

オキシダント濃度の予測に関する研究

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STUDIES ON THE PREDICTION OF OXIDANT CONCENTRATION

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Table 1- Variables Used in Factor Analysis

No.	Name	Time	Total		Group-1*		Group-2**		Group-3***	
			Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
1.	Oxidant (PPb)	0900	23.1	13.8	15.2	8.3	26.9	12.3	26.8	16.8
2.	Nitric Oxide (PPb)	0900	2.2	2.0	1.9	1.6	1.8	1.4	2.9	2.8
3.	Nitrogen Dioxide (PPb)	0900	12.3	5.9	10.3	5.0	12.4	6.5	14.4	5.6
4.	Sulfur Dioxide (PPb)	0900	17.5	7.8	14.3	6.7	17.4	8.6	20.8	7.0
5.	Particulate Matter ($\mu\text{g}/\text{m}^3 \times 10$)	0900	6.1	4.9	5.1	5.8	5.9	5.0	7.3	3.7
6.	Temperature ($^{\circ}\text{C}$)	0600	19.6	4.1	20.7	3.4	18.4	4.9	19.9	3.3
7.	Temperature ($^{\circ}\text{C}$)	0900	22.9	3.6	22.5	3.0	22.0	4.2	24.2	3.0
8.	Relative Humidity (%)	0900	74.2	15.4	82.1	12.8	69.8	18.1	71.3	11.6
9.	Wind Direction	0900	7.7	5.0	7.2	4.6	9.1	5.4	6.7	4.8
10.	Wind Velocity (m/s)	0900	2.7	2.3	3.8	2.7	2.9	2.3	1.4	0.8
11.	Weather	0900	3.9	2.7	5.5	2.9	3.5	2.6	2.8	1.9
12.	Visibility (Km)	0900	8.5	8.5	10.3	9.2	8.4	10.4	6.8	4.4
13.	Diurnal Range of Temp. ($^{\circ}\text{C}$)		6.4	3.1	3.7	2.3	6.9	2.7	8.5	2.1
14.	(Max.Temp.-Normal Max.Temp.) ($^{\circ}\text{C}$)		-0.1	2.4	-1.8	2.1	-0.04	2.1	1.5	2.2
15.	Gozaisho Wind Direction	0900	9.4	3.8	9.1	3.6	8.6	4.2	10.7	3.5
16.	Gozaisho Wind Velocity (m/s)	0900	5.4	3.5	7.0	4.0	5.4	3.5	3.8	2.2
17.	Solar Radiation (cal/cm ² /hr)	0700-0900	19.2	10.4	13.9	10.6	20.6	9.7	22.8	9.3
18.	Max. Temp. ($^{\circ}\text{C}$)		26.0	4.1	24.4	3.3	25.4	4.6	28.4	3.1
19.	Min. Relative Humidity (%)		58.9	16.2	68.2	15.2	54.0	17.7	55.1	11.2

Five air pollution measurements and fourteen weather variables. Summer date (May-September)

- * Group-1 : Maximam oxidant concentration >40 PPb
- ** Group-2 : Maximam oxidant concentration 41-80 PPb
- *** Group-3 : Maximam oxidant concentration <81 PPb

Table 3-1- Factor Analysis (1)

	Eigen Vector			Factor Loading			Proportion
	Z1	Z2	Z3	Z1	Z2	Z3	
1. Oxidant	-0.23	-0.03	0.01	-0.52			27.1
2. Nitric Oxide	-0.02	0.20	0.23				28.9
3. Nitrogen Dioxide	-0.05	0.13	0.43			0.72	60.0
4. Sulfur Dioxide	-0.17	0.09	0.38			0.64	58.9
5. Particulate Matter	0.03	0.35	0.20		0.67		57.2
6. Temp. (0600h)	0.13	0.44	-0.23		0.83		92.8
7. Temp. (0900h)	-0.07	0.46	-0.22		0.88		92.7
8. Relative Humidity	0.36	0.21	-0.02	0.83			85.5
9. Wind Direction	-0.13	-0.08	-0.24				28.9
10. Wind Velocity	0.06	-0.21	-0.24				33.6
11. Weather	0.37	-0.03	-0.01	0.85		-0.65	72.7
12. Visibility	-0.10	0.05	-0.38				48.1
13. Diurnal Range of Temp.	-0.39	0.01	0.04	-0.88			78.1
14. (Max.Temp.-Normal Max.Temp.)	-0.33	0.20	-0.08	-0.77			74.7
15. Gozaisho Wind Direction	-0.14	0.01	-0.25				28.2
16. Gozaisho Wind Velocity	0.04	-0.19	-0.32			-0.55	44.4
17. Solar Radiation	-0.37	-0.04	0.02	-0.85			72.9
18. Max. Temp.	-0.16	0.44	-0.20		0.84		96.2
19. Min. Relative Humidity	0.38	0.17	-0.01	0.87			86.6
Eigen Value	5.23	3.58	2.88				
Proportion	27.52	46.38	61.54				

Table 3-2- Factor Analysis (2)

- Roated Factor Reading -

	F1	F2	F3	Proportion
1. Oxidant				12.6
2. Nitric Oxide				5.7
3. Nitrogen Dioxide			0.78	61.4
4. Sulfur Dioxide			0.75	68.5
5. Particulate Matter			0.67	70.5
6. Temp. (0600h)		0.90		95.8
7. Temp. (0900h)		0.97		94.7
8. Relative Humidity	0.88			83.7
9. Wind Direction				6.9
10. Wind Velocity				1.4
11. Weather	0.88			82.8
12. Visibility			-0.55	50.8
13. Diurnal Range of Temp.	-0.82			66.8
14. (Max.Temp.-Normal Max.Temp.)	-0.60			56.3
15. Gozaisho Wind Direction				6.5
16. Gozaisho Wind Velocity				11.7
17. Solar Radiation	-0.89			80.1
18. Max. Temp.		0.92		90.2
19. Min. Relative Humidity	0.87			80.0

Table 4- Multiple Regression Analysis

	Regression Coefficient	Standard Error of Regression Coefficient	Computed t Value
Diurnal Range of Temp.	7.78449	1.33998	5.80942
Gozaisho Wind Velocity	-3.73791	0.78630	-4.75382
Oxidant	1.18379	0.20376	5.80976
Min. Relative Humidity	0.99439	0.25052	3.96936
Gozaisho Wind Direction	3.28684	0.73212	4.48948
Visibility	-0.98617	0.31018	-3.17933
Nitric Oxide	3.21028	1.32872	2.41607

Independent variables : Two air pollution measurements, and five weather variables.

Dependent variables : Daily maximum oxidant concentration.

Table 5- Variance Analysis

	Variation	D.F.	Variance	F Ratio
Variation to Regression	96294.6	7	13756.4	24.3477
Variation to Error	46329.8	82	565.0	
Total Variation	142624.4	89	1602.5	

Table 6- Correlation Coefficients Between Daily Maximum
Oxidant Concentrations and Environmental Factors

	Daily Maximum Oxidant Concentration
Oxidant	0.40*
Nitric Oxide	0.21
Nitrogen Dioxide	0.29*
Sulfur Dioxide	0.36*
Particulate Matter	0.28
Temp. (0600h)	-0.03
Temp. (0900h)	0.23
Relative Humidity	-0.25
Wind Direction	-0.08*
Wind Velocity	-0.44*
Weather	-0.36*
Visibility	-0.18*
Diurnal Range of Temp.	0.57*
(Max.Temp.- Normal Max Temp.)	0.51
Gozaisho Wind Direction	0.24*
Gozaisho Wind Velocity	-0.39*
Solar Radiation	0.38*
Max. Temp.	0.39*
Min. Relative Humidity	-0.27

* Significant at 1% level.

Table 7- Factor Analysis (3)

	Z ₁	Z ₂	Z ₃
Diurnal Range of Temp.	-0.82	-0.41	0.03
Gozaisho Wind Velocity	-0.15	0.78	0.10
Oxidant	-0.60	0.02	-0.43
Min. Relative Humidity	0.87	0.22	0.04
Gozaisho Wind Direction	-0.53	0.40	0.25
Visibility	-0.33	0.42	0.55
Nitric Oxide	0.09	-0.58	0.68

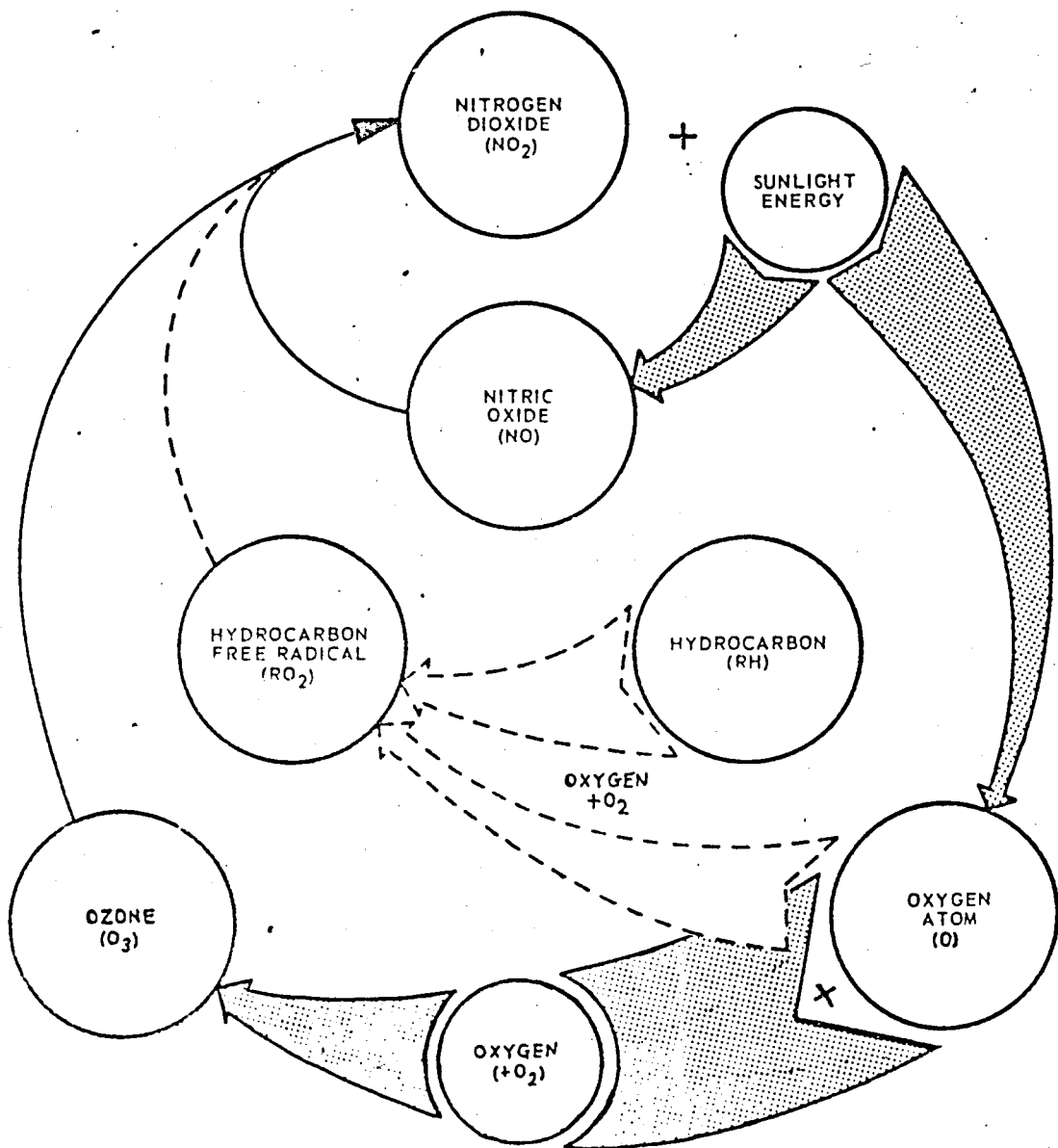


Fig.1- Interaction of hydrocarbons with atmospheric nitrogen oxide photolytic cycle.

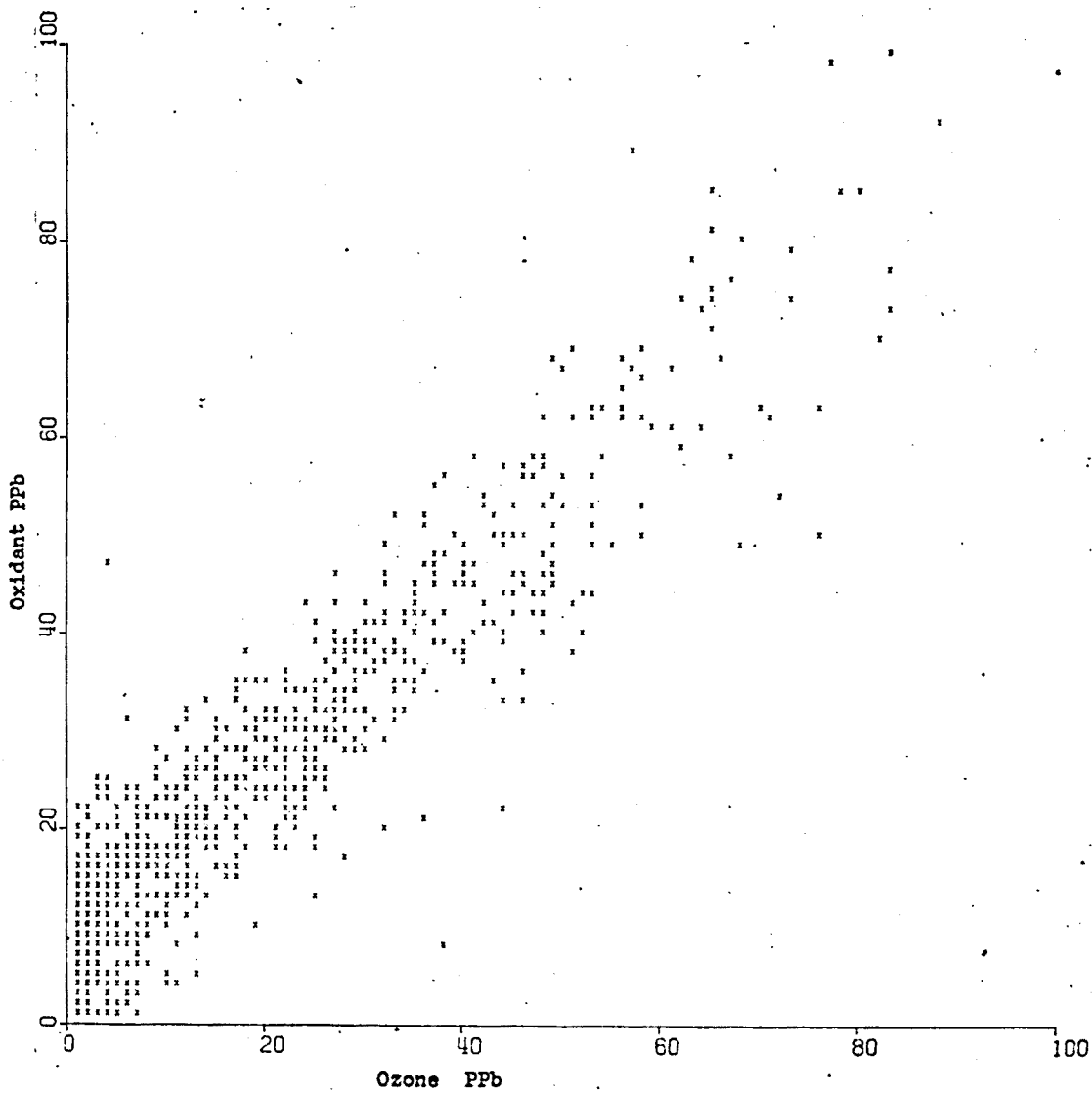


Fig. 2- Relationship between ozone and oxidant concentrations.

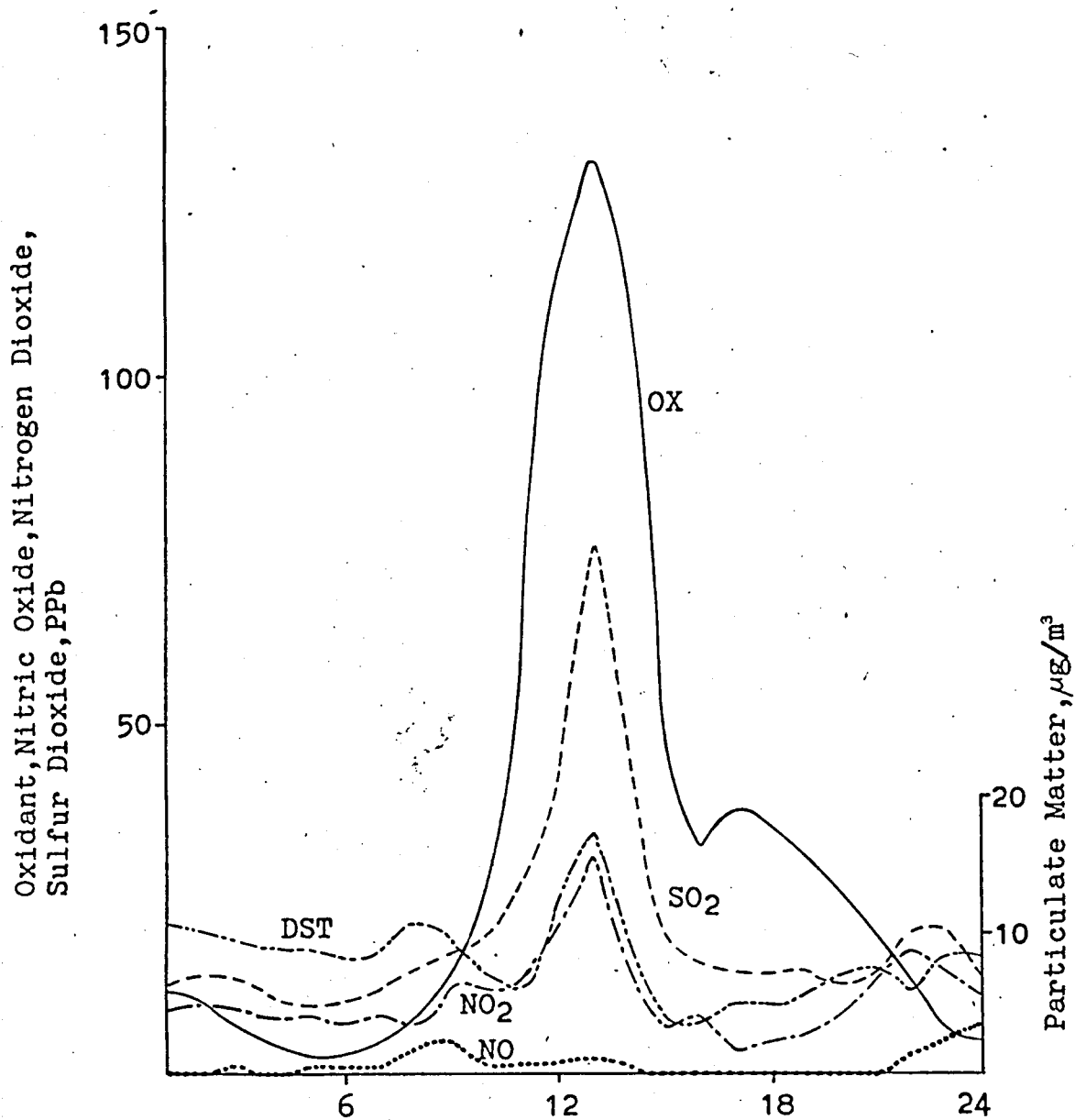


Fig. 3 - Hourly variation of selected pollutants in Yokkaichi on Thursday, August 1, 1974.

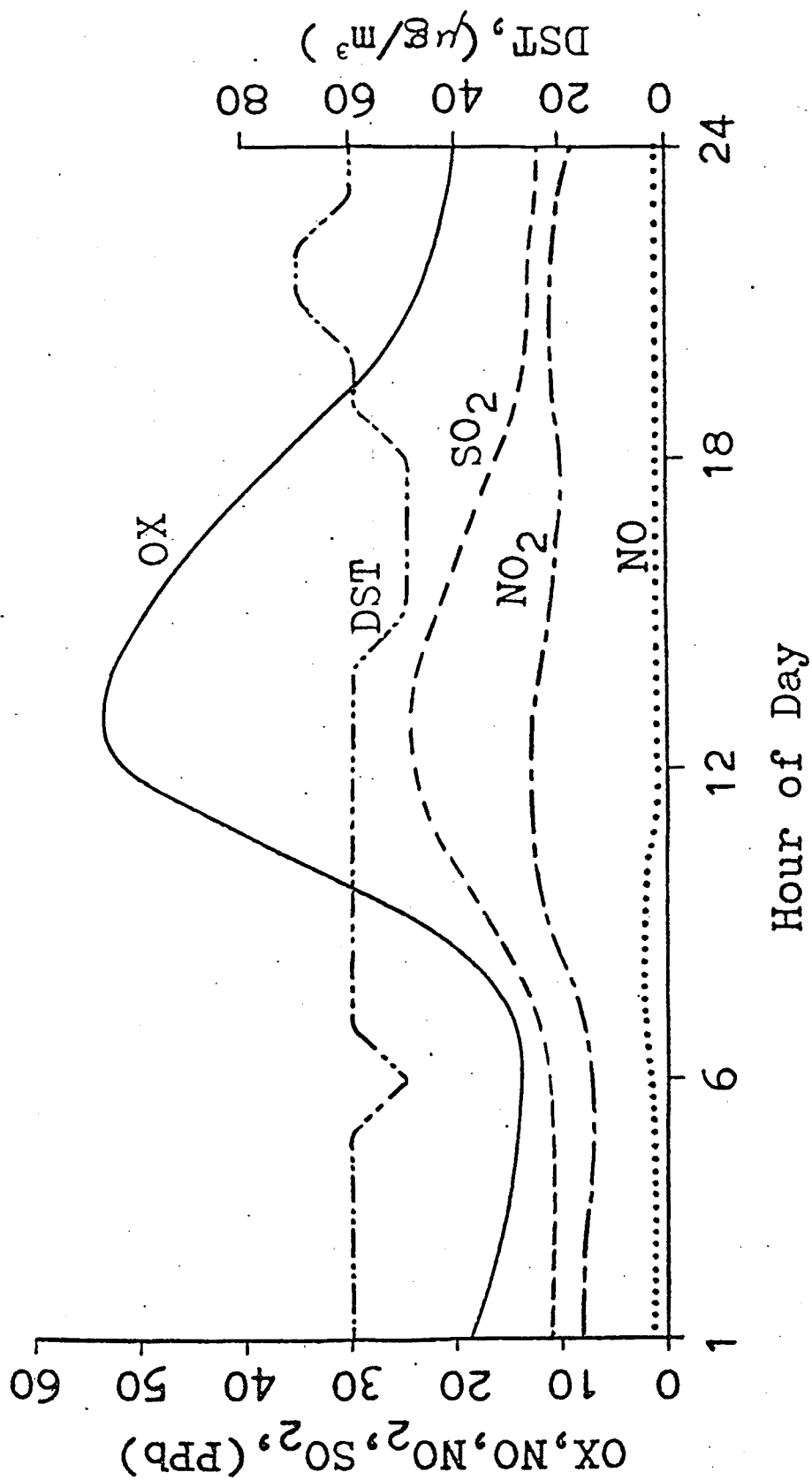


Fig. 4- Diurnal variation of selected pollutants in Yokkaichi, May-September, 1974.

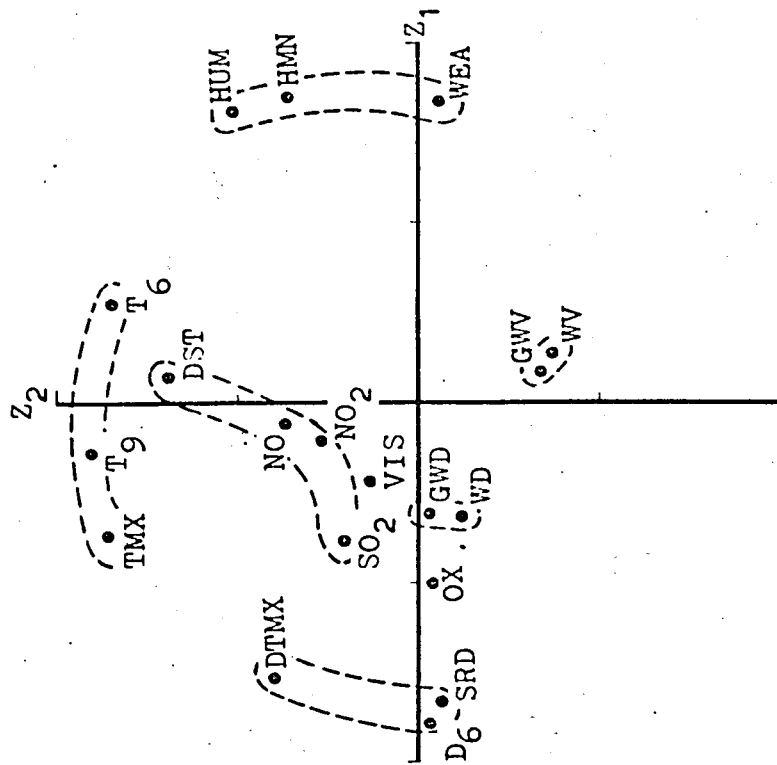


Fig.5- Factor readings corresponding to Z_1 and Z_2 axes.

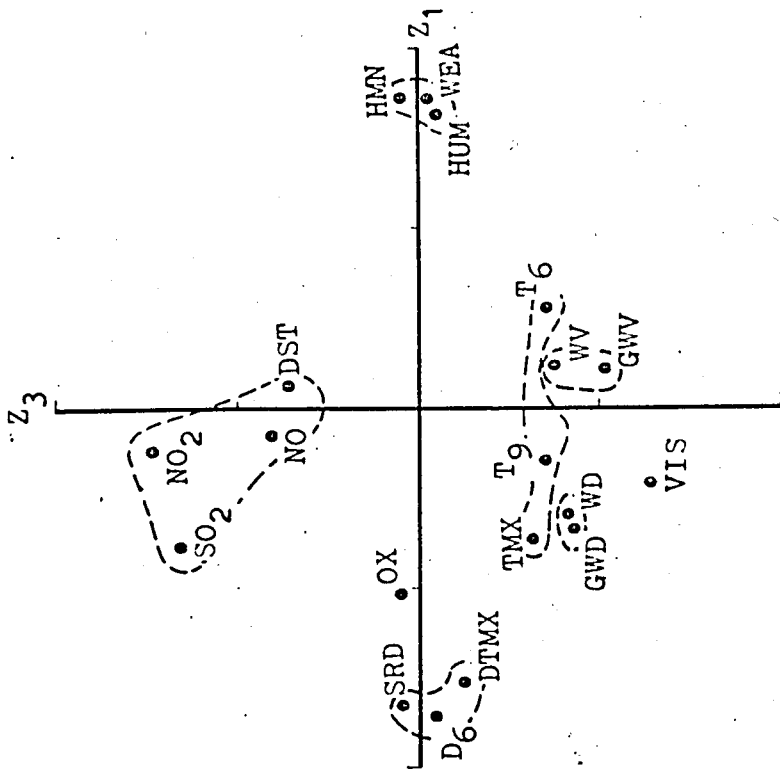


Fig.6- Factor readings corresponding to Z_1 and Z_3 axes.

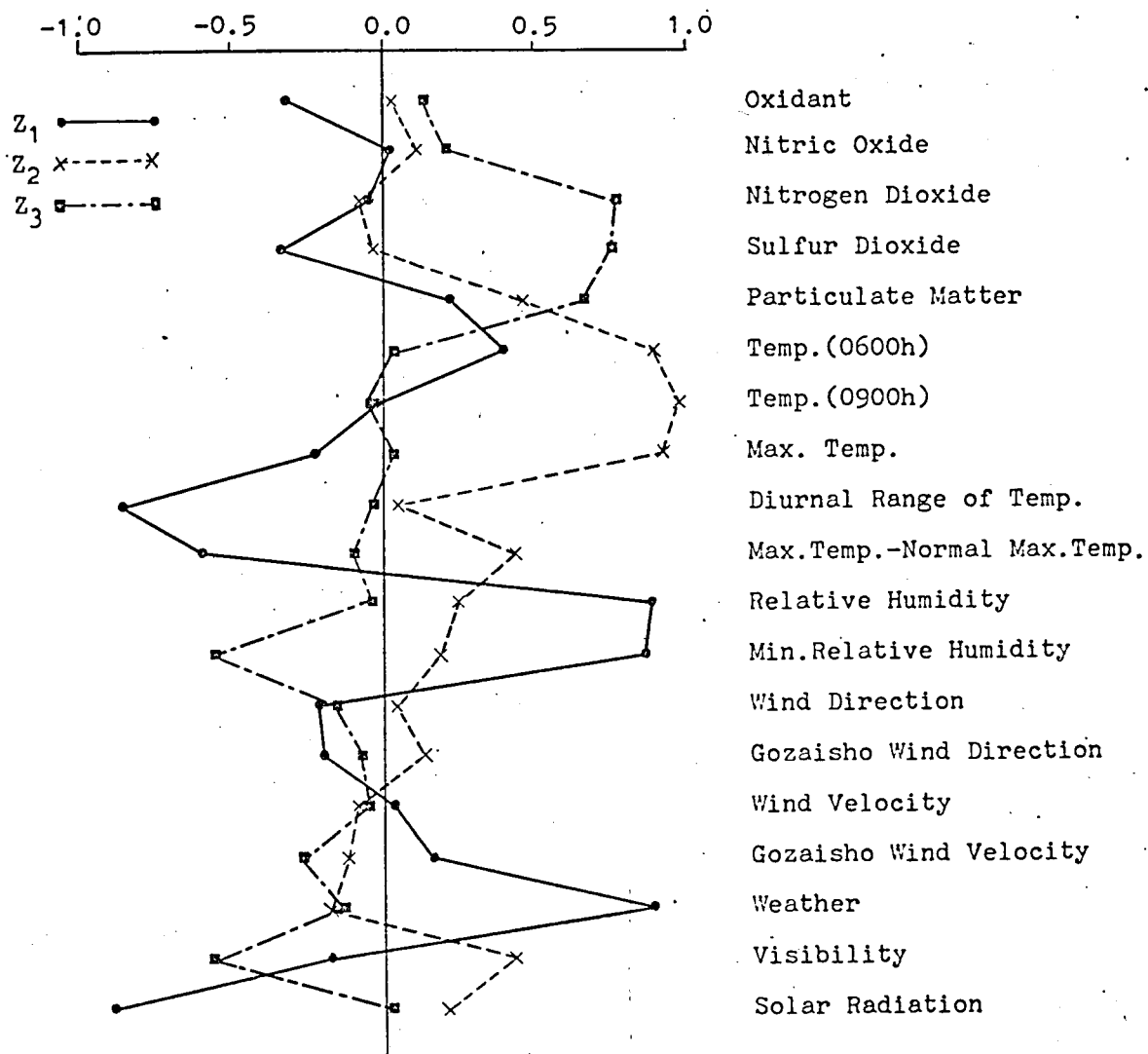


Fig. 7- Graph of factor loadings.

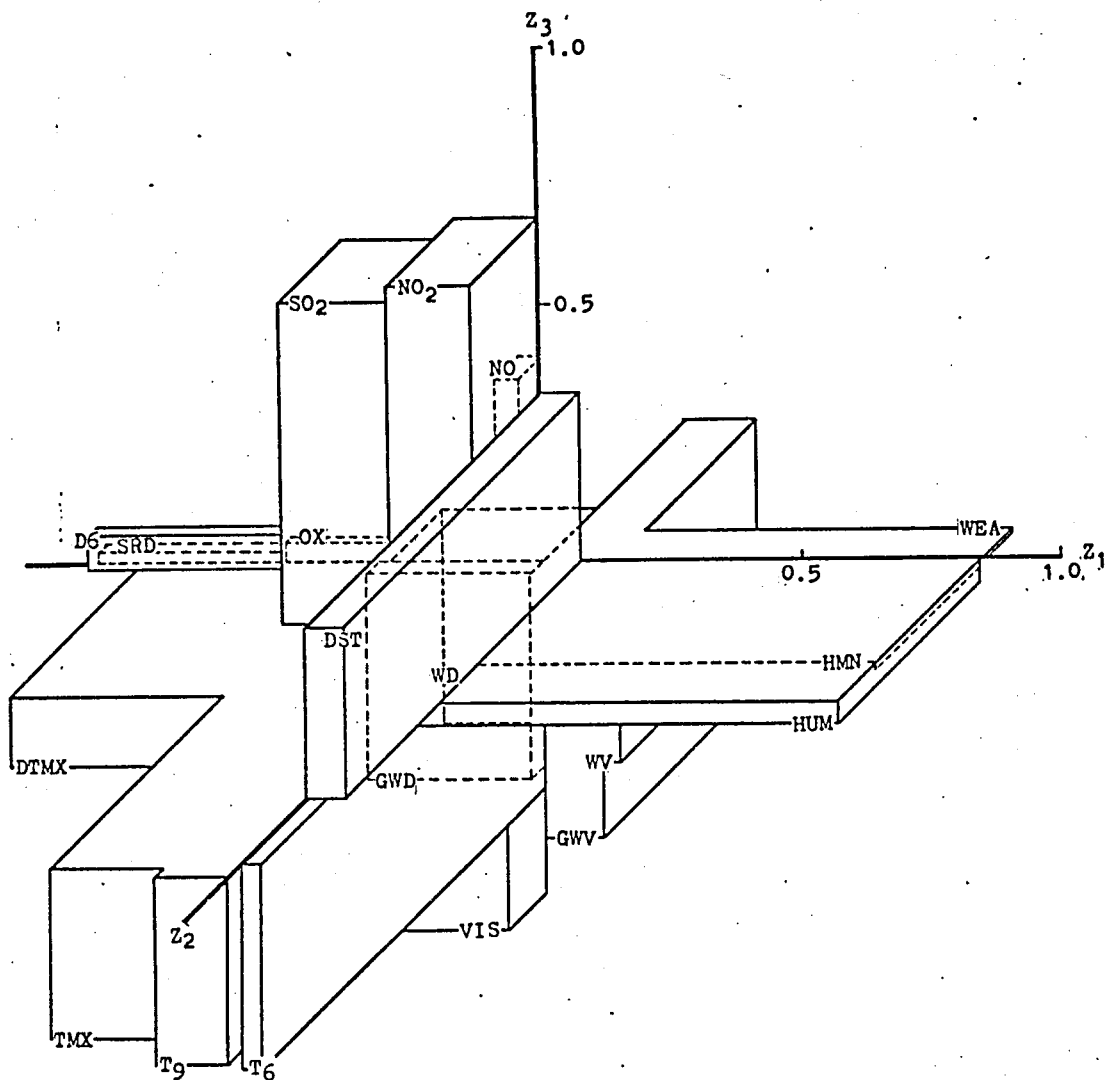


Fig. 8- Factor readings corresponding to Z_1 , Z_2 , and Z_3 axes.

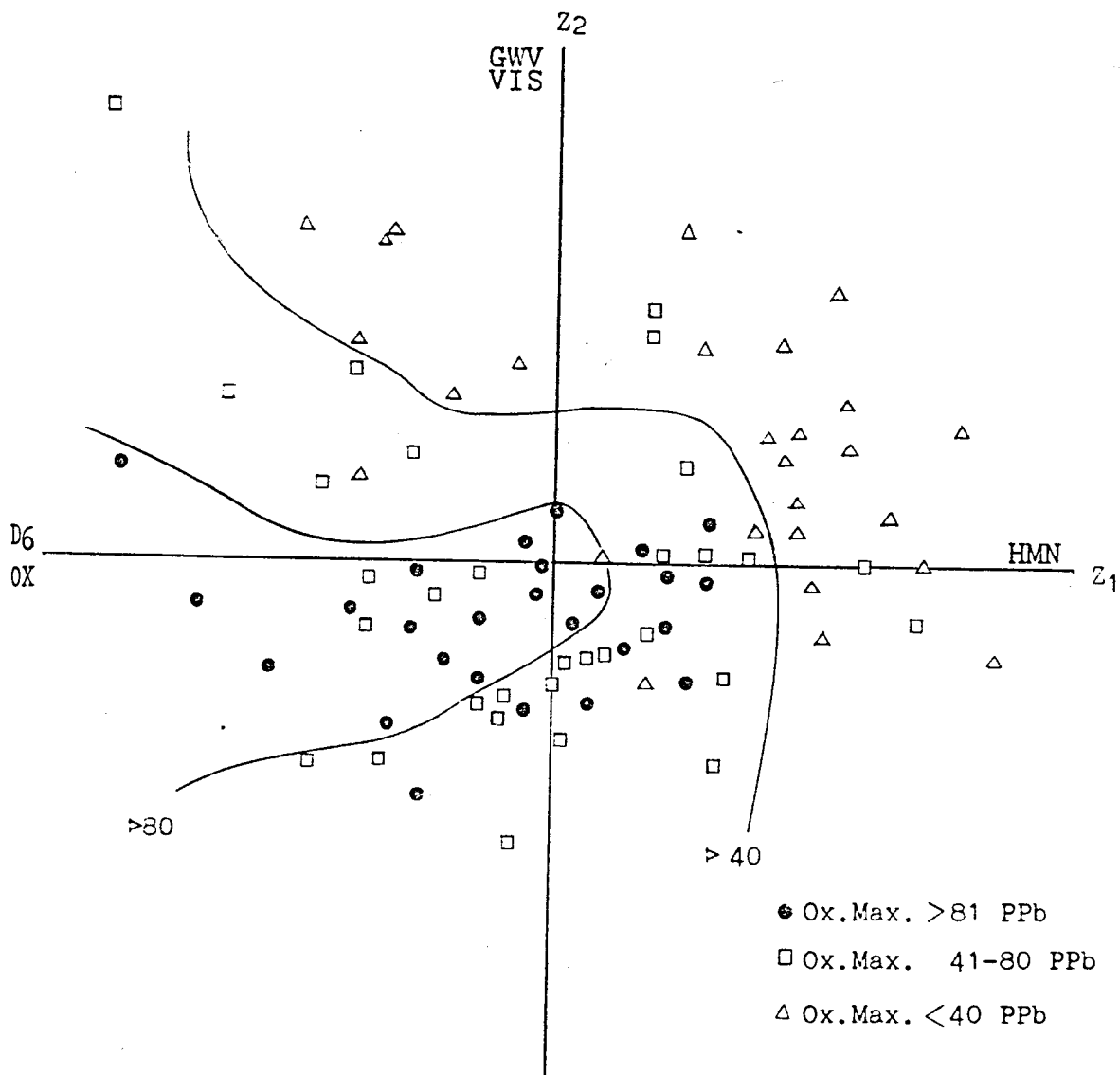


Fig. 9- Display of maximam oxidant concentrations by Z_1 and Z_2 scores. Used to two pollutants and five weather variables.

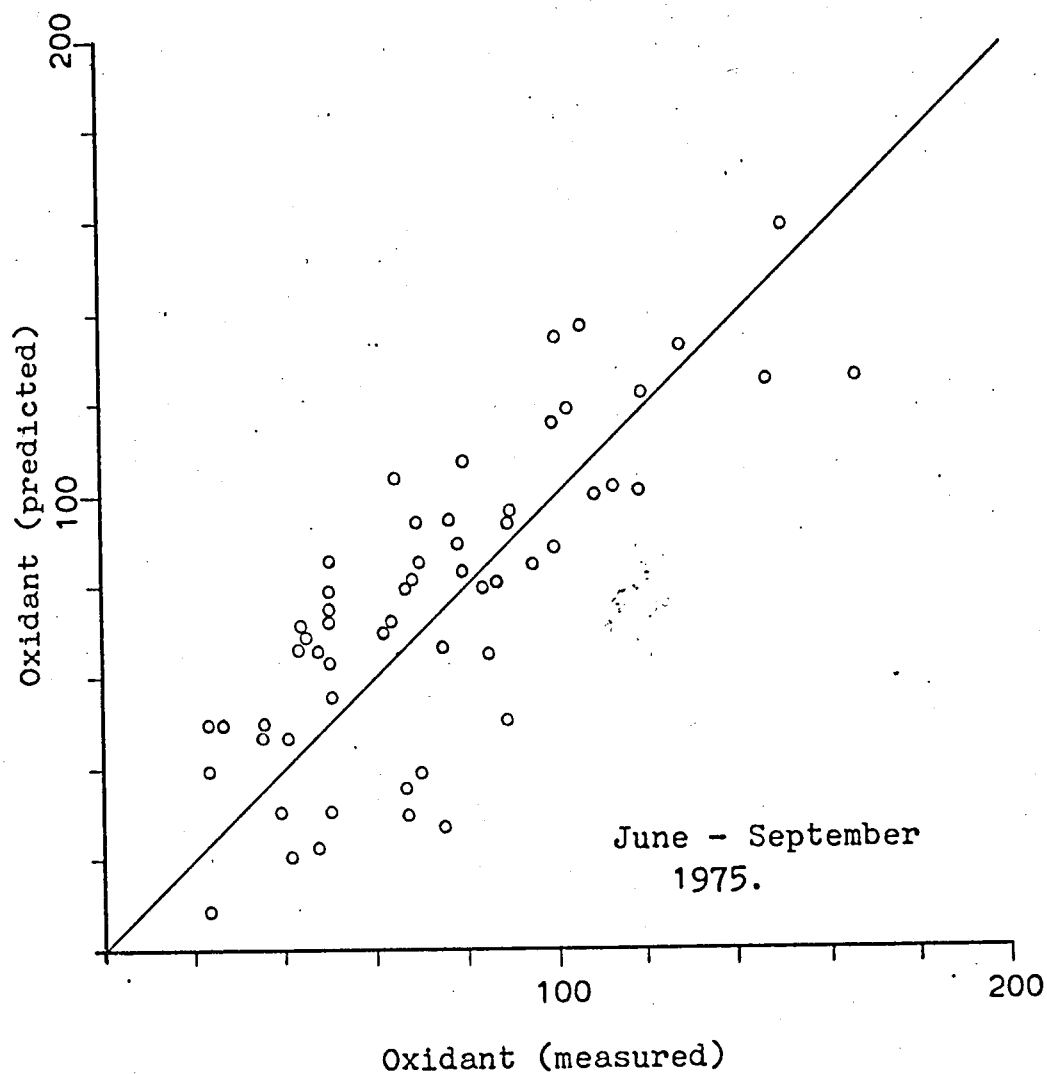


Fig. 10- Relationship between measured daily maximum oxidant concentrations and predicted daily maximum oxidant concentrations. Used to seven variables.