Appendix 4

ANALYSIS OF AIR POLLUUTION MECHANISM

4.1 Dispersion Simulation

4.1.1 Details of Jabotabek Air Pollution Simulation Model (SURASII)

1. Outline

This chapter describes the 'Dispersion Simulation Model' and 'Results of Simulation'.

2. Dispersion Simulation Model

(1) Objectives of the Jabotabek Simulation Model for Air Pollution

The Jabotabek Simulation Model for Air Pollution is a model modified to emulate the air pollution of Jakarta by the Jabotabek Study Team who has developed it comparing the simulation results with the actual ambient monitoring results. The targets of the model are as follows :

- Simulated air pollutants are SO_2, NO_2, CO, and NO_x,
- Computerized value is annual arithmetic mean concentration,
- Pollutant sources are motor vehicles, factories and establishments (including power plants, ships, aircraft, as well as households), and
- Target area of concentration calculation is Jabotabek.

(2) Methodology

The outline of the model is as follows :

- Meteorological data and ambient air quality data,
- CONCAWE Equation (CONCAWE, 1966) and Briggs Equation (Briggs, 1969) for the height of the plume rise, and
- Gaussian Plume Equation and Gaussian Puff Equation for the dispersion model

The simulation procedure is shown in **Figure 1**.

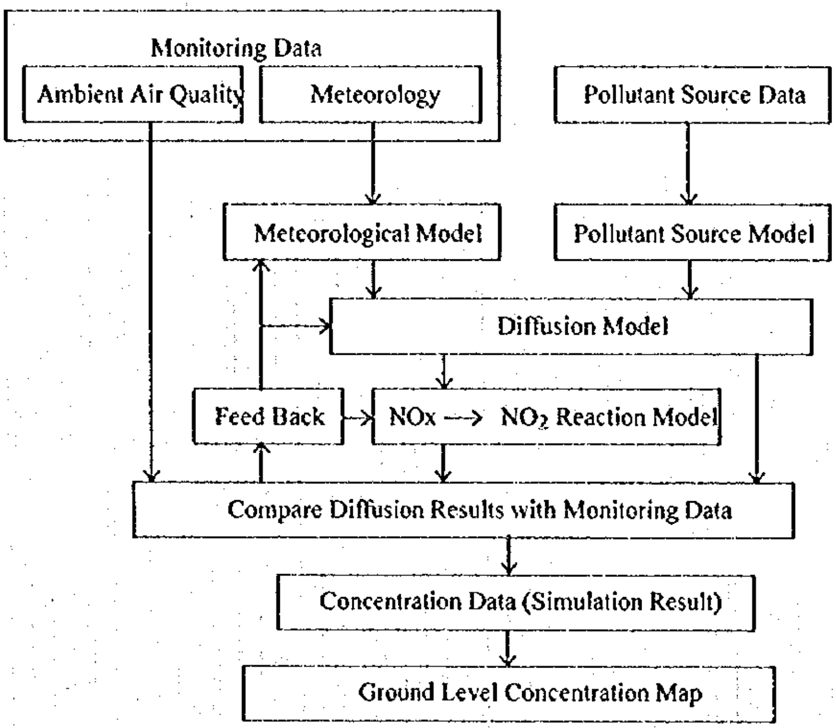


Figure 1 Flow Chart of Diffusion Simulation

(3) Target Years

The target years are 1996 for the present case, and 2010 for the future case.

(4) Target Air Pollutants

SO_2 and NO_2 are important problems according to experiences in other countries. SPM is also said to be an important problem in Jakarta. So, concentration of SO_2, NO_2, CO, Primary SPM and NOx are targets of this simulation model. Recently,

SPM consists of Primary SPM and Secondary SPM. Primary SPM means SPM emitted originally from stacks and exhaust pipes. Secondary SPM means formulated SPM in the air with other air pollutants, after emission from stack or exhaust pipe. Only Primary SPM was simulated because SPM mainly consists of Primary SPM. Secondary SPM model also should be included to the simulation model if there are enough data available to establish a Secondary SPM formulating model.

The quantity of SPM emitted from stack or exhaust pipe was assumed to be the amount of SPM although the definition of SPM sometimes may include larger particulate.

(5) Averaging Time of Concentration

Long-term average (one-year arithmetic mean) of concentration was calculated to omit hourly, daily and seasonally drifts and errors.

To simulate concentration of annual average, first, the meteorological information was grouped by matrixes of 16 wind directions, 8 ranks of wind speed and 11 stability classifications for each matrix of 4 seasons and 4 time zones. Second, dispersion of pollutants per source was calculated for the average condition of each matrix. Third, it was summarized to average concentration by each season-time zone. Finally, one-year arithmetic mean was calculated, using the following equation :

$$C_y = \sum_t \left(\sum_s \left(\sum_{rm} F(Q_s \cdot W_{rm}) \cdot f_{rm} \right) \cdot f_t \right)$$

where

C_y	:	Yearly average of concentration
t	:	Matrix of season and time zone
s	:	Pollutant source
rm	:	Representative meteorology
$F()$	:	Dispersion equation
Q_s	:	Quantity of pollutant from each source
W_{rm}	:	Meteorological information of each representative meteorology
f_{rm}	:	Frequency of each representative meteorology compared with each season and time zone
f_t	:	Ratio of each time zone compared with one year

On the other hand, the simulation for short term, e.g. 1 hour average of concentration is also necessary for the simulation under specified condition. However, further study is required for this purpose.

(6) Pollutant Sources

Targets of pollutant sources in this Study are motor vehicles, factories & establishments (including power plants, cement factories etc.), ships, aircraft and households.

(7) Area of Simulation

Area of simulation is the whole area of Jabotabek (around 105 km long in east-west direction and around 100 km in north-south direction). Calculation was made for more than 6,600 center points of 1 km by 1 km meshes.

(8) Season and Time Zoning

Season was defined in order to consider the seasonal variation of effectual factors for diffusion, e.g. primary wind direction.

There is also daily variation of effective factors, e.g. solar and net radiation as well as traffic volume variation. To take them into account, one year was divided into 4 time zones by the variation of traffic volume and the concentration variation of air pollutant. The zoning is shown in **Table 1**.

Table 1 Seasons and Time Zones

Seasons	Month
Rainy Season	January to March
Transition 1	April to June
Dry Season	July to September
Transition 2	October to December

Time Zones	Time
Morning	6:00 to 10:00
Afternoon	10:00 to 17:00
Night	17:00 to 24:00
Midnight	0:00 to 6:00

(9) Applied Meteorological Data

After examination of wind rose diagrams and diurnal changes of wind speed, wind data at Pulo Gadung were used for The DKI Jakarta area and those at EMC were used for the Botabek area. Net radiation was observed only at EMC.

(10) Atmospheric Stability

Pasquill's Stability Classification is generally prevalent to evaluate the atmospheric stability. Pasquill's Stability Classification redefined by Senshu (as shown in Table 2) was adopted in this Jabotabek study because the reliable data were net radiation and wind speed.

Atmospheric stability was originally classified by the vertical profile of atmospheric temperature. However, it is difficult to make continuous measurements (up to an altitude of around 1,000 m) of the vertical profiles of temperature. Therefore, Pasquill proposed a method of classifying the atmospheric stability into A through F, by meteorological observation of wind velocity, solar radiation and cloud amount. After Pasquill, some modifications were made for definition of atmospheric stability.

The Pasquill's Stability Classification modified by Senshu is used when net radiation data are available while solar radiation data are not available.

Table 2 Pasquill's Stability Classification (Senshu, 1977)

	Daytime				Nighttime		
	Net radiation (γ, cal/cm²/h)						
Surface wind Speed (m/sec)	γ >=30	30>γ >=15	15>γ >=7.5	7.5>γ >=0	0>γ >=-1.8	-1.8>γ >=-3.6	-3.6>γ
U<2	A	A-B	B	dD	nD	G	G
2<=U<3	A-B	B	C	dD	nD	E	F
3<=U<4	B	B-C	C	dD	nD	nD	E
4<=U<6	C	C-D	dD	dD	nD	nD	E
6<=U	C	dD	dD	dD	nD	nD	E

(11) Vertical Zoning and Estimate of Upper Layer Wind

Generally, the wind speed tends to increase with height from the ground surface.

The diffusion field was divided into three fields in the vertical direction as shown in **Table 3**.

Table 3 Vertical Zoning

	Diffusion Zone	Type of Source	Height of Source	Representative Height of Diffusion Field
1	Surface	Vehicle	0 to 3 m	1.5 m
2	Lower	Household	3 to 50m	Monitoring Height
3	Upper	Power Plants	50 ~ 150m	100m

The next equation by US.EPA was applied to estimate the wind speed of other fields.

$$U_z = U_s \cdot \left(\frac{Z}{Z_s} \right)^p$$

where

U_z : Estimated wind speed at height Z(m)

U_s : Measured wind speed at height Zs(m)

p : Factor, as shown in **Table 4.**

Table 4 Factor p

Stability	A	AB-B	BC-C	CD-D	E	F & G
p	0.1	0.15	0.2	0.25	0.25	0.3

Source :US.EPA

(12) Meteorological Classification

The classification of wind direction (16 directions and calm) and atmospheric stability (11 ranks, A to G) was also utilized for simulation modeling. Wind speed data were classified as shown in **Table 5** and the average speed of each rank was used as representative wind speed.

Table 5 Wind Speed Classification

Rank	Wind Velocity	Representative Wind Velocity
Calm	0.0 ~ 0.4 m/s	-
Windy-1	0.5 ~ 0.9 m/s	Yearly average of each rank
Windy-2	1.0 ~ 1.9 m/s	
Windy-3	2.0 ~ 2.9 m/s	
Windy-4	3.0 ~ 3.9 m/s	
Windy-5	4.0 ~ 5.9 m/s	
Windy-6	6.0 ~ 7.9 m/s	
Windy-7	8.0 m/s ~	

(13) Source Type

Sources with quantitative air pollutants were modeled as point or line source individually. Sources with small pollutants were compiled to area sources. The definition of modeling is shown in **Table 6**.

Table 6 Source Type

Source Category	Size/Condition	Source Types for Simulation
Factory & Establishment	Large	Point
	Small	Area
Household	All	Area
Motor Vehicle	Major Road	Line
	Minor Road	Area
Ship	Mooring	Point
	Cruising	Area
Aircraft	Approach & Climb-out	Point (Series)
	Take-off	Line
	Idling & Taxiing	Area

(14) Dispersion Model

Effective Stack Height

Effective stack height was set or calculated as shown in **Table 7.**

Table 7 Effective Stack Height

Source Category	Source Type	Windy	Calm
Factory & Establishment	Point	CONCAWE	Briggs
	Area	40 m	55 m
Household	Area	10 m	15 m
Motor Vehicle	Line	0.5 m	0.5 m
	Area	3 m	5 m
Ship	Point	CONCAWE	Briggs
	Area	25 m	30 m
Aircraft	Point	(Altitude)	(Altitude)
	Line	20 m	30 m
	Area	20 m	30 m

The CONCAWE equation (CONCAWE, 1966) is :

$$H_e = H_0 + 0.175 \cdot Q_H^{\frac{1}{2}} \cdot u^{-\frac{3}{4}}$$

where

H_e : Effective stack height (m)

H_0 : Actual stack height (m)

Q_H : Released heat (cal/s)

$$Q_H = \rho \cdot C_p \cdot Q \cdot (T_G - T_A)$$

where

ρ : Air density at 0°C (1.293 x 10^3 g/m^3)

C_p : Isopiestic specific heat (0.24 cal/kg)

Q : Volume of emitted gas (m^{3}N/s)

T_G : Temperature of exhaust gas (°C)

T_A : Temperature of atmosphere (28 °C)

u : Wind speed at stack top (m/s)

The Briggs equation (Briggs, 1969) is :

$$H_e = H_0 + 1.4 \cdot Q_H^{1/4} \cdot (d\theta / dz)^{-3/8}$$

where

$d\theta / dz$: Temperature gradient (0.005 °C/m for daytime, and 0.010 °C/m for nighttime)

Diffusion Formulas

Gaussian plume model equation and Gaussian puff model equation were selected for diffusion formulas, as shown in **Table 8**.

Table 8 Diffusion Formulas

Source	Windy	Calm
Point	Simplified Gaussian Plume Equation	Simplified Gaussian Puff Equation
Line	Simplified Gaussian Plume Equation	Simplified Gaussian Puff Equation
Area	Simplified Gaussian Plume Equation	Simplified Gaussian Puff Equation

a) Gaussian Plume Equation

Original formula of Gaussian plume model is as follows :

$$C(x,y,z) = \frac{Q_p}{2\pi\sigma_y\sigma_z u} \cdot \exp\left(-\frac{y^2}{2\sigma_y^2}\right) \cdot F$$

where

$$F = \left\{\exp\left[-\frac{(z - He)^2}{2\sigma_z^2}\right] + \exp\left[-\frac{(z + He)^2}{2\sigma_z^2}\right]\right\}$$

C : Concentration at calculation point.

x : Distance from source to calculation point along wind direction (m).

y : Distance from source to calculation point upright to wind direction (m).
z : Height of calculation point (m).
Q_p : Emission rate of pollutant (m^3N/sec).
u : Wind speed (m/sec).
He : Effective stack height
σ_y : Diffusion width upright to wind direction (m)
σ_z : Vertical diffusion width (m)

Because the original formula is time consuming in the practical use, this formula was simplified as the next one by Holland (1953) with the assumption that frequency inside each 16 wind direction ranks is constant, which was applied for the Jabotabek simulation model.

$$C(R,z) = \sqrt{\frac{1}{2\pi}} \frac{Q_p}{\frac{\pi}{8} R\sigma_z u} \cdot F$$

where

R : Distance from source to calculation point (m)

b) Gaussian Puff Equation

On the other hand, the formula of original Gaussian puff model is as follows :

$$C(x,y,z) = \frac{Q_p}{(2\pi)^{3/2}\sigma_x\sigma_y\sigma_z} \cdot \exp\left(-\frac{(x-ut)^2}{2\sigma_x^{\ 2}} - \frac{y^2}{2\sigma_y^{\ 2}}\right) \cdot F$$

where

t : Time from stack or exhaust gas pipe (sec)
Others : same as the Plume Equation Section

It is also time consuming in the practical use and its simplified equation, which is used in Jabotabek simulation model, is as follows :

$$C(R,z) = \frac{Q_p}{(2\pi)^{3/2}\gamma} \cdot \left\{ \frac{1}{R^2 + \frac{\alpha^2}{\gamma^2}(He-z)^2} + \frac{1}{R^2 + \frac{\alpha^2}{\gamma^2}(He+z)^2} \right\}$$

where

$\alpha = \sigma_x / t = \sigma_y / t$ (t : 3600 sec)

$\gamma = \sigma_t / t \quad (t: 3600 \text{ sec})$

(15) Diffusion Width

Diffusion Width for Plume Equation

JEA Equation for simulating Pasquill - Gifford Chart was used for plume equation. The equation is :

$$\sigma_y(x) = \gamma_y \cdot x^{\alpha_y}$$

$$\sigma_z(x) = \gamma_z \cdot x^{\alpha_z}$$

where

γ_y, α_y, γ_z, α_z : Constants depending on atmospheric stability (**Table 9**).

x : Distance from source along wind direction (m).

Table 9 Constant for σ_y and σ_z for Plume Equation

Stability	α_y	γ_y	x	α_z	γ_z	x (m)
A	0.901	0.426	0 ~ 1,000	1.122	0.0800	0 ~ 300
	0.851	0.602	1,000 ~	1.514	0.00855	300 ~ 500
				2.109	0.000212	500 ~
B	0.914	0.282	0 ~ 1,000	0.964	0.1272	0 ~ 500
	0.865	0.396	1,000 ~	1.094	0.0570	500 ~
C	0.924	0.1772	0 ~ 1,000	0.918	0.1068	0 ~
	0.855	0.232	1,000			
D	0.929	0.1107	0 ~ 1,000	0.826	0.1046	0 ~ 1,000
	0.889	0.1467	1,000 ~	0.632	0.400	1,000 ~ 10,000
				0.555	0.811	10,000 ~
E	0.921	0.0864	0 ~ 1,000	0.788	0.0928	0 ~ 1,000
	0.897	0.1019	1,000 ~	0.565	0.433	1,000 ~ 10,000
				0.415	1.732	10,000 ~
F	0.929	0.0554	0 ~ 1,000	0.784	0.0621	0 ~ 1,000
	0.889	0.0733	1,000 ~	0.526	0.370	1,000 ~ 10,000
				0.323	2.41	10,000 ~
G	0.921	0.0380	0 ~ 1,000	0.794	0.0373	0 ~ 1,000
	0.896	0.0452	1,000 ~	0.637	0.1105	1,000 ~ 2,000
				0.431	0.529	2,000 ~ 10,000
				0.222	3.62	10,000 ~

Source : JEA, 1993

Diffusion Width for Puff Equation

This JEA table derived from Turner Chart was used for puff equation (**Table 10**).

Table 10 α and γ for Puff Equation

Stability	α	γ
A	0.948	1.569
B	0.781	0.474
C	0.635	0.208
D	0.470	0.113
E	0.439	0.067
F	0.439	0.048
G	0.439	0.029

Source : JEA, 1993

(16) Reaction Model from NO to NO_2

Reaction Model from NO to NO_2 follows the model of Yamamoto, Yokoyama, et al. (Ref.217). The equation is :

$$[NO_2] = [NO_x]_D \cdot \left[1 - \frac{\alpha}{1+\beta}\left\{\exp(-Kt) + \beta\right\}\right]$$

where

$[NO_2]$, $[NOx]_D$: Concentration of NO_2 and NOx

α : NO/NOx ratio near pollutant source, shown in **Table 11**

β : NO/NOx ratio far from pollutant source, shown in **Table 11**

t : Time from stack/ exhaust gas pipe (sec)

$K = F_K \cdot u \cdot [O_3]_B \cdot F_{O3}$

where

F_K : Experimental constant, shown in **Table 11**

u : Wind speed (m/s)

$[O_3]_B$: Background concentration of O_3 (ppm), shown in **Table 12**

F_{O3} : O_3 Background factor, shown in **Table 13**

Table 11 NO/NOx Ratio, Near Source (α) and Far From Source (β), and Experimental Constant (F_K)

Source Category	Source Type	α	β	F_K
Factory & Establishment	Point	0.85	0.3	0.0062
	Area	0.85	0.3	0.062
Household	Area	0.85	0.3	0.062
Motor Vehicle	Line	0.95	0.3	*1
	Area	0.85	0.3	0.062
Ship	Point	0.85	0.3	0.0062
	Area	0.85	0.3	0.062
Aircraft	Point	0.85	0.3	0.0062
	Line	0.85	0.3	0.062
	Area	0.85	0.3	0.062

Note : *1 F_K= (0.4 x Q_{NOx}) when the air pollutant source is nearer than 300m and (0.4 x Q_{NOx}) is less than 0.15, and F_K=0.15 in other case.

Table 12 Background Concentration of O_3 (ppm)

	Morning	Afternoon	Night	Midnight
DKI Jakarta				
Rainy	0.003	0.005	0.001	0.001
Transition 1	0.008	0.018	0.003	0.002
Dry	0.010	0.022	0.004	0.002
Transition 2	0.007	0.013	0.002	0.001
Botabek				
Rainy	0.006	0.019	0.004	0.001
Transition 1	0.008	0.041	0.009	0.001
Dry	0.011	0.050	0.011	0.001
Transition 2	0.010	0.034	0.009	0.001

Note : $[O_3]_B$=0.85 x ($[O_x]$-0.06[NOx]), where $[O_3]$ and [NOx] were summarized by the Study Team using the data at EMC.

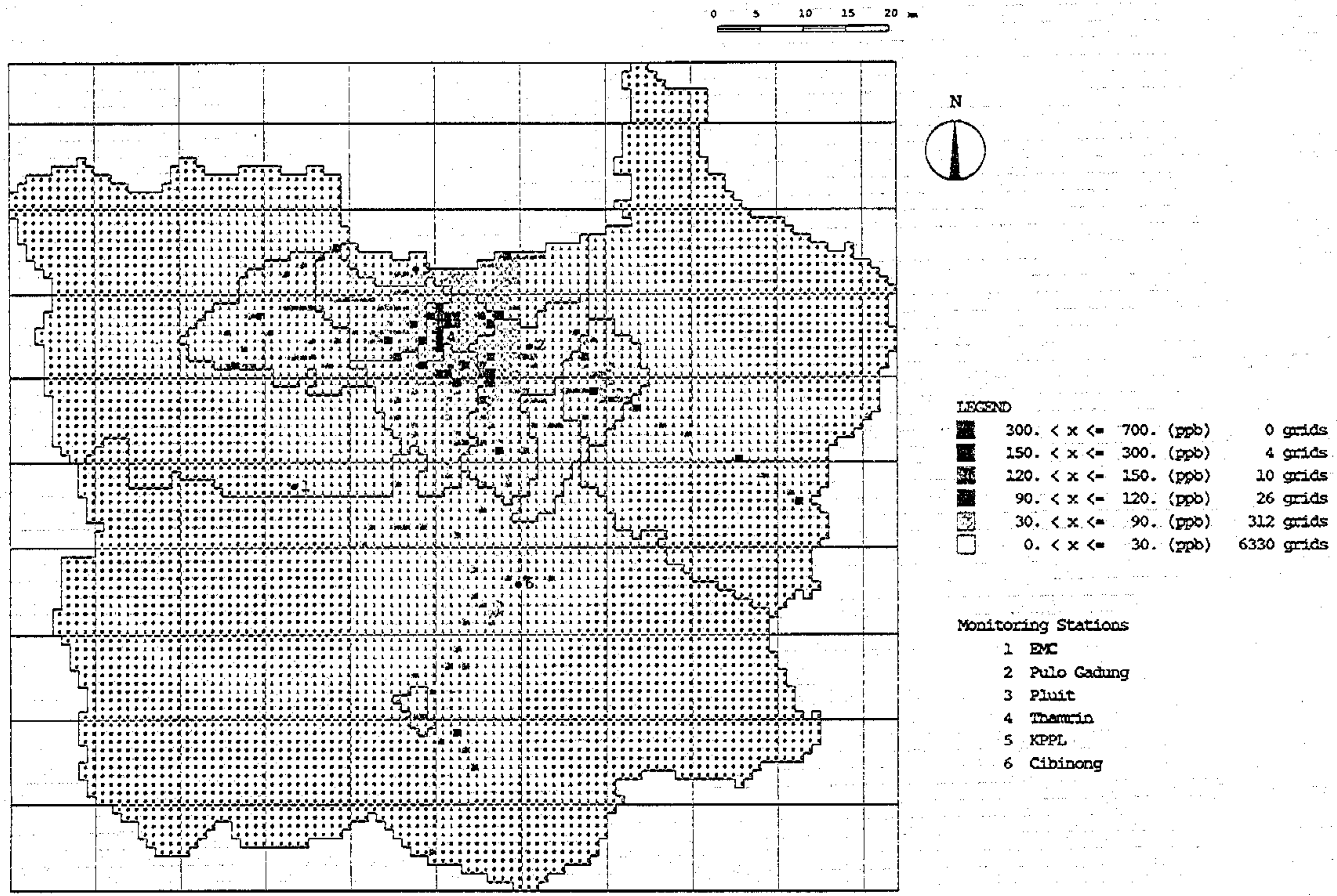
Table 13 O_3 Background Factor

Time Zone	Daytime	Nighttime
k (Parallel wind to line source)	0.55	0.33
k (other cases)	1	1

Note : If the source is line source and the azimuth between the direction of line and the wind direction is less than or equal to 30 degrees, k is 0.55 in daytime, 0.33 in nighttime, and 1.0 otherwise.

4.1.2 Concentration Map of NOx and SPM

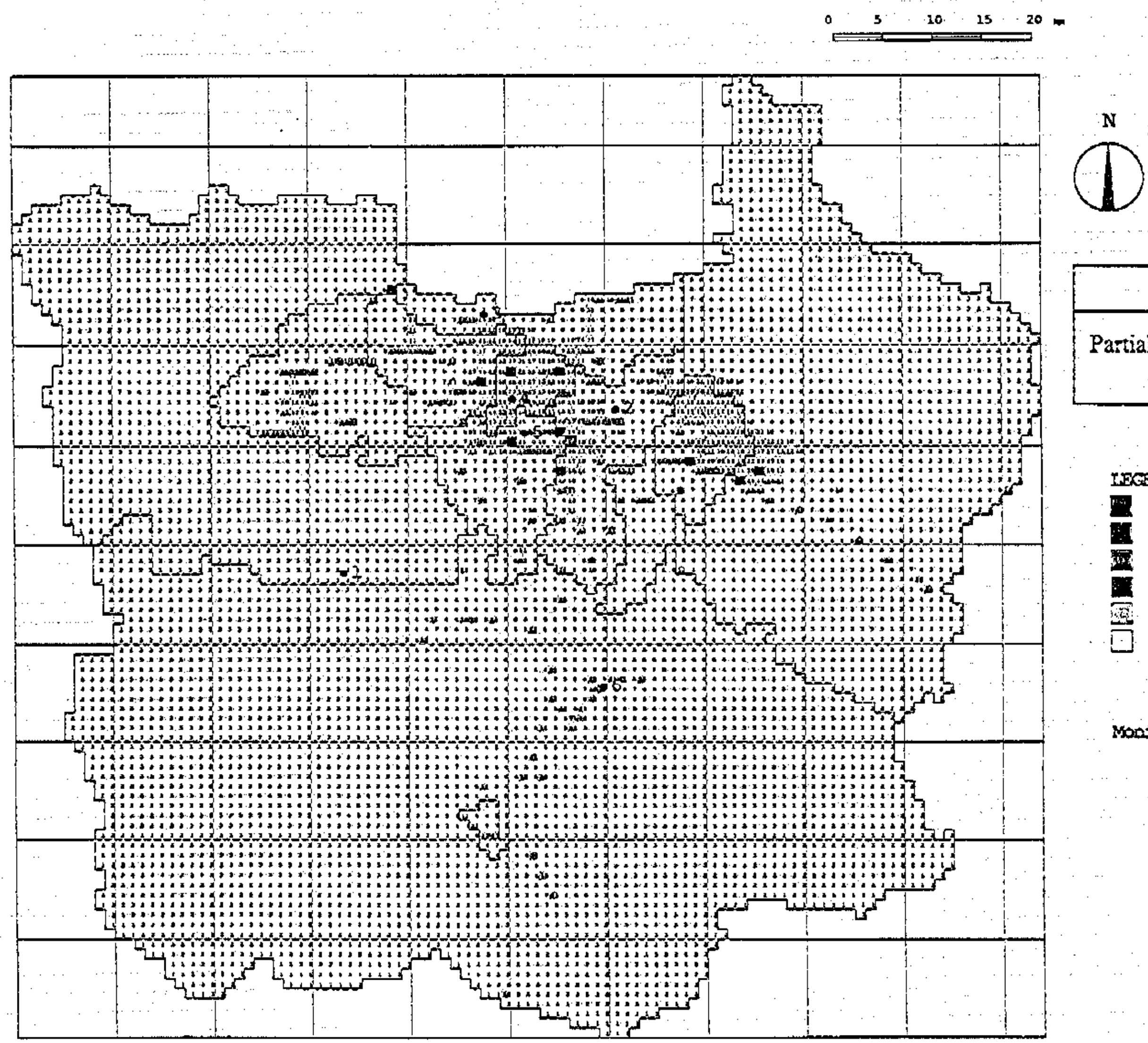
Present Condition (1995)



NOx 10ppb Annual Average C MAX= 273.0ppb

Background Concentration: 0.ppb

Present Condition (1995)



Note: Approximate Estimate Only

Partial Contribution from Automobiles, Factories and Households

Underestimation

LEGEND

120. < x <=	240.	(ug/m3)	0 grids
60. < x <=	120.	(ug/m3)	0 grids
50. < x <=	60.	(ug/m3)	1 grids
30. < x <=	50.	(ug/m3)	10 grids
10. < x <=	30.	(ug/m3)	344 grids
0. < x <=	10.	(ug/m3)	6327 grids

Monitoring Stations

1 EMC
2 Pulo Gadung
3 Pluit
4 Thamrin
5 KPPL
6 Cibinong

SPM ug/m3 Annual Average

C MAX= 54.4ug/m3
Background Concentration: 0.ug/m3

4.2 Chemical Mass Balance (CMB) Analysis

4.2.1 Analytical Results of PM Sources

Unit: ppm wt.

	Boiler HSD	Boiler HSD	Furnace Electricity	Generator HSD	Boiler LNG
Na	<200000.	<600000.	<2000000.	<60000.	<200000.
Al	<40000.	<100000.	<300000.	<10000.	50000 (36)
Cl	<4000.	<2000.	<30000.	3900 (16)	<4000.
K	<70000.	<200000.	<600000.	<20000.	<70000.
Ca	<100000.	<300000.	<900000.	<30000.	<100000.
Sc	<0.5	<1.	<4.	<0.1	<0.5
Ti	<3000.	5000 (40)	<10000.	<800.	<3000.
V	40 (40)	110 (19)	200 (40)	2100 (4)	6400 (2)
Cr	<40.	<100.	<300.	<10.	500 (8)
Mn	<500.	<2000.	<4000.	<200.	<500.
Fe	<2000.	14000 (16)	<10000.	2200 (9)	<2000.
Co	<2.	<6.	<20.	79 (2)	<2.
Ni	<6.	<300.	<800.	1400 (2)	<100.
Cu	<1000.	<2000.	<5000.	500 (40)	<2000.
Zn	<80.	1800 (20)	39000 (3)	1800 (2)	<80.
As	<10.	<40.	<100.	<0.7	<10.
Se	<0.8	<5.	20 (40)	2 (40)	1 (40)
Br	<30.	<100.	<300.	<10.	<30.
Rb	<3.	<100.	<300.	<10.	<6.
Sr	<50.	<400.	<1000.	<90.	<70.
Mo	<600.	<2000.	<5000.	<200.	<3.
Ag	<0.5	<20.	<50.	<2.	<0.8
Cd	<3.	<20.	<60.	<3.	<7.
Sn	<60.	<300.	<700.	<40.	<90.
Sb	<2.	80 (4)	190 (4)	14 (3)	<2.
I	<20.	<200.	<500.	<10.	<30.
Cs	<0.2	<6.	<10.	<0.6	<2.
Ba	<50.	<8000.	<20000.	<800.	<40.
La	<20.	<40.	<100.	10 (18)	<10.
Ce	<10.	<40.	<100.	<4.	<10.
Sm	<3.	<10.	<30.	<1.	<3.
Eu	<1.	<4.	<10.	<0.4	<0.2
Yb	<0.1	<8.	<20.	<0.8	<0.2
Lu	<0.01	<3.	<7.	<0.3	<0.8
Hf	<0.1	<20.	<40.	<2.	<0.2
Ta	<0.3	<3.	<2.	<0.3	<0.4
W	<30.	<20.	<0.6	<5.	<0.9
Hg	<0.4	<2.	<20.	<1.	<3.
Th	<0.08	<8.	<20.	<0.8	<0.1
U	<0.3	<40.	<100.	<4.	<0.7

Cl-	2200	4200	17000	2500	180
Br-	0	0	0	0	0
NO3-	0	0	0	0	0
SO42-	26000	90000	56000	56000	160000
Na+	350	0	0	2800	4500
K+	2600	3100	4000	890	2100
NH4+	690	0	0	2000	15000
Ca2+	2900	17000	22000	17000	34000
Mg2+	56	0	10000	310	900
Cel	950000	240000	660000	49000	-
Cor	45000	230000	210000	4000	-
Ct	995000	470000	870000	53000	-

Unit: ppm wt.

	Boiler MFO	Boiler MFO	Cement Kiln Coal	Cement Kiln Coal	Furnace MFO
Na	6600 (2)	110000 (11)	40000	<6000.	<200000.
Al	990 (17)	<2000.	7000	<1000.	<30000.
Cl	700 (30)	<200.	600	500 (16)	<1000.
K	4900 (9)	28000 (18)	10000	<2000.	<50000.
Ca	2000 (40)	<2000.	40000 (8)	140000 (4)	<80000.
Sc	0.63 (5)	<0.02	0.8 (2)	1.8 (1)	<0.3
Ti	<900.	400 (40)	0 (35)	750 (22)	<4000.
V	12000 (2)	240 (4)	5 (10)	19 (4)	24000 (2)
Cr	160 (3)	10 (9)	. (32)	8.9 (8)	460 (6)
Mn	20 (26)	<20.	0 (26)	110 (18)	<400.
Fe	5600 (4)	1100 (5)	2000 (2)	6600 (2)	25000 (5)
Co	3.7 (9)	3.3 (5)	0.3 (5)	2.2 (4)	15 (14)
Ni	52 (22)	94 (4)	4	5 (32)	<20.
Cu	<400.	<200.	0 (40)	<40.	<2000.
Zn	2600 (2)	53 (6)	10	6 (28)	10000 (2)
As	35 (8)	<0.7	2	1.1 (18)	58 (16)
Se	18 (6)	1.7 (19)	0.7 (40)	0.4 (27)	75 (7)
Br	110 (2)	<2.	3 (8)	7.2 (9)	370 (3)
Rb	10 (40)	150 (2)	3	7 (10)	<20.
Sr	1100 (5)	<10.	70 (9)	530 (4)	<300.
Mo	24 (8)	<30.	100	<20.	<500.
Ag	13 (5)	<0.3	1	<0.2	50 (10)
Cd	20 (11)	<2.	2	<0.4	110 (17)
Sn	<100.	<10.	0 (40)	<7.	<800.
Sb	150 (3)	1.6 (7)	0.3 (3)	0.9 (4)	550 (3)
I	<10.	<6.	8	7 (23)	<40.
Cs	1.6 (11)	8 (2)	0.8 (6)	2.7 (3)	<0.5
Ba	210 (15)	<100.	500	<90.	<2000.
La	2.8 (10)	<0.7	. (40)	4.8 (5)	<10.
Ce	7.7 (18)	<0.6	0	7.9 (9)	<10.
Sm	0.22 (4)	<0.2	0.6	0.61 (8)	<2.
Eu	<0.2	<0.07	0.2	0.2 (14)	<1.
Yb	<0.2	<0.1	0.4	0.1 (32)	<2.
Lu	<0.02	<0.04	0.1	<0.03	<0.09
Hf	0.2 (40)	<0.2	0.9	<0.2	<0.9
Ta	<0.3	<0.05	0.2	0.12 (19)	<1.
W	11 (8)	<1.	1	<0.4	36 (21)
Hg	6.1 (9)	<0.1	0.5	<0.3	10 (41)
Th	0.4 (31)	<0.1	0.4	1.1 (5)	<2.
U	<0.4	<0.6	2	0.62 (24)	<2.

Cl-	101	0	540	280	670
Br-	0	0	0	0	0
NO3-	0	0	0	0	0
SO42-	40000	490000	36000	6900	71000
Na+	7000	160000	1600	0	27000
K+	800	26000	480	80	2500
NH4+	830	0	0	0	3700
Ca2+	4300	1200	24000	8100	26000
Mg2+	560	63	310	200	4700
Cel	760000	12000	-	0	120000
Cor	0	700	-	400	50000
Ct	760000	19000	-	0	170000

Unit: ppm wt.

	Generator HSD	Boiler Coal	Boiler HSD	Boiler MFO	Generator HSD
Na	<100000.	<50000.	<200000.	<30000.	<2000000.
Al	36000 (23)	<9000.	<9000.	<6000.	<400000.
Cl	<2000.	<1000.	<500.	<300.	<9000.
K	<40000.	<20000.	<70000.	<10000.	<800000.
Ca	<60000.	<20000.	<100000.	<5000.	<1000000.
Sc	<0.2	<0.1	<0.5	<0.07	<0.08
Ti	<1000.	18000 (6)	<2000.	2000 (40)	<20000.
V	30 (40)	490 (2)	<30.	37000 (2)	600 (33)
Cr	150 (10)	160 (6)	860 (4)	60 (8)	4700 (5)
Mn	<300.	<100.	<500.	<50.	<6000.
Fe	2400 (21)	5600 (5)	50000 (3)	3200 (6)	300000 (6)
Co	<0.4	4.2 (14)	25 (13)	2 (15)	170 (16)
Ni	<50.	<20.	240 (22)	20 (37)	<800.
Cu	<500.	<200.	<900.	<1000.	<9000.
Zn	2400 (2)	1500 (2)	12000 (2)	1100 (2)	120000 (2)
As	17 (22)	13 (19)	150 (10)	14 (11)	1200 (12)
Se	32 (8)	22 (7)	140 (4)	15 (7)	940 (11)
Br	110 (7)	130 (3)	530 (3)	54 (4)	5100 (3)
Rb	<20.	<7.	<30.	<5.	<300.
Sr	<100.	<70.	<300.	<40.	53000 (8)
Mo	<300.	<100.	<600.	<90.	<6000.
Ag	8.1 (23)	10 (11)	36 (10)	2.5 (24)	390 (16)
Cd	40 (31)	<6.	130 (16)	13 (13)	1200 (20)
Sn	<200.	<100.	<600.	<70.	<6000.
Sb	150 (2)	120 (2)	730 (3)	64 (2)	7100 (2)
I	<20.	<10.	<40.	<10.	<500.
Cs	<1.	<0.2	<2.	<0.3	<20.
Ba	<1000.	<600.	<3000.	<400.	<30000.
La	<8.	<3.	<10.	<2.	<200.
Ce	<7.	<3.	<10.	<2.	<100.
Sm	<2.	<0.7	<3.	<0.5	<30.
Eu	<0.4	<0.3	<1.	<0.1	<10.
Yb	<0.5	<0.3	<3.	<0.1	<10.
Lu	<0.04	<0.2	<0.1	<0.01	<1.
Hf	<0.4	<1.	<5.	<0.1	<60.
Ta	<0.6	<0.4	<1.	<0.2	<20.
W	26 (18)	<0.8	120 (10)	15 (9)	680 (17)
Hg	<2.	1 (48)	20 (31)	0.7 (44)	<50.
Th	<1.	<0.6	<3.	<0.4	<30.
U	<1.	<0.6	<2.	<0.3	<30.

Cl-	0	210	0	48	46000
Br-	0	0	0	0	0
NO3-	0	0	0	0	0
SO42-	34000	13000	24000	46000	29000
Na+	310	2100	2000	10000	41000
K+	0	340	79	9100	15000
NH4+	0	1.8	0	5300	0
Ca2+	5100	670	4500	19000	0
Mg2+	0	12	0	3000	1600
Cel	810000	560000	900000	280000	0
Cor	29000	0	0	0	110000
Ct	840000	560000	900000	280000	110000

Unit: ppm wt.

	Boiler HSD	Generator HSD	Furnace IDO	Furnace MFO	Open Burning Waste
Na	<100000.	<50000.	<80000.	1900 (2)	95000 (2)
Al	30000 (26)	10000 (37)	<5000.	140000 (3)	<3000.
Cl	<2000.	<1000.	<2000.	<1000.	26000 (8)
K	<40000.	<20000.	<30000.	600 (40)	<9000.
Ca	<50000.	<30000.	<40000.	10000 (40)	<60000.
Sc	<0.2	<0.1	<0.2	0.29 (13)	32 (2)
Ti	<1000.	<500.	3000 (40)	33000 (14)	<800.
V	73 (21)	30 (30)	9200 (2)	13000 (2)	<6.
Cr	240 (6)	420 (4)	280 (4)	39 (13)	<30.
Mn	<300.	<100.	750 (10)	160 (15)	<300.
Fe	15000 (5)	18000 (4)	18000 (4)	2100 (22)	<1000.
Co	7.2 (15)	9.7 (9)	9.7 (8)	<0.8	<1.
Ni	<20.	120 (14)	<40.	<10.	<50.
Cu	<700.	<300.	160000 (2)	<2000.	<2000.
Zn	4700 (2)	3500 (2)	5200 (2)	100 (22)	<50.
As	41 (14)	39 (13)	57 (10)	0.7 (40)	<1.
Se	64 (8)	55 (4)	53 (4)	<2.	<2.
Br	190 (4)	230 (3)	170 (4)	52 (3)	<1.
Rb	<20.	<9.	<10.	<7.	<7.
Sr	<100.	1700 (7)	2300 (5)	<100.	<200.
Mo	<300.	<200.	<200.	2 (40)	<7.
Ag	11 (17)	6.9 (19)	12 (14)	<1.	<0.2
Cd	30 (31)	44 (17)	50 (10)	<5.	<5.
Sn	<300.	<900.	<200.	<100.	<1.
Sb	340 (2)	300 (3)	250 (2)	10 (2)	<0.9
I	20 (40)	19 (24)	<30.	<50.	<30.
Cs	<0.9	<0.5	<0.4	0.5 (40)	<0.6
Ba	<1000.	<700.	<1000.	<50.	<80.
La	<7.	<1.	<6.	0.4 (40)	<0.4
Ce	<7.	<4.	<5.	2 (40)	<1.
Sm	<2.	<0.9	<1.	0.083 (15)	<0.01
Eu	<0.7	<0.4	<0.4	0.5 (40)	<0.2
Yb	<0.6	<0.4	<0.4	<0.3	<0.4
Lu	<0.06	<0.2	<0.3	<0.02	0.03 (40)
Hf	<0.5	<1.	<2.	<0.6	<0.2
Ta	<0.7	<0.5	<0.6	<0.5	<0.4
W	96 (5)	22 (13)	53 (7)	<0.8	<3.
Hg	7 (26)	8.2 (16)	7.9 (20)	<0.8	<1.
Th	<1.	<0.7	<1.	0.3 (40)	<0.2
U	<1.	<0.7	<0.9	<0.5	<0.6

Cl-	500	150	400	-	22000
Br-	0	0	0	-	-
NO3-	860	0	0	-	1100
SO42-	11000	11000	41000	-	3000
Na+	2900	280	31000	-	11000
K+	510	0	8600	-	2500
NH4+	0	0	22000	-	0
Ca2+	2200	1200	14000	-	90
Mg2+	97	210	1700	-	0
Cel	-	870000	67000	-	-
Cor	-	20000	7000	-	-
Ct	-	890000	74000	-	-

Unit: ppm wt.

	Open Burning Waste	Open Burning Waste	Open Burning Waste	Thamrin Soil	EMC Soil
Na	160000 (2)	160000 (2)	150000 (2)	1700 (2)	130 (4)
Al	<20000.	<30000.	<30000.	120000 (7)	150000 (2)
Cl	4000 (41)	21000 (12)	<1000.	200 (40)	<200.
K	<9000.	<20000.	<20000.	2000 (40)	500 (40)
Ca	<60000.	<90000.	<90000.	10000 (40)	4000 (40)
Sc	31 (2)	69 (3)	47 (2)	27 (2)	31 (2)
Ti	<3000.	<3000.	<5000.	7500 (11)	9500 (12)
V	<50.	<70.	<70.	230 (4)	270 (6)
Cr	<30.	<50.	<50.	27 (7)	19 (12)
Mn	<300.	<500.	<500.	2300 (13)	5100 (12)
Fe	<1000.	<2000.	<2000.	75000 (2)	77000 (2)
Co	<1.	<2.	<2.	31 (2)	37 (1)
Ni	<50.	<90.	<80.	9 (40)	<10.
Cu	<1000.	<4000.	<2000.	2700 (14)	1000 (27)
Zn	<50.	<80.	<70.	400 (7)	130 (15)
As	<1.	<2.	<2.	5.8 (5)	7.3 (4)
Se	<2.	<3.	<2.	<0.8	1 (46)
Br	<2.	<2.	<2.	47 (3)	5.9 (8)
Rb	<7.	<10.	<9.	10 (27)	4 (40)
Sr	<200.	<300.	<200.	<50.	<50.
Mo	<7.	<10.	<10.	3.8 (15)	3.2 (19)
Ag	<0.2	<0.4	<2.	<0.9	<0.9
Cd	<7.	<9.	<8.	<2.	3 (40)
Sn	<1.	<0.9	<2.	<30.	30 (40)
Sb	<0.9	<0.1	<1.	1.6 (5)	0.4 (8)
I	<30.	<50.	<50.	20 (40)	30 (40)
Cs	<0.6	<1.	<0.8	2.5 (7)	2.5 (7)
Ba	<80.	<100.	<100.	250 (10)	200 (11)
La	<0.5	<0.6	<0.6	17 (2)	27 (2)
Ce	<1.	<2.	<2.	51 (4)	64 (4)
Sm	<0.01	<0.02	<0.02	3.9 (2)	6.4 (3)
Eu	<0.2	<0.3	<0.3	1.3 (6)	2.3 (3)
Yb	<0.2	<0.2	<0.4	2 (6)	3.1 (5)
Lu	0.02 (40)	0.07 (40)	<0.04	0.37 (6)	0.52 (4)
Hf	2.7 (20)	2 (28)	2.4 (20)	5 (2)	5.1 (3)
Ta	<0.5	<0.7	<0.6	0.87 (18)	0.65 (19)
W	<4.	<10.	<6.	<0.5	1 (40)
Hg	<1.	<2.	<2.	<0.2	0.34 (20)
Th	<0.2	<0.3	<0.3	7.7 (3)	8.1 (3)
U	<0.8	<0.9	<0.9	1.5 (8)	1.2 (12)

Cl-	53000	19000	75000	-	-
Br-	-	-	-	-	-
NO3-	0	3800	0	-	-
SO42-	0	7300	30000	-	-
Na+	34000	11000	83000	-	-
K+	7500	950	35000	-	-
NH4+	0	0	0	-	-
Ca2+	0	0	0	-	-
Mg2+	0	0	0	-	-
Cel	-	-	-	-	-
Cor	-	-	-	-	-
Ct	-	-	-	-	-

4.3 User's Guide of SUURI-KEIKAKU Air Pollution Analysis System

User's Guide
of
SUURI-KEIKAKU Air-Pollution Analysis System
(SURASH, Limited Version for Jakarta, 1997)

Limited Version for
The Study
on
the Integrated Air Quality Management
for Jakarta Metropolitan Area
in the Republic of Indonesia
of
Japan International Cooperation Agency (JICA),
and
Environmental Impact Management Agency (BAPEDAL)
the Republic of Indonesia

March, 1996
SUURI KEIKAKU CO., LTD.

Contents

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2. Introduction

SYSTEM Requirement:

The SURASH dispersion simulation system has been developed by SUURI-KEIKAKU CO., LTD. (SUR). This system runs under Windows 95 and IBM compatible computer that has at least 16MB memories (recommend 24 MB or more) and 300 MB hard disk (recommend 600 MB or more).

Objects and Method:

The SURASH (SUURI-KEIKAKU Air-Pollution Analysis System) consists of various programs for analyzing meteorology, evaluating the performance of a dispersion model, and calculating concentration distribution of air pollutants. We saw up an easy operation system. Therefore, everyone can use this model fluently without computer knowledge. This model consists of control part, computing and graphic parts. Control and graphic parts are written by Visual Basic, and computing part is written by FORTRAN.

Limitation:

Most basic data of the SURASH are wind observation data and emission source data from various origins. SURASH have pre-determined data format. However, This system has no function to prepare basic data. For this reason, the basic data should be decided according to a user's purpose. For example, there are a lot of methods to estimate emissions from sources. Generally, emission source data on factories are made from the results of a questionnaire survey. The questionnaire items and formats will vary depending on its purpose. Therefore, it is almost impossible to standardize the survey format. For this reason, we did not prepare a program to form basic data. The user should make the necessary data using a editor program.

And more:

This use's guide shows the operation method of SURASH step by step. The user can use it easily with this manual, if he/she is familiar with the operation of Windows 95.

3. Installation

Only two steps are required to install SURASH. That is;

1) Copy "SURASH" folder to the anywhere of your target machine.
2) Open "SYSTEM" folder in the "SURASH" folder, then start "Setup.exe" and follow the instructions.

4. Getting Started

4.1 Overview of procedures

(1)The flow of procedures of this program after you click the starting icon,is as the following figure.

(2)You can select a program module you want to execute from Air Quality Analysis or Dispersion Simulation on Main Menu.

(3)After you select a program module, select a specific function on the sub-menu of the module.

(4)Keep on selecting the setting file for the function with the Dialog Box.

(5)Check configuration of parameter files that are registered in the setting file. If you change any parameter files, make a new setting file to register a new set of parameter files.

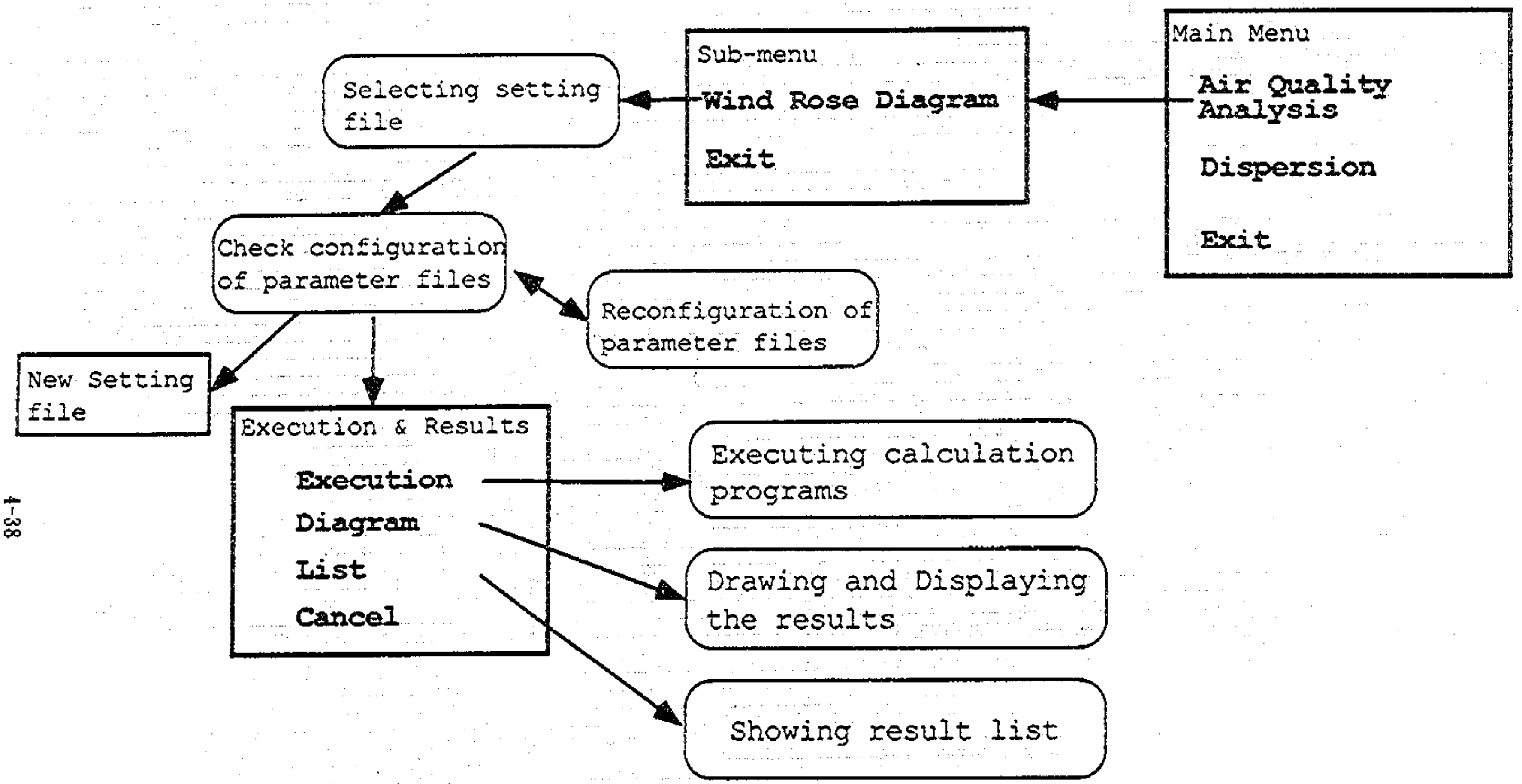
(6)Execute the calculation program(s) and a diagram program.

How to start
Click the icon of **SURASH** in **VB** folder(directory) under the **Sursys** folder of C:drive.

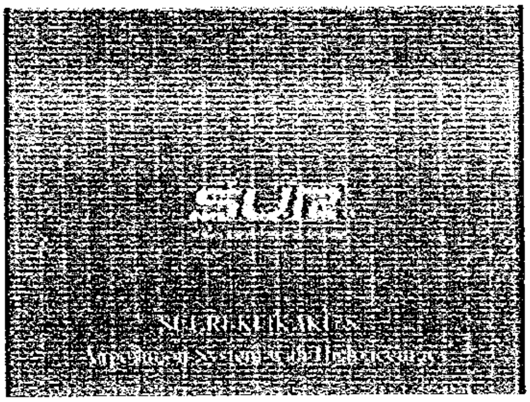
How to end
Click the "END" icon on the "Main Menu".

4.2 Opening the Main Menu

Opening
Click the icon of **SURASH** in **VB** folder. You will see the opening title of **SURASH**.



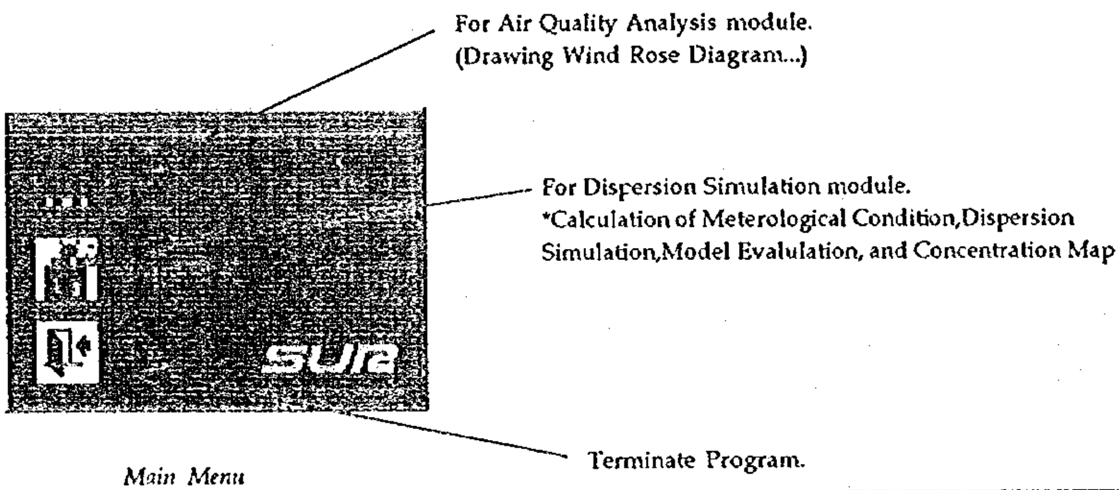
The diagram about procedures of the Air Quality Analysis module



Opening title

Main Menu

Click the icon of this program. Main Menu appears as shown above. To select a function, click one icon of "Air Quality Analysis" or "Dispersion". To close this program, click "Exit" icon.



Main Menu

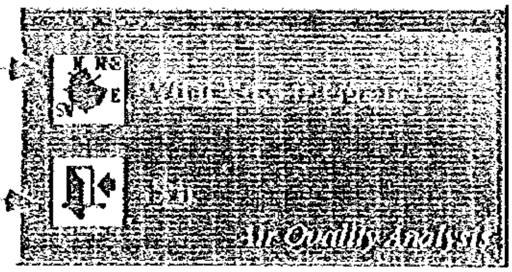
4.3 Air Quality Analysis

Opening the Sub-menu for Air Quality Analysis

To draw "Wind Rose diagrams", click the icon. You will find a dialog box for the parameter file.

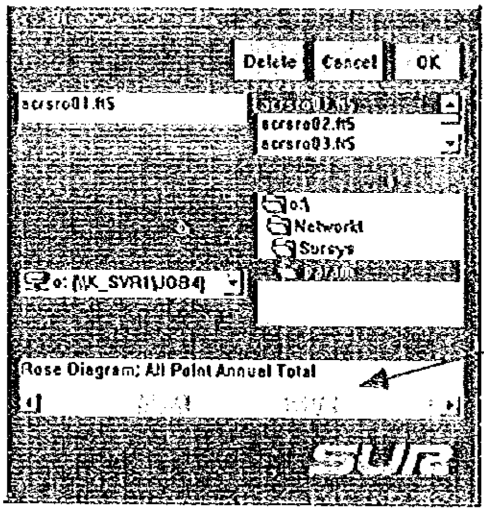
Use Wind Rose module

Close submenu



Air Quality Analysis Submenu

Selecting a parameter file for Air Quality Analysis



Select a setting File

Decide a setting file and press OK button,you will find the configration window for the parameter file.

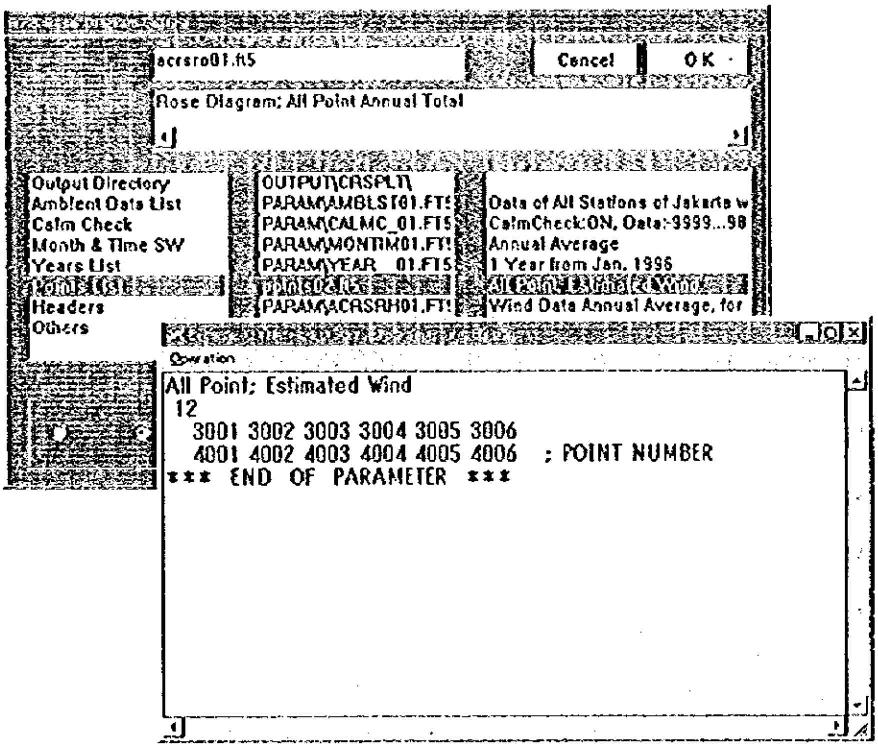
Comment of the setting file that you that is being selected.

Configuration of each parameter files in the setting file

Check each parameter files for procedures that are described in the parameter file you selected.

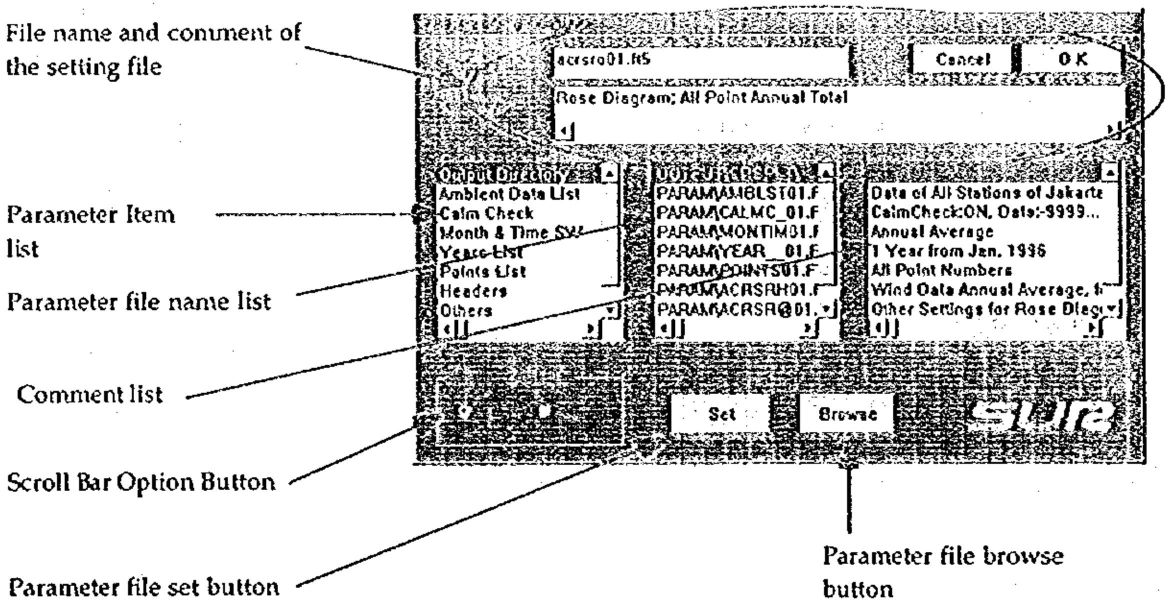
Browse contents of a parameter file

Click "Browse" button of the configuration window. you will see contents of the file you selected on the lists above the button.

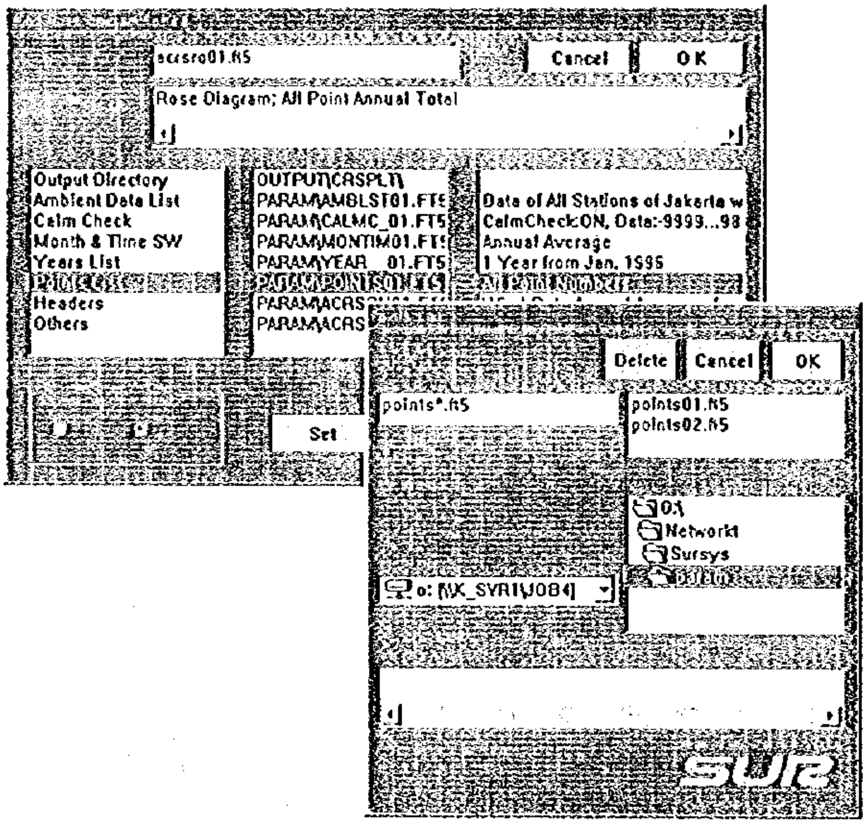


Browse contents of a parameter file

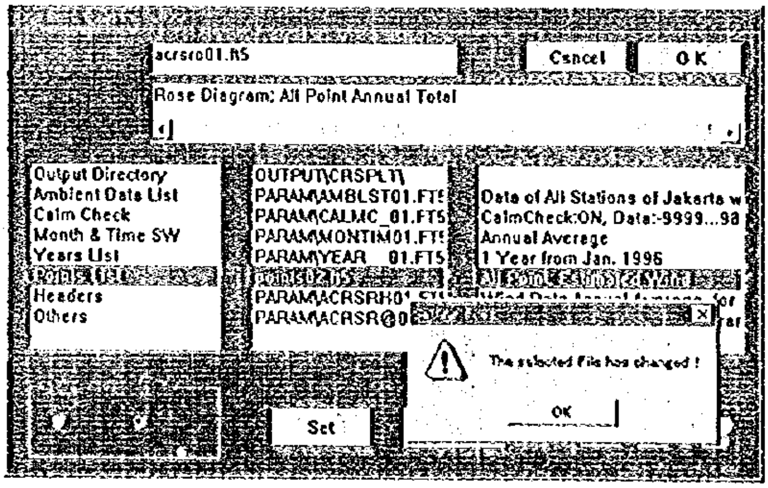
To change one of parameter files in the setting file, select the file and click the "SET" button. You can replace the file to another one using the file dialog box.



Configration window for setting file



Replace a parameter file with another file



Change of a parameter

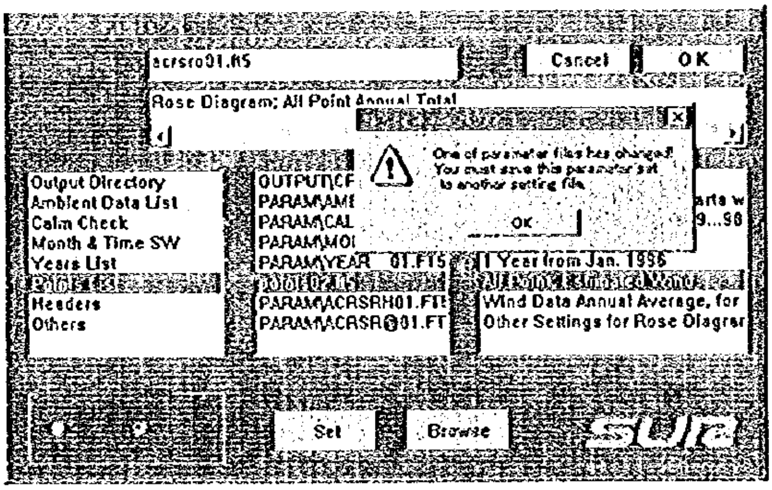
If you change a parameter file, the notifier, that show the change, appears.

Executing Wind Rose Diagram programs

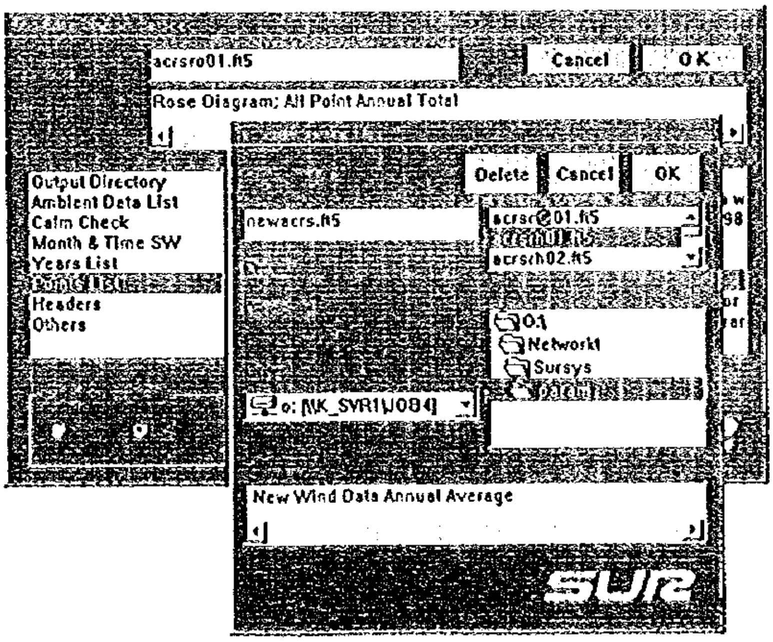
After you confirmed configuration of the setting file, to execute the Wind Rose Diagram program, click "OK" button on the configuration window.

If configuration of the setting file has been changed, the notifier that shows the change appears. Set a new setting file of the configuration with the file dialog box and save it.

If you make the new setting file, the new configuration of setting parameters you set is never saved in this system (Execution of the program is only done with the new configuration).



Confirmation of changing a parameter file



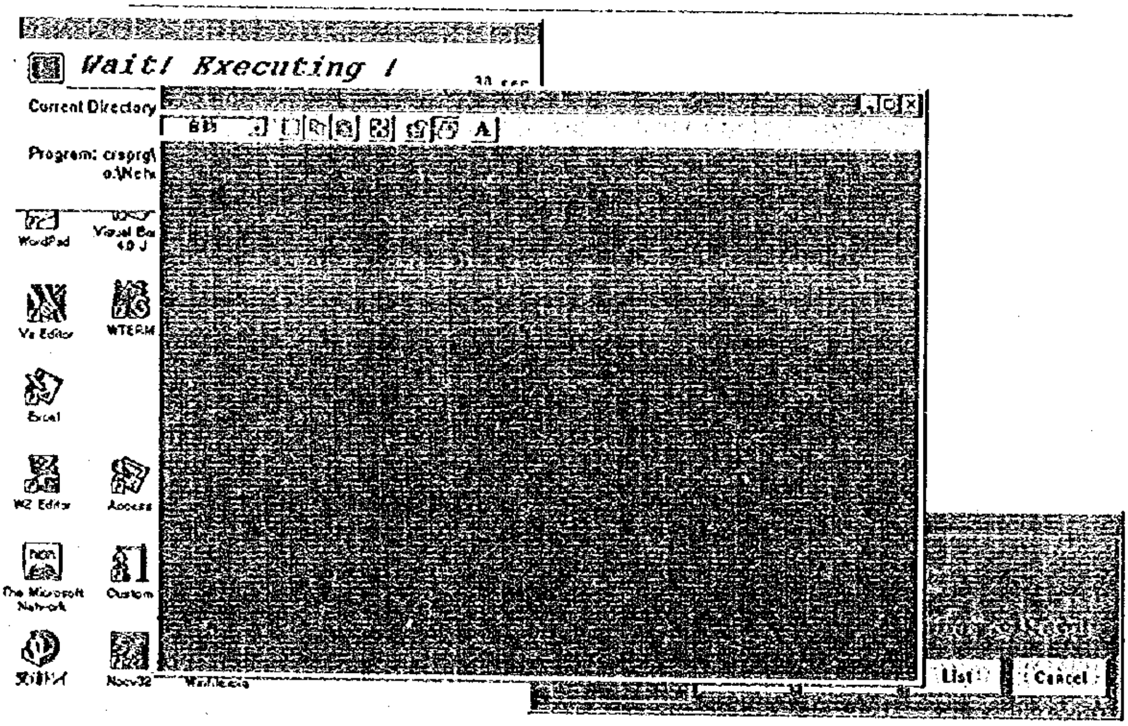
Registration of a new setting file

Execution of the program

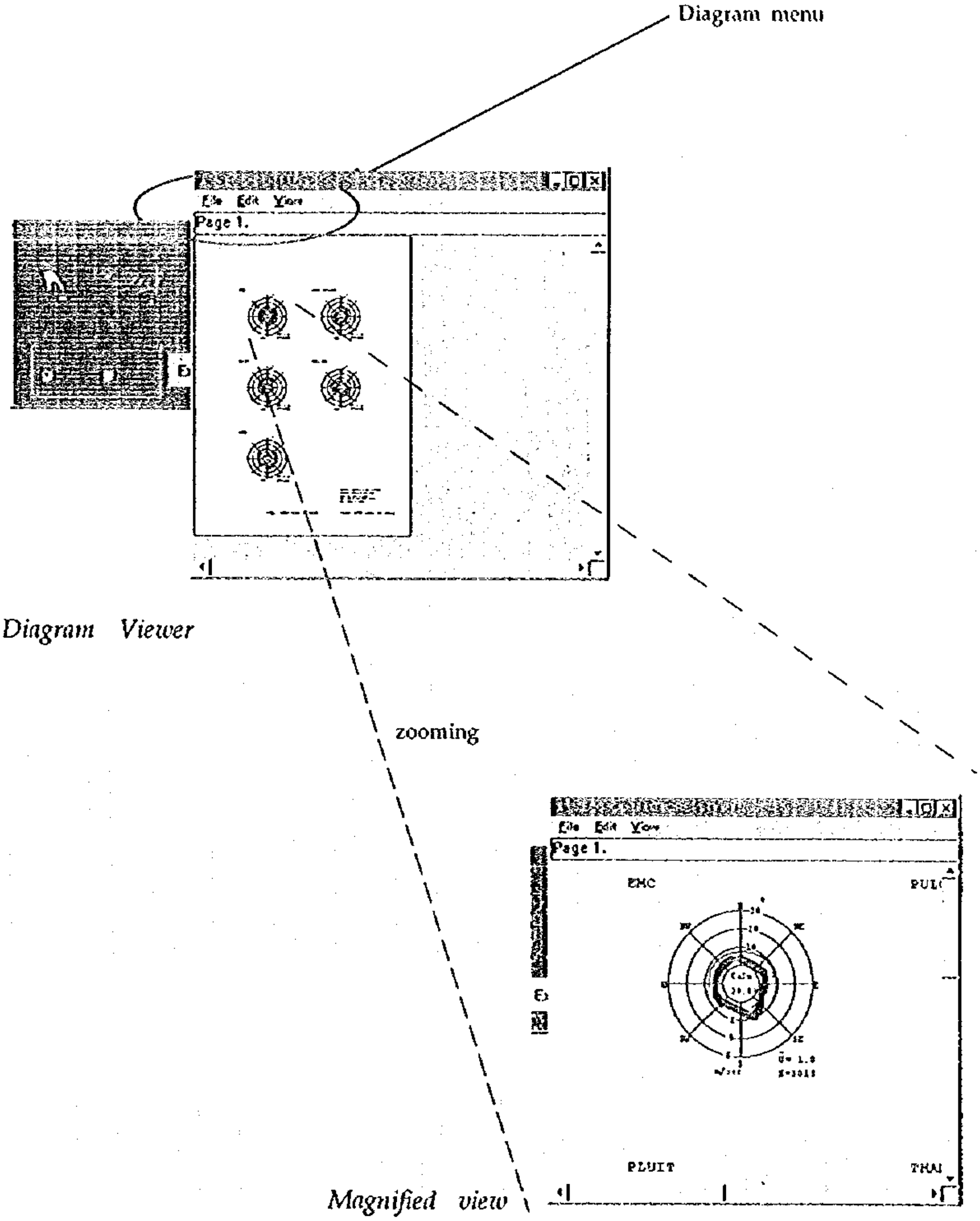
Click "Dialog" button of the Execution & Results window. Diagram Viewer appears. It shows Wind Rose Diagrams as drawing results.

You can change magnification of displaying diagrams on this viewer.

You are able to copy the diagrams as bitmap graphics to other graphic application programs by this viewer. And this Viewer also prints them out.



Execution of calculation programs



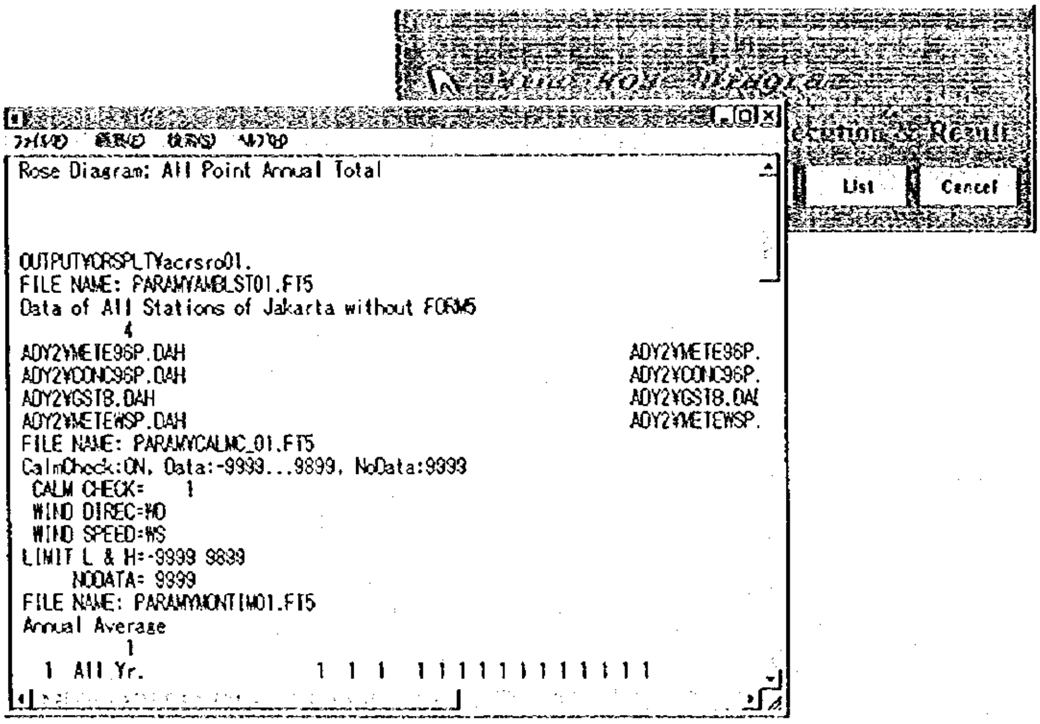
Drawing results (Wind Rose Diagram)

Showing the result list

Click "List" button of the Execution & Results window.   A text editor, for example Microsoft NotePad,   appears.

This editor shows the list as the results of execution.

Microsoft NotePad(notepad.exe) is set as the defalut text editor of the system.



Text Editor for showing result list

4.4 Dispersion Simulation

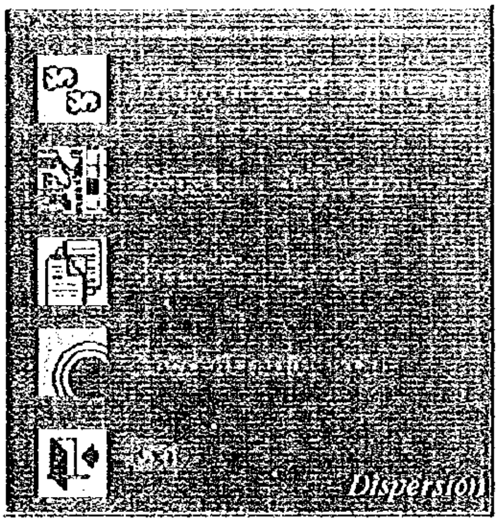
This program module calculates distribution of air pollutant and display the concentration map and so on.

Procedures of this program module is similar to ones of Ambient Analysis module.

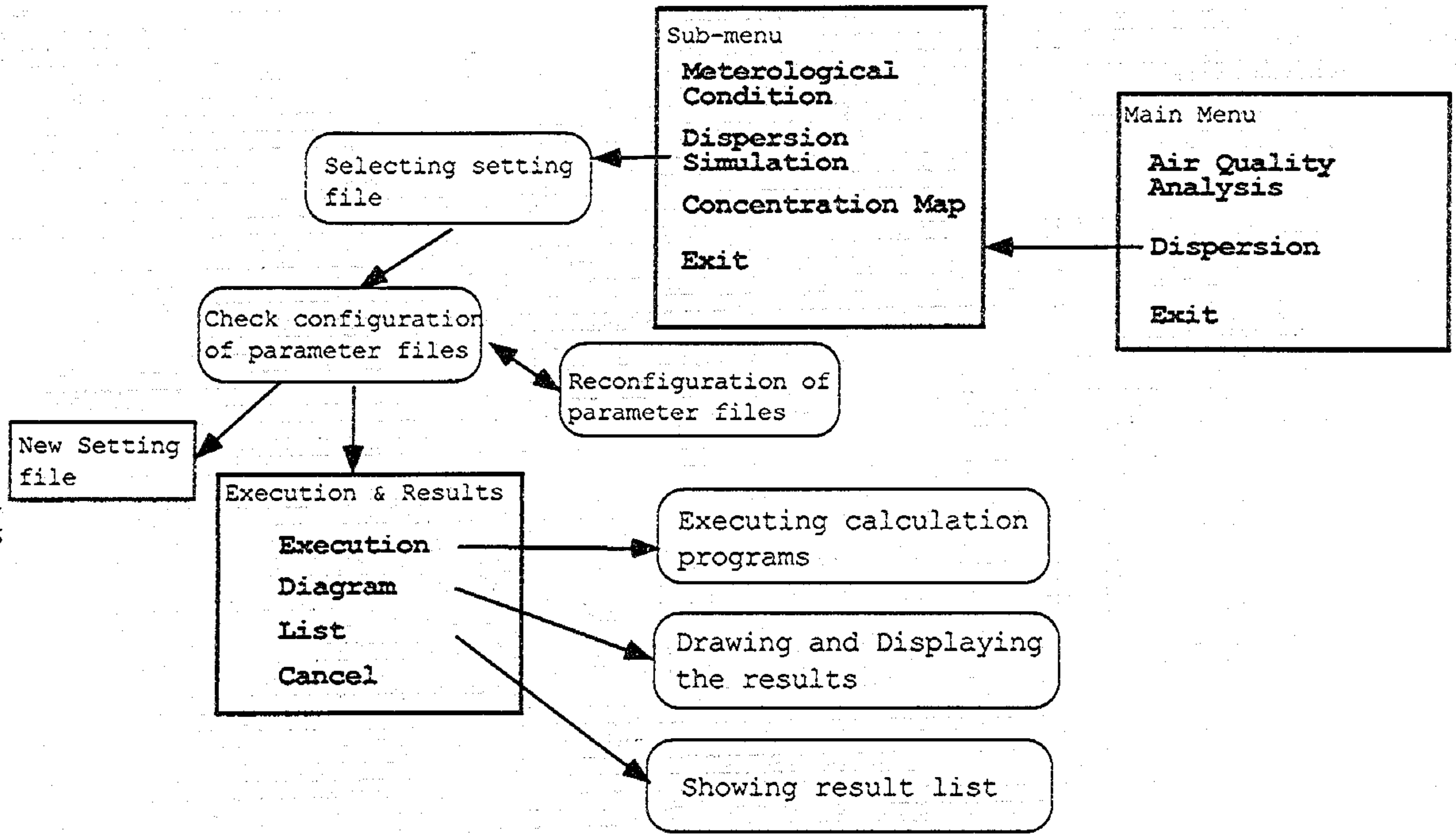
At first, you select the setting file and check the configuration of parameter files. Second, you execute the programs that calculate distribution of air pollutant. Third, you let the program draw the concentration map as the results.

You can select the way to display the results, for example, concentration map, result list, scatter diagram as the model you made, etc.

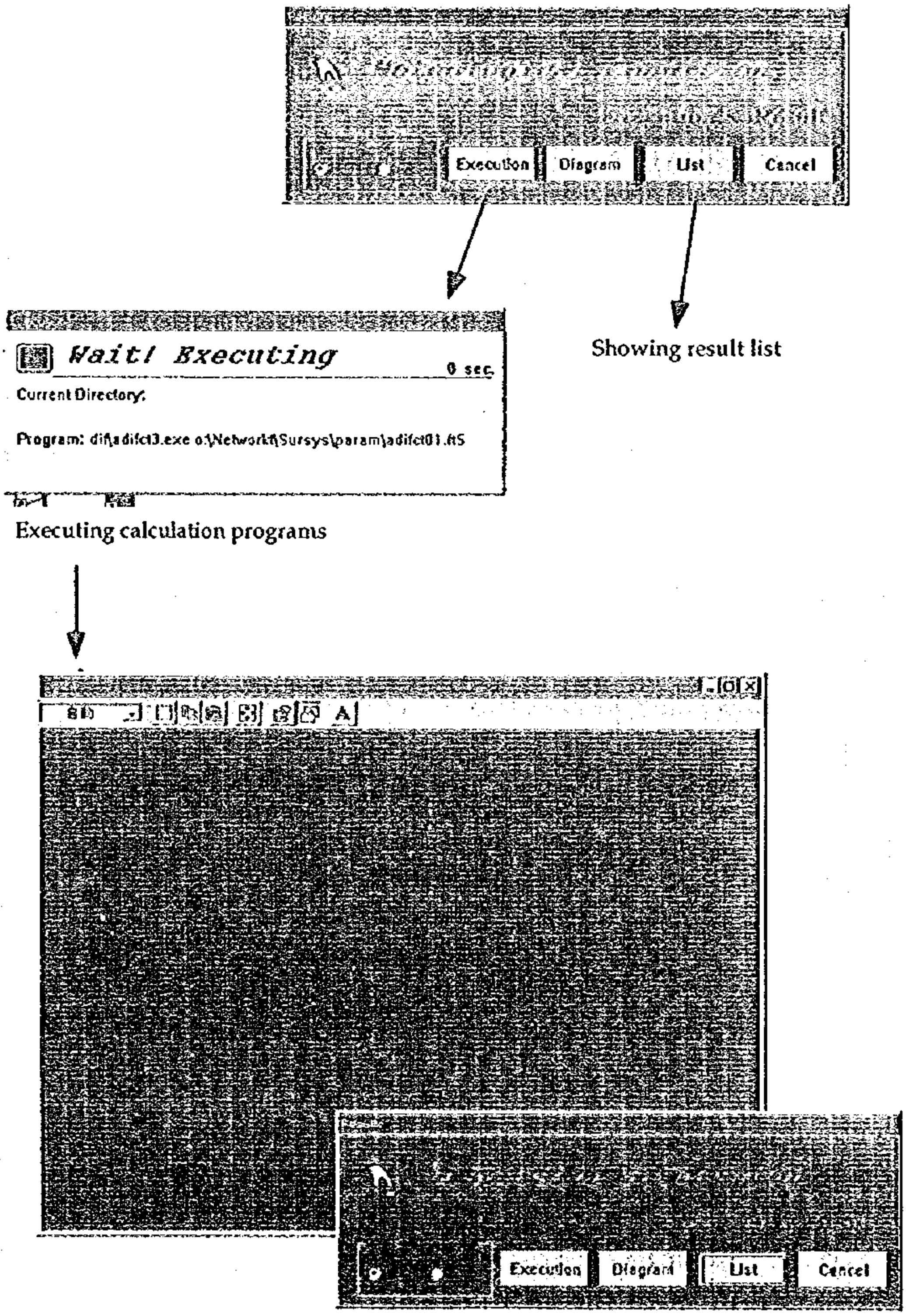
Opening the sub-menu for Dispersion Simulation



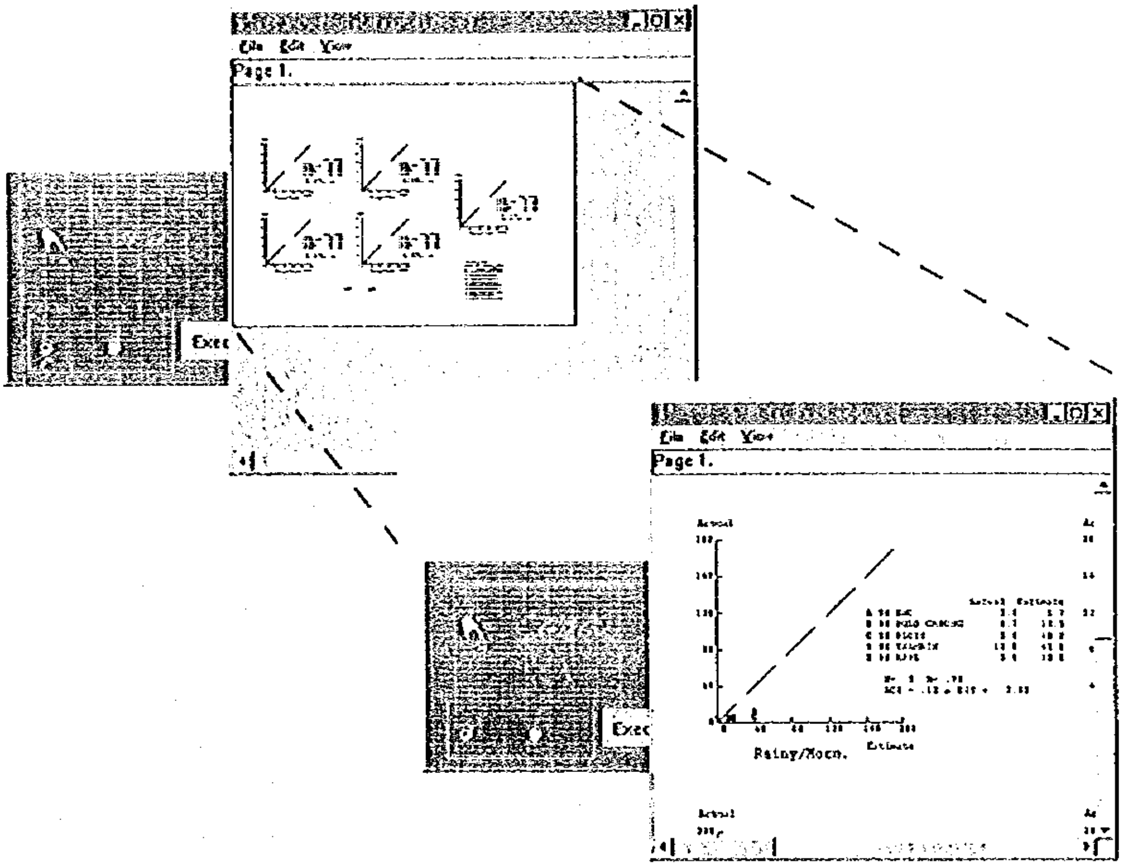
Sub-menu for Dispersion Simulation



The diagram about procedures of the Dispersion Simulation module

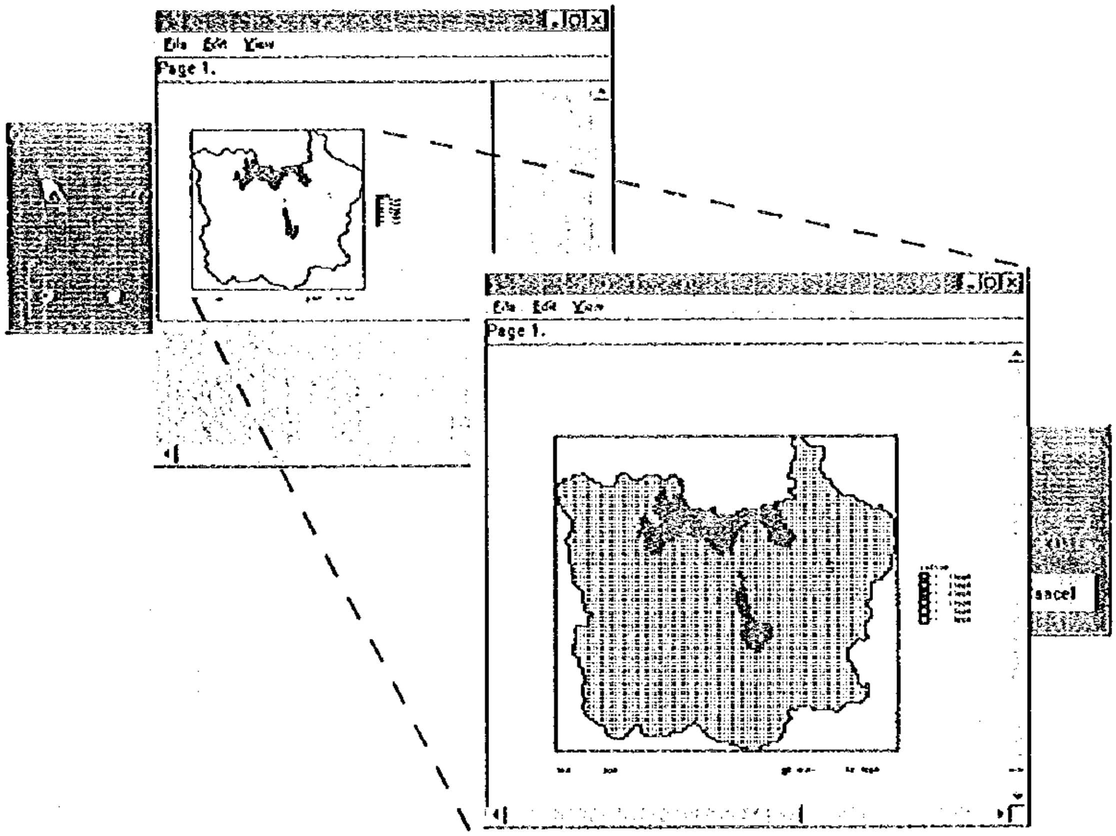


Execution of Meteorological Condition



Model Evaluation by scatter diagrams

Dispersion calculation results can be displaced as a concentration map or as a program list. Verify the model and the actual measured value using scatter diagrams.



Concentration Map

5. Components of SURASH

SURASH's directory structure is described in Section 5.1. Paramter setting files of Air Quality Analysis group is explained in Section 5.2, and those of Dispersion Simulation group are written in Section 5.3.

Sample of each parameter file is shown in Section 5.4.

5. 1. Directory Structures

The programs and other files of the SURASH system are stored as follows;

<SURSYS>	Control programs and its definition files
<ADY2>	Storage of DAM Format files
<CRSPRG>	Programs and their source files for Air Quality Analysis
<DIF>	Programs and their source files for Dispersion
<OUTPUT>	Directory for Outputs
<CRSPLT>	Output of Air Quality Analysis
<DIF>	Output of Dispersion
<PARAM>	Storage of parameter files for analysis
<PLTPRG>	Drawing programs and their source files of Air Quality Analysis
<PS40>	Work Directory for FORTRAN Power Station Compiler
<SOURCE>	Storage of emission data files
<SUBPRG>	Source files of subroutines for FORTRAN components
<SYSTEM>	System DLLs for the control part
<VB>	Source codes of the control part
<VEC3>	Draw data viewer and its source files

5. 2. Air Quality Analysis

(1) Wind Rose Diagram

This component draws wind rose diagrams by using the hourly data in DAM Format.

The parameter files for this component are as shown in Table 5.1.

A Sample output is shown in Fig. 5.1.

Table 5.1 Parameter Files for Wind Rose Diagram

Parameter	Purpose	Default File Type
Output Directory	Definition of directory for output files	output\crsplt\
Ambient Data List	To select the hourly data files in DAM Format	param\amblst*.ft5
Calm Check	Definition for calm checking of wind data.	param\calmc*.ft5
Month & Time SW	Definition of season and time zone	param\montim*.ft5
Years List	Definition of year	param\year__*.ft5
Points List	Definition of points	param\points*.ft5
Headers	Definition of headers for output	param\acrsrh*.ft5
Others	Other definitions	param\acrsr@*.ft5

5. 3. Dispersion Simulation

(1) Meteorological Condition

This component converts the hourly meteorological data in DAM Format to input data of dispersion simulation program.

The parameter files for this component are as shown in Table 5.2.

Table 5.2 Parameter Files for Meteorological Condition

Parameter	Purpose	Default File Type
Output Directory	Definition of directory for output files	output\dif\
Ambient Data List	To select the hourly data files in DAM Format	param\amblst*.ft5
Calm Check	Definition for calm checking of wind data.	param\calmc*.ft5
Month & Time SW	Definition of season and time zone	param\montim*.ft5
Years List	Definition of year	param\year__*.ft5
Points List	Definition of points	param\points*.ft5
WD Rank List	Definition of wind direction classification	param\wdrank*.ft5
WS Rank List	Definition of wind speed classification	param\wsrank*.ft5
STAB Rank List	Definition of stability classification	param\strank*.ft5
Others	Other definitions	param\adifc_*.ft5

(2) Dispersion Simulation

This component is the main program of SURASH, simulate the dispersion of air pollutants.

The parameter files for this component are as shown in Table 5.3.

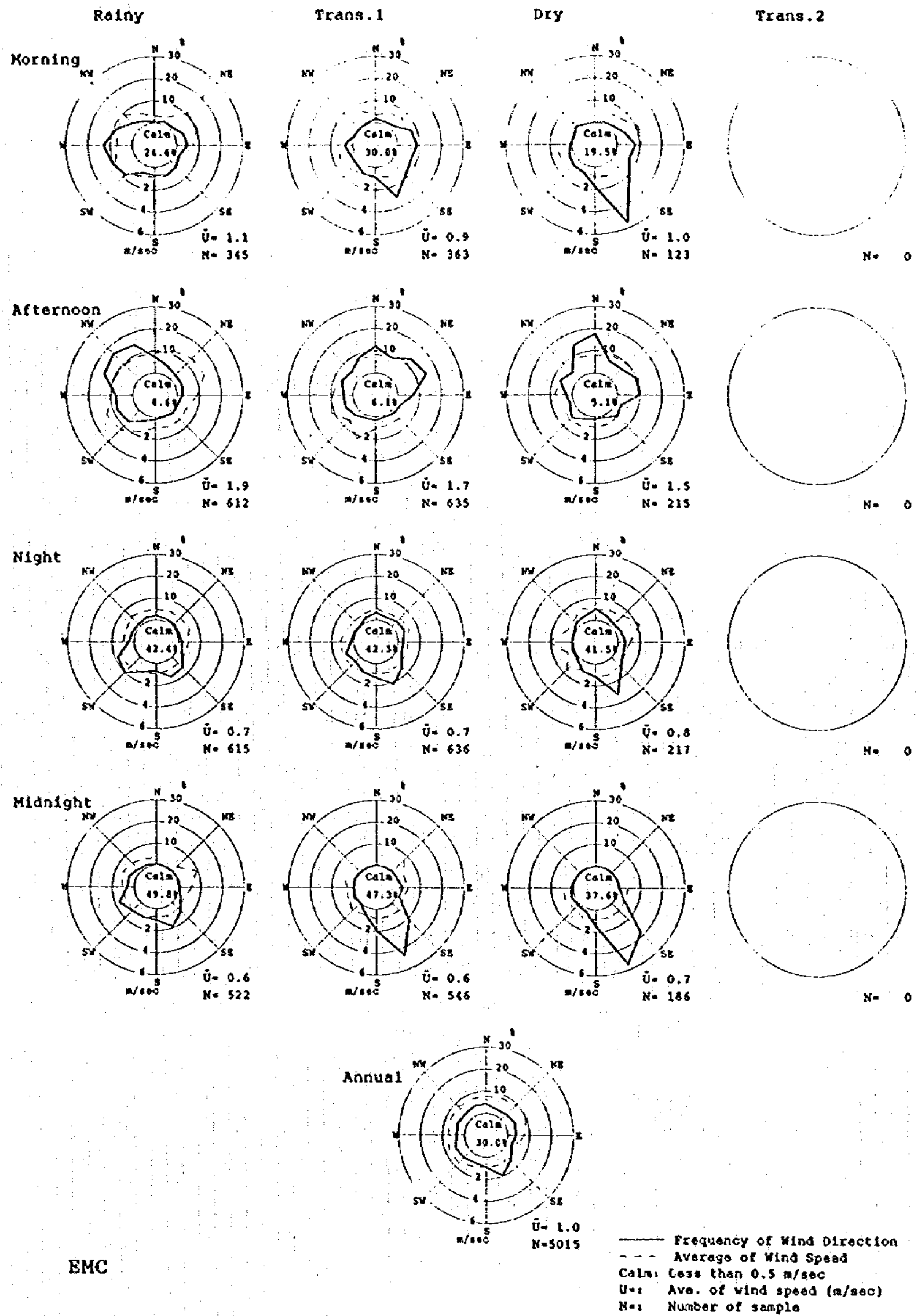


Fig. 5.1 Sample output of Wind Rose Diagram function

Table 5.3 Parameter Files for Dispersion Simulation

Parameter	Purpose	Default File Type
Output Directory	Definition of directory for output files	output\dif\
Source File List	Definition of emission data file to use	param\src__*.ft5
Meteorological Condition	Definition of Meteorological Condition output file to use	param\wgt__*.ft5
Cal. Points List	Definition of points to calculate	param\pnt__*.ft5
Met. Points List	Definition of Meteorological Condition data to use	param\met__*.ft5
Constants Table	Constants for Dispersion Simulation Model	param\cnst_*.ft5
Others	Other Definitions	param\prt__*.ft5

(3) Model Evaluation

This component is to evaluate the simulation model, by comparing the simulation result with the monitoring data.

The parameter files for this component are as shown in Table 5.4.

A Sample output is shown in Fig. 5.2.

Table 5.4 Parameter Files for Model Evaluation

Parameter	Purpose	Default File Type
Output Directory	Definition of directory for output files	output\dif\
Ambient Data List	To select the hourly data files in DAM Format	param\amblst*.ft5
Calm Check	Definition for calm checking of wind data.	param\calmc*.ft5
Month & Time SW	Definition of season and time zone	param\montim*.ft5
Years List	Definition of year	param\year__*.ft5
Pollutants List	Definition of pollutants	param\qcodes*.ft5
Points List	Definition of points	param\points*.ft5
Dispersion Case List	Select the parameter setting file of Dispersion Simulation to evaluate	param\difs_*.ft5
Headers	Definition of headers for output	param\difsh_*.ft5

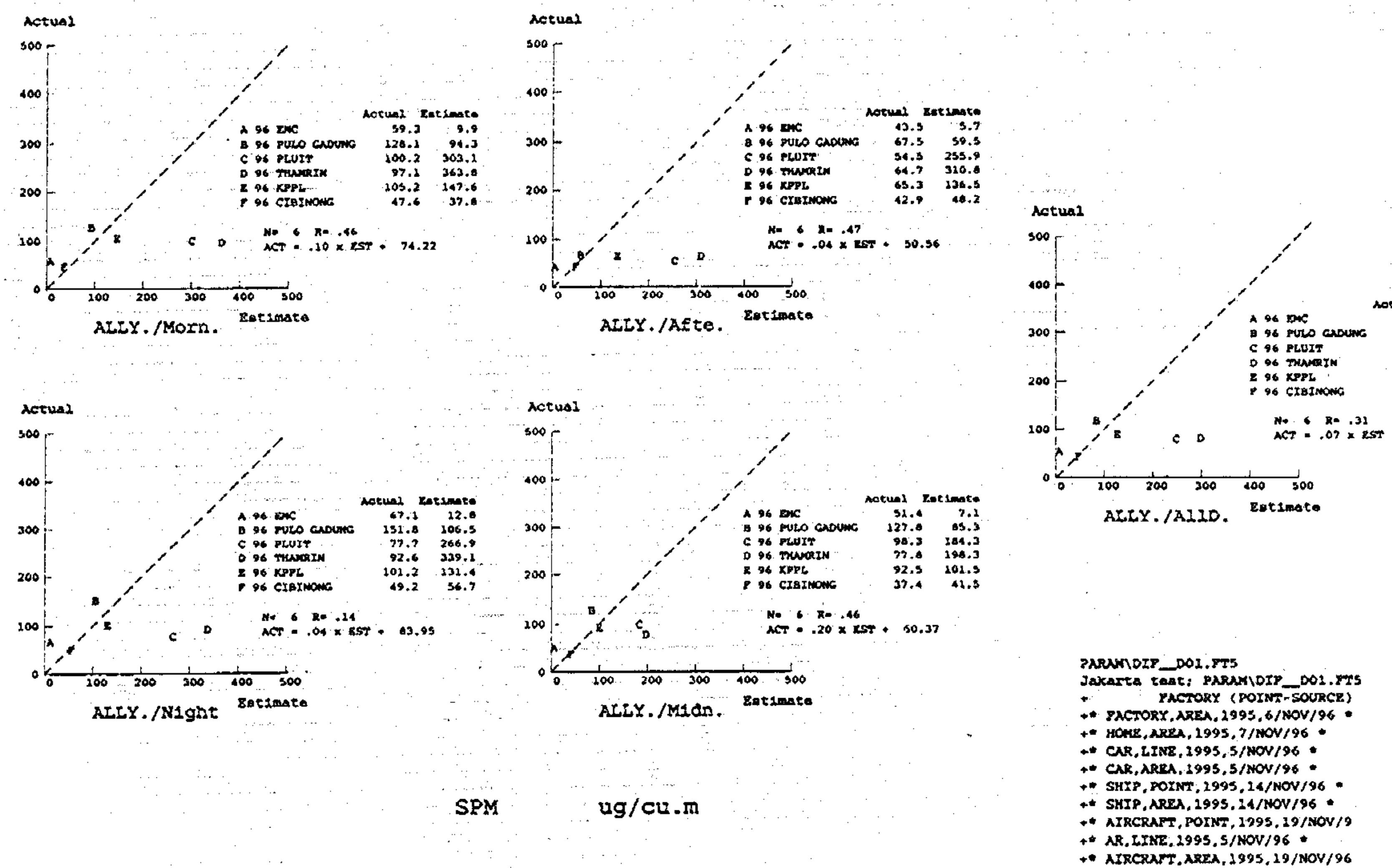


Fig. 5.2 Sample output of Model Evaluation function

(4) Concentration Map

This component is to draw the distribution of pollutants' concentration.

Notice: Be careful to select parameter setting file of dispersion for grid calculation.

The parameter files for this component are as shown in Table 5.5.

A Sample output is shown in Fig. 5.3.

Table 5.5 Parameter Files for Concentration Map

Parameter	Purpose	Default File Type
Output Directory	Definition of directory for output files	output\dif\
Diffusion Output List	To select the hourly data files in DAM Format	param\cout_*.ft5
Ranking for Hatching	Pattern definition file for each concentration rank.	param\rnk_*.ft5
Headers	Definition of headers for output	param\cmaph*.ft5
Map Information	Information for Map Display	param\map_*.ft5

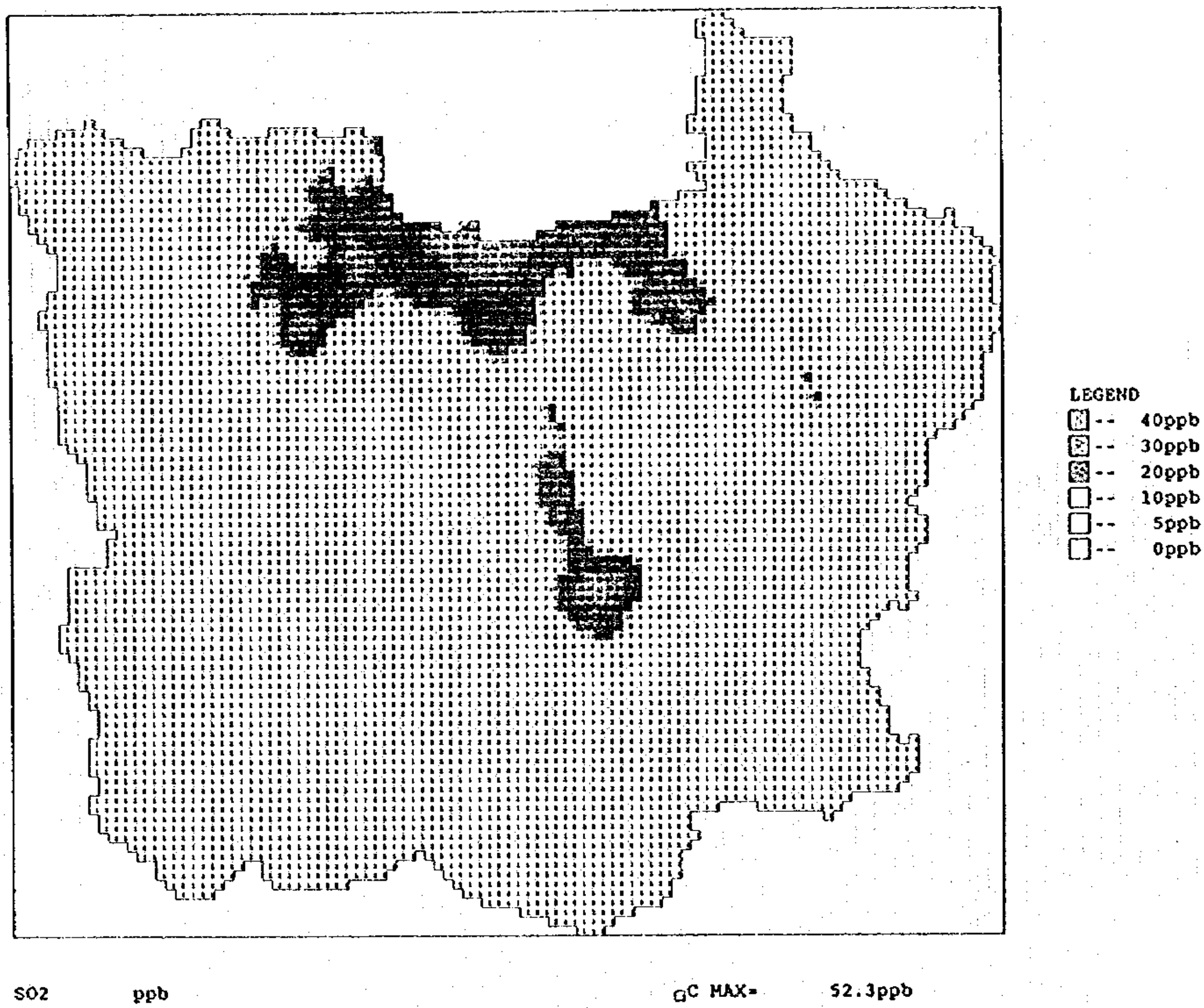


Fig. 5.3 Sample output of Concentration Map function

5. 4. Smaples of Parameter Files

(1) Ambient Data List

To select the hourly data files in DAM Format.

Sample: param\amblst01.ft5

```
Data of All Stations of Jakarta without FORM5
4            : ALL DAM FILES
'ADY2\METE96P.DAH'              'ADY2\METE96P.DAD'
'ADY2\CONC96P.DAH' 'ADY2\CONC96P.DAD'
'ADY2\GSTB.DAH'                 'ADY2\GSTB.DAD'
'ADY2\METEWSP.DAH''ADY2\METEWSP.DAD'
*** END OF PARAMETER ***
```

(2) Calm Check

Definition for calm checking of wind data.

Sample: param\calmc_01.ft5.

```
CalmCheck:ON, Data:-9999...9899, NoData:9999
  1              ; 1 : CLAM CHECK ON
 'WD'  'WS'      ; Code for Wind Direction & Speed
 -9999  9899     ; DATA LIMIT LOW & HIGH
  9999           ; NO-DATA
*** END OF PARAMETER ***
```

(3) Cal. Points List

Definition of points to calculate.

Sample: param\pnt__d01.ft5.

```
Jakarta Monitoring Station
'MOVE C.P.'  0
'MESH CAL.'  0
  40000.00,  25000.00, 104,  97,  1000.,  1000.,  1.5,
'RECEPTOR' 6
   1 'EMC           '  74609.9   72115.8   2.2
   2 'PULO GADUNG     '  102017.35  88662.1  3.0
   3 'PLUIT         '  88758.3   97758.7   3.0
   4 'THAMRIN        '  91567.3   89761.2   5.0
   5 'KPPL          '  92791.6   86288.9   8.5
   6 'CIBINONG       '  100690.2   60718.2   3.0
 97:00000000000000000000000000000000000000000000000000000000000000000000000000110000000000000000000000000000
 96:00000000000000000000000000000000000000000000000000000000000000000000000001111000000000000000000000000000
 95:00000000000000000000000000000000000000000000000000000000000000000000000000111110000000000000000000000000
 94:00000000000000000000000000000000000000000000000000000000000000000000000000111111111000000000000000000000
 93:00000000000000000000000000000000000000000000000000000000000000000000000000111111111000000000000000000000
 92:00000000000000000000000000000000000000000000000000000000000000000000000000111111111000000000000000000000
 91:00000000000000000000000000000000000000000000000000000000000000000000000000111111111000000000000000000000
 90:00000000000000000000000000000000000000000000000000000000000000000000000001111111110000000000000000000000
*Rest are omitted.
```

(4) Constants Table

Constants for Dispersion Simulation Model

Sample: param\cnst_d01.ft5.

```
Constants Jakarta Model 96/11/15

'Q-ITEMS'  5 2
   'SO2    ppb  ''NOx    ppb  '
   'CO     ppb  ''SPM    ug/cu.m''NO2    ppb  '
```

```
'Area Turbo ' 1

'Stack Group'   10
'SOURCES'    1   1   1   1   1   1   1   1   1   1
'Cal. Dist'  99.  99.  99.  99.  99.  99.  99.  99.  99.  99.
'HE-CAL.OPT'  3   1   1   1   1   3   1   1   1   1
'HE-CALM+ '  0.  0.  0.  5.  0.  0.  0.  0.  0.  0.
'SigZ0/Line'  0.  0.  0.  1.0  0.  0.  0.  0.  0.  0.
'W.BLOCK Z'  0   0   0   1   1   0   0   0   0   0
'Alfa /NO2'  0.83  0.83  0.83  0.80  0.83  0.83  0.83  0.83  0.80  0.83
*Rest are omitted.
```

(5) Dispersion Case List

Select the parameter settinf file of Dispersion Simulation to evaluation.

Sample: param\difs_d01.ft5.

```
All Stacks: 96/11/20 Model
        8 'SO2' 'NOx' 'NO2' 'NO ' 'CO ' 'SPM' 'NO2T' 'NO_T'
1
PARAM\DIF__D01.FT5
        1   1   1   1   1   1   1   1
 1 '+' 0    0
```

(6) Diffusion Output List

To select the hourly data files in DAM Format

Sample: param\cout_d02.ft5.

```
Hatching map; test case Factory P Only; param\cout_d02.ft5
Factory P, test-1 (96/11/20)
OUTPUT\DIF\DIF__D02.IDX  + 11 1 0 0 0 0 0 0 0 0 0 0     0
END

Factory A, test-1 (96/11/20)
OUTPUT\DIF\DIF__D02.IDX  + 11 0 1 0 0 0 0 0 0 0 0 0     0
END

Total   , test-1 (96/11/20)
OUTPUT\DIF\DIF__D02.IDX  + 11 1 1 1 1 1 1 1 1 1 1 1     0
END
```

(7) Headers

Definition of headers for output. Select file depending on program to be used. The following is a sample for a concentration map program.

Sample: param\cmaphd01.ft5.

```
Headers for Hatching; PARAM\CMAPHD01.FT5
'A4LAND'
1
 16.  8. 0.3 'LEGEND'
3
  3.  2. 0.3 'Q-NAME'
 13.  2. 0.3 'C-MAX'
  9.  2. 0.3 'AAA'

1
  3. 3.

 15. 0. 0.
```

(8) Map Information

Information for Map Display.

Sample: param\map_d01.ft5.

```
for Map Drawing; PARAM\MAP__D01.FT5
40000. 25000.
 104   94
```

(9) Met. Points List

Definition of Meteorological Condition data to use.

Sample: param\met__d01.ft5.

```
Weather Block 96/11/20
'W BLOCK' 1 3001
'W BLOCK' 1   1
'W BLOCK' 1 4001
```

(10) Meteorological Condition

Definition of Meteorological Condition output file to use.

Sample: param\wgt__d01.ft5.

```
Dummy Meteorological Data for Program Check 96/11/15
1
OUTPUT\DIF\ADIFCTD1.MDT
*** END OF PARAMETER ***
```

(11) Month & Time SW

Definition of season and time zone.

Sample: param\montim01.ft5.

```
Annual Average
1        : NK : All Year
'All Yr.' 1 1 1 1 1 1 1 1 1 1 1 1
1        : NJ : All Day
'All Dy.' 1   1 12 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1        : NKJ: Combinations of Season/TimeZone
  1  1
*** END OF PARAMETER ***
```

(12) Points List

Definition of points.

Sample: param\points01.ft5.

```
All Point Numbers
 6
    1  2  3  4  5  6  ; POINT NUMBER
*** END OF PARAMETER ***
```

(13) Pollutants List

Definition of pollutants.

Sample: param\qcodes01.ft5.

```
All Pollutant Parameters
 6
'SO2'
'NO '
'NO2'
'NOX'
'CO '
'SPM'
*** END OF PARAMETER ***
```

(14) Ranking for Hatching

Pattern definition file for each concentration rank.

Sample: param\rnk_d01.ft5.

```
Ranking & Hatching Data Ver1: Jakarta
6  7  -1  -1 993 663 666 939 900
'SO2'  0.  5.  10.  20.  30.  40.  50.
'NOx'  0.  5.  10.  20.  30.  40.  50.
'CO '  0.  5.  10.  20.  30.  40.  50.
'SPM'  0.  5.  10.  20.  30.  40.  50.
'NO2'  0.  5.  10.  20.  30.  40.  50.
'NO '  0.  5.  10.  20.  30.  40.  50.
```

(15) Source File List

Definition of emission data file to use.

Sample: param\src__d01.ft5.

```
Stack for Program Check 96/11/15
10
SOURCE\FACP95.STK
SOURCE\FARA95.STK
SOURCE\HARA95.STK
SOURCE\CARL95.STK
SOURCE\CARA95.STK
SOURCE\SPNT95.STK
SOURCE\SARA95.STK
SOURCE\AIRP95.STK
SOURCE\AIRL95.STK
SOURCE\AIRA95.STK
*** END OF PARAMETER ***
```

(16) WD Rank List, WS Rank List, STAB Rank List

Definition of wind direction classification.

Sample: param\wdrank01.ft5.

```
Wind Direction Rank for Weather Weight
'WD'
17 17
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
'  N' 'NNE' ' NE' 'ENE' '  E' 'ESE' ' SE' 'SSE' '  S'
'SSW' ' SW' 'WSW' '  W' 'WNW' ' NW' 'NNW' '  C'
```

Definition of wind speed classification.

Sample: param\wsrank01.ft5.

```
Wind Speed Rank for Weather Weight
```

```
'WS'
8 0
4 9 19 29 39 59 79 999
'  -0.4M/S' '0.5-0.9M/S' '1.0-1.9M/S' '2.0-2.9M/S'
'3.0-3.9M/S' '4.0-5.9M/S' '6.0-7.9M/S' '8.0M/S-'
```

Definition of stability classification.

Sample: param\strank01.ft5.

```
Stability Rank for Weather Weight
'SSTB'
11 11
1 2 3 4 5 6 7 8 9 10 11
 ' A' ' AB' ' B' ' BC' ' C' ' CD' ' dD' ' nD' ' E' ' F' ' G'
```

(17) Years List

Definition of year.

Sample: param\year__01.ft5.

```
1 Year from Jan. 1996
1 1  1996            ; MONTH OF START, NUMBER OF YEARS, YEARS
*** END OF PARAMETER ***
```

6. Appendix

6. 1. Data File Format

(1) Emission Data File Format

All emission data should be made as a text file in the format as shown in Table 6.1.

Table 6.1 Emission Data Format

Block No.	Record No	Category No	Type & Length*	Data Name	Comment
1	1	1	A40	FNAME	Remark of file
2	1	1	I3	NSK	Number of source kind
2	2 ~ NSK+1	1	I3	NJSO	Source number
2	2 ~ NSK+1	2	A30	SNAME	Remark of each source type
3	1	1	I3	ISO	Type of emission 1:Point source 2:Line source 3:Area source
3	1	2	I3	JSO	Source type code**
3	1	3	I8	ICODE	Source code
3	1	4	F10.2	X XS X	Point of x-axis (m) (P***) Start point of x-axis (m) (L***) Center point of x-axis (m) (A***)
3	1	5	F10.2	Y YS Y	Point of y-axis (m) (P***) Start point of y-axis (m) (L***) Center point of y-axis (m) (A***)
3	1	6	F10.2	H0 HE HE	Height of stack (m) (P***) Effective height at windy case (m) (L***) Effective height at windy case (m) (A***)
3	1	7	F10.2	DIA XE	Diameter of stack (m) (P***) End point of x-axis (m) (L***) Dummy (A***)
3	1	8	F10.2	TEMP YE	Temperature of stack gas (°C) (P***) End point of y-axis (m) (L***) Dummy (A***)
3	1	9	F10.2	HGAS BRE	Quantity of stack gases (m^3N/h)(P***) Width of road (m) (L***) Dummy (A***)
3	1	9	A40	NAME	Remark of each source

(To be continued)

Table 6.1 Emission Data Format (Cont.)

Block No.	Record No	Category No	Type & Length*	Data Name	Comment
3	2	1 ~ N	NxE10.4	SO2(i,j)	SO2 emission (m^3N/h)****
3	3	1 ~ N	NxE10.4	NOx(i,j)	NOx emission (m^3N/h)****
3	4	1 ~ N	NxE10.4	CO(i,j)	CO emission (m^3N/h)****
3	5	1 ~ N	NxE10.4	SPM(i,j)	SPM emission (kg/h)****

Note: Type & Length is shown as FORMAT Style of FORTRAN.
**1: Point Sources of Factories, 2: Area Sources of Factories,
3: Area Sourece of Households, 4: Line Sources of Vehicles,
5: Area Sources of Vehicles, 6: Point Sources of Ships,
7: Area Sources of Ships, 8: Point Sources of Air Planes,
9: Line Sources of Air Planes, 10: Area Sources of Air Planes.
*** P: Point Source, L: Line Source, A: Area Source
****I: Time Zone Suffix, j: Season Suffix, N: Number of Time Zone x Number of Season

6. 2. Contacting SUURI-KEIKAKU Co., Ltd.

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Address: Department of Environmental Studies, Suuri Keikaku Co., Ltd., 101, Tokyo, Chiyoda-ku, Kanda Jimbocho, 2-30, JAPAN
Phone: (+81) 3-3288-6060

Appendix 5

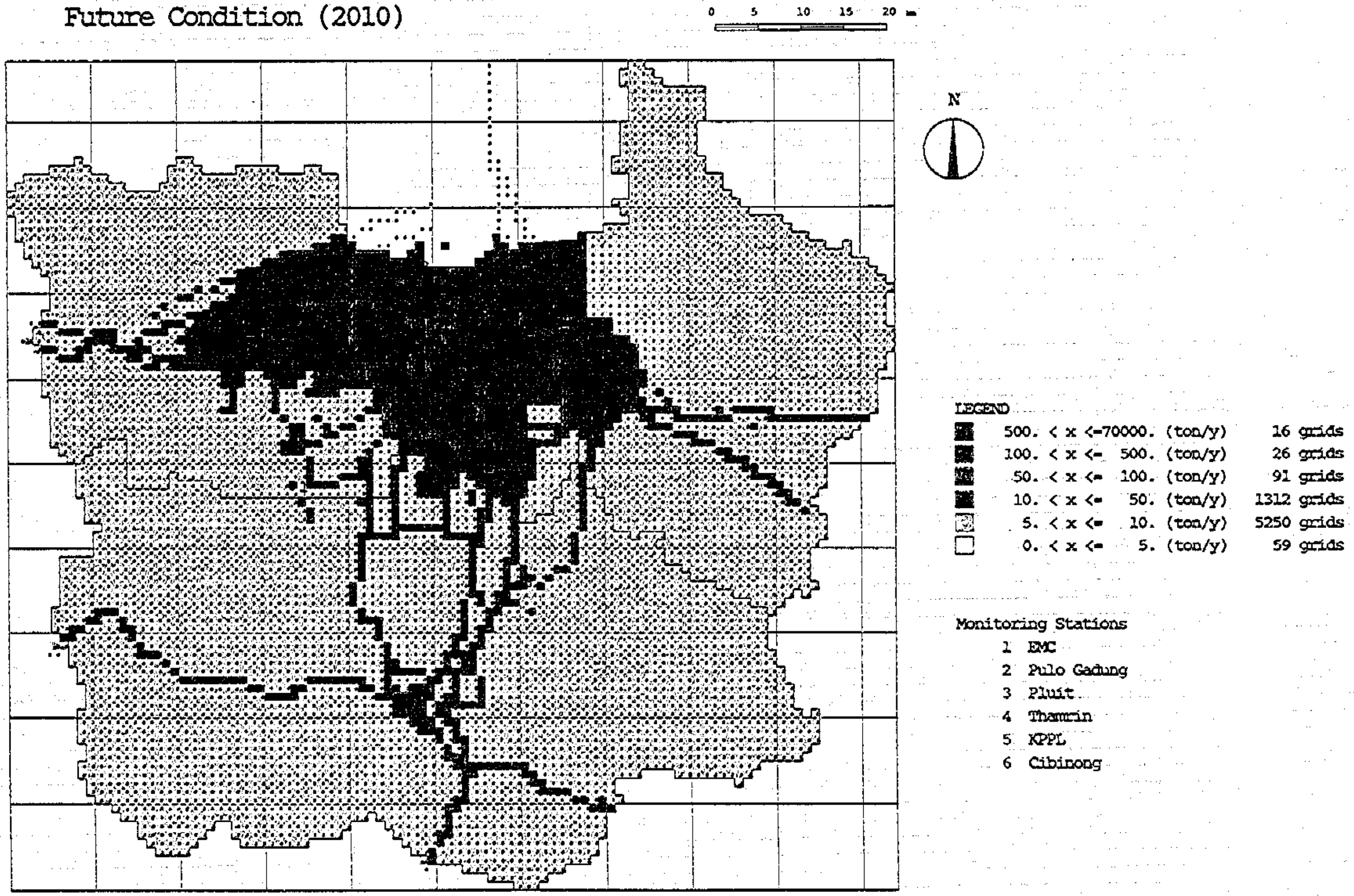
ESTIMATE OF FUTURE AIR QUALITY WITHOUT CONTERMEASURES

5.1 Simulation of Air Quality without Countermeasures in 2010

Appendix 5.1 Simulation of Air Quality without Countermeasures in 2010

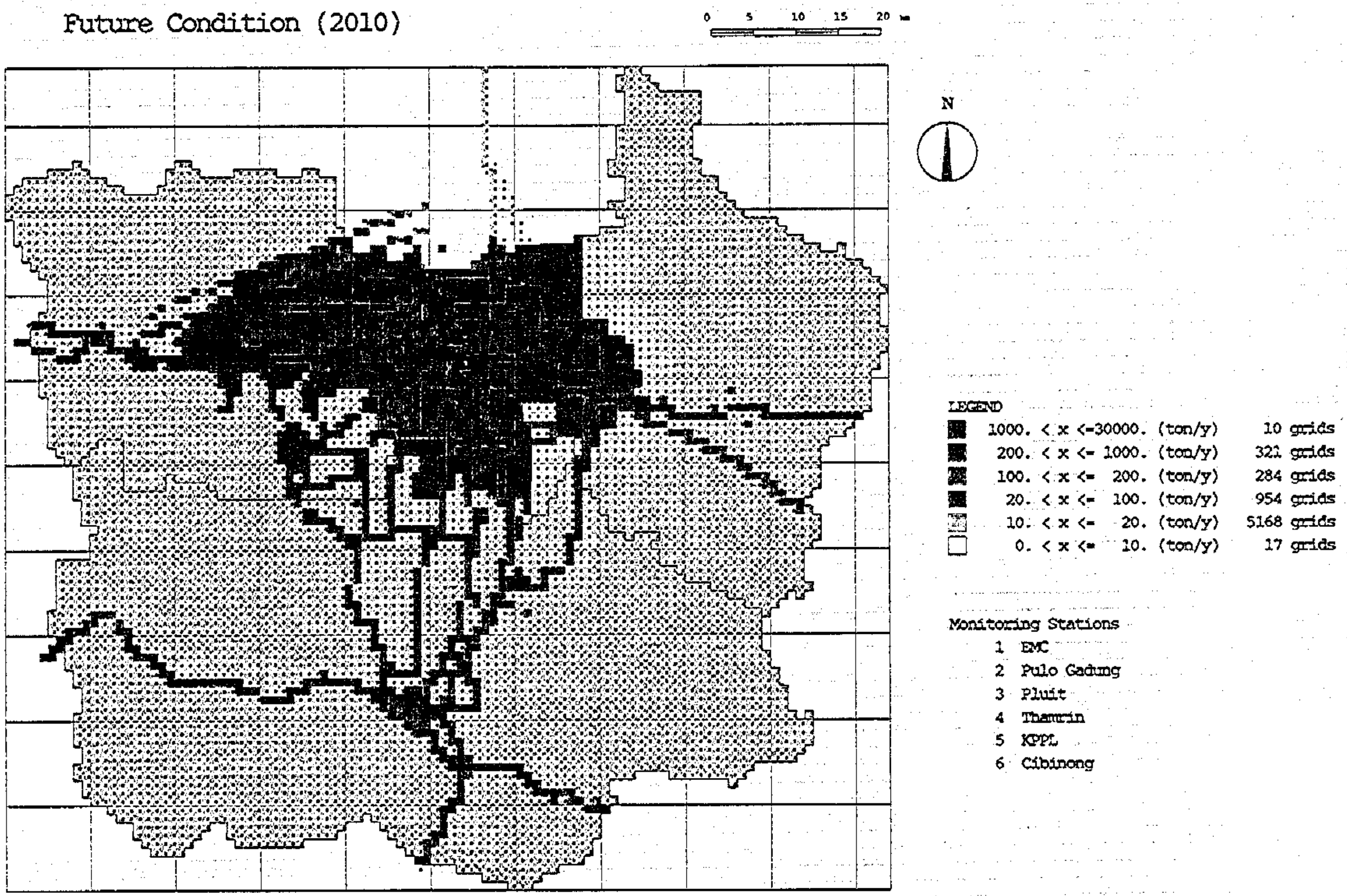
5.1.1 Pollutant Emission Map of SO_x and NO_x in 2010

Future Condition (2010)



SOx 1000ton/y Pollutant Emissions Q MAX= 65209.5ton/y

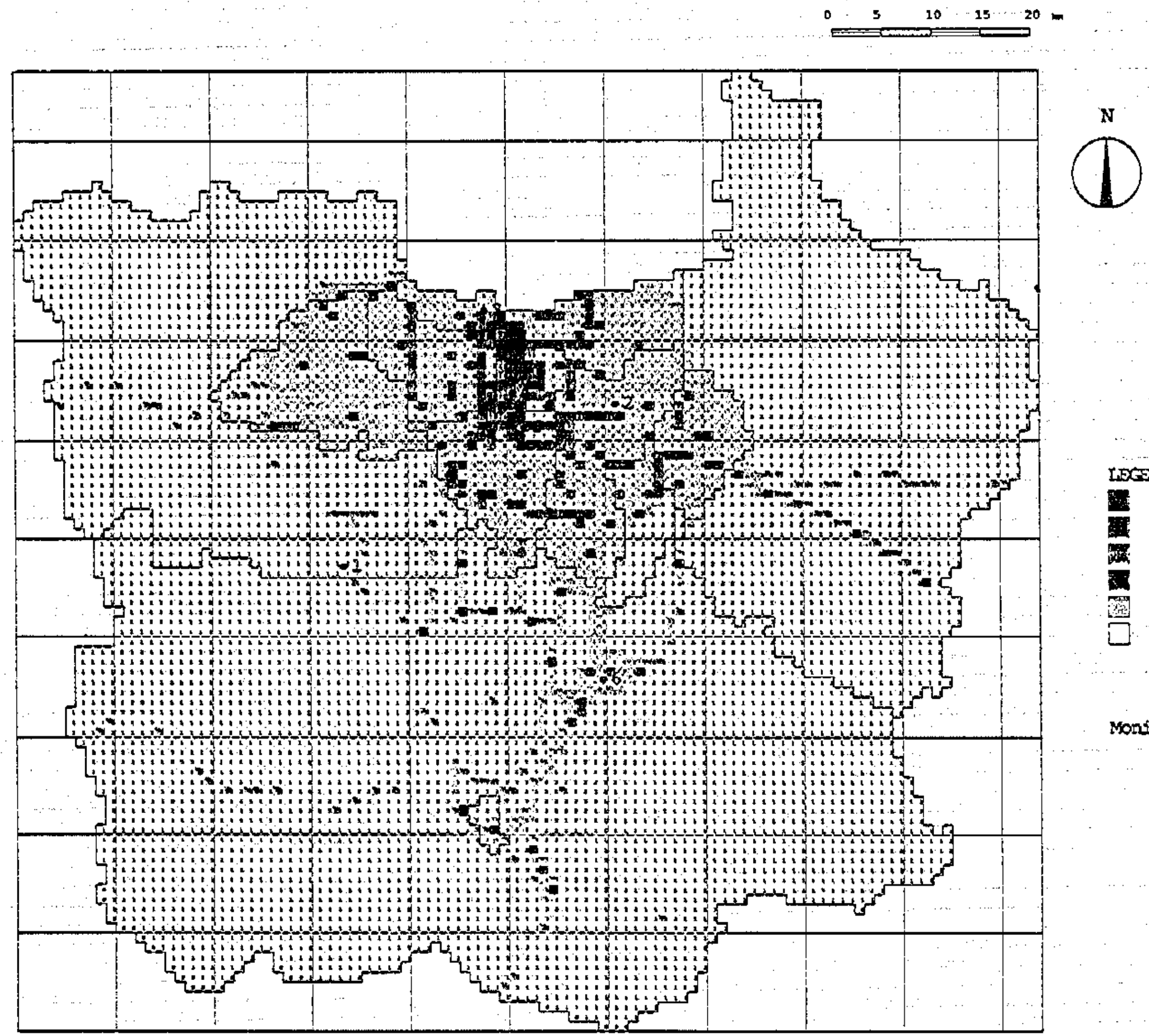
Future Condition (2010)



NOx 1000ton/y Pollutant Emissions □Q MAX= 29814.4ton/y

5.1.2 Concentration Map of NOx and SPM in 2010

Future Condition (2010)



LEGEND

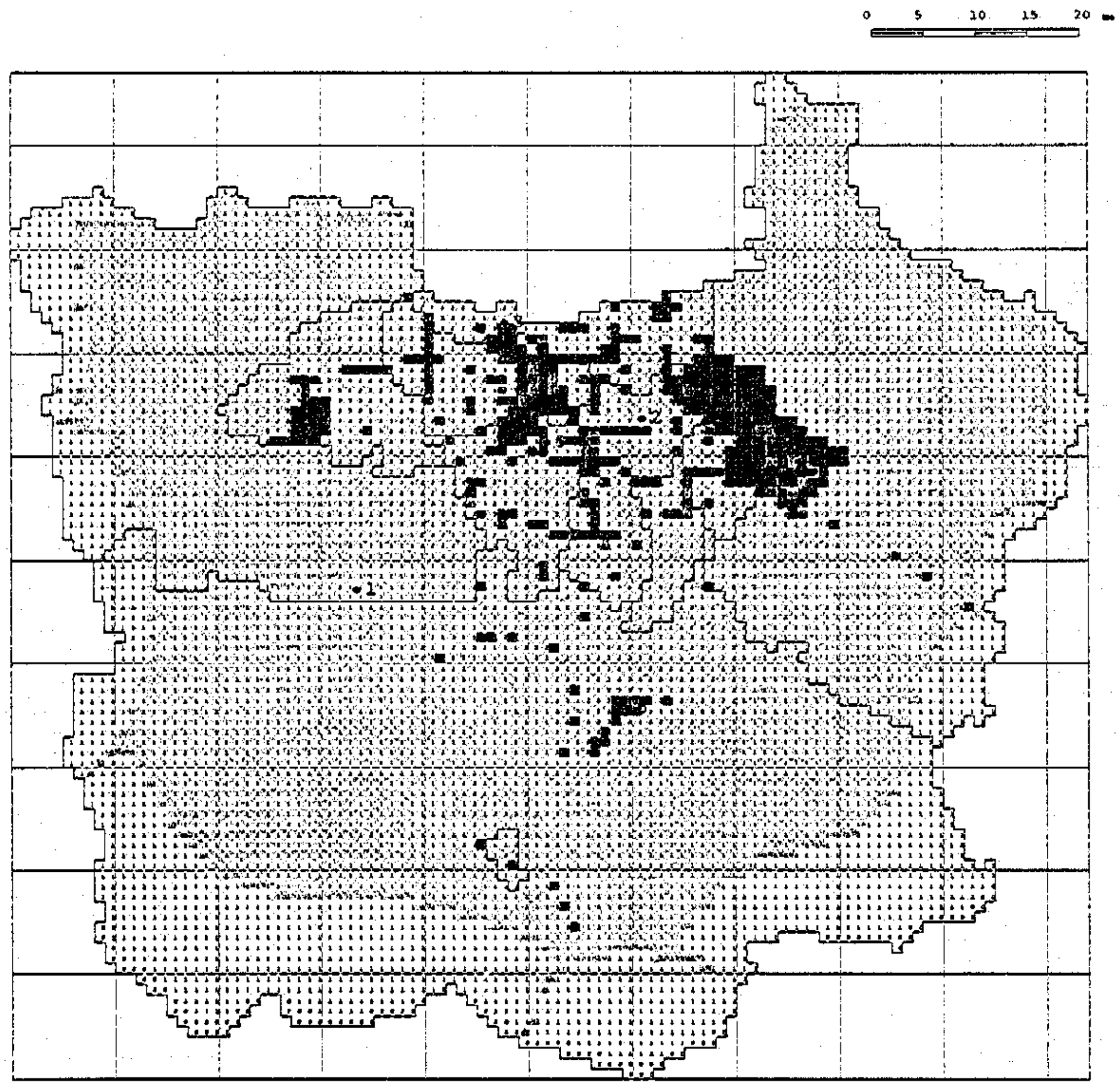
300. < x <= 700.	(ppb)	5 grids
150. < x <= 300.	(ppb)	73 grids
120. < x <= 150.	(ppb)	55 grids
90. < x <= 120.	(ppb)	100 grids
30. < x <= 90.	(ppb)	986 grids
0. < x <= 30.	(ppb)	5463 grids

Monitoring Stations
1 EMC
2 Pulo Gadung
3 Pluit
4 Thamrin
5 KPPL
6 Cibinong

NOx 10ppb Annual Average

□C MAX= 689.2ppb
Background Concentration: 0.ppb

Future Condition (2010)



Note: Approximate Estimate Only

Partial Contribution from Automobiles, Factories and Households

Underestimation

LEGEND

120. < x <= 240.	(ug/m3)	2 grids
60. < x <= 120.	(ug/m3)	29 grids
50. < x <= 60.	(ug/m3)	31 grids
30. < x <= 50.	(ug/m3)	331 grids
10. < x <= 30.	(ug/m3)	4872 grids
0. < x <= 10.	(ug/m3)	1417 grids

Monitoring Stations

1 EMC
2 Pulo Gadung
3 Pluit
4 Thamrin
5 KPPL
6 Cibinong

SPM 10ug/m3 Annual Average

C MAX= 142.0ug/m3
Background Concentration: 0.ug/m3