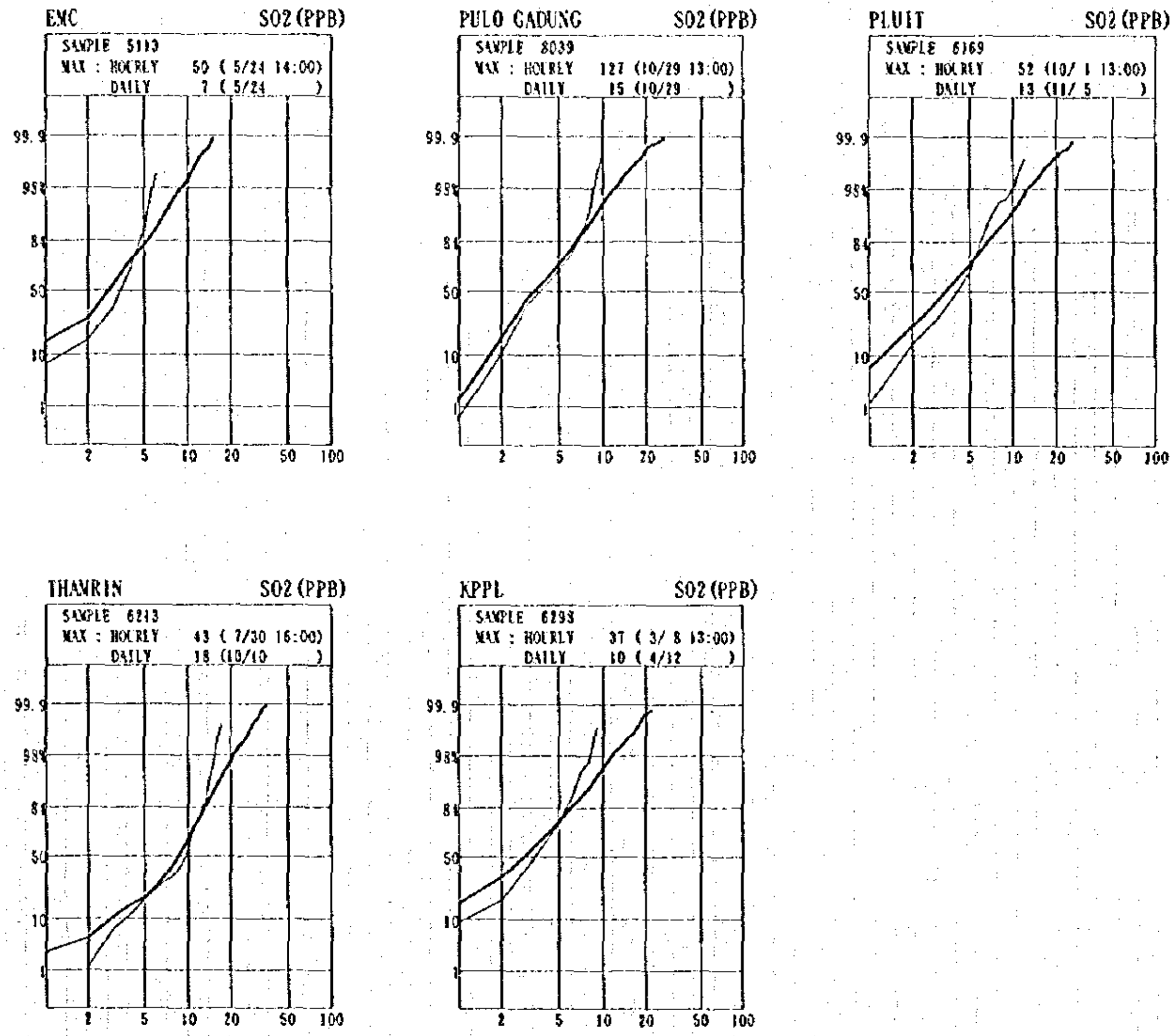


Fig. Cumulative Distribution Year 1996 (Jan. to Dec.)

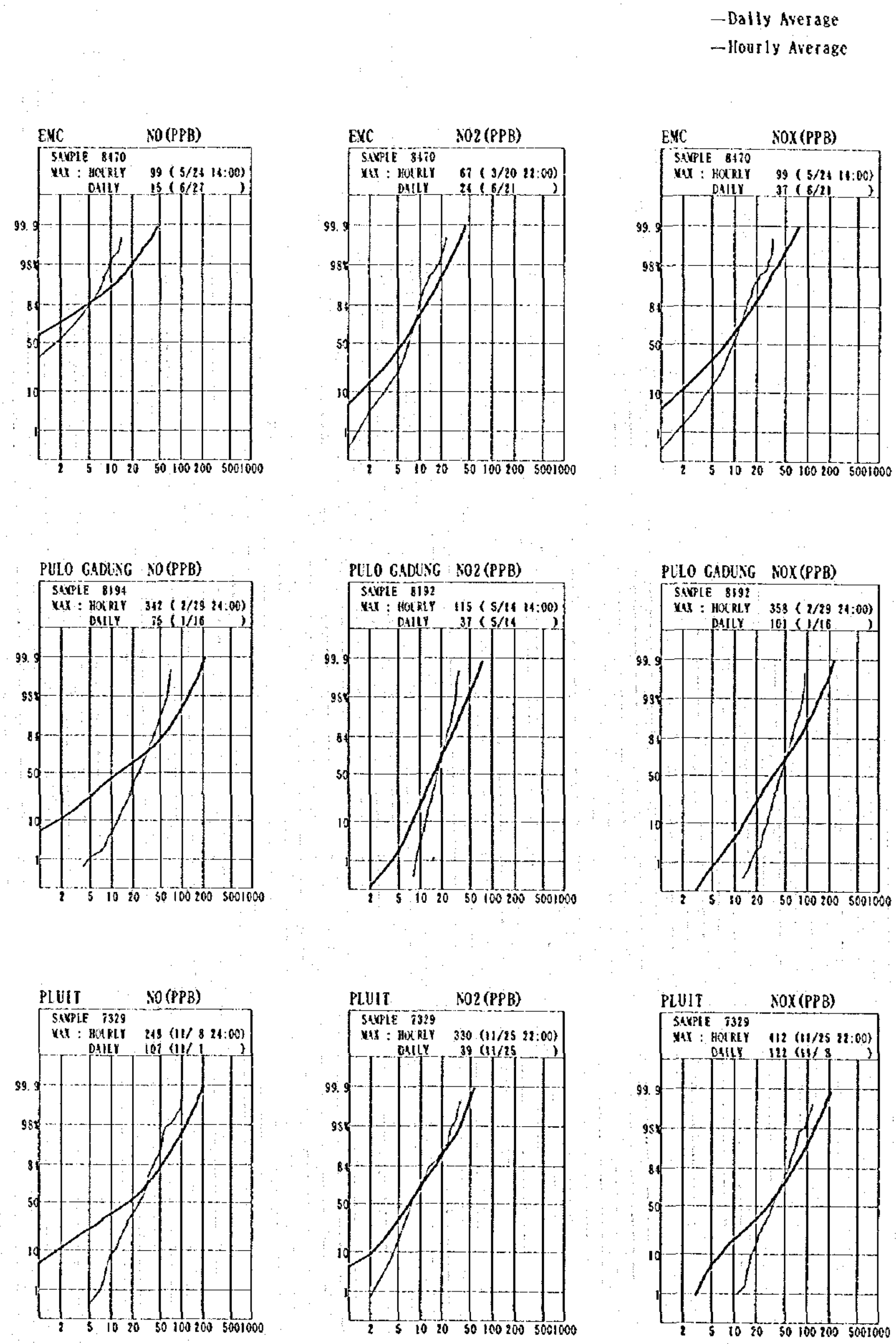


Fig. Cumulative Distribution Year 1996 (Jan. to Dec.)

--Daily Average
--Hourly Average

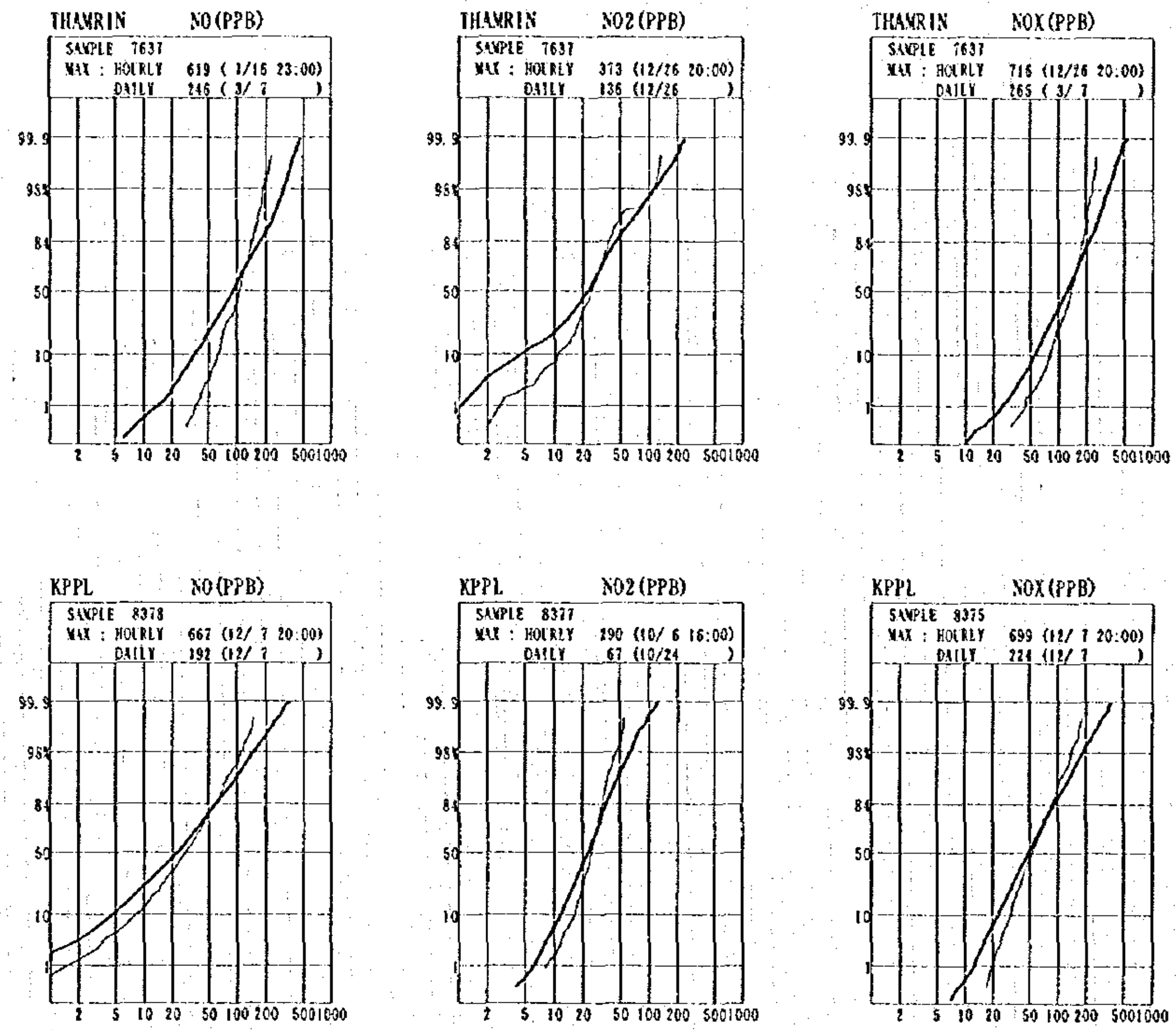


Fig. Cumulative Distribution Year 1996 (Jan. to Dec.)

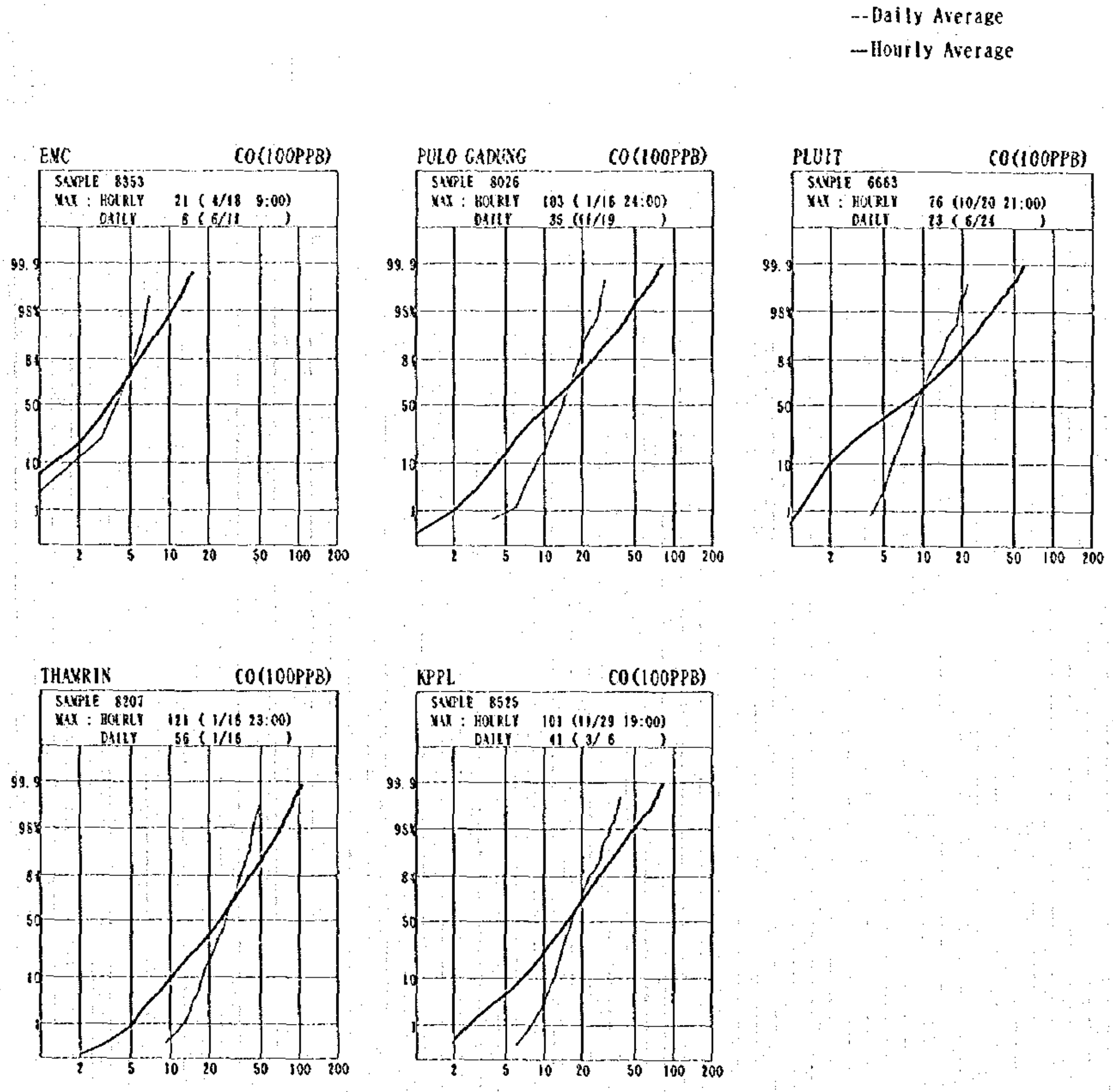
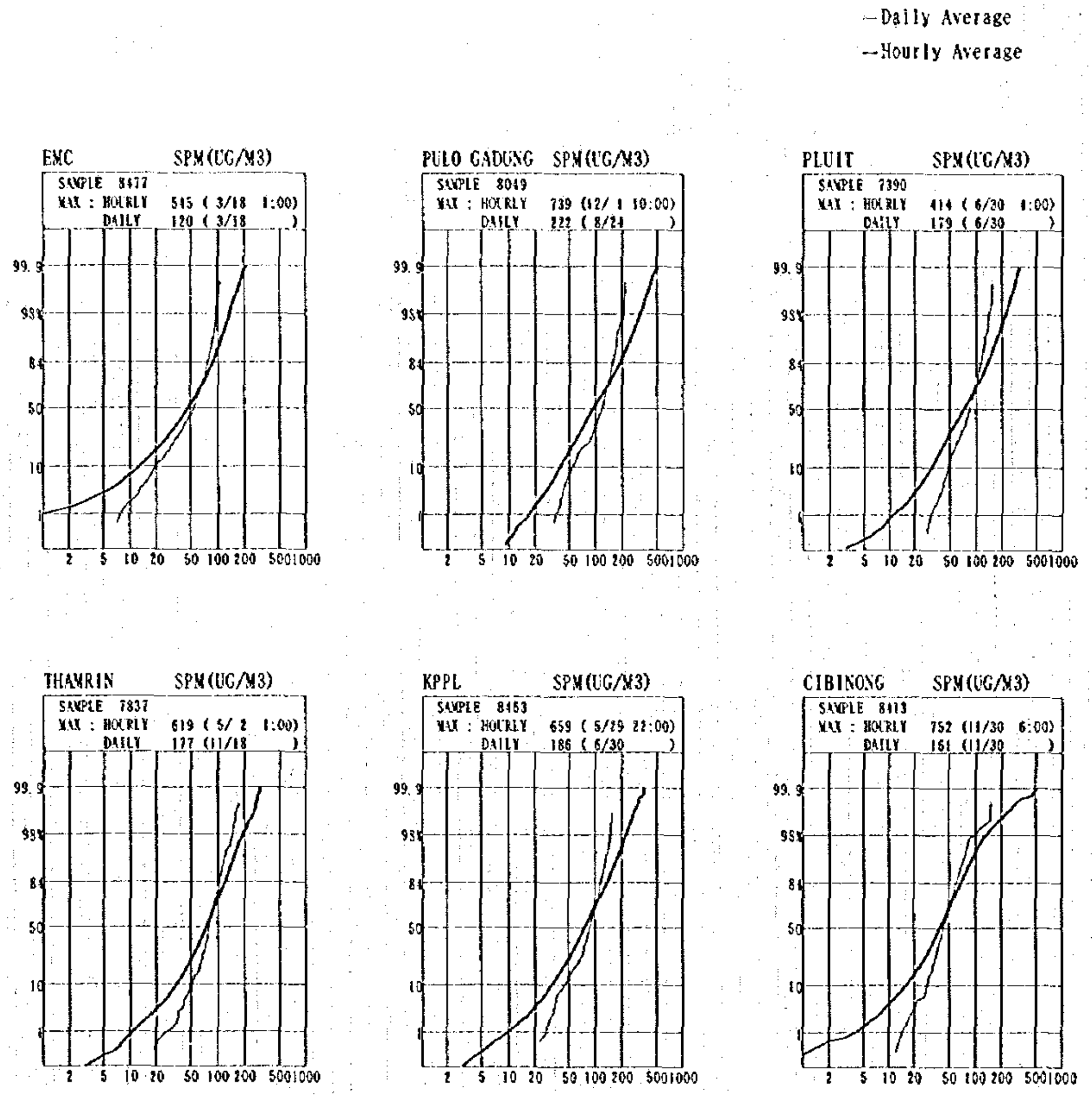


Fig. Cumulative Distribution Year 1996 (Jan. to Dec.)



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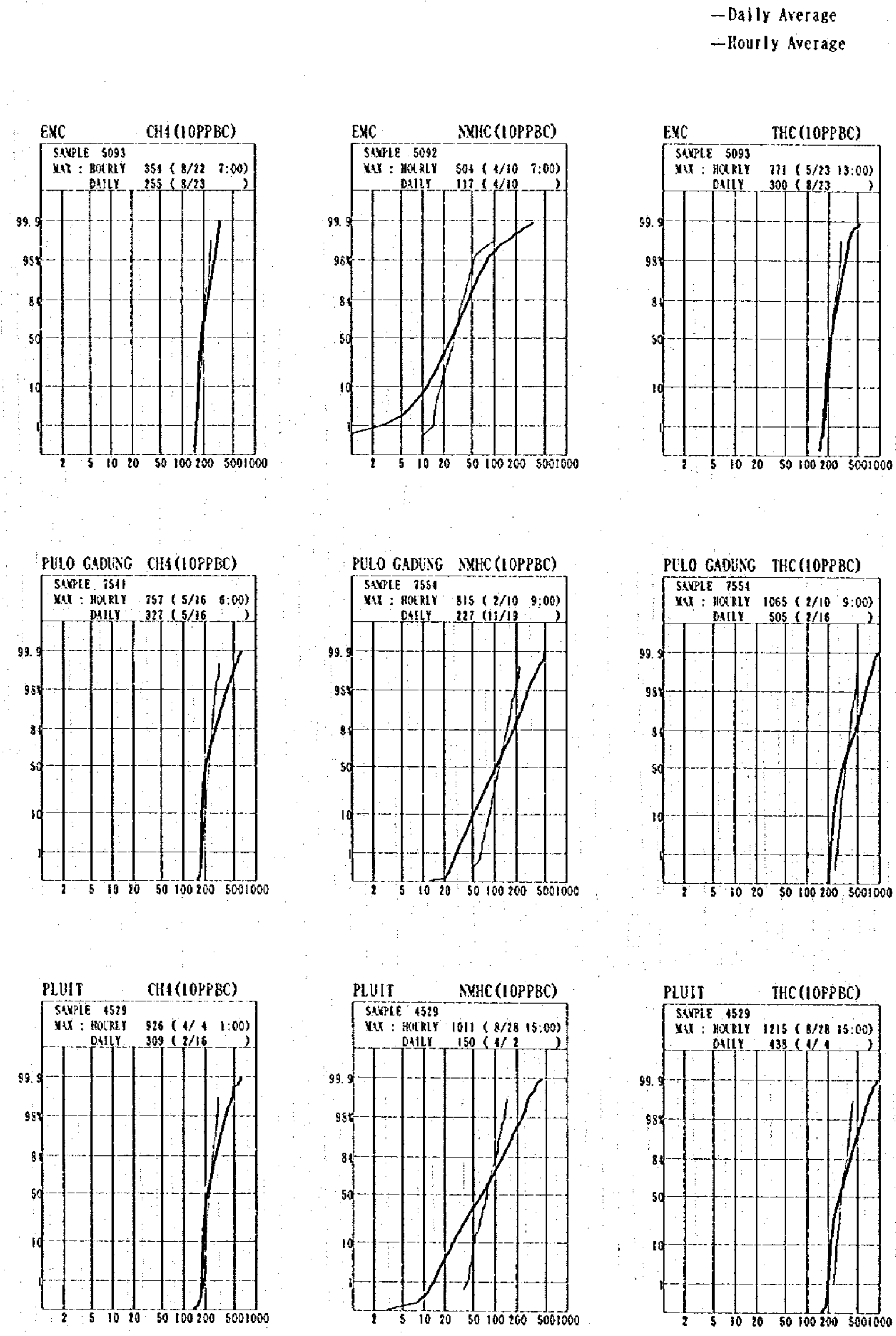


Fig. Cumulative Distribution Year 1996 (Jan. to Dec.)

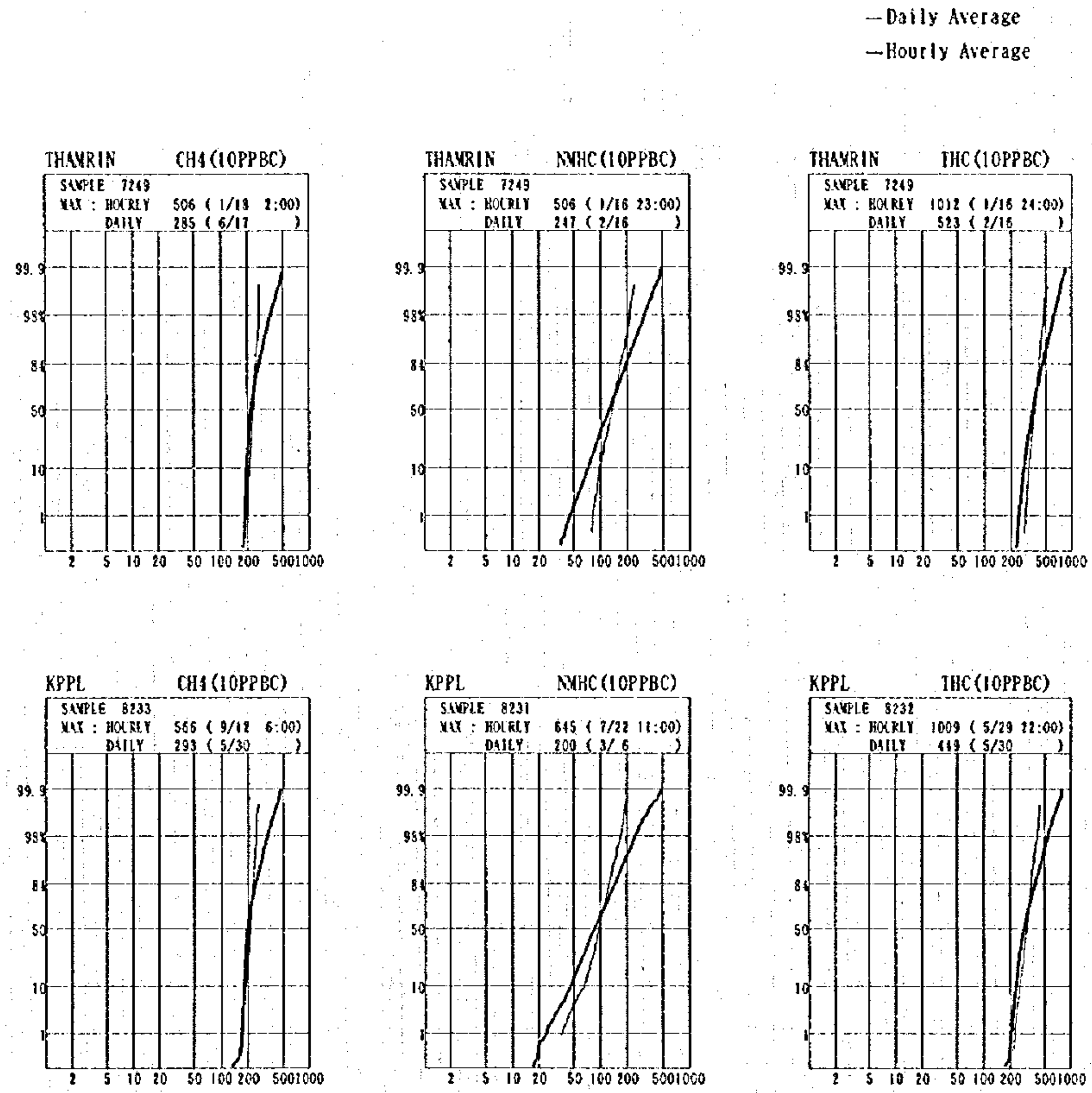


Fig. Cumulative Distribution Year 1996 (Jan. to Dec.)

—Daily Average
--Hourly Average

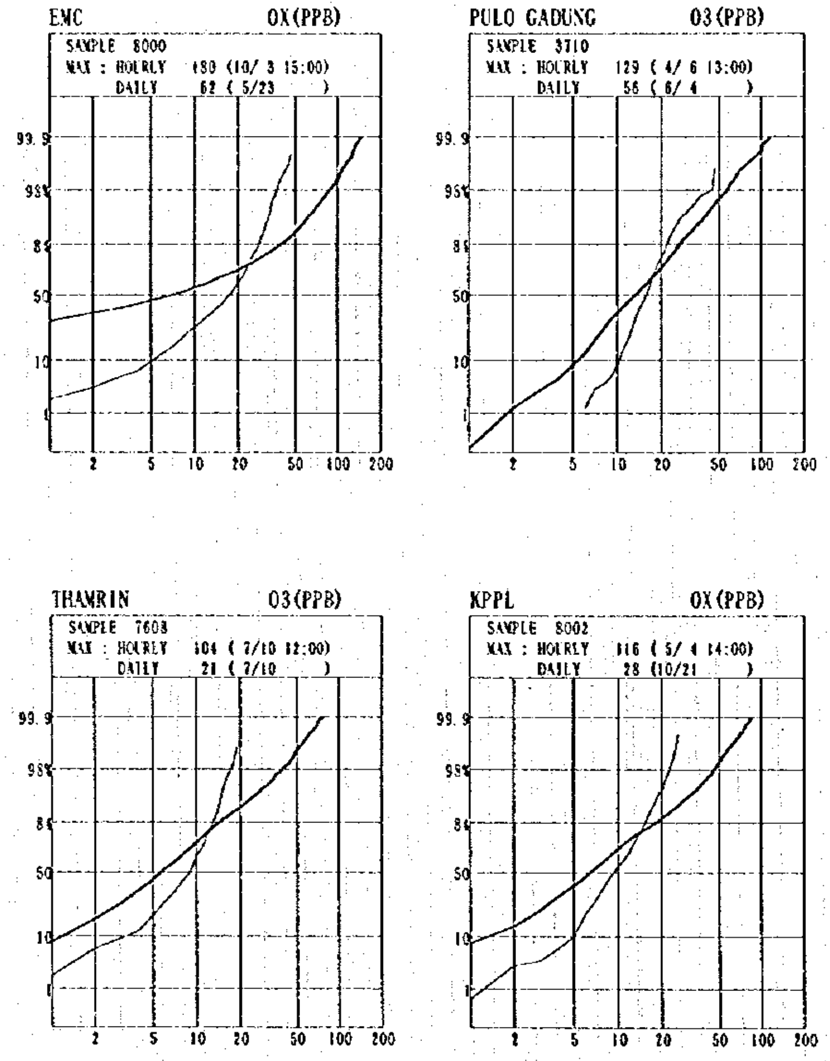
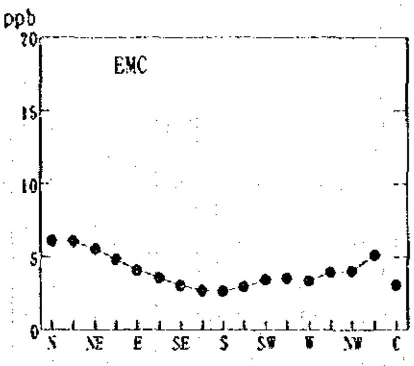
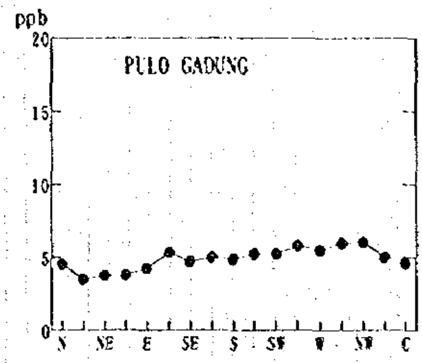
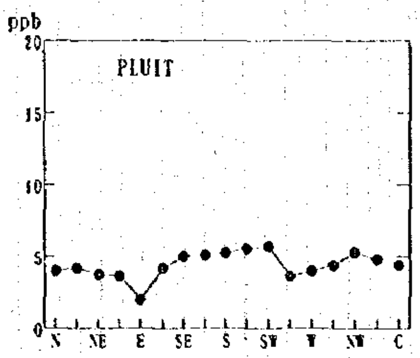


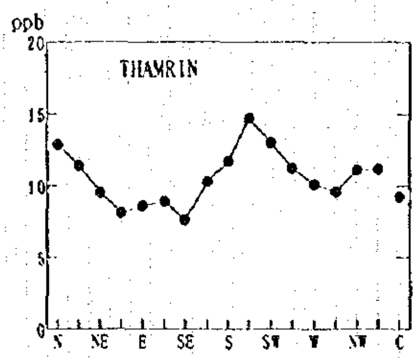
Fig. Cumulative Distribution Year 1996 (Jan. to Dec.)

2.1.2 Average Concentration by Wind Directions









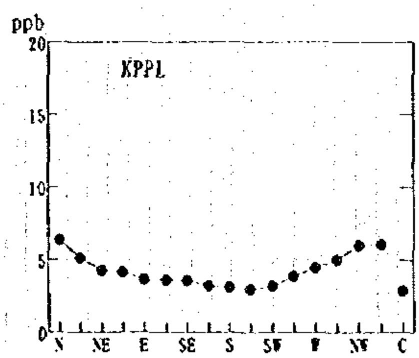


Fig. Average Concentration by Wind Directions (Sulfur Dioxide)
Year 1996 (Jan. to Dec.)

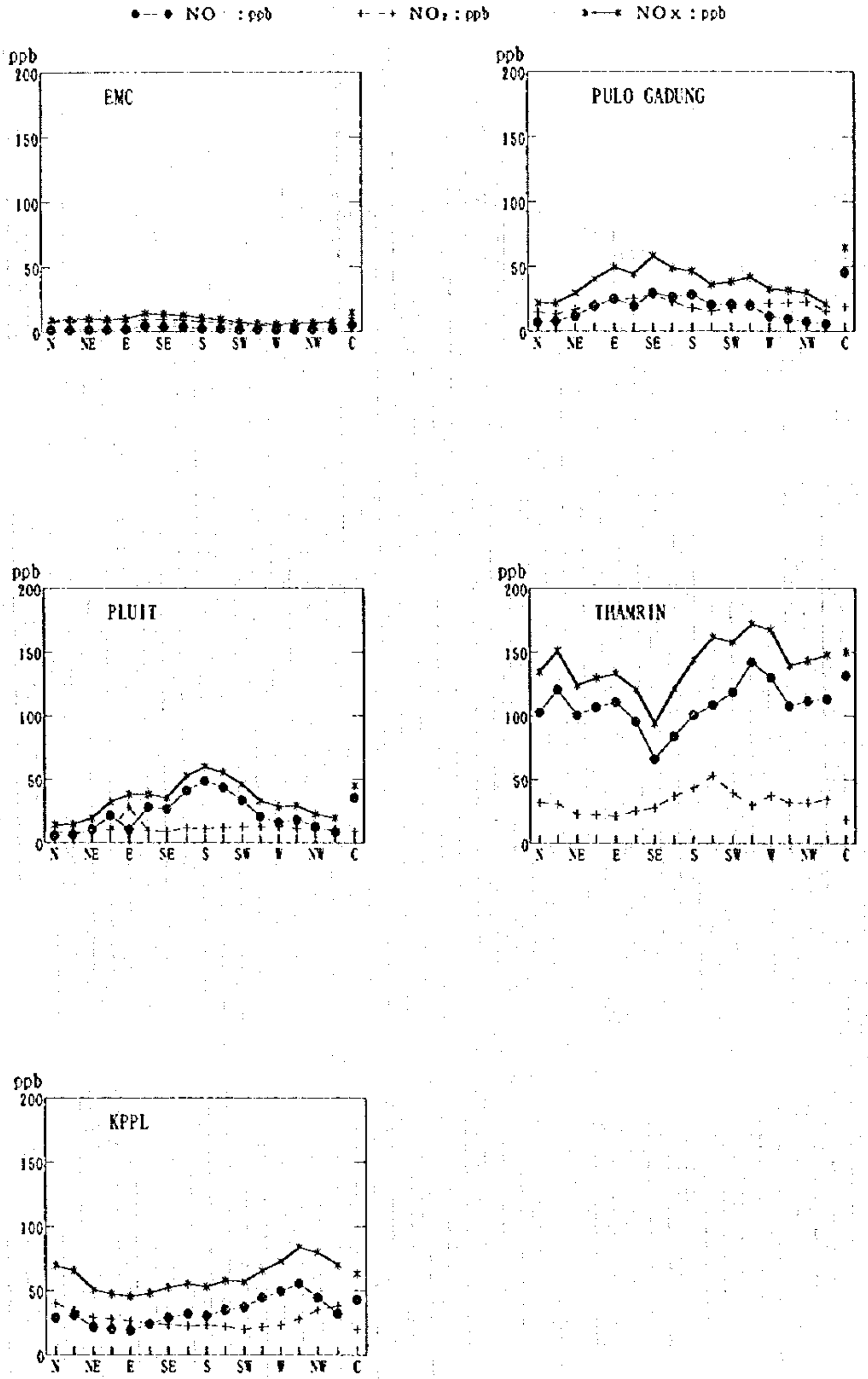
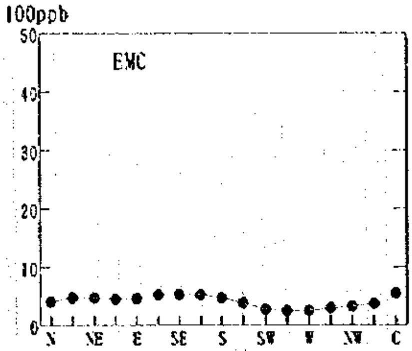
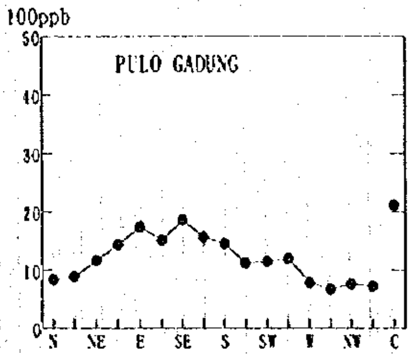
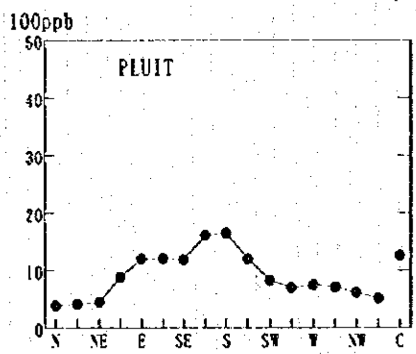


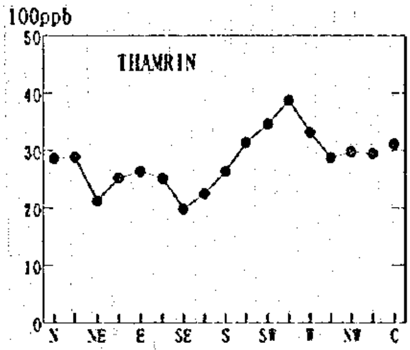
Fig. Average Concentration by Wind Directions (Nitrogen Oxides)

Year 1996 (Jan. to Dec.)









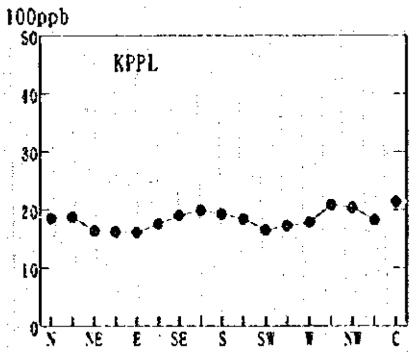


Fig. Average Concentration by Wind Directions(Carbon Monoxide)
Year 1996 (Jan. to Dec.)

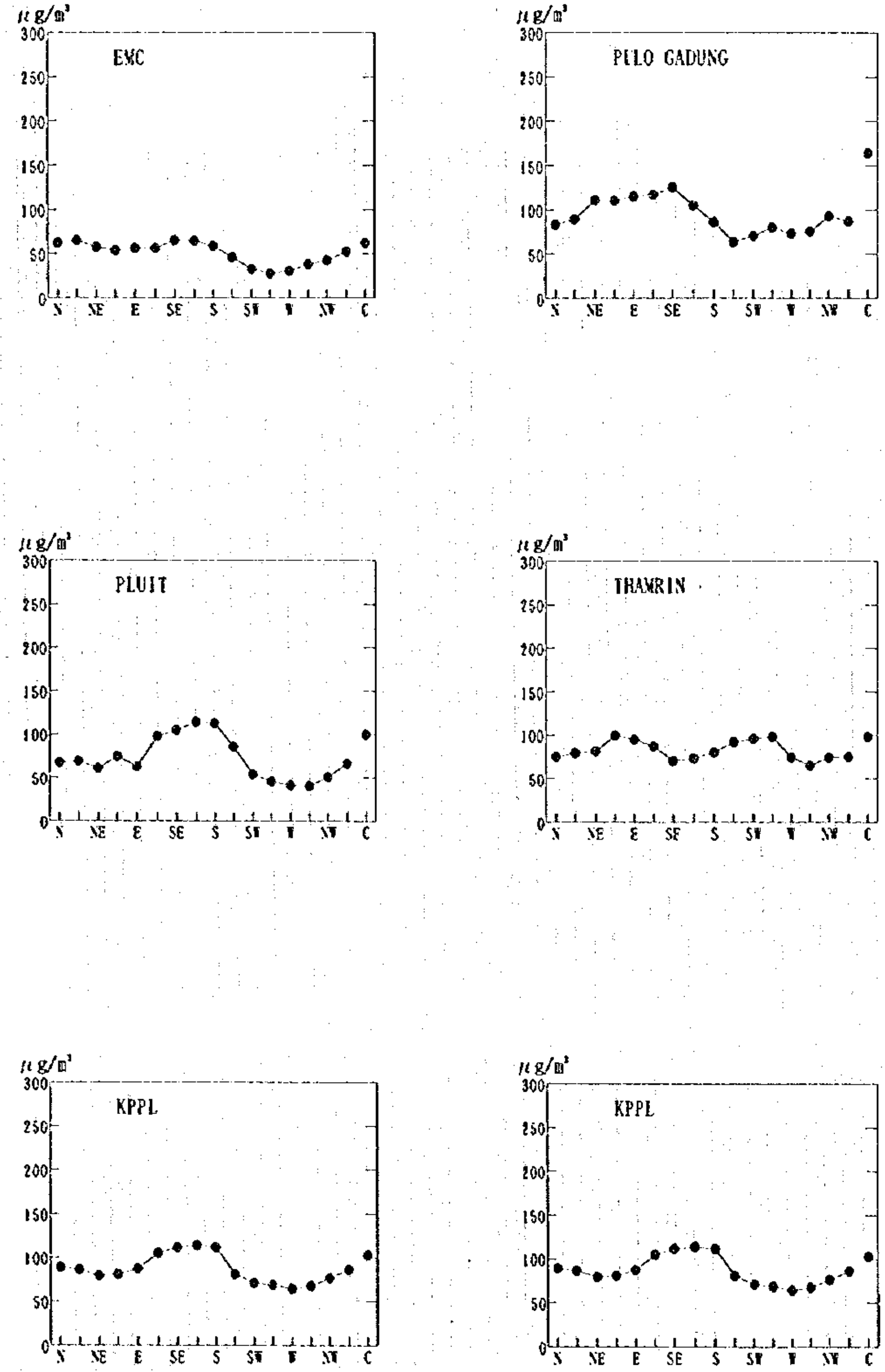


Fig. Average Concentration by Wind Directions (Suspended Particulate Matter)

Year 1996 (Jan. to Dec.)

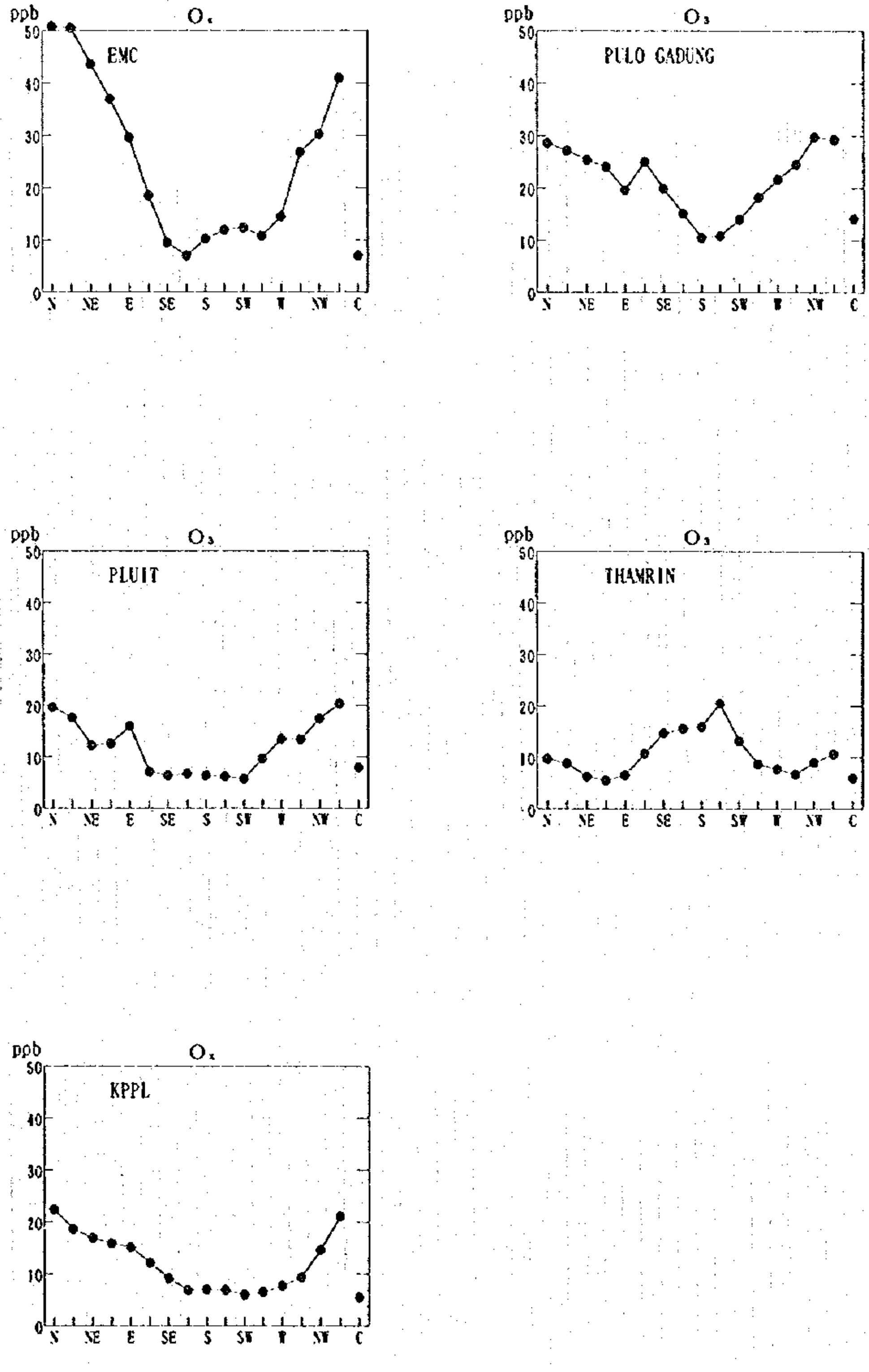


Fig. Average Concentration by Wind Directions (Oxidant&O3)

Year 1996 (Jan. to Dec.)

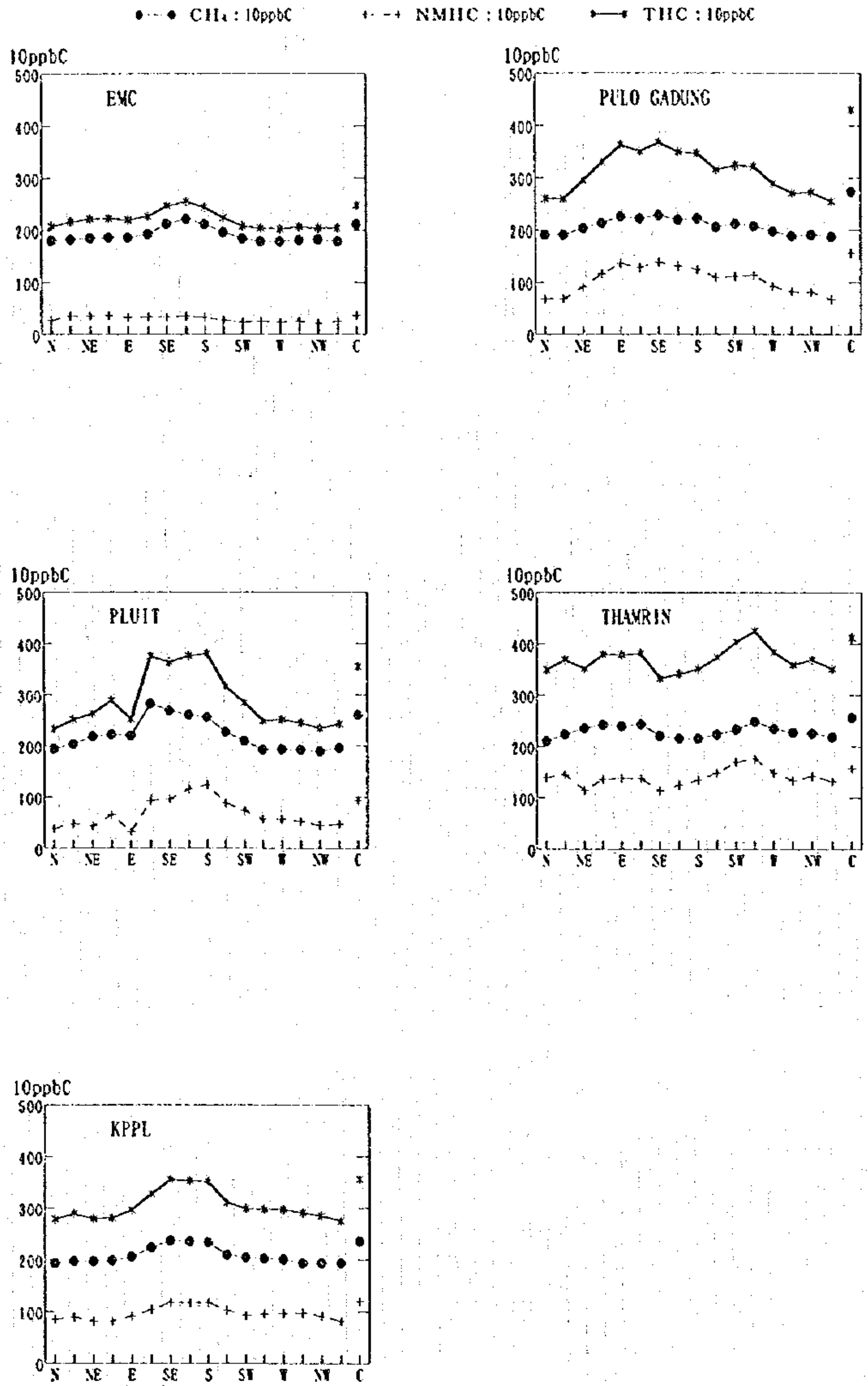


Fig. Average Concentration by Wind Directions (Hydrocarbons)

Year 1996 (Jan. to Dec.)

2.1.3 Average Concentration by Stability

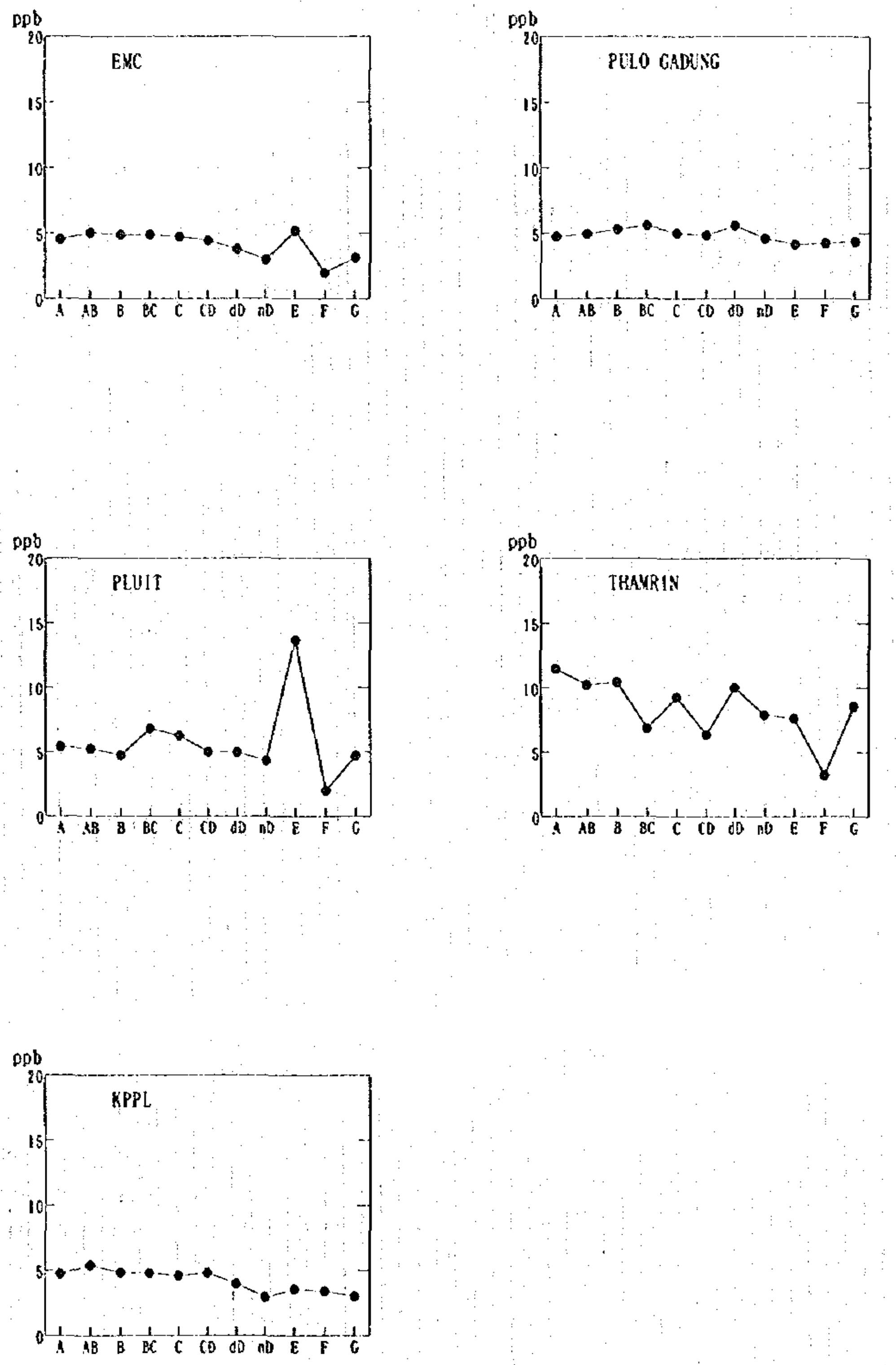


Fig. Average Concentration by Stability (Sulfur Dioxide)

Year 1996 (Jan. to Dec.)

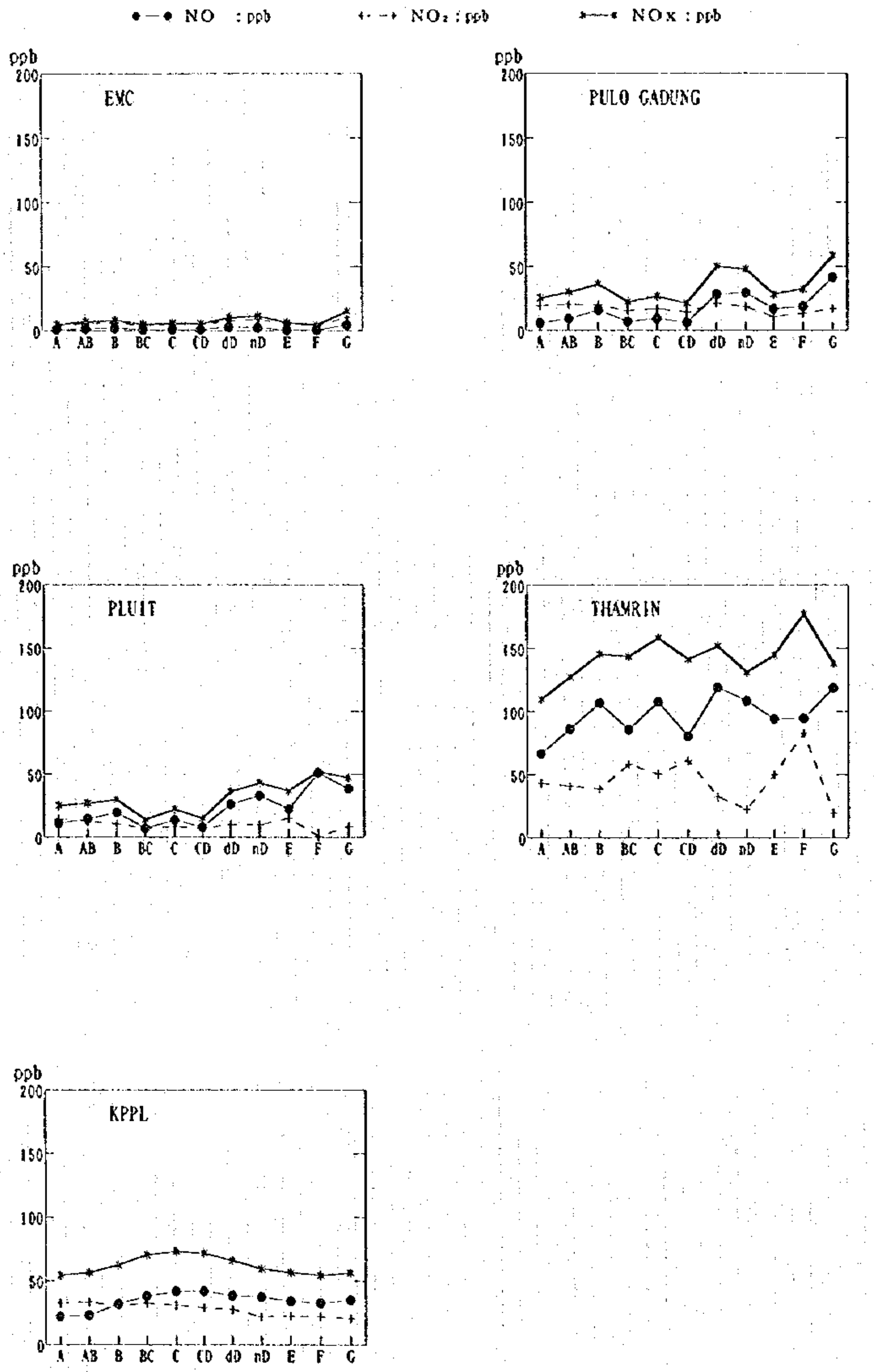


Fig. Average Concentration by Stability (Nitrogen Oxides)

Year 1996 (Jan. to Dec.)

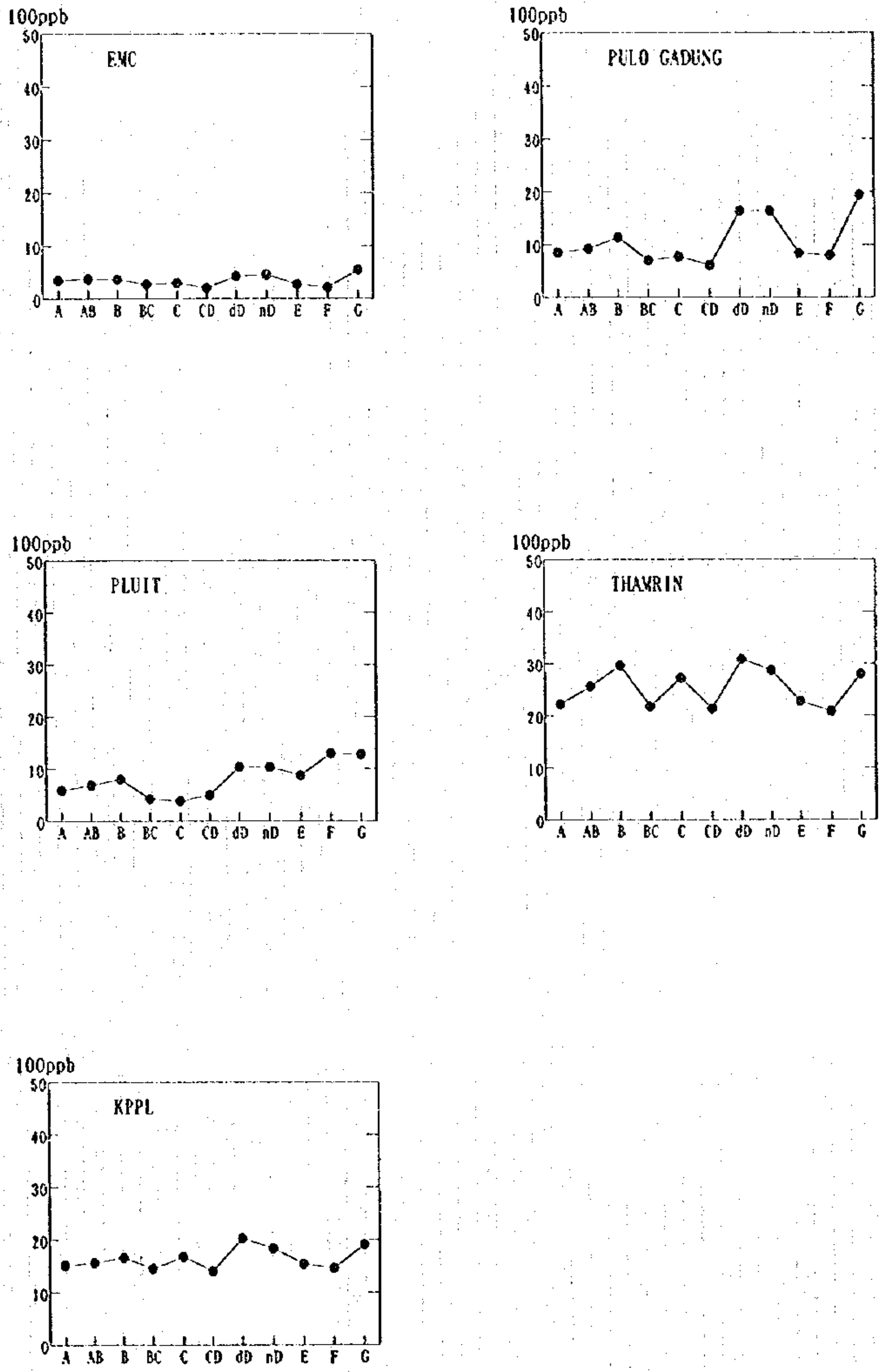


Fig. Average Concentration by Stability (Carbon Monoxide)
Year 1996 (Jan. to Dec.)

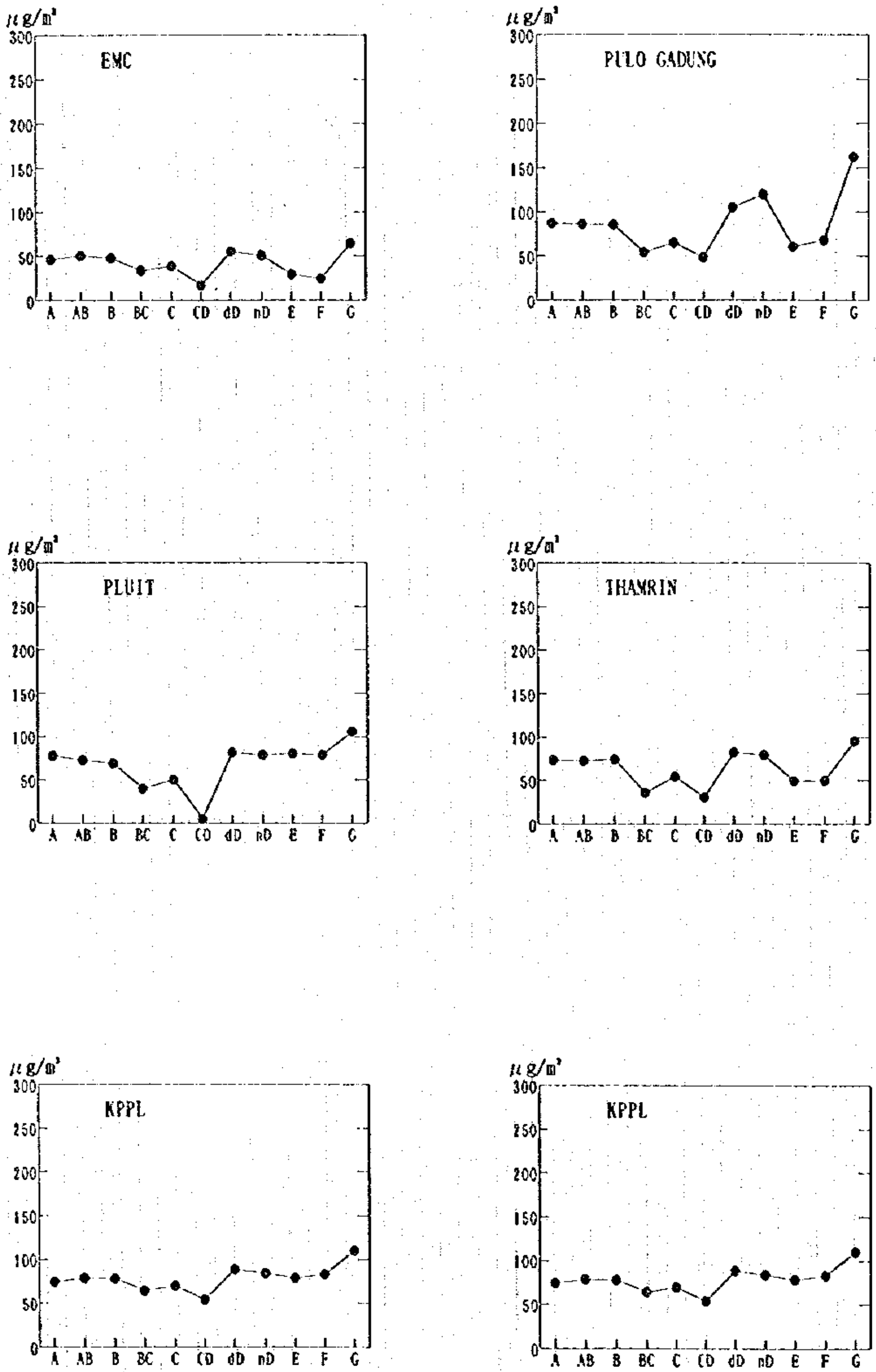


Fig. Average Concentration by Stability (Suspended Particulate Matter)

Year 1996 (Jan. to Dec.)

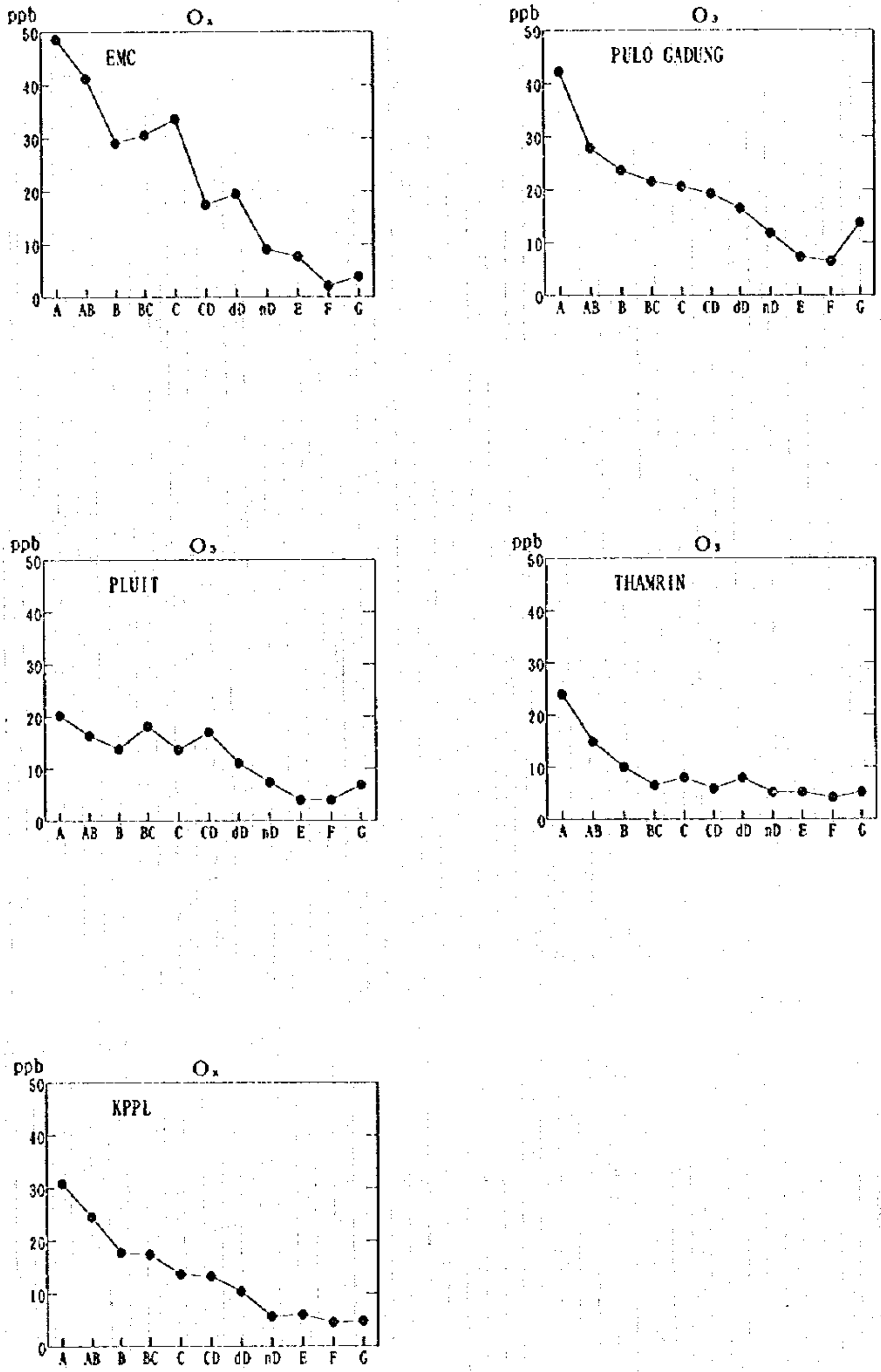


Fig. Average Concentration by Stability (Oxidant&Ozone)

Year 1996 (Jan. to Dec.)

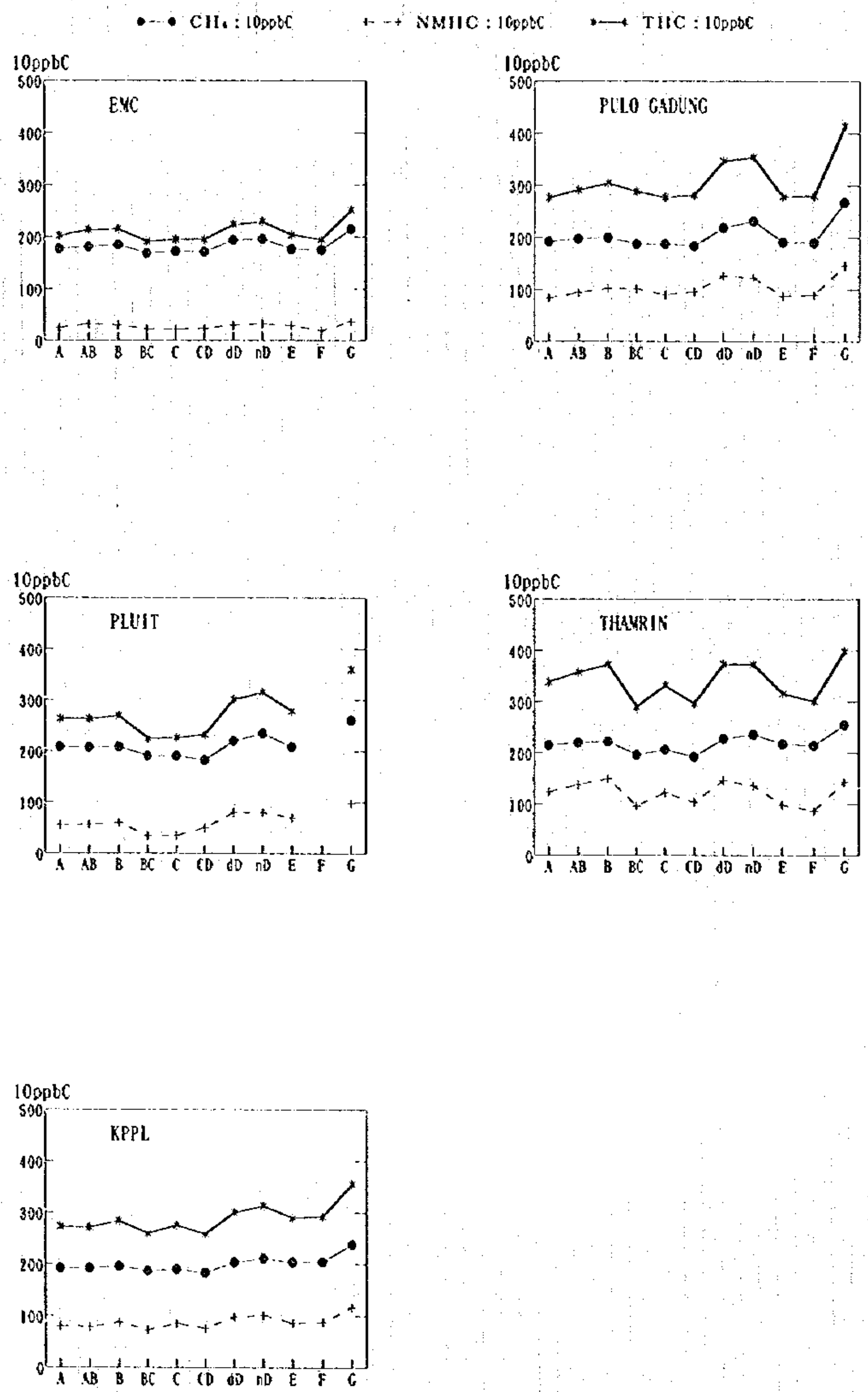


Fig. Average Concentration by Stability (Hydrocarbons)

Year 1996 (Jan. to Dec.)

2.2 Note on Management of Ambient Air Monitoring Stations

2.2 NOTE ON MANAGEMENT OF AMBIENT AIR MONITORING STATIONS

Based on the experience of the JICA Team in Jabotabek, in 1995 and 1996, this Note is prepared to recommend maintenance and inspection of ambient air monitoring stations in order to obtain reliable accurate data for a longer period.

1. Problems Encountered and Countermeasures Proposed

1) Temperature Control of Monitoring Stations

The indoor temperature of a monitoring station has to be controlled at about 25℃. When an air conditioner broke down, the indoor temperature rose to 50℃. Because of the alarm triggered by the temperature rise, there were a zero drift on a dry SO_2 analyzer and interruption of measurements on the dry NOx and O_3 analyzers. All the analyzers had automatic re-start functions. However, the air conditioner did not have the function.

All air conditioners in monitoring stations should be equipped with automatic re-start devices. Also by applying a telemeter system, a central management station will be able to check the indoor temperature of stations and any abnormality of analyzers.

2) High Humidity

Because of high humidity in Indonesia and wide difference between outdoor and indoor temperatures, condensate entered even into the detection units of some of analyzers in the Pulogadung and Pluit stations. As a result, the analyzers could not monitor the air quality.

Drain pots as shown in **Figure 1** were installed in the air sampling pipe before the analyzers of NOx, O_3, Ox, HC, and CO, and insulated the pipe so as to prevent the air temperature from dropping. No further problem was encountered.

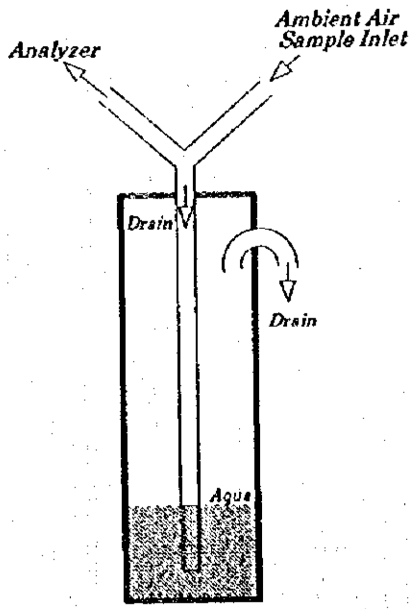
3) Power Supply

Two container stations showed lack of power supply capacity and occurred blackouts due to overload. The problems were fixed by increasing the capacity. In the design stage, enough capacity should be assigned anticipating future expansion.

4) Location of Wind Vanes and Anemometers

Wind vanes and anemometers have been installed at the Pulogadung, Pluit, and Thamrin stations. As the sensors are too close to near-by trees, measurements of wind may not be so accurate. The locations should be changed or trees should be cut or removed.

Figure 1 Skeleton Drawing of Drain Pot



2. Recommendation on Management of Monitoring Stations

2. 1 General

1) Sampling

(a) Material and length of sampling line

Use tetra-fluoro-ethylene resin pipes for the sampling and internal connecting lines in order not to adsorb or decompose samples. PVC pipes can be used for CO and SPM analyzers.

The length of a sampling line to an analyzer should be less than 5 m. If it is longer than that, a manifold shall be installed.

(b) Cleaning of sampling line

Periodically clean or change a sampling line, in order not to adsorb or decompose samples by dust deposited on the inner surface of the line.

(c) Material of filters

Use tetra-fluoro-ethylene resin filters in order not to adsorb or decompose samples. Glass of cellulose fiber filters can be used for CO analyzers.

(d) Change of absorbent piping

Periodically change piping for absorbent solutions, in order to avoid plugging by algae or fungi grew on the inner surface.

(e) Check of sample flow rate

Periodically check flow rate of sampling air to an analyzer.

2) Analytical System

(a) Cleaning or change of absorption impinger

Periodically clean or change the absorption impinger, in order to avoid interruption of analysis or decrease of absorption efficiency caused by algae or fungi grew on the inner surface.

(b) Check of absorbent volume

Periodically measure the content volume of absorbent using a graduated cylinder. When using an intermittent analyzer, repeat five times discharging and measurement, and determine the average of the five as the volume. When using a continuous analyzer, collect discharged absorbent for ten minutes and determine flow rate in one minute.

(c) Cleaning of Reactor and Absorption Cell

Periodically clean the reactor and absorption cell, in order not to deteriorate sensitivity of analysis by deposit of dust on the inner surface after a long introduction of ambient air.

2.2 Inspection and Maintenance

1) Kinds of Inspection and Maintenance

There are three kinds of inspection and maintenance work. The frequent work is to change or refill spare or consumable parts to keep normal continuous operation. The less frequent work is to avoid mal-functioning by changing deteriorated parts. Finally the emergency work is to give quick and temporary repairs to abnormal or broken parts of an analyzer. **Tables 1-A to -E** indicate the inspection and maintenance items common to analyzers. Individual items must be referred to the respective manual supplied by manufacturers. The tables are arranged according to frequency of the work.

Table 1 Gist of Inspection and Maintenance Common to Air Pollutant Analyzers

- A Frequent Work (weekly, bi-weekly, and monthly)
- B Less Frequent Work (once in 3 months)
- C Less Frequent Work (once in 6 months)
- D Less Frequent Work (once a year)
- E Emergency Work

Table 1-A Frequent Work

Frequency	Description
Weekly	1. Confirm the previous inspection record
	2. Check air flow rate
	3. Check sampling system
	4. Check piping
	5. Check liquid leakage
	6. Check condensate trap
	7. Check timer
Bi-weekly	1. Change filter
	2. Confirm temperature of constant temperature vessel
	3. Check silica-gel
Monthly	1. Confirm checked value, span, and zero
	2. Refill lubricant oil
	3. Clean capillary tube
	4. Confirm zero leakage on sampling line
	5. Confirm span
	6. Cleaning light path

Table 1-B Less Frequent Work (Once in 3 Months)

Parts to be inspected, tuned, cleaned, calibrated, etc.	1. Absorption impinger
	2. Bubbler
	3. Liquid volume
	4. Calibration by standard solution or gas
	5. Cleaning of cell

Table 1-C Less Frequent Work (Once in 6 Months)

Parts to be inspected, tuned, cleaned, calibrated, refilled, etc.	
1. Recorder	a. Chart moving mechanism
	b. Point or pen recording mechanism
	c. Servo-mechanism
	d. Mechanical zero position
	e. Timing and gain of recording point
	f. Zero and span
	g. Linearity
2. Sample Flow Part	a. Flow meter
	b. Flow control valve
	c. Capillary
	d. Bypass filter
	e. Inner valve of gas pump and diaphragm
	f. Gas piping
	g. Mist trap and its O-ring
	h. Piping joint
	I. Leakage of sample air
3. Liquid Flow Part	a. Piping
	b. Piping joint
	c. Pump diaphragm
	d. Pinch valve
	e. Check valve
4. Programmer Part	a. Individual input voltage
	b. Each programmed movement
	c. Backup battery
	d. Surge absorber
5. Overall Movement Test	a. Transmission output
	b. Signal, output and input
	c. Movement of automatic range changer
6. Surrounding Part	a. Manifold
	b. Sample line

Table 1-D Less Frequent Work (Once in a Year)

Parts to be renewed	
1. Recorder	a. Pen point
	b. Wheel drive string
	c. Ink pat
	d. Ink tube
2. Sample Flow Part	a. Flow indicator (calibration)
	b. Inner valve and diaphragm of gas pump
	c. Sample line
	d. Confirmation of no leakage on sample line
3. Liquid Flow Part	a. Piping
	b. Diaphragm of pump
	c. Pinch valve and tube
4. Programmer Part	a. Back-up battery
	b. Surge absorber
5. Surrounding Part	a. Sample line

Table 1-E Emergency Work

When abnormality happened	1. Find what, where, why, when, and how
	2. Plan and implement emergency repair
	3. Switch on when supply resumes after blackout

2) Performance Test

Automated analyzers shall be tested for their performance to know capability, individual character, and reliability. Timing and test items are as follows:

(a) Timing of Performance Test

- When purchased
- After repairing a damage which may affect accuracy
- Once every 3, 6, or 12 months after inspection and maintenance work

(b) Items of Performance Test

- Zero drift
- Span drift
- Repeatability
- Linearity
- Stability of sample flow rate

3) Calibration of Scale

Calibrate the scale in order to keep normal and accurate performance of an analyzer.

There are two calibration methods, dynamic and static, using standard gas, solution or membrane. The known concentration sample passes through the sensor in the dynamic calibration method. The scale is calibrated at three points; zero, span (around 90% point of the maximum range), and intermediate, assuming the calibration curve is straight. In order to check the straightness of the curve, four or five points will be used for calibration in full range.

4) Overhaul

Even if appropriate maintenance is performed, an analyzer will deteriorate by aging of its parts. Overhaul is recommendable once a year, or when encountering excess period of missing data, or when it is judged difficult to keep accuracy by ordinary maintenance.

5) Life of Automated Analyzer

A period of five to seven years is the best anticipated life of an analyzer.

6) Reserve of Monitored Data

Monitored data should be kept at least for three years. The data may need to be reviewed or confirmed later.

2.3 Spare Unit

To avoid long period of data missing by overhaul, break down, or else, or to double check the data when abnormality is resulted, a spare unit is recommendable to be kept in store. Especially imported units may need to repair for longer if it cannot be fixed domestically.

2.4 Safety

1) Safety Precaution at Monitoring Stations

Combustible gases such as hydrogen for HC analyzer have to be handled carefully. It is better to establish a safety precaution plan as the standard procedure.

2) Disposal of Reagents

Spent reagents have to be disposed for appropriate treatment so as not to cause pollution or hazard. Radiation source of β-ray should be returned to the local agent of the manufacturer after replacement or demolition.

2.3 Definition of PM, Dust, TSP and SPM

2.3 Definition of PM, Dust, TSP and SPM

(1) PM

PM (Particulate Matter) as pollutant is powdered materials generated by combustion, heating, processing, transportation, handling, etc.. A great part of PM existing in the air comes from natural sources, including the ground, oceans, and volcanoes. However, there are many artificial PM sources in urban areas, and many of the harmful particulates originate in artificial sources. PM also includes fume, mist and smoke.

(2) Dust

Dust is a part of PM. When PM is suspending in duct and its loading in gas is measured by JIS method, it is called dust, because the word "dust" is used in the title of the JIS method.

(3) TSP

TSP (Total Suspended Particle) is defined as the particle (concentration) in the ambient air, collected totally without size classification by means of a high volume air sampler.

(4) SPM

Particle in the ambient air having a diameter of less than 10 um is referred to as suspended particulate matter (SPM). Suspended particulate matter falls by gravity in the atmosphere very slowly, and remains in the air for a relatively long period of time.

2.4 Chemical Components in Ambient Particulate Matter

2.4 Chemical Components in Ambient Particulate Matter

Table (1) Chemical Components in Ambient Particulate Matter in January, 1996

Unit: ng/m3, (Error in %)

	EMC-Jan/29		JICA-Jan/29		KPPL-Jan/29		Pulo Gadung-Jan/29		Pluit-Jan/29	
Na	980	(11)	710	(13)	860	(12)	1100	(10)	1500	(10)
Al	<400.		2000	(26)	5300	(12)	4300	(5)	4900	(5)
Cl	600	(7)	670	(10)	1100	(6)	1500	(5)	1200	(6)
K	330	(12)	380	(9)	660	(6)	700	(6)	860	(7)
Ca	<300.		2500	(20)	17000	(7)	4300	(12)	5000	(9)
Sc	0.19	(2)	0.59	(2)	1.4	(1)	0.86	(1)	1.2	(1)
Ti	200	(43)	200	(30)	520	(20)	660	(11)	440	(20)
V	1.6	(16)	5	(11)	12	(6)	9.3	(6)	11	(5)
Cr	1.1	(13)	10	(3)	6.1	(5)	10	(4)	7.5	(3)
Mn	19	(14)	67	(8)	100	(11)	130	(8)	120	(9)
Fe	600	(3)	2200	(2)	5400	(2)	3900	(1)	4500	(1)
Co	0.35	(10)	1.1	(4)	1.5	(3)	3.9	(3)	1.7	(5)
Ni	<0.8		9.6	(15)	<2.		<0.7		<3.	
Cu	40	(46)	<10.		190	(12)	50	(31)	1400	(4)
Zn	30	(4)	130	(3)	190	(2)	480	(2)	340	(2)
As	0.35	(20)	<0.5		<0.5		0.86	(24)	3.3	(13)
Se	0.83	(8)	0.2	(45)	<0.2		2.1	(6)	0.72	(13)
Br	7.5	(6)	71	(6)	100	(7)	28	(6)	32	(7)
Rb	1.7	(16)	<2.		3.9	(14)	2.6	(14)	4.4	(10)
Sr	<3.		<7.		87	(15)	<6.		<9.	
Mo	<2.		10	(36)	<5.		<5.		8	(41)
Ag	<0.1		<0.1		<0.1		2	(6)	2	(8)
Cd	<0.4		<0.7		4	(27)	<0.5		<0.8	
Sn	<3.		<6.		<7.		<5.		<5.	
Sb	0.2	(27)	2.9	(11)	2.5	(17)	1.3	(12)	5.3	(7)
I	8.2	(16)	<2.		7	(37)	4	(30)	3	(32)
Cs	0.18	(12)	0.19	(20)	0.31	(15)	0.19	(16)	0.29	(15)
Ba	5	(44)	24	(21)	37	(22)	39	(9)	36	(20)
La	0.27	(17)	0.71	(10)	1.5	(5)	1	(7)	1.7	(5)
Ce	0.74	(11)	1.8	(14)	3.9	(15)	2.7	(17)	4.2	(13)
Sm	0.04	(35)	0.14	(20)	0.27	(12)	0.13	(19)	0.31	(10)
Eu	0.02	(36)	0.05	(37)	0.13	(13)	0.05	(27)	0.11	(18)
Yb	<0.02		<0.07		0.18	(21)	0.1	(21)	0.22	(14)
Lu	0.005	(19)	0.015	(13)	0.04	(25)	0.024	(22)	0.036	(21)
Hf	0.08	(31)	0.22	(19)	0.41	(11)	0.55	(7)	0.57	(5)
Ta	0.03	(40)	<0.03		0.07	(33)	0.074	(23)	0.09	(40)
W	0.09	(40)	0.2	(40)	0.1	(45)	1.3	(7)	0.29	(24)
Pb	100	(10)	370	(10)	430	(10)	210	(10)	440	(10)
Th	0.13	(11)	0.38	(7)	0.68	(4)	0.41	(6)	0.8	(3)
U	<0.07		<0.2		<0.2		<0.2		0.3	(41)

Unit:ug/m3

SPM	64	83	165.8	130.7	122.9
Cl^-	0.766	0.848	0.934	1.26	1.16
NO_3^-	0.712	0.625	0.636	1.16	0.519
SO_4^{2-}	1.71	1.75	2.32	2.17	1.73
Na^+	1.08	0.578	0.693	0.706	0.453
NH_4^+	0.041	0.079	0.037	0	0.018
K^+	0.52	0.536	0.722	0.372	0.16
Ca^{2+}	0.139	0.558	4.67	0.795	0.845
Mg^{2+}	0.018	0.026	0.096	0.076	0.035
Cor	4.09	8.03	13.94	12.81	8.55
Cel	10.31	17.2	47.06	27.38	26.39
Ct	14.4	25.24	61	40.19	34.94

Table (2) Chemical Components in Ambient Particulate Matter in February, 1996

Unit: ng/m3, (Error in %)

	EMC-Feb/12		JICA-Feb/12		KPPL-Feb/12		Pulo Gadung-Feb/12		Pluit-Mar/05	
Na	1200	(10)	1100	(11)	1100	(10)	990	(10)	1900	(6)
Al	900	(25)	<300.		2800	(6)	2000	(9)	2800	(6)
Cl	81	(25)	370	(10)	1100	(4)	1300	(5)	1900	(4)
K	650	(10)	460	(10)	630	(9)	750	(6)	600	(11)
Ca	<600.		<400.		2800	(16)	1800	(17)	3400	(14)
Sc	0.25	(2)	0.075	(6)	0.82	(1)	0.58	(1)	0.51	(1)
Ti	100	(40)	<80.		200	(25)	300	(26)	300	(30)
V	4	(14)	4.4	(12)	8	(7)	7.2	(9)	6.1	(8)
Cr	2	(14)	30	(2)	4.5	(5)	9.7	(4)	1.4	(14)
Mn	160	(6)	110	(6)	430	(5)	240	(6)	56	(11)
Fe	940	(3)	450	(5)	3000	(1)	2900	(2)	2000	(2)
Co	0.47	(11)	0.91	(4)	0.95	(3)	3	(5)	0.48	(5)
Ni	<2.		33	(6)	<1.		3	(42)	<1.	
Cu	100	(26)	<10.		100	(18)	60	(37)	710	(4)
Zn	110	(3)	190	(2)	210	(2)	410	(2)	27	(5)
As	3.4	(15)	2	(30)	<0.9		1	(35)	0.56	(16)
Se	1.2	(10)	1	(17)	0.72	(13)	0.91	(10)	0.3	(41)
Br	16	(4)	120	(6)	140	(8)	73	(7)	13	(4)
Rb	2.4	(24)	<1.		2	(35)	2.4	(17)	1	(31)
Sr	<6.		<7.		<9.		<6.		<4.	
Mo	10	(40)	<5.		<5.		<1.		10	(25)
Ag	<0.08		0.1	(40)	0.2	(40)	0.64	(13)	0.51	(9)
Cd	<0.7		<0.9		<0.7		<0.6		1.9	(18)
Sn	<7.		<6.		<5.		5	(40)	<4.	
Sb	12	(6)	3.2	(13)	3.4	(17)	4.1	(10)	0.8	(8)
I	4	(40)	5	(20)	4	(30)	4	(47)	<2.	
Cs	0.4	(8)	0.2	(27)	0.2	(17)	0.2	(17)	0.11	(24)
Ba	10	(33)	<8.		30	(17)	42	(6)	13	(15)
La	0.38	(20)	0.2	(42)	0.87	(8)	0.7	(8)	1.1	(7)
Ce	0.92	(25)	0.5	(28)	2.2	(15)	2.1	(18)	1.9	(12)
Sm	0.08	(28)	<0.04		0.14	(20)	0.11	(18)	0.21	(10)
Eu	<0.02		0.03	(39)	0.078	(18)	0.06	(27)	0.04	(35)
Yb	<0.03		<0.02		0.096	(19)	0.06	(32)	0.11	(23)
Lu	0.019	(23)	<0.002		0.019	(21)	0.02	(28)	0.013	(12)
Hf	0.16	(24)	<0.06		0.22	(15)	0.49	(7)	0.17	(16)
Ta	0.06	(40)	<0.03		0.06	(40)	0.06	(40)	0.04	(40)
W	<0.2		<0.09		0.2	(40)	1.2	(8)	<0.1	
Pb	840	(10)	460	(10)	720	(10)	480	(10)	74	(10)
Th	0.22	(12)	0.09	(28)	0.34	(6)	0.47	(4)	0.25	(7)
U	<0.07		<0.3		<0.2		<0.08		0.2	(42)

Unit:ug/m3

	EMC-Feb/12	JICA-Feb/12	KPPL-Feb/12	Pulo Gadung-Feb/12	Pluit-Mar/05
SPM	38.4	45.1	125.3	139.1	67.3
Cl-	0.03	0.113	0.767	1.068	1.474
NO3-	0.503	0.836	1.39	1.78	0.805
SO42-	2.699	3.842	4.73	5.161	2.581
Na+	0.681	0.716	1.057	1.396	1.158
NH4+	0.139	0.596	0.093	0.36	0.04
K+	0.266	0.458	0.534	0.644	0.158
Ca2+	0.322	1.757	2.372	1.445	1.033
Mg2+	0.046	0.06	0.137	0.124	0.104
Cor	8.32	10.47	16.07	23.82	2.87
Cel	11.45	20.47	32.42	44.37	7.87
Ct	19.78	30.94	48.5	68.19	10.75

Table (3) Chemical Components in Ambient Particulate Matter in March, 1996

Unit: ng/m3, (Error in %)

	EMC	JICA-Mar/12	KPPL-Mar/11	Pulo Gadung-Mar/1	Pluit-Mar/26
Na	-	420 (10)	1600 (8)	2000 (7)	990 (6)
Al	-	500 (27)	8000 (9)	4200 (5)	1200 (11)
Cl	-	800 (5)	2200 (4)	2300 (5)	1500 (6)
K	-	330 (12)	790 (9)	820 (14)	470 (12)
Ca	-	900 (29)	5700 (10)	2800 (20)	2100 (20)
Sc	-	0.15 (2)	2 (2)	1 (1)	0.36 (2)
Ti	-	100 (36)	660 (12)	510 (13)	100 (40)
V	-	3.7 (10)	19 (5)	19 (7)	8 (7)
Cr	-	32 (2)	7.4 (4)	42 (2)	9.5 (3)
Mn	-	97 (6)	140 (9)	180 (7)	140 (6)
Fe	-	1500 (2)	6700 (2)	5400 (2)	3200 (2)
Co	-	3.8 (6)	8 (7)	16 (5)	0.97 (3)
Ni	-	24 (4)	5 (26)	17 (10)	7 (15)
Cu	-	<20.	160 (17)	1600 (5)	1500 (5)
Zn	-	880 (1)	260 (2)	1800 (1)	1200 (1)
As	-	2 (14)	2 (41)	3.5 (19)	5.9 (6)
Se	-	1.4 (5)	1.2 (15)	1.1 (12)	2.2 (5)
Br	-	60 (4)	130 (7)	68 (4)	26 (4)
Rb	-	1 (34)	3.7 (13)	3.3 (20)	1.8 (22)
Sr	-	<8.	54 (17)	<10.	<8.
Mo	-	9 (28)	6 (48)	22 (20)	13 (20)
Ag	-	0.78 (12)	0.54 (17)	1.1 (7)	1.9 (5)
Cd	-	4.8 (24)	<0.6	19 (11)	4 (21)
Sn	-	<8.	<10.	<20.	9 (44)
Sb	-	3.3 (6)	6.5 (9)	12 (6)	3.5 (5)
I	-	<2.	3 (35)	7 (40)	<1.
Cs	-	<0.05	0.26 (15)	0.35 (17)	0.1 (32)
Ba	-	<2.	37 (13)	53 (8)	17 (20)
La	-	0.36 (11)	2.1 (5)	2.2 (4)	0.83 (6)
Ce	-	0.6 (27)	4.4 (15)	4.3 (12)	1 (29)
Sm	-	0.072 (18)	0.41 (11)	0.37 (10)	0.17 (10)
Eu	-	<0.02	0.13 (20)	0.07 (33)	<0.03
Yb	-	0.08 (36)	0.23 (17)	0.21 (21)	0.1 (31)
Lu	-	0.003 (44)	0.061 (18)	0.031 (9)	0.0097 (20)
Hf	-	0.07 (33)	0.42 (10)	2.4 (3)	0.14 (21)
Ta	-	0.04 (40)	<0.08	0.2 (40)	0.08 (40)
W	-	0.32 (18)	0.4 (40)	6.2 (4)	0.5 (17)
Pb	-	480 (10)	760 (10)	880 (10)	380 (10)
Th	-	0.072 (19)	0.61 (4)	1.3 (3)	0.28 (6)
U	-	<0.05	<0.07	0.3 (41)	<0.1

Unit:ug/m3

	EMC	JICA-Mar/12	KPPL-Mar/11	Pulo Gadung-Mar/1	Pluit-Mar/26
SPM	-	52.9	210.3	166.3	69.2
Cl-	-	0.22	1.792	1.553	1.048
NO3-	-	0.262	2.715	1.801	0.56
SO42-	-	2.748	5.668	7.781	2.769
Na+	-	0.415	1.191	1.493	0.565
NH4+	-	0.031	0	0.062	0.108
K+	-	0.24	0.335	0.515	0.154
Ca2+	-	1.145	4.154	2.876	1.301
Mg2+	-	0.049	0.257	0.154	0.069
Cor	-	11.25	22.19	23.78	7.81
Cel	-	20.6	36.57	31.81	14.51
Ct	-	31.84	58.77	55.59	22.32

Table (4) Chemical Components in Ambient Particulate Matter in April, 1996

Unit: ng/m3, (Error in %)

	EMC	JICA	KPPL-Apr/09	Pulo Gadung-Apr/0	Pluit-Apr/09
Na	-	-	1600 (7)	2900 (7)	3300 (7)
Al	-	-	5500 (4)	5200 (5)	8300 (4)
Cl	-	-	2000 (4)	3100 (4)	3100 (3)
K	-	-	650 (11)	1100 (8)	1400 (9)
Ca	-	-	4500 (7)	5700 (8)	7800 (8)
Sc	-	-	1.4 (2)	1.6 (1)	1.8 (1)
Ti	-	-	460 (14)	610 (15)	590 (13)
V	-	-	11 (5)	14 (7)	17 (4)
Cr	-	-	5.9 (4)	16 (2)	9.5 (4)
Mn	-	-	97 (9)	160 (7)	170 (9)
Fe	-	-	4700 (2)	6700 (2)	6900 (2)
Co	-	-	2.9 (2)	3.9 (7)	2.9 (7)
Ni	-	-	<2.	8.9 (11)	8.1 (13)
Cu	-	-	80 (31)	100 (39)	1500 (5)
Zn	-	-	130 (3)	480 (2)	180 (3)
As	-	-	1 (48)	4.9 (18)	7.9 (11)
Se	-	-	0.52 (20)	2.8 (7)	1.8 (9)
Br	-	-	75 (7)	46 (6)	23 (5)
Rb	-	-	2.8 (13)	4.4 (16)	5.1 (13)
Sr	-	-	35 (17)	54 (17)	73 (9)
Mo	-	-	8 (30)	16 (21)	12 (24)
Ag	-	-	0.1 (40)	0.72 (10)	1.4 (7)
Cd	-	-	<0.4	0.7 (40)	2 (41)
Sn	-	-	<7.	<3.	<3.
Sb	-	-	6.7 (8)	11 (6)	8.1 (6)
I	-	-	5.9 (22)	6.8 (20)	6 (29)
Cs	-	-	0.25 (11)	0.31 (11)	0.3 (10)
Ba	-	-	35 (10)	56 (8)	46 (9)
La	-	-	1.3 (5)	2.4 (4)	2.5 (4)
Ce	-	-	3 (16)	4.8 (14)	5.2 (14)
Sm	-	-	0.27 (10)	0.38 (9)	0.48 (9)
Eu	-	-	0.11 (13)	0.12 (17)	0.17 (12)
Yb	-	-	0.14 (16)	0.18 (15)	0.24 (12)
Lu	-	-	0.046 (18)	0.059 (23)	0.076 (16)
Hf	-	-	0.35 (7)	0.77 (6)	0.57 (6)
Ta	-	-	0.07 (40)	0.2 (14)	0.082 (18)
W	-	-	0.2 (40)	2 (6)	0.6 (29)
Pb	-	-	500 (10)	770 (10)	760 (10)
Th	-	-	0.53 (3)	1.8 (2)	0.96 (3)
U	-	-	<0.1	0.2 (34)	0.2 (35)

Unit:ug/m3

SPM	-	-	132.3	191.2	171.4
Cl-	-	-	1.4	2.695	1.886
NO3-	-	-	1.23	2.785	0.886
SO42-	-	-	1.79	4.684	2.943
Na+	-	-	0.989	1.856	1.354
NH4+	-	-	0	0	0.209
K+	-	-	0.133	0.424	0.265
Ca2+	-	-	1.826	5.096	2.218
Mg2+	-	-	0.121	0.318	0.131
Cor	-	-	11.08	16.91	6.87
Cel	-	-	25.15	37.97	18.55
Ct	-	-	36.23	54.88	25.42

Table (5) Chemical Components in Ambient Particulate Matter in May, 1996

Unit: ng/m3, (Error in %)

	EMC-May/06		JICA-May/06		KPPL-May/08		Pulo Gadung-May/0		Pluit-May/08	
Na	210	(16)	250	(16)	1200	(9)	1400	(9)	1500	(9)
Al	<800.		<1000.		3900	(10)	7100	(6)	2600	(15)
Cl	<10.		150	(15)	3600	(3)	2200	(2)	1100	(4)
K	230	(12)	360	(8)	720	(6)	1100	(6)	710	(16)
Ca	<50.		1000	(31)	8200	(7)	10000	(7)	4500	(11)
Sc	0.024	(7)	0.071	(3)	1.1	(2)	1.5	(2)	0.75	(2)
Ti	<40.		80	(40)	430	(13)	900	(18)	400	(29)
V	0.7	(41)	4.3	(17)	11	(5)	18	(5)	9.9	(5)
Cr	0.87	(15)	4.1	(5)	5.4	(8)	14	(3)	5.5	(4)
Mn	5	(28)	33	(11)	100	(8)	310	(5)	89	(8)
Fe	73	(13)	370	(4)	3900	(2)	5800	(2)	3300	(2)
Co	0.18	(13)	0.84	(9)	2.3	(9)	3	(7)	3.7	(6)
Ni	<1.		11	(6)	3	(26)	5.6	(16)	5.5	(17)
Cu	<20.		<20.		<60.		<70.		2500	(3)
Zn	24	(3)	160	(1)	370	(2)	530	(2)	510	(2)
As	0.99	(9)	1.3	(15)	4	(28)	4	(20)	4	(28)
Se	0.42	(14)	0.64	(17)	1.6	(7)	2.6	(4)	1.1	(11)
Br	4.2	(4)	22	(4)	51	(6)	58	(6)	130	(8)
Rb	0.8	(31)	0.9	(36)	2.6	(19)	4.8	(11)	2.6	(22)
Sr	<3.		<5.		<9.		<8.		<7.	
Mo	25	(13)	23	(15)	10	(29)	10	(30)	<3.	
Ag	0.1	(40)	0.18	(23)	0.2	(40)	0.2	(40)	2.8	(4)
Cd	<0.2		<0.3		4	(29)	<0.5		0.7	(40)
Sn	<2.		<5.		<9.		<10.		<7.	
Sb	2.1	(4)	4.9	(4)	17	(7)	10	(6)	3.9	(13)
I	4.7	(21)	4.8	(25)	7.8	(13)	14	(11)	9	(15)
Cs	0.095	(17)	0.084	(21)	0.31	(10)	0.7	(5)	0.24	(16)
Ba	<1.		<3.		28	(13)	40	(9)	22	(18)
La	0.2	(15)	0.25	(15)	1.2	(6)	1.9	(5)	1.2	(7)
Ce	0.29	(21)	0.4	(30)	2.4	(16)	4	(14)	2.8	(11)
Sm	0.085	(13)	0.082	(20)	0.24	(11)	0.34	(9)	0.23	(12)
Eu	<0.001		<0.01		0.098	(21)	0.087	(16)	0.067	(23)
Yb	0.03	(40)	<0.05		0.17	(19)	0.29	(10)	0.17	(20)
Lu	0.003	(36)	0.004	(49)	0.047	(23)	0.049	(22)	0.04	(17)
Hf	0.096	(21)	0.11	(21)	0.23	(15)	3.2	(2)	0.33	(10)
Ta	0.01	(40)	0.03	(40)	0.07	(40)	0.35	(10)	0.3	(12)
W	0.1	(44)	0.08	(40)	0.2	(45)	1.3	(8)	0.51	(24)
Pb	170	(10)	330	(10)	460	(10)	430	(10)	250	(10)
Th	0.1	(12)	0.11	(13)	0.51	(5)	0.85	(3)	0.61	(3)
U	0.2	(35)	<0.1		<0.1		<0.2		<0.1	

Unit:ug/m3

SPM	14.6	64.5	176	222.9	112.6
Cl-	0.044	0.048	2.881	1.6	0.835
NO3-	0.123	0.184	4.72	3.131	3.072
SO42-	1.998	4.142	4.737	5.638	4.594
Na+	0.099	0.201	0.894	0.96	0.988
NH4+	0.24	0.561	0	0.035	0.047
K+	0.123	0.254	0.279	0.425	0.301
Ca2+	0.108	0.268	4.389	3.728	2.193
Mg2+	0.006	0.026	0.223	0.253	0.133
Cor	1.34	7.21	17.02	25.11	10.64
Cel	5.9	23.9	35.56	40.86	23.17
Ct	7.23	31.11	52.58	65.98	33.81

Table (6) Chemical Components in Ambient Particulate Matter in June, 1996

Unit: ng/m3, (Error in %)

	EMC-Jun/18		JICA-Jun/11		KPPL-Jun/18		Pulo Gadung-Jun/19		Pluit-Jun/19	
Na	350	(17)	250	(20)	2600	(9)	2000	(9)	2500	(8)
Al	<1000.		<1000.		8600	(7)	12000	(5)	6100	(7)
Cl	<40.		100	(17)	7900	(2)	1700	(4)	1200	(5)
K	650	(7)	240	(18)	<1000.		1400	(8)	1300	(9)
Ca	<400.		<200.		5100	(13)	7200	(13)	5300	(10)
Sc	0.026	(11)	0.018	(16)	2.4	(3)	2.6	(2)	1.8	(1)
Ti	<60.		<60.		900	(27)	1100	(14)	660	(21)
V	3.7	(15)	2	(15)	28	(7)	28	(5)	21	(4)
Cr	4.9	(7)	5	(6)	18	(5)	16	(3)	12	(3)
Mn	8.9	(23)	21	(13)	230	(6)	230	(7)	190	(8)
Fe	110	(13)	220	(8)	9000	(3)	9000	(2)	8100	(2)
Co	0.67	(7)	0.93	(5)	29	(5)	5.1	(8)	3.6	(6)
Ni	3	(27)	2.1	(24)	12	(16)	6.4	(14)	10	(10)
Cu	<30.		<40.		210	(20)	<30.		3300	(3)
Zn	95	(2)	120	(2)	1000	(3)	490	(2)	690	(2)
As	14	(19)	1.2	(13)	<0.4		6	(30)	2.8	(17)
Se	1.6	(20)	1	(9)	3.5	(10)	12	(2)	1.8	(5)
Br	18	(5)	35	(4)	1000	(10)	110	(8)	35	(6)
Rb	2.1	(22)	<0.5		5.8	(15)	6.4	(11)	5.8	(6)
Sr	<10.		<5.		<20.		<8.		<7.	
Mo	10	(32)	10	(26)	<3.		<6.		<1.	
Ag	1.2	(8)	0.28	(20)	0.9	(30)	0.1	(40)	3.6	(4)
Cd	<0.6		<0.3		<2.		<0.6		<0.5	
Sn	<20.		<5.		<20.		<9.		<9.	
Sb	64	(6)	2	(6)	11	(9)	16	(9)	4.4	(7)
I	9	(13)	4	(40)	740	(3)	280	(3)	150	(4)
Cs	0.31	(11)	<0.05		0.45	(15)	0.65	(6)	0.48	(7)
Ba	<5.		<2.		64	(18)	57	(10)	44	(7)
La	0.2	(27)	0.2	(30)	3	(11)	4.7	(5)	2.4	(5)
Ce	<0.2		<0.1		6.3	(11)	11	(7)	5.5	(15)
Sm	0.079	(24)	0.082	(23)	0.32	(17)	0.46	(8)	0.4	(9)
Eu	<0.01		<0.02		0.2	(25)	0.21	(11)	0.16	(10)
Yb	<0.04		<0.04		0.29	(19)	0.4	(7)	0.27	(13)
Lu	0.029	(20)	<0.001		0.061	(18)	0.056	(20)	0.058	(15)
Hf	<0.08		<0.01		0.61	(13)	0.72	(6)	0.45	(8)
Ta	<0.03		<0.01		<0.08		0.15	(17)	0.22	(12)
W	0.06	(40)	0.2	(27)	<0.7		0.6	(29)	1.1	(7)
Pb	4000	(10)	290	(10)	980	(10)	460	(10)	340	(10)
Th	0.08	(30)	0.04	(46)	2.3	(6)	2	(10)	0.89	(3)
U	<0.04		<0.08		<0.2		<0.04		<0.1	

Unit:ug/m3

SPM	54.5	29.3	322.5	259.3	188.2
Cl-	0.071	0.165	6.59	1.471	0.879
NO3-	0.259	0.155	4.091	3.268	2.161
SO42-	6.602	1.818	5.991	8.482	8.611
Na+	0.304	0.144	1.902	1.437	1.493
NH4+	0.795	0.066	0	0	0.435
K+	0.504	0.099	0.582	0.716	0.61
Ca2+	0.446	0.296	5.846	3.909	2.109
Mg2+	0.021	0	0.334	0.296	0.21
Cor	8.61	8.05	43.62	39.6	18.27
Cel	20.33	13.44	73.34	52.84	34.63
Ct	28.94	21.5	116.95	92.43	52.9

Table (7) Chemical Components in Ambient Particulate Matter in July, 1996

Unit: ng/m3, (Error in %)

	EMC-Jly/16	JICA-Jly/16	KPPL-Jly/09	Pulo Gadung-Jly/23	Pluit-Jly/23
Na	310 (14)	510 (11)	2300 (6)	1700 (5)	2400 (5)
Al	<300.	<800.	10000 (4)	7400 (8)	6700 (7)
Cl	<30.	310 (12)	2800 (3)	2100 (3)	1800 (3)
K	<300.	<500.	1800 (12)	1400 (17)	1500 (14)
Ca	<300.	<1000.	13000 (6)	6000 (25)	8700 (8)
Sc	0.029 (12)	0.095 (5)	2.3 (2)	1.6 (1)	1.4 (1)
Ti	<60.	200 (40)	770 (15)	600 (17)	570 (23)
V	4.5 (12)	7.8 (8)	25 (4)	38 (4)	35 (5)
Cr	1.3 (23)	9.7 (5)	12 (3)	18 (3)	9.5 (4)
Mn	7 (30)	71 (7)	200 (7)	190 (7)	140 (8)
Fe	110 (15)	630 (5)	8200 (2)	6400 (2)	6100 (2)
Co	0.7 (5)	1.6 (4)	3.7 (2)	2.5 (2)	2.2 (3)
Ni	<2.	31 (5)	5.9 (19)	7.4 (20)	11 (8)
Cu	<30.	<40.	90 (34)	590 (9)	7800 (3)
Zn	80 (2)	510 (2)	770 (2)	1000 (2)	350 (2)
As	6.2 (16)	2.2 (12)	7 (28)	3.4 (9)	13 (6)
Se	0.82 (13)	1.4 (8)	2.3 (4)	3.2 (3)	14 (2)
Br	11 (3)	51 (2)	81 (6)	52 (3)	36 (4)
Rb	1 (29)	2.9 (19)	6.8 (11)	5 (11)	5.2 (6)
Sr	<5.	<6.	<6.	<8.	62 (12)
Mo	29 (15)	33 (14)	10 (21)	21 (15)	15 (17)
Ag	0.09 (40)	0.4 (22)	0.47 (19)	0.4 (31)	8.6 (2)
Cd	2 (31)	<2.	0.8 (40)	3 (34)	0.8 (40)
Sn	<7.	20 (28)	30 (33)	9 (40)	10 (40)
Sb	37 (4)	7.1 (3)	28 (6)	3.8 (4)	4.2 (5)
I	9.3 (11)	9 (15)	12 (8)	6.4 (15)	10 (12)
Cs	0.2 (12)	0.18 (15)	0.6 (4)	0.4 (11)	0.35 (9)
Ba	<5.	<8.	69 (9)	53 (9)	39 (13)
La	0.2 (28)	0.38 (18)	2.4 (4)	2 (3)	2.2 (4)
Ce	<0.01	0.73 (24)	6.3 (8)	4.4 (12)	5.7 (9)
Sm	0.079 (19)	0.11 (23)	0.43 (9)	0.36 (7)	0.37 (6)
Eu	<0.02	<0.000 7	0.16 (9)	0.12 (12)	0.13 (9)
Yb	0.06 (33)	0.06 (49)	0.31 (13)	0.31 (10)	0.37 (10)
Lu	<0.002	<0.003	0.04 (15)	0.031 (15)	0.039 (11)
Hf	0.08 (43)	<0.04	0.56 (8)	0.55 (7)	0.51 (6)
Ta	0.06 (40)	0.04 (40)	0.13 (15)	0.2 (9)	0.35 (6)
W	0.1 (40)	0.1 (40)	0.3 (37)	0.74 (21)	0.77 (20)
Pb	1600 (10)	490 (10)	1100 (10)	290 (10)	260 (10)
Th	0.074 (23)	0.1 (28)	1.5 (3)	0.77 (5)	0.93 (3)
U	<0.1	<0.02	0.2 (33)	<0.2	0.2 (39)

Unit:ug/m3

	EMC-Jly/16	JICA-Jly/16	KPPL-Jly/09	Pulo Gadung-Jly/23	Pluit-Jly/23
SPM	38.9	107.5	275.6	192.5	193.7
Cl-	0.023	0.202	2.097	1.474	1.145
NO3-	0.149	1.409	8.339	2.57	3.747
SO42-	3.61	5.724	10.579	6.598	8.134
Na+	0.158	0.415	1.583	0.854	1.288
NH4+	0.498	0.759	0	0.474	0.554
K+	0.272	0.546	0.719	0.523	0.151
Ca2+	0.161	0.5	8.876	2.026	3.438
Mg2+	0.014	0.049	0.444	0.13	0.178
Cor	6.48	23.68	34.76	23.22	15.45
Cel	15.03	41.96	58.96	39.07	32.6
Ct	21.51	65.64	93.73	62.29	48.05

Table (8) Chemical Components in Ambient Particulate Matter in August, 1996

Unit: ng/m3, (Error in %)

	EMC-Aug/19	JICA-Aug/21	KPPL-Aug/16	Pulo Gadong-Aug/1	Pluit-Aug/16
Na	280 (15)	360 (14)	870 (5)	1100 (4)	2300 (5)
Al	1000 (48)	<800.	6500 (6)	6500 (7)	5500 (9)
Cl	<60.	180 (10)	1100 (4)	670 (4)	2300 (3)
K	400 (36)	<500.	1100 (22)	1000 (16)	1900 (17)
Ca	<300.	<400.	6700 (8)	4700 (10)	8000 (8)
Sc	0.067 (5)	0.065 (4)	0.95 (1)	1.2 (1)	1.7 (1)
Ti	<70.	<70.	500 (22)	670 (12)	570 (12)
V	4.2 (18)	4.4 (15)	15 (7)	18 (6)	24 (5)
Cr	4.3 (6)	21 (4)	5.1 (5)	18 (3)	9.7 (4)
Mn	9 (21)	21 (15)	97 (8)	160 (6)	140 (8)
Fe	250 (7)	400 (4)	3300 (2)	5100 (1)	6200 (2)
Co	0.12 (15)	0.49 (6)	1.3 (3)	2.8 (2)	2.3 (3)
Ni	2.5 (23)	12 (8)	4.3 (15)	9.8 (13)	7.3 (18)
Cu	<20.	<30.	<30.	440 (9)	7200 (2)
Zn	62 (4)	190 (2)	150 (2)	600 (2)	280 (3)
As	1.1 (6)	2.7 (15)	6 (25)	3.4 (15)	14 (14)
Se	1.5 (4)	5.7 (3)	1.6 (6)	23 (3)	3.7 (3)
Br	11 (3)	66 (3)	65 (5)	45 (3)	56 (4)
Rb	1.7 (21)	2.4 (18)	3 (13)	3.8 (12)	7.3 (10)
Sr	<3.	<4.	<5.	<6.	<7.
Mo	37 (10)	32 (12)	14 (19)	19 (14)	18 (17)
Ag	0.1 (40)	0.1 (31)	0.2 (40)	0.43 (19)	9.5 (2)
Cd	<0.3	<0.5	<0.5	0.4 (40)	<0.6
Sn	19 (11)	<5.	<7.	<10.	20 (39)
Sb	1.5 (4)	11 (3)	36 (5)	11 (4)	31 (5)
I	7.5 (12)	10 (15)	6 (17)	5 (26)	6 (40)
Cs	0.21 (13)	0.13 (20)	0.29 (8)	0.35 (10)	0.51 (6)
Ba	<4.	<6.	27 (14)	42 (10)	44 (11)
La	0.35 (16)	0.27 (20)	1.1 (4)	1.5 (5)	2.4 (4)
Ce	0.56 (23)	0.3 (35)	2 (18)	3.6 (4)	5.6 (8)
Sm	0.12 (14)	0.1 (19)	0.21 (10)	0.29 (6)	0.43 (7)
Eu	<0.006	<0.02	0.08 (23)	0.082 (15)	0.16 (10)
Yb	0.08 (26)	0.1 (32)	0.16 (18)	0.3 (11)	0.35 (10)
Lu	<0.001	<0.007	0.01 (34)	0.024 (16)	0.04 (26)
Hf	0.09 (38)	0.1 (27)	0.22 (11)	0.6 (5)	0.47 (9)
Ta	0.02 (40)	0.03 (40)	0.09 (40)	0.26 (9)	0.1 (40)
W	0.09 (40)	<0.1	0.3 (40)	1.9 (8)	0.5 (40)
Pb	210 (10)	650 (10)	1900 (10)	650 (10)	1400 (10)
Th	0.15 (17)	0.14 (12)	0.55 (4)	0.76 (2)	1 (4)
U	0.2 (42)	<0.08	<0.03	0.2 (33)	<0.06

Unit:ug/m3

	EMC-Aug/19	JICA-Aug/21	KPPL-Aug/16	Pulo Gadong-Aug/1	Pluit-Aug/16
SPM	34.3	63	142.1	148.9	224.4
Cl-	0.14	0.136	0.608	0.524	1.056
NO3-	0.159	0.411	2.421	2.286	2.283
SO42-	7.242	4.042	5.111	8.107	6.646
Na+	0.162	0.244	0.423	0.808	0.77
NH4+	1.613	0.367	0.227	0.588	0.636
K+	0.35	0.392	0.365	0.658	0.502
Ca2+	0.194	0.361	2.583	2.051	2.22
Mg2+	0.009	0.018	0.124	0.175	0.124
Cor	3.91	12.49	17.26	22.85	29.17
Cel	13.01	32.69	35.45	39.93	49.91
Ct	16.92	45.18	52.71	62.77	79.09

Table (9) Chemical Components in Ambient Particulate Matter in September, 1996

Unit: ng/m3, (Error in %)

	EMC-Sep/04		JICA-Sep/04		KPPL-Sep/16		Pulo Gadung-Sep/16		Pluit-Sep/16	
Na	540	(10)	210000	(5)	2300	(7)	2800	(7)	4300	(7)
Al	<1000.		29000	(7)	8400	(6)	14000	(5)	10000	(9)
Cl	<60.		7300	(6)	3900	(3)	4200	(3)	4600	(3)
K	600	(10)	270000	(11)	1100	(8)	2300	(7)	1700	(8)
Ca	<600.		130000	(8)	12000	(7)	10000	(10)	9000	(20)
Sc	0.05	(6)	1	(3)	1.7	(1)	2.5	(1)	1.6	(1)
Ti	<50.		<1000.		610	(12)	1100	(9)	700	(33)
V	2.4	(24)	<9.		16	(6)	30	(6)	22	(8)
Cr	3.9	(5)	27	(7)	9.9	(4)	16	(3)	14	(3)
Mn	<2.		67	(5)	170	(11)	260	(11)	150	(11)
Fe	210	(8)	3000	(4)	5900	(1)	8600	(2)	6700	(2)
Co	0.16	(15)	1.8	(17)	2.3	(3)	3.6	(2)	2.6	(2)
Ni	2	(26)	9	(46)	3.5	(22)	6.7	(25)	7.1	(17)
Cu	<30.		<500.		<80.		340	(16)	12000	(3)
Zn	110	(2)	370	(3)	550	(2)	610	(2)	530	(1)
As	4.9	(13)	<4.		1.4	(21)	3	(28)	18	(10)
Se	1.3	(9)	4.3	(11)	6.3	(3)	3.8	(3)	6.1	(4)
Br	14	(3)	53	(6)	39	(5)	64	(5)	41	(6)
Rb	2.3	(19)	50	(5)	4.3	(10)	8.3	(9)	6.6	(9)
Sr	<6.		<30.		69	(11)	<10.		79	(11)
Mo	22	(13)	<7.		10	(25)	18	(21)	10	(28)
Ag	0.06	(40)	0.4	(40)	0.52	(18)	0.1	(40)	7.9	(3)
Cd	2	(31)	<4.		0.8	(40)	0.8	(40)	2	(40)
Sn	8	(40)	70	(40)	<10.		30	(45)	10	(47)
Sb	19	(4)	790	(9)	3.1	(6)	12	(5)	13	(6)
I	12	(10)	9	(40)	12	(12)	22	(9)	21	(12)
Cs	0.26	(8)	1.1	(8)	0.37	(8)	0.57	(6)	0.45	(11)
Ba	<2.		1300	(4)	36	(10)	59	(12)	48	(12)
La	0.23	(22)	8.9	(5)	1.9	(5)	2.7	(4)	2.3	(4)
Ce	<0.2		21	(6)	6	(38)	7.3	(11)	6.1	(5)
Sm	0.083	(20)	0.62	(8)	0.36	(9)	0.52	(7)	0.42	(10)
Eu	<0.02		0.2	(49)	0.11	(9)	0.15	(13)	0.13	(12)
Yb	0.05	(39)	0.65	(17)	0.21	(12)	0.37	(13)	0.32	(10)
Lu	0.01	(36)	0.084	(22)	0.034	(12)	0.045	(11)	0.043	(13)
Hf	<0.03		12	(4)	0.4	(7)	0.77	(7)	0.51	(9)
Ta	0.05	(40)	0.83	(14)	0.13	(22)	0.25	(14)	0.31	(11)
W	<0.07		<3.		0.31	(24)	1.2	(16)	0.85	(24)
Pb	880	(3)	1300	(3)	330	(7)	430	(6)	1000	(3)
Th	0.05	(47)	3.1	(6)	0.71	(4)	1.1	(4)	1.1	(3)
U	<0.1		<0.2		0.2	(38)	0.2	(47)	0.4	(28)

Unit:ug/m3

SPM	47.42	156.34	194.66	321.44	233.86
Cl-	0	6.817	2.991	2.612	2.607
NO3-	0.066	5.302	2.776	5.665	6.048
SO42-	4.62	15.954	4.88	7.234	10.033
Na+	0.295	13.022	1.525	1.779	2.989
NH4+	0.787	0.304	0	0.059	0.167
K+	0.468	0.588	0.471	1.241	1.057
Ca2+	0.074	0.817	3.625	3.95	3.253
Mg2+	0.02	0.099	0.269	0.386	0.438
Cor	7.8	21.74	18.62	47.8	27.54
Cel	18.29	33.4	29.73	65.02	44.85
Ct	26.09	55.14	48.35	112.82	72.39

Table (10) Chemical Components in Ambient Particulate Matter in October, 1996

Unit: ng/m3, (Error in %)

	EMC-Oct/09		JICA-Oct/09		KPPL	Pulo Gadung-Oct/22		Pluit-Oct/22	
Na	450	(11)	770	(9)	-	1900	(8)	2700	(7)
Al	5000	(13)	4200	(15)	-	16000	(4)	17000	(4)
Cl	<50.		1300	(5)	-	1900	(4)	4000	(3)
K	460	(14)	770	(12)	-	1800	(8)	1900	(8)
Ca	<600.		4600	(14)	-	10000	(10)	16000	(8)
Sc	0.074	(3)	0.48	(2)	-	2.8	(2)	2.8	(1)
Ti	100	(40)	500	(45)	-	1400	(9)	1600	(11)
V	3	(30)	12	(6)	-	40	(5)	47	(5)
Cr	11	(4)	28	(3)	-	25	(3)	19	(3)
Mn	17	(24)	110	(11)	-	420	(9)	290	(17)
Fe	270	(6)	1900	(2)	-	11000	(2)	11000	(1)
Co	0.27	(10)	2.6	(3)	-	5.5	(2)	4.1	(2)
Ni	4	(16)	46	(3)	-	6	(27)	12	(10)
Cu	<80.		200	(35)	-	200	(26)	8200	(3)
Zn	67	(3)	350	(2)	-	1100	(2)	660	(2)
As	4	(13)	2.7	(22)	-	3	(34)	27	(10)
Se	1.7	(5)	1.5	(5)	-	2.1	(6)	4.8	(3)
Br	13	(3)	59	(4)	-	130	(7)	54	(6)
Rb	1.8	(20)	3.1	(15)	-	7	(9)	8.3	(9)
Sr	<6.		<8.		-	<10.		120	(12)
Mo	52	(10)	56	(11)	-	14	(25)	10	(26)
Ag	0.06	(40)	0.3	(27)	-	0.42	(23)	6.8	(3)
Cd	<0.4		3	(46)	-	5	(34)	8.8	(19)
Sn	<6.		30	(22)	-	<7.		20	(38)
Sb	16	(4)	14	(5)	-	13	(7)	19	(6)
I	17	(9)	12	(19)	-	15	(8)	14	(19)
Cs	0.28	(8)	0.25	(10)	-	0.58	(7)	0.6	(6)
Ba	10	(41)	28	(14)	-	81	(8)	76	(6)
La	<0.1		0.48	(12)	-	3.4	(4)	3.8	(4)
Ce	<0.1		1.1	(17)	-	7.9	(4)	8.9	(5)
Sm	0.077	(19)	0.16	(13)	-	0.62	(9)	0.65	(8)
Eu	<0.02		<0.03		-	0.17	(11)	0.25	(8)
Yb	<0.02		0.13	(22)	-	0.39	(8)	0.49	(6)
Lu	0.01	(44)	0.02	(42)	-	0.055	(8)	0.07	(6)
Hf	0.15	(22)	0.32	(10)	-	1.1	(4)	0.85	(5)
Ta	0.02	(40)	0.07	(40)	-	0.32	(15)	0.48	(8)
W	<0.06		0.2	(40)	-	1.7	(10)	0.98	(13)
Pb	1600	(3)	870	(4)	-	1300	(2)	690	(3)
Th	0.06	(35)	0.31	(6)	-	1.5	(4)	1.5	(4)
U	<0.1		0.2	(44)	-	<0.2		0.3	(30)

Unit:ug/m3

	EMC-Oct/09	JICA-Oct/09	KPPL	Pulo Gadung-Oct/22	Pluit-Oct/22
SPM	47.31	152.76	-	328.08	303.38
Cl-	0	0.335	-	1.007	1.961
NO3-	0	4.915	-	5.257	4.558
SO42-	4.677	7.264	-	8.814	9.274
Na+	0.395	0.582	-	0.826	0.948
NH4+	0.666	1.049	-	0.463	0.936
K+	0.399	0.655	-	0.787	0.678
Ca2+	0.142	2.395	-	3.893	4.271
Mg2+	0.026	0.229	-	0.224	0.237
Cor	5.52	19.62	-	38.63	26.11
Cel	18.43	44.68	-	66.15	58.16
Ct	23.95	64.3	-	104.79	84.27

Table (11) Chemical Components in Ambient Particulate Matter in November, 1996

Unit: ng/m3, (Error in %)

	EMC-Nov/06		JICA-Nov/06		KPPL-Nov/06		Pulo Gadung-Nov/1		Pluit
Na	290	(15)	820	(9)	560	(13)	1200	(7)	-
Al	3000	(47)	2900	(21)	7500	(10)	9900	(8)	-
Cl	<10.		2200	(5)	1200	(7)	1200	(5)	-
K	100	(28)	310	(24)	520	(20)	840	(10)	-
Ca	<600.		3400	(19)	5000	(14)	6600	(18)	-
Sc	0.022	(11)	0.19	(2)	0.48	(1)	1	(1)	-
Ti	<80.		100	(40)	300	(35)	400	(40)	-
V	<1.		<3.		6	(26)	18	(13)	-
Cr	5.7	(5)	17	(3)	4.6	(6)	16	(3)	-
Mn	<2.		68	(11)	42	(19)	260	(13)	-
Fe	86	(16)	800	(2)	1900	(2)	5200	(2)	-
Co	0.11	(15)	1.8	(3)	0.79	(6)	2.1	(3)	-
Ni	1	(34)	32	(2)	2	(44)	6.7	(18)	-
Cu	<10.		200	(27)	<60.		160	(24)	-
Zn	5.2	(18)	190	(2)	560	(2)	1000	(2)	-
As	0.2	(19)	0.93	(24)	<0.4		4.1	(16)	-
Se	0.23	(20)	0.31	(17)	0.28	(20)	2	(5)	-
Br	3.2	(8)	62	(4)	160	(6)	57	(4)	-
Rb	<0.4		1	(35)	1.8	(25)	3.3	(14)	-
Sr	<2.		<4.		<6.		<7.		-
Mo	28	(14)	22	(19)	23	(23)	18	(20)	-
Ag	<0.02		0.08	(40)	0.1	(40)	0.5	(27)	-
Cd	<0.2		<0.4		<0.6		5.7	(23)	-
Sn	<2.		10	(31)	<4.		20	(35)	-
Sb	0.3	(17)	2	(7)	3.1	(11)	11	(5)	-
I	4	(38)	2	(40)	8	(27)	9	(28)	-
Cs	0.05	(39)	0.08	(30)	0.14	(20)	0.28	(9)	-
Ba	<0.2		8	(36)	22	(16)	35	(12)	-
La	0.2	(30)	0.43	(12)	0.74	(10)	1.5	(4)	-
Ce	<0.2		0.58	(20)	1.5	(12)	4	(11)	-
Sm	0.091	(22)	0.11	(17)	0.16	(15)	0.3	(10)	-
Eu	<0.01		<0.02		0.066	(18)	0.1	(16)	-
Yb	<0.02		0.05	(44)	0.084	(21)	0.2	(12)	-
Lu	0.003	(44)	0.01	(48)	0.01	(35)	0.035	(19)	-
Hf	<0.04		0.1	(27)	0.08	(40)	0.32	(11)	-
Ta	0.02	(24)	0.04	(40)	0.057	(25)	0.24	(9)	-
W	0.1	(40)	0.2	(40)	<0.1		1.4	(8)	-
Pb	<100.		640	(6)	830	(4)	820	(4)	-
Th	0.07	(27)	0.12	(17)	0.23	(10)	0.56	(5)	-
U	<0.2		<0.1		<0.07		0.2	(46)	-

Unit:ug/m3

SPM	17.45	55.57	79.44	168.65	-
Cl-	0	1.075	0.91	0.901	-
NO3-	0.202	3.914	0.995	3.329	-
SO42-	0	1.003	0.798	6.81	-
Na+	0.059	0.664	0.266	0.66	-
NH4+	0	0	0	0.618	-
K+	0.022	0.194	0.204	0.586	-
Ca2+	0.006	1.185	0.696	2.203	-
Mg2+	0.005	0.098	0.042	0.166	-
Cor	0.58	4.28	9.75	17.38	-
Cel	3.96	12.89	23.85	33.65	-
Ct	4.54	17.17	33.59	51.02	-

Table (12) Chemical Components in Ambient Particulate Matter in December, 1996

Unit: ng/m3, (Error in %)

	EMC-Dec/10		JICA-Dec/10		KPPL-Dec/26		Pulo Gadung-Dec/28		Pluit
Na	410	(11)	470	(12)	1100	(10)	570	(9)	-
Al	<1000.		<900.		4500	(16)	<1000.		-
Cl	390	(6)	690	(3)	1800	(3)	440	(5)	-
K	160	(25)	290	(23)	550	(18)	410	(16)	-
Ca	<200.		2200	(20)	16000	(4)	1000	(28)	-
Sc	0.036	(6)	0.29	(2)	1.2	(2)	0.22	(2)	-
Ti	<100.		100	(40)	620	(12)	200	(31)	-
V	<0.4		4.6	(10)	15	(7)	3.3	(17)	-
Cr	1.9	(11)	9.6	(5)	14	(4)	5.6	(5)	-
Mn	7	(31)	33	(18)	120	(14)	30	(14)	-
Fe	130	(8)	1100	(2)	4000	(1)	950	(2)	-
Co	0.06	(26)	0.55	(7)	1.9	(4)	0.42	(5)	-
Ni	1.6	(24)	6.4	(14)	8.9	(10)	3.1	(13)	-
Cu	40	(40)	220	(13)	160	(19)	67	(19)	-
Zn	6.7	(13)	81	(3)	290	(2)	98	(3)	-
As	0.17	(21)	0.4	(43)	2	(46)	2.1	(9)	-
Se	0.24	(18)	0.25	(20)	0.55	(17)	0.48	(8)	-
Br	3.2	(6)	49	(4)	140	(7)	30	(3)	-
Rb	<0.4		<0.7		2.9	(12)	1.7	(18)	-
Sr	<2.		<4.		86	(11)	<4.		-
Mo	24	(14)	23	(18)	10	(29)	17	(17)	-
Ag	0.03	(40)	<0.07		<0.09		0.21	(18)	-
Cd	<0.2		3	(37)	3	(34)	<0.3		-
Sn	3	(42)	7	(38)	5	(40)	10	(40)	-
Sb	0.2	(24)	2.2	(6)	4.8	(10)	2.7	(5)	-
I	3.3	(15)	4.3	(11)	5.8	(14)	3.7	(13)	-
Cs	0.04	(46)	0.094	(23)	0.23	(14)	0.1	(18)	-
Ba	<2.		10	(31)	39	(12)	12	(20)	-
La	0.2	(28)	0.46	(11)	1.3	(5)	0.34	(12)	-
Ce	<0.07		0.76	(21)	3.8	(11)	0.74	(14)	-
Sm	0.079	(21)	0.13	(16)	0.28	(12)	0.09	(18)	-
Eu	<0.01		<0.02		0.087	(14)	0.02	(37)	-
Yb	<0.01		<0.04		0.13	(13)	0.04	(36)	-
Lu	0.007	(41)	<0.009		0.031	(18)	0.01	(34)	-
Hf	<0.06		0.07	(40)	0.38	(9)	0.08	(34)	-
Ta	0.03	(31)	0.09	(25)	0.1	(27)	0.08	(40)	-
W	0.08	(49)	0.2	(43)	0.3	(34)	0.55	(13)	-
Pb	150	(11)	320	(7)	770	(4)	260	(8)	-
Th	0.05	(32)	0.19	(9)	0.63	(4)	0.31	(7)	-
U	<0.1		<0.1		<0.1		<0.06		-

Unit:ug/m3

	EMC-Dec/10	JICA-Dec/10	KPPL-Dec/26	Pulo Gadung-Dec/28	Pluit
SPM	8.68	64.2	-	-	-
Cl-	0.272	0.288	1.422	0.21	-
NO3-	0.181	0.449	2.088	0.531	-
SO42-	0	0.974	2.213	1.359	-
Na+	0.15	0.211	0.538	0.332	-
NH4+	0	0.008	0	0	-
K+	0.055	0.11	0.185	0.132	-
Ca2+	0.167	0.548	2.57	0.228	-
Mg2+	0	0.047	0.089	0.024	-
Cor	0.03	5.25	12.09	6.36	-
Cel	2.25	12.55	32.75	16.29	-
Ct	2.28	17.79	44.84	22.65	-

Appendix 3

FUEL AND EMISSION STUDIES

3.1 Fuel Consumption in Jabotabek

3.1 Fuel Consumption in Jabotabek

1. Factories

(1) Trends of Annual Fuel Consumption

Main fuels used in Jabotabek by factories are High Speed Diesel (Minyak solar), Industrial Diesel Oil (Minyak diesel), Marine Fuel Oil (Minyak bakar), natural gas and coal.
Trends of the annual fuel consumption except for coal by factories in Jabotabek are shown in **Table 1** and **Figures from 1 to 6.**

Table 1 Annual Fuel Consumption by Factories
(1985/1986 ~ 1995/1996)

	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96
HSD	742273	696815	711037	726037	736060	941913	1048384	1409536	1458781	1405662	(1520070)
IDO	620393	540438	470981	486467	590780	578168	620283	760877	775811	725047	(763825)
MFO	157194	145916	149381	159941	160788	191294	257046	311972	368213	424620	(410190)
kerosene								9995	15970	14085	(17475)
LPG			22997	25758	29061	48665	53694	57265	59273	68881	(77171)
natural gas		227178	298199	373478	696023	884436	1097005	1307891	1667416	3514612	4741679

(Source: #162, #213 and #214)
Figures in brackets mean estimated values by linear regression (see Figures from 1 to 5)
Unit: kl/year for HSD, IDO, MFO and kerosene
ton/year for LPG
1000 m3 for natural gas

These figures show that the annual consumption of HSD, IDO, MFO, kerosene and LPG has been increasing steadily with cyclical fluctuations. The consumption of naural gas has shown rapid increase since 1993 when PLN.T.PRIOK and PLN.M.KARANG started power generation by natural gas.

Annual coal consumption is shown in **Table 2.** Cement industry is the major user of coal.

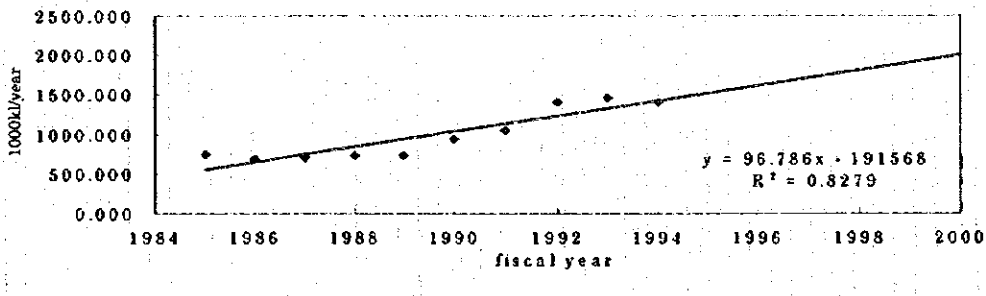


Figure 1 Annual Trends of Consumption of HSD

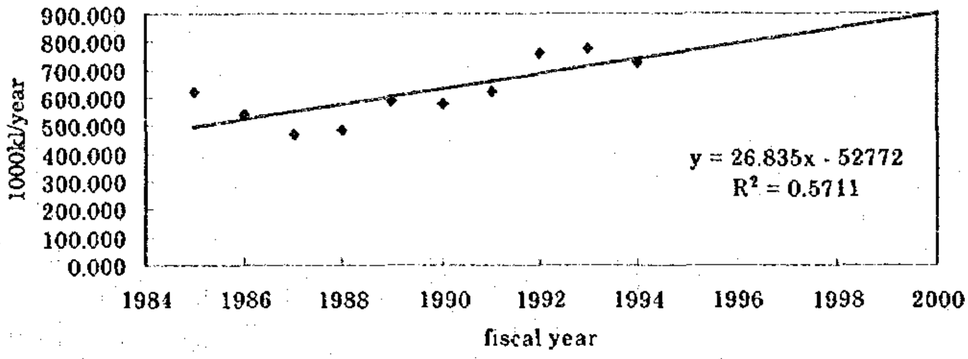


Figure 2 Trends of Annual Consumption of IDO

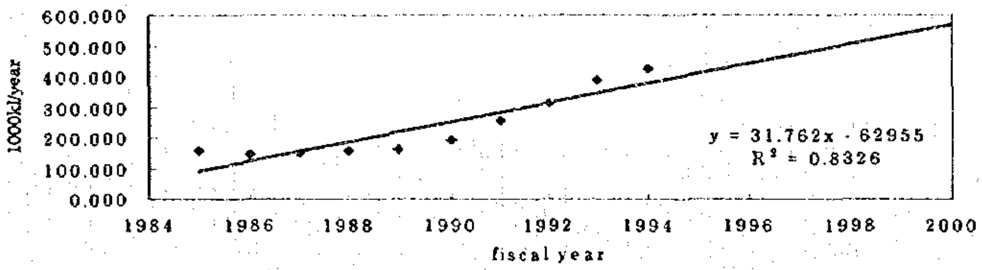


Figure 3 Trend of Annual Consumption of MFO

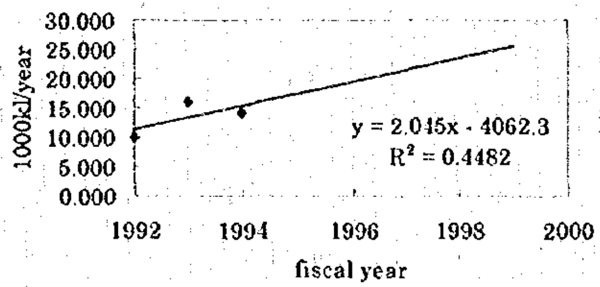


Figure 4 Trends of Annual Consumption of Kerosene

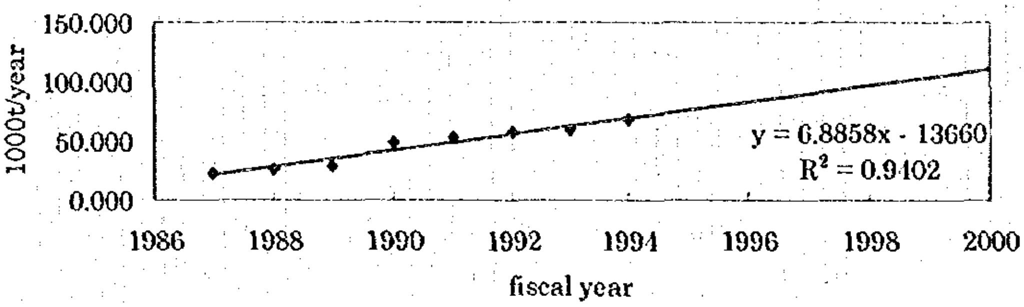


Figure 5 Trends of Annual Consumption of LPG

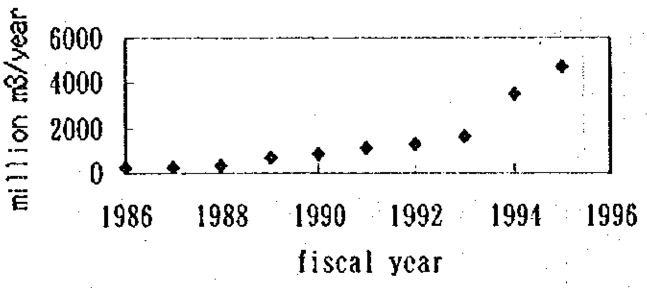


Figure 6 Trends of Annual Consumption of Natural Gas

Table 2 Annual Coal Consumption in Jabotabek

(unit: ton/year)

	1993/94	1994/95	1995/96
Cement		1,335,400	1,327,900
Others	28,000		

(Source: #211)

2) Total Fuel Consumption in Jabotabek in 1995

Table 3 compares each fuel consumption by factories responded to questionnaire survey (Table 4.3.8 in the main report) and the estimated value (Tables 1 and 2). For MFO and coal, their consumption by the responded factories fully covers the estimated consumption in Jabotabek. However, for HSD, IDO, kerosene and LPG, their coverage rate is below 20%.

Table 3 Comparison of Consumption by Responded Factories and Estimated Consumption in Jabotabek Based on Statistical Data (1995)

Fuel	Consumption by questionnaire factories	Estimated consumption in JABOTABEK	Coverage rate (%)
HSD	295,886	1,520,070	19.5
IDO	153,021	763,825	20.0
MFO	498,109	410,190	121.4
Kerosene	894	17,475	5.1
Coal	1,647,263	1,330,700	123.8
Natural gas	4,059,741	4,741,679	85.6
LPG	559	77,171	0.7

Unit: kl/year for HSD, IDO, MFO and kerosene
ton for coal and LPG
1000 m3/year for natural gas

(2) Households

1) Trend of Annual Fuel Consumption

Major fuels used by households in Jabotabek are kerosene and LPG. Trend of annual fuel consumption by households is shown in **Table 4** and **Figures 7 and 8**. Annual consumption of kerosene and LPG is steadily increasing.

Table 4 Trend of Annual Fuel Consumption by Households

	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95
Kerosene	1414776	1453961	1445305	1544618	1653554	1877500	1853077	1949304	2059117	2129382
LPG			68989	71988	56407	87686	103075	116851	136532	148412

Unit: kl/year for kerosene
ton/year for LPG

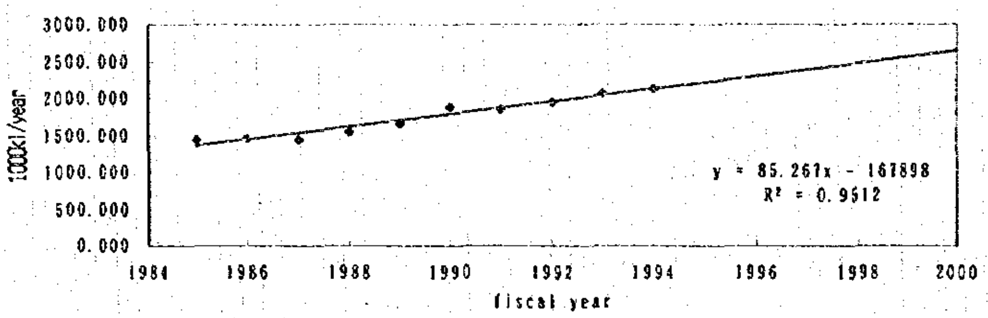


Figure 7 Trend of Annual Consumption of Kerosene by Households

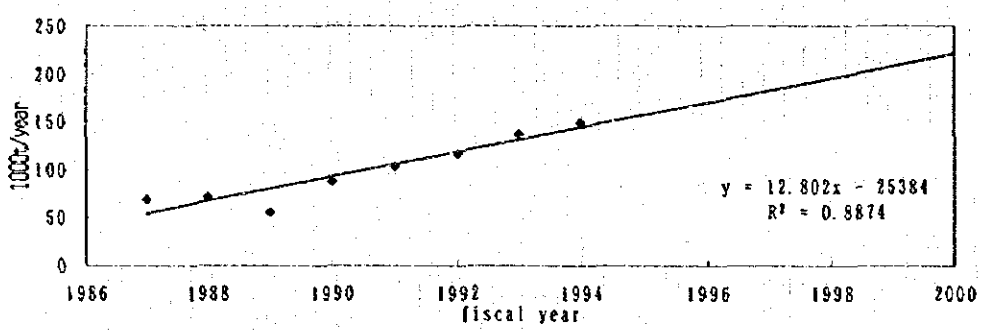


Figure 8 Trend of Annual Consumption of LPG by Households

(3) Motor Vehicles

1) Trends of Annual Fuel Consumption

In abotabek, Solar is used by diesel vehicles and the main fuel for gasoline vehicles is Premium gasoline. Trends of annual consumption of Solar and Premium are shown in **Table 5** and **Figures 9 and 10**. Consumption of these fuels is steadily growing.

Table 5 Total Fuel Consumption by Motor Vehicles in Jabotabek (1995)

(kl/year)

	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95
Solar	599691	662247	728851	790479	810400	1050314	1126153	1139780	1292456	1459786
Premium	1026232	1074556	1121779	1160993	1270369	1665280	1932153	2030945	2132704	2405770

(Source: #162)

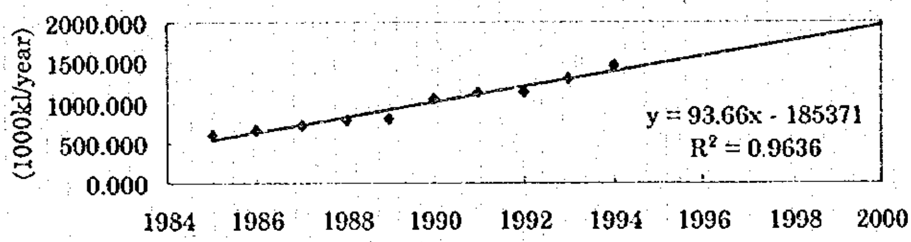


Figure 9 Trends of Annual Consumption of Solar

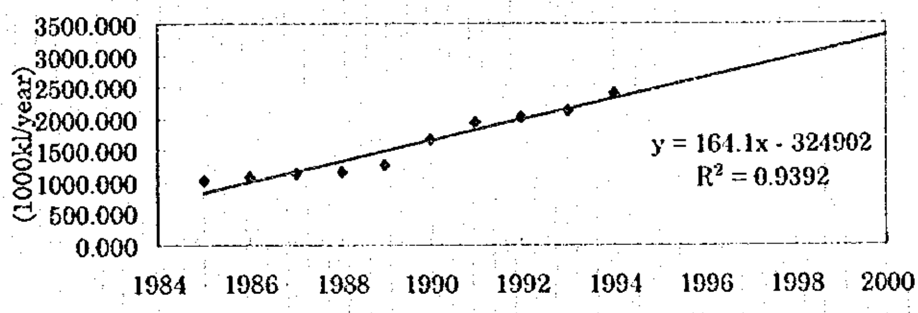


Figure 10 Trends of Annual Consumption of Premium