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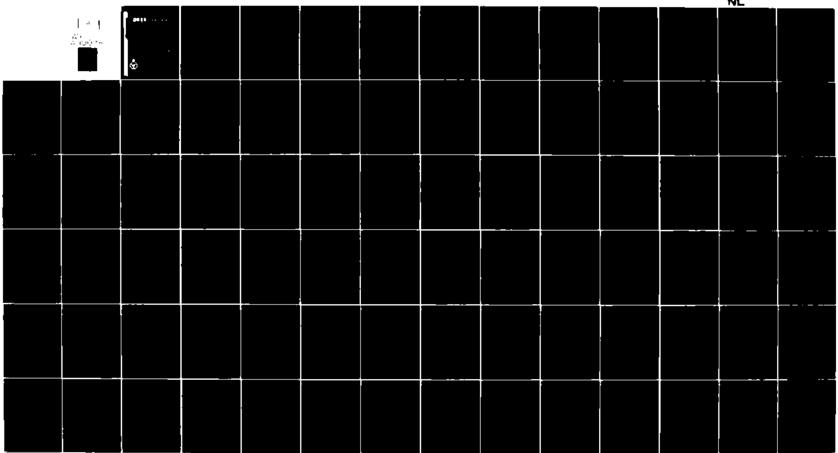

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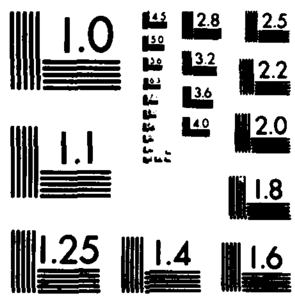

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DIFFUSION AND GROUND DEPOSITION OF 100 MICRON PARTICLES FROM A POINT AT A HEIGHT OF 92 METRES (U)

by

O. Johnson

Project No. 13E10

SEPTEMBER 1980

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ACKNOWLEDGEMENTS

E.R. Walker of the Meteorology Section wrote the programme for carrying out the field trials. C.H.H. Diehl, M.G. Dudley and E.E. Howlett of the Particulate Group carried out the assessment of the deposit density distribution for the particulate trials. Mrs B.R. Larson of the Computer Group made the Sloping Plume model calculations required for predicting the deposit density distribution. S.B. Mellsen of the Chemistry Section made similar calculations using the Monaghan and McPherson K-Theory model. Members of the Meteorology Section and the Instrumentation Group measured and processed the meteorological data. Their contributions are very much appreciated.

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ABSTRACT

The results of a series of field trials on the diffusion and ground deposition of 100 micron glass microspheres from a continuous point source at a height of 92 metres are discussed. The observed crosswind integrated deposit density as a function of distance from the source was used to test two prediction models. One of these models employs appropriately averaged standard deviations of vertical turbulence as the main parameter of atmospheric diffusion. The other is the steady state K-Theory diffusion model with a coefficient of eddy diffusivity which varies with height. In general, there was reasonably good agreement between the observed and predicted crosswind integrated deposit density as a function of distance, for the sloping plume model. However, the K-Theory model predicts a peak deposit much lower than observed and a more gradual decrease in the deposit density than observed.

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DIFFUSION AND GROUND DEPOSITION OF 100 MICRON PARTICLES FROM A POINT AT A HEIGHT OF 92 METRES (U)

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INTRODUCTION

During the period between 1958 and 1967 several series of field trials were conducted at the Defence Research Establishment Suffield in a study of the diffusion and deposition on the ground of particles released from low level sources. Hage (1961) reported on a series of field trials in which glass microspheres of 100 microns diameter were released from a continuous point source at a height of 15 metres, and Walker (1965) reported on similar trials using 50 micron particles released from 8 metres. Results of seven field trials in which 30 micron glass microspheres were released from a height of 2.75 metres have been reported by Johnson, McCallum and Larson (1974).

For these series of field trials, mathematical models for predicting the downwind distribution of deposit density on the ground have been tested. In addition the mass recovery, estimated from the deposits on the surface samplers, was compared with the total mass emitted.

In this paper the results of 14 field trials on the diffusion and deposition on the ground of glass microspheres of nominal 100 micron mass median diameter from a continuous point source at a height of 92 metres are discussed. (Trial 2 was unsuccessful.) The main objective of this study was to provide a mathematical model which adequately predicts the downwind distribution of the deposit density of particles of terminal velocities equivalent to those of about 100 micron glass microspheres. Two models were tested: a Gaussian Sloping Plume model, Walker (1965), and a Steady State K-Theory model, Monaghan and McPherson (private communication).

EXPERIMENTAL DETAILS

The sampling technique and meteorological instrumentation were similar to those described by Hage, Diehl and Dudley (1960). Glass microspheres coated with fluorescent dye were emitted continuously for periods of 28 to 60 minutes from the top of a 92 metre tower. The particles were collected on horizontal adhesive sampling surfaces placed on the ground along crosswind arcs at downwind distances up to 4,828 metres. The number of particles collected on each sampling surface were counted visually under ultra-violet light, by means of a magnifier.

The distribution of particle sizes by mass was determined for two samples taken from the lot used in the field trials. The data are given in Table 1.

On four of the field trials, microspheres from the sampling surfaces on a small number of arcs were measured by microscope, so that the variation in mass median diameter with downwind distance could be compared with that predicted from the model, using the distribution in the bulk sample. The data are given in Table 2.

Meteorological measurements in support of the field trials were made near the source for a period of 60 minutes, which included the period of emission (Table 3). Wind speeds were recorded at 8 levels on the 92 metre tower (Table 4) and the temperature difference between heights of 13 and 1 metre were measured (Table 5). Crosswind and vertical angular deflections of light vanes, mounted at heights of 16, 48 and 92 metres on the tower, were recorded continuously on magnetic tape and high speed recorder paper charts. The magnetic tape record was digitized at one second intervals and the standard deviations of the vane angles were computed with data averaging times of 1, 5, 10, 20, 60 and 100 seconds.

PREDICTION MODELS FOR DOWNWIND DISTRIBUTION OF DEPOSIT DENSITY

(a) Sloping Plume Model

Since the microspheres used for these field trials vary somewhat in size, there is a certain amount of downwind spread in the deposit pattern which has to be considered. Walker (1965) developed a prediction model in which particles in each size class were spread about the non-turbulent gravity fall path by Gaussian vertical turbulence, with angular standard deviation σ. The horizontal wind speed $\bar{u}$ was considered constant, and if the terminal velocity of the particle size class is 'v', then the distribution of mass Q about the gravity fall path is:

$$\frac{dQ}{d\theta} = \frac{Q}{\sqrt{2\pi}\,\sigma} \exp\left(-\theta^2/2\sigma^2\right) \quad \ldots\ldots\ldots\ldots\ldots \quad (1)$$

$$\text{where } \theta = \phi - \tan^{-1}\frac{v}{\bar{u}}$$

and σ is the angular standard deviation of Gaussian turbulent spread. These relationships are shown in Figure 29. The distance downwind 'x' travelled by a particle before landing is

$$x = h \cot \phi$$

Hence $$\theta = \tan^{-1}\frac{h}{x} - \tan^{-1}\frac{v}{\bar{u}} \approx \frac{h}{x} - \frac{v}{\bar{u}}$$

The deposit density is then

$$D = \left|\frac{dQ}{dx}\right| = \left|\frac{dQ}{d\theta}\right| \left|\frac{d\theta}{dx}\right| = \frac{h}{x^2} \frac{Q}{\sqrt{2\pi}\,\sigma} \exp\left(-\theta^2/2\sigma^2\right). \quad \ldots \quad (2)$$

The average of the standard deviation σ at 16, 48 and 92 metres was taken from Table 6, as equivalent to the vertical vane angle standard deviation when the data were averaged over periods equal to the travel time divided by the factor β, which represents the ratio between Lagrangian and Eulerian time scales, Pasquill (1962). The travel time was taken as the distance to each sampling arc divided by the mean of the wind speed at 16, 48 and 92 metres. $\beta = 1$ and $\beta = 4$ were used in the prediction model.

(b) Steady State K-Theory Model

In the K-theory model, Monaghan and McPherson (private communication), the atmospheric dispersion of particulate material is described by the two-dimensional steady state diffusion equation

$$u(z)\,\partial c/\partial x = \partial\{K(z)\,\partial c/\partial z\}/\partial z + q\,\partial c/\partial z \quad \ldots\ldots\ldots\ldots \quad (3)$$

where c = steady state concentration at x,z for a continuous line source, or total dosage when the line source is instantaneous.

$K(z)$ = the coefficient of eddy diffusivity at height z.

$u(z)$ = the mean horizontal wind speed at height z.

q = terminal velocity of the particles, assumed monodisperse.

It is assumed that there is an impervious "lid" for diffusion at height H, where the vertical flux of material is zero or,

$$\lim_{z \to H} F = 0$$

The flux of material at the lower boundary of the turbulent atmosphere is given by

$$\lim_{z \to 0} \{-F\} = E(P_a + q/S)S \lim_{z \to 0} c$$

P_a is the mean transport velocity of non-settling material between the rough surface and the turbulent boundary layer and is related to the sublayer Stanton member B by

$$P_a = u_* B/S$$

where S is the total specific surface of the roughness elements, and E is the efficiency of retention of the surface.

The boundary conditions are therefore

$$\lim_{z\to H} \{K(z)\ \partial c/\partial z + qc\} = 0$$

and $$\lim_{z\to 0} \{K(z)\ \partial c/\partial z + qc\} = E(P_a + q/S)S \lim_{z\to 0} c,$$

with the initial condition

$$\lim_{x\to 0} c = Q\delta(z-h)/u(h)$$

where Q is the source strength, h is the release height and $\delta(z)$ is the Dirac delta function.

Simple functional forms for mean wind speed and the eddy diffusion coefficient were adopted as follows:

$$u(z) = u(2) \quad \{(x+\Delta\ell)/2\}^p$$

and $$K(z) = A(z+\Delta\ell)\ u(2) \quad ;$$

p and A are constants related to atmospheric stability and $\Delta\ell$ is a length of the same order as the roughness length z_o of the surface. u(2) is the mean wind speed at 2 meters.

In the above equations the following assumptions were made:

E = 1

S = 1

H = 500 meters

$$P_a = 0.01\, u(2)$$

$$A = 0.04$$

Equation (3) is solved by a finite difference approximation method in which the discretization in the vertical is in terms of equal intervals of diffusive resistance rather than length.

DEPOSIT DATA AND ANALYSIS

The particle counts on each sampling surface were converted to deposit densities in mg/m^2 by using a mean particle mass computed from Table 1. The data are given in Appendix A. The downwind distribution of deposit density was determined by crosswind integration along each arc. This was done by multiplying the deposit density by the spacing of the samplers and then summing. Table 7 shows the crosswind integrated deposit density (CWID) normalized by dividing by the total mass emitted.

The CWID at each sampling distance was predicted from equation (2) of the sloping plume model. The predicted and observed normalized CWID as a function of distance for $\beta = 1$ and $\beta = 4$ are given in Table 7 as Model A and plotted in Figures 1 to 14. Predictions of the CWID distribution were also made using the steady state K-Theory model.

Comparison of the predicted and observed distances to peak deposit, peak deposit and recovery to the farthest sampling distance are given in Table 8.

DISCUSSION

(a) Sloping Plume Model

Table 8 shows the predicted and observed deposit density characteristics for all the trials. In general, there is fairly good agreement between predicted and observed deposit density characteristics. The average of the predicted distances to the peak deposit was 9% less than observed when $\beta = 4$ was used. The average of the predicted peak CWID was 19% higher than observed. Predicted recovery to the maximum distance sampled was 15% higher than observed. The reduced observed CWID and recovery may be attributed to the very low recoveries for trials 5, 7 and 8. The wind speeds for these trials were very high and may have raised dust which subsequently settled on the sampling surfaces.

Figures 1 to 14 show that the choice of $\beta = 1$ or $\beta = 4$ makes a considerable difference in the predicted pattern of the deposit density as a function of distance from the source, particularly with respect to the distance to the peak deposit and the magnitude of the peak. In general the observed data are better predicted when $\beta = 4$ is used in the sloping plume model.

The results of the sizing of the particles on the sampling surfaces given in Table 2 show that there is only a small decrease in the mass median diameter with distance from the source. In view of these results, the observed deposit density was not corrected for variation in particle size with distance from the source.

(b) Steady State K-Theory Model

The downwind distribution of the CWID predicted by the K-Theory Model was computed from equation (3) and most of the characteristics of the distribution are given in Table 8 as Model B. The predicted and observed characteristics are compared as well as the predictions made by the two models.

When averaged for all the trials the ratio of the predicted to observed distance to the peak deposit was 0.9 for the sloping plume model (Model A) and 1.0 for the K-Theory (Model B). The ratio of predicted to observed peak deposit density was 1.2 for Model A and 0.45 for Model B. The ratio of predicted to observed CWID at the maximum distance sampled was 0.75 for Model A and 2.0 for Model B. The ratio of predicted to observed recovery to the maximum distance sampled was 1.15 for Model A and 0.90 for Model B.

The distance to peak deposit and recovery are, on average, well predicted by both models. However, the K-Theory Model predicts a peak deposit much lower than observed and a more gradual decrease in the deposit density with distance than observed.

CROSSWIND SPREAD OF THE DEPOSIT DENSITY

The angular standard deviations for the particle deposit density distribution across each sampling arc, σ_p, were compared with the crosswind vane angle standard deviation, σ_y, using data averaging times equal to the travel time to each arc ($\beta = 1$) and one quarter of the travel time ($\beta = 4$). The data are given in Table 9 and plotted in Figures 15 - 28.

With $\beta = 4$ the average of the ratio $\frac{\sigma_y}{\sigma_p}$ for all the trials was 1.06. For 9 of the trials σ_y was greater than σ_p. $\frac{\sigma_y}{\sigma_p}$ varied between 0.66 and 1.35 except Trial 7 for which the ratio was 1.49. There appears to be no obvious explanation for the high ratio for this trial. The decrease in the observed standard deviation with distance is consistent with predictions.

Similar results were reported by Walker (1965) for 50 micron microspheres released from a height of 8 metres. For 30 micron microspheres emitted from a height of 2.75 metres, Johnson et al. (1974), the ratio σ_y/σ_p varied between 0.73 and 0.83.

CONCLUSIONS

The observed crosswind integrated deposit density as a function of distance was compared with that predicted by the Gaussian sloping plume model, using standard deviations of the plume equivalent to the vertical turbulence standard deviations when the data were averaged over periods equivalent to the travel time to each sampling arc ($\beta = 1$) and one quarter of the travel time ($\beta = 4$). For most of the trials there was good agreement between the observed and predicted deposit density distribution when $\beta = 4$ was used.

The distance to the peak deposit and recovery were well predicted by the Steady State K-Theory model. However, the predicted peak deposit was much lower than observed and there was a more gradual decrease in the deposit density with distance than observed.

A comparison of predictions by the two models indicates that the data are better predicted by the sloping model than by the K-Theory model.

The standard deviation of the crosswind distribution of the deposit density was compared with the standard deviation of crosswind turbulence using averaging periods for $\beta = 1$ and $\beta = 4$. There was reasonably good agreement between observed and predicted standard deviations when $\beta = 4$ was used.

REFERENCES

Hage, K.D.	1961	"Description and Test of a Model for the Deposit of Particulates from an Elevated Source", Suffield Technical Paper No. 217.
Hage, K.D., C.H.H. Diehl and M.G. Dudley	1960	"On the Ground Deposit of Particles Emitted from a Continuous Elevated Point Source. Part I. Deposition of Nominal 100μ Glass Microspheres from 15 Metres", Suffield Technical Paper No. 197.
Johnson, O. J.A. McCallum and B.R. Larson	1974	"Diffusion and Deposition of 30 Micron Particles from a Low Level Source", Suffield Technical Paper No. 367.
Pasquill, F.	1962	"Atmospheric Diffusion", Van Nostrand, London.
Walker, E.R.	1965	"On the Ground Deposit of Particles Emitted from a Continuous Elevated Point Source. Part II. Deposit of Nominal 50μ Glass Microspheres from 8 Metres", Suffield Technical Paper No. 304.

TABLE 1

CUMULATIVE MASS - DIAMETER DISTRIBUTION OF MICROSPHERES

SAMPLE 1															
Diameter (μ)	89	94	97	98	99	100	101	102	103	104	105	106	107	108	109
Mass (%)	1.19	2.59	5.67	10.44	13.71	17.08	27.49	29.28	36.64	42.32	46.22	48.22	58.53	60.64	62.82
Diameter (μ)	110	111	113	115	117	118	119	127							
Mass (%)	69.53	83.32	85.75	88.30	90.99	93.74	96.57	100							
SAMPLE 2															
Diameter (μ)	92	94	97	98	99	100	101	102	103	105	106	107	108	109	111
Mass (%)	1.33	4.17	5.73	8.94	17.22	20.63	29.42	34.85	40.44	44.38	48.44	60.95	65.24	74.06	78.71
Diameter (μ)	112	113	114	115	118	120	124								
Mass (%)	83.49	85.94	88.46	91.04	93.83	96.77	100.0								

TABLE 2

OBSERVED AND COMPUTED MASS MEAN DIAMETERS AT SAMPLING ARCS (MICRONS)

TRIAL	REFERENCE	ARC DISTANCE (METERS) 182.9	274.3	365.8	548.6	731.5	1097.3	1609.3	2414	3621
3	OBS.			110.6	109.3		106.9	106.3		
	Eq(4) $\beta=1$			110.1	108.7		106.6	105.6		
	$\beta=4$			109.1	108.3		107.3	106.8		
4	OBS.	108.6	105.9	105.6	102.8	104.2				
	Eq(4) $\beta=1$	111.9	109.3	107.8	105.9	104.3				
	$\beta=4$	109.8	108.6	107.9	107.0	106.4				
5	OBS.					107.0	103.7			101.1
	Eq(4) $\beta=1$					113.8	110.4			
	$\beta=4$					110.4	109.2			
6	OBS.			113.0	113.7	107.6	109.7	112.7	112.0	121.5
	Eq(4) $\beta=1$			113.6	111.5	110.2	108.6	107.0	104.9	102.0
	$\beta=4$			110.5	109.4	108.8	108.2	107.5	106.9	106.2
7	OBS.									115.6
	Eq(4) $\beta=1$									107.0
	$\beta=4$									107.4

TABLE 3

EMISSION PARAMETERS

TRIAL NO.	DATE DD/MM/YY	START MST	DURATION MIN.	AMOUNT EMITTED(gm)	EMISSION HEIGHT(m)
1	13/02/64	1454	47	22652	92.5
3	06/10/64	1105	60	13522	92.5
4	23/10/64	1111	40	7765	92.5
5	28/10/64	1428	45	13494	92.5
6	27/04/65	1434	36	16837	92.5
7	28/04/65	1038	29	19051	92.5
8	10/05/65	1726	28	22425	92.5
9	14/07/65	1108	10	50μ 1360 100μ 1360	30.5
10	14/07/65	1512	43	9072	92.5
11	06/10/66	1605	41	9072	92.5
12	24/11/66	1503	38	9072	92.5
13	13/12/66	1457	36	9072	92.5
14	15/12/66	1420	29	9072	92.5
15	16/12/66	1040	29	9072	92.5

TABLE 4

WINDSPEED ($m.sec^{-1}$) OVER EMISSION PERIOD

TRIAL NO.	HEIGHTS (m)								Surface To	
	2	8	16	32	48	64	80	92	92m	30m
1	3.03	3.52	3.71	3.89	3.95	4.00	4.04	4.08	3.84	
3	3.80	4.72	4.90	5.00	5.02	5.05	5.08	5.09	4.92	
4	1.96	2.27	2.39	2.58	2.39	2.65	2.70	2.77	2.49	
5	8.21	10.59	11.75	12.62	13.07	13.95	14.36	15.10	12.88	
6	6.66	8.18	8.61	8.94	9.00	9.46	9.60	9.69	8.96	
7	10.75	12.53	13.38	14.18	14.60	14.90	15.12	15.26	14.44	
8	6.51	11.28	13.36	15.32	16.63	17.67	18.52	19.16	15.86	
9	3.91	5.44	5.91	6.35	6.55	6.66	6.75	6.84		5.47
10	2.04	3.12	3.86	4.68	5.19	5.55	5.82	6.00	4.72	
11	4.00	5.42	6.53	7.62	8.50	9.20	9.75	10.06	8.07	
12	2.08	8.08	9.44	11.15	12.46	13.52	14.60	15.45	11.87	
13	4.77	6.50	7.92	10.10	11.77	13.00	14.03	14.70	10.96	
14	3.45	5.33	6.37	7.62	8.65	9.70	10.65	11.31	8.30	
15	4.70	7.10	8.41	10.02	11.62	13.40	14.65	15.62	11.24	

TABLE 5

METEOROLOGICAL CONDITIONS

TRIAL NO.	ΔT °C 13m - 1m	T °C	R.H. %	WIND DIRECTION (Deg)
1	0.10	3.3	31	280
3	-1.00	21.1	39	270
4	-1.10	12.2	46	250
5	-0.28	13.3	34	250
6	-1.85	24.4	24	240
7	-1.15	20.6	40	235
8	-0.38	21.7	28	245
9	-2.00	27.2	45	260
10	-1.35	28.3	34	283
11	0.40	23.3	28	270
12	-0.10	4.1	68	220
13	1.30	4.1	78	210
14	0.90	5.2	72	235
15	1.40	5.2	76	245

TABLE 6

MEAN STANDARD DEVIATION OF VANE ANGLES AT 16, 48 and 92 m (RADIANS) OVER EMISSION PERIOD

TRIAL NO.	(a) VERTICAL ANGLE AVERAGING TIME (SECONDS) 1	5	10	15	20	60	75	150	300	600	900	1200
1*	.090	.076	.068	.064	.060	.046	.045	.034	.026	.021	.018	
3	.158	.138	.126	.118	.113	.091	.086	.080	.054	.040	.029	.022
4	.220	.204	.192	.186	.178	.136	.130	.103	.074	.044	.026	
5=	.071	.051	.043	.040	.037	.027	.026	.021	.016	.010		
6	.096	.080	.072	.067	.063	.046	.042	.032	.022	.011		
7	.076	.062	.057	.053	.051	.040	.037	.031	.027	.026		
8	.051	.035	.028	.025	.021	.015	.014	.010	.008			
9x	.104	.090	.082	.077	.073	.056						
10	.188	.168	.152	.143	.136	.108	.111	.084	.071			
11*	.057	.041	.034	.030	.027	.019	.018	.014	.012			
12●	.035	.022	.016	.014	.012	.008	.008	.007	.006			
13	.047	.037	.034	.032	.030	.027	.025	.022	.019			
14=	.042	.032	.028	.026	.025	.020	.015	.008	.004			
15	.043	.027	.019	.016	.014	.010	.009	.007	.003			

* 48m misg; = 48m only; x 92m misg; ● 16 m misg.

TABLE 6 (Cont'd)

MEAN STANDARD DEVIATION OF VANE ANGLES AT 16, 48 and 92 m (RADIANS) OVER EMISSION PERIOD

TRIAL NO.	(b) HORIZONTAL ANGLE AVERAGING TIME (SECONDS)											
	1	5	10	15	20	60	75	150	300	600	900	1200
1	.123	.115	.111	.109	.107	.099	.097	.085	.075	.062	.054	
3	.253	.247	.244	.242	.240	.231	.229	.223	.215	.212	.202	.197
4	.204	.189	.181	.173	.168	.136	.131	.102	.064	.034	.016	
5	.090	.077	.070	.066	.064	.054	.051	.042	.034	.026		
6	.208	.200	.196	.192	.189	.176	.172	.160	.138	.083		
7	.113	.099	.092	.088	.086	.075	.072	.062	.052	.028		
8	.089	.076	.069	.067	.065	.060	.059	.056	.052			
9^x	.145	.136	.131	.127	.125	.102						
10	.259	.252	.248	.244	.242	.228	.224	.211	.187	.163		
11*	.060	.047	.042	.038	.035	.028	.025	.022	.020			
12	.061	.047	.040	.037	.035	.031	.031	.030	.029			
13^x	.075	.066	.063	.062	.061	.059	.059	.056	.051			
14	.050	.039	.033	.031	.029	.025	.025	.023	.021	.021		
15	.064	.052	.041	.044	.042	.038	.037	.035	.030			

x 92 m misg; * 48 m misg;

TABLE 7

OBSERVED AND PREDICTED NORMALIZED CROSSWIND INTEGRATED DEPOSIT DENSITIES (mg $g^{-1}m^{-1}$)

Trial	Reference	ARC DISTANCE (m)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
1	Observed		.001	1.208	2.654	1.137		.262		.120	.026		
	Predicted β=1		.018	.624	2.972	1.389		.070		.001	.000		
	β=4		.149	1.282	2.139	1.130		.208		.022	.001		
3	Observed	.001	.020	.879	1.494	1.032		.461		.217	.109	.064	.008
	Predicted β=1	.009	.367	1.028	1.312	.991		.417		.130	.026	.002	.000
	β=4	.096	.834	1.257	1.043	.676		.303		.125	.045	.014	.006
4	Observed	.845	2.418	1.178	.882	.374		.255		.132	.085	.013	
	Predicted β=1	1.180	2.966	2.547	.988	.307		.021		.000	.000	.000	
	β=4	2.125	2.466	1.746	.755	.356		.108		.028	.005	.000	
5	Observed			.000	.011	.082		.251		.325	.111	.061	.026
	Predicted β=1			.000	.002	.049		.422		.542	.294	.076	.019
	β=4			.000	.046	.243		.493		.404	.200	.077	.035
6	Observed		.000	.144	.379	.482		.376		.229	.225	.095	.030
	Predicted β=1		.000	.013	.247	.600		.761		.466	.127	.015	.001
	β=4		.011	.142	.585	.701		.501		.272	.115	.041	.017
7	Observed				.005	.070		.162		.138	.085	.034	.015
	Predicted β=1				.045	.218		.427		.381	.207	.084	.041
	β=4				.195	.383		.420		.285	.146	.066	.036
8	Observed				.003	.012		.118		.205	.113	.054	.000
	Predicted β=1				.000	.000		.017		.339	.584	.123	.020
	β=4				.000	.010		.184		.439	.342	.132	.048

TABLE 7 (Cont'd)

OBSERVED AND PREDICTED NORMALIZED CROSSWIND INTEGRATED DEPOSIT DENSITIES (mg $g^{-1}m^{-1}$)

Trial	Reference	ARC DISTANCE (m)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
9	Observed	2.707	1.966	.851	.327	.158	.129	.102	.082	.034	.023		
	Predicted β=1	3.735	4.244	1.884	.220	.032	.006	.001	.000	.000	.000		
	β=4	4.000	2.914	1.533	.418	.138	.052	.023	.007	.003	.000		
10	Observed	.001	.218	.882	.926	.663	.376	.259	.176	.161	.099	.035	
	Predicted β=1	.064	.724	1.261	1.213	.818	.521	.340	.192	.124	.037	.009	
	β=4	.382	1.176	1.320	.917	.575	.368	.260	.161	.112	.043	.016	
11	Observed			.002	.039	.256	.609	.835	.741	.534	.092	.008	
	Predicted β=1			.000	.001	.111	.783	1.486	1.128	.518	.018	.000	
	β=4			.000	.028	.417	.986	1.148	.802	.489	.060	.004	
12	Observed						.066	.217	.381	.659	.149	.056	
	Predicted β=1						.001	.036	.342	1.120	.274	.003	
	β=4						.007	.109	.602	1.015	.296	.009	
13	Observed						.069	.369	.873	.674	.236		
	Predicted β=1						.341	.607	.713	.619	.223		
	β=4						.459	.629	.620	.494	.192		
14	Observed					.007	.267	1.106	1.179	.654	.028	.009	
	Predicted β=1					.104	.707	1.341	1.185	.593	.005	.000	
	β=4					.323	.903	1.107	.822	.500	.078	.006	
15	Observed						.036	.194	.393	.691	.212	.023	
	Predicted β=1						.004	.069	.656	1.395	.135	.001	
	β=4						.032	.220	.819	1.012	.235	.008	

TABLE 8

COMPARISON OF OBSERVED AND PREDICTED NORMALIZED CROSSWIND INTEGRATED DEPOSIT DENSITY CHARACTERISTICS

Trial Number	1	3	4	5	6	7	8	9	10	11	12	13	14	15
Distance to Peak Deposit (m)														
Observed	550	530	275	1500	750	1200	1440	183	450	1150	1640	1410	1270	1700
Predicted Model A	500	380	275	1100	750	990	1760	183	370	1100	1610	1200	1000	1560
Predicted Model B	800	950	460	1600	1370	1750	1370	185	450	950	1100	1100	900	1100
Peak Deposit (mg $g^{-1}m^{-1}$)														
Observed	2.654	1.322	2.418	.334	.482	.166	.213	2.707	.967	.844	.665	.875	1.23	.735
Predicted Model A	2.359	1.253	2.466	.493	.701	.428	.443	4.000	1.323	1.150	1.150	.645	1.11	1.050
Predicted Model B	.635	.478	.980	.185	.236	.129	.243	1.617	.949	.450	.324	.359	.536	.365
CWID at Farthest Distance Sampled (mg $g^{-1}m^{-1}$)														
Observed	.026	.008	.014	.026	.030	.015	.000	.023	.035	.008	.056	.236	.009	.023
Predicted Model A	.001	.006	.000	.035	.017	.036	.048	.000	.016	.004	.009	.192	.006	.008
Predicted Model B	.143	.038	.025	.071	.107	.067	.067	.047	.028	.080	.100	.095	.065	.094
Recovery to Farthest Distance Sampled (%)														
Observed	118	114	100	55	90	30	37	92	80	87	64	74	88	73
Predicted Model A	99	88	92	88	87	74	86	109	87	99	94	72	96	94
Predicted Model B	71	101	92	55	64	42	67	84	93	73	66	71	86	71
Windspeed (m sec^{-1})	3.84	4.92	2.49	12.88	8.96	14.44	15.86	5.47	4.72	8.07	11.87	10.96	8.30	11.24
ΔT 13m - 1m (°C)	-.10	-1.00	-1.10	-.28	-1.85	-1.15	-.38	-2.00	-1.35	.40	-.10	1.30	.90	1.40

TABLE 9

STANDARD DEVIATIONS OF CROSSWIND PARTICLE DISTRIBUTION σ_p (RADIANS) AND CROSSWIND VANE ANGLES σ_y (RADIANS)

Trial No.	Reference	ARC DISTANCE (m) 182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
1	σ_y $\beta=1$		.097	.093	.086	.081		.075		.068	.061		
	$\beta=4$		.108	.106	.103	.101		.097		.091	.084		
	σ_p		.071	.142	.109	.107		.103		.113	.099		
3	σ_y $\beta=1$	.235	.232	.229	.226	.223		.219		.214	.209	.204	.200
	$\beta=4$	.244	.242	.240	.237	.235		.232		.229	.225	.221	.217
	σ_p	.111	.230	.241	.239	.244		.225		.232	.208	.205	.033
4	σ_y $\beta=1$	.133	.116	.103	.080	.065		.047		.030	.015	.000	
	$\beta=4$	.169	.158	.150	.138	.132		.116		.098	.075	.056	
	σ_p	.142	.147	.161	.117	.152		.123		.093	.062	.036	
5	σ_y $\beta=1$			.060	.057	.054		.048		.044	.040	.035	.032
	$\beta=4$			.073	.069	.067		.064		.060	.058	.052	.047
	σ_p			.025	.064	.050		.056		.053	.051	.042	.022
6	σ_y $\beta=1$		.185	.182	.176	.171		.164		.156	.144	.117	.092
	$\beta=4$		.198	.195	.191	.189		.185		.180	.174	.167	.163
	σ_p		.059	.124	.182	.222		.225		.221	.188	.164	.111
7	σ_y $\beta=1$				.080	.077		.071		.066	.061	.055	.048
	$\beta=4$				.092	.090		.086		.082	.078	.074	.070
	σ_p				.022	.056		.079		.065	.062	.054	.048

TABLE 9 (Cont'd)

STANDARD DEVIATIONS OF CROSSWIND PARTICLE DISTRIBUTION σ_p (RADIANS) AND CROSSWIND VANE ANGLES σ_y (RADIANS)

Trial No.	Reference	ARC DISTANCE (m)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
8	σ_y β=1				.062	.061		.060		.058	.056	.054	.052
	β=4				.070	.068		.066		.063	.062	.060	.060
	σ_p				.055	.068		.067		.059	.064	.067	.009
9	σ_y β=1	.114	.105	.100*									
	β=4	.132	.129	.124	.120	.114	.109	.105	.101*				
	σ_p 100 μ	.119	.118	.117	.131	.142	.139	.123	.128	.147	.056		
	50 μ	.129	.147	.124	.131	.132	.141	.138	.170	.165	.151	.101	
10	σ_y β=1	.235	.228	.224	.217	.210	.202	.196	.188	.183	.169	.155	
	β=4	.248	.245	.242	.238	.235	.231	.228	.225	.222	.215	.202	
	σ_p	.140	.185	.249	.260	.254	.244	.239	.237	.212	.203	.149	
11	σ_y β=1			.030	.025	.024	.023	.022	.021	.021	.020	.019	
	β=4			.041	[illegible]	.034	.033	.031	.030	.029	.025	.023	
	σ_p			.037	.050	.047	.047	.045	.044	.043	.040	.020	
12	σ_y β=1						.031	.030	.030	.030	.030	.029	
	β=4						.035	.034	.033	.032	.031	.031	
	σ_p						.058	.045	.047	.046	.054	.051	
13	σ_y β=1						.059	.058	.057	.056	.053		
	β=4						.061	.061	.060	.060	.059		
	σ_p						.034	.036	.048	.061	.051		

* Less than 500 #'s.

TABLE 9 (Cont'd)

STANDARD DEVIATIONS OF CROSSWIND PARTICLE DISTRIBUTION σ_p (RADIANS) AND CROSSWIND VANE ANGLES σ_y (RADIANS)

Trial No.	Reference	ARC DISTANCE (m)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
14	σ_y $\beta=1$					.024	.024	.023	.022	.022	.021	.021	
	$\beta=4$					.028	.028	.027	.026	.026	.024	.024	
	σ_p					.032	.032	.037	.038	.034	.042	.033	
15	σ_y $\beta=1$						.037	.036	.035	.035	.033	.032	
	$\beta=4$						.042	.041	.040	.040	.038	.036	
	σ_p						.034	.030	.035	.033	.030	.025	

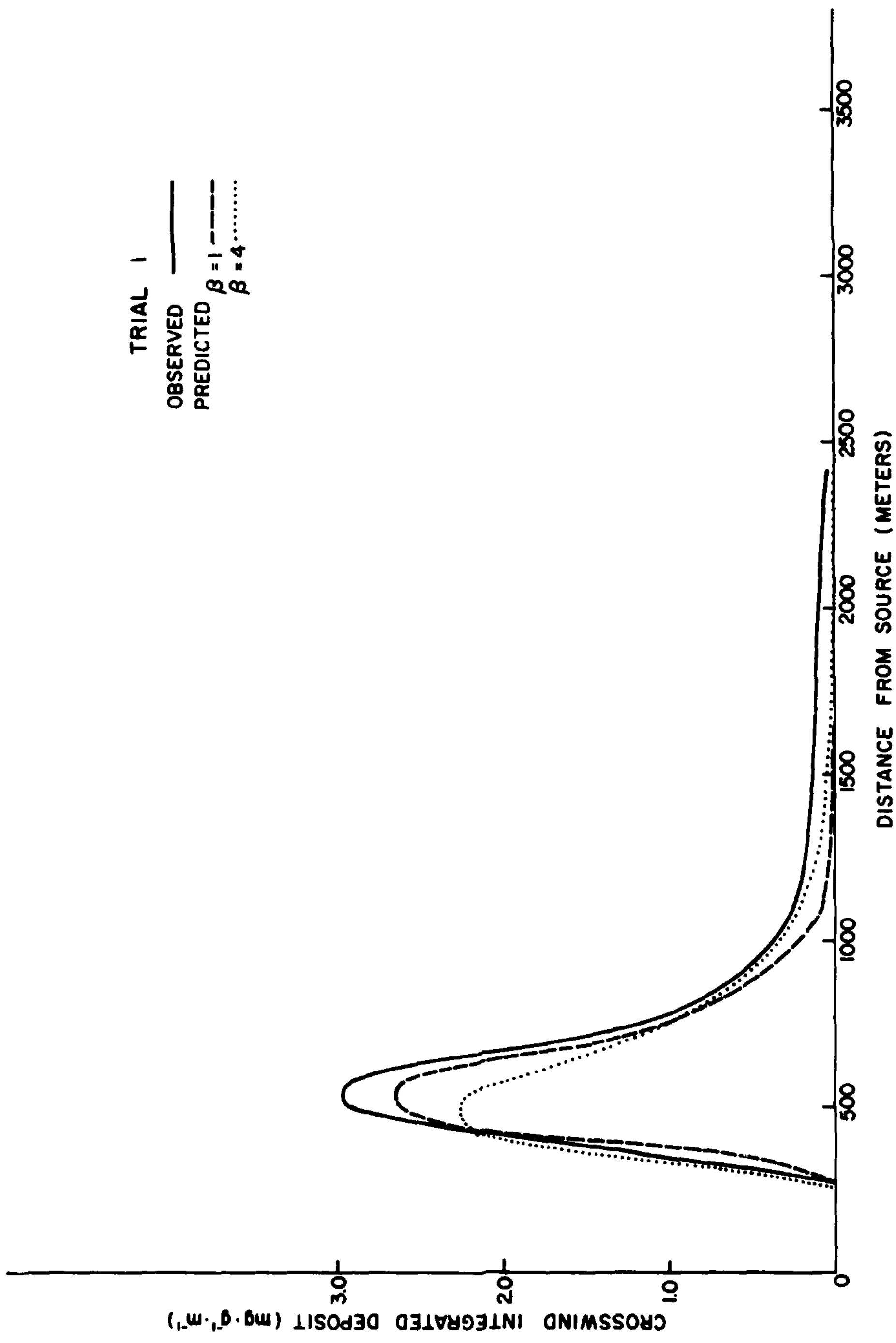


FIGURE 1 : OBSERVED AND PREDICTED CROSSWIND INTEGRATED DEPOSIT AS A FUNCTION OF DISTANCE

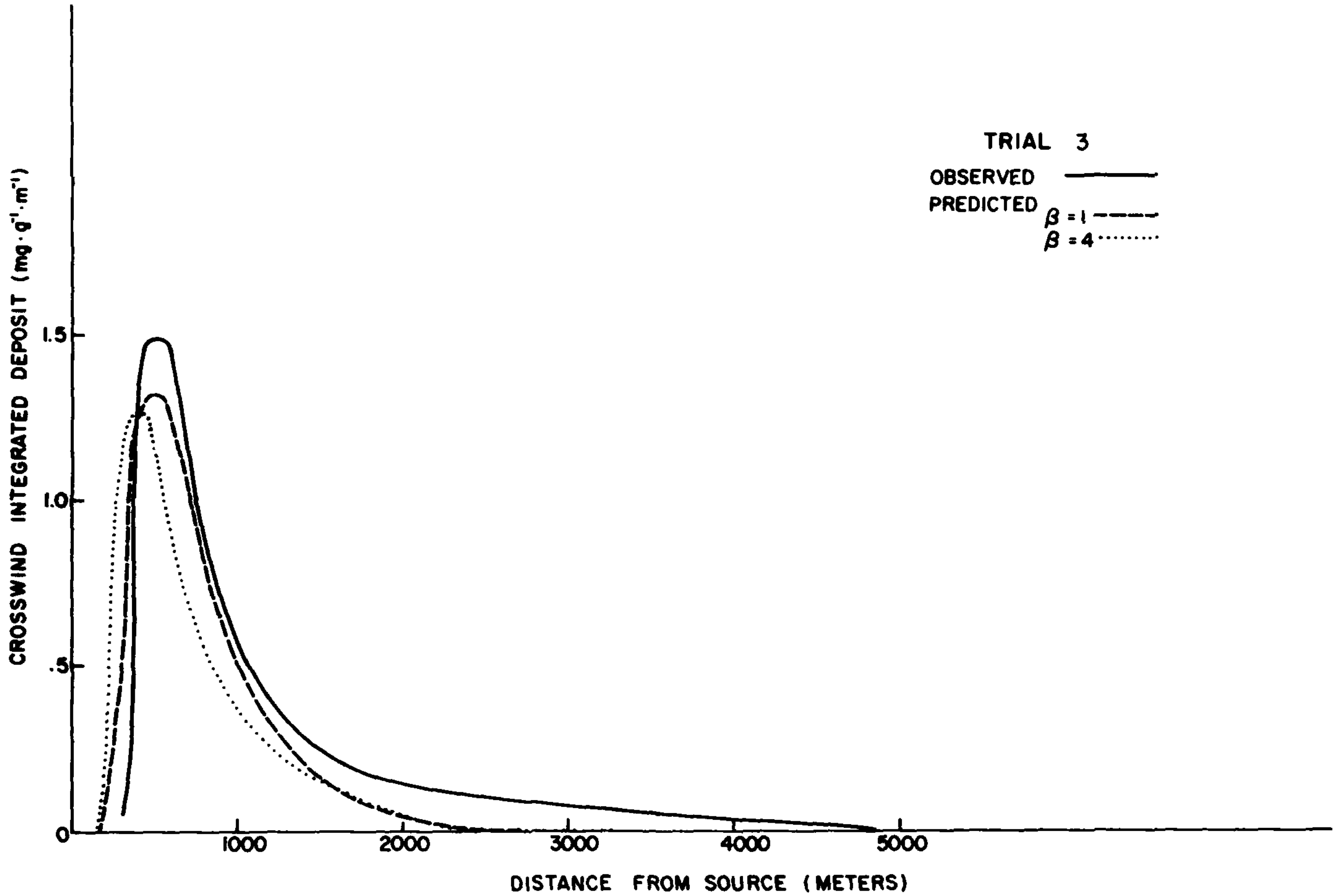


FIGURE 2 : OBSERVED AND PREDICTED CROSSWIND INTEGRATED DEPOSIT AS A FUNCTION OF DISTANCE

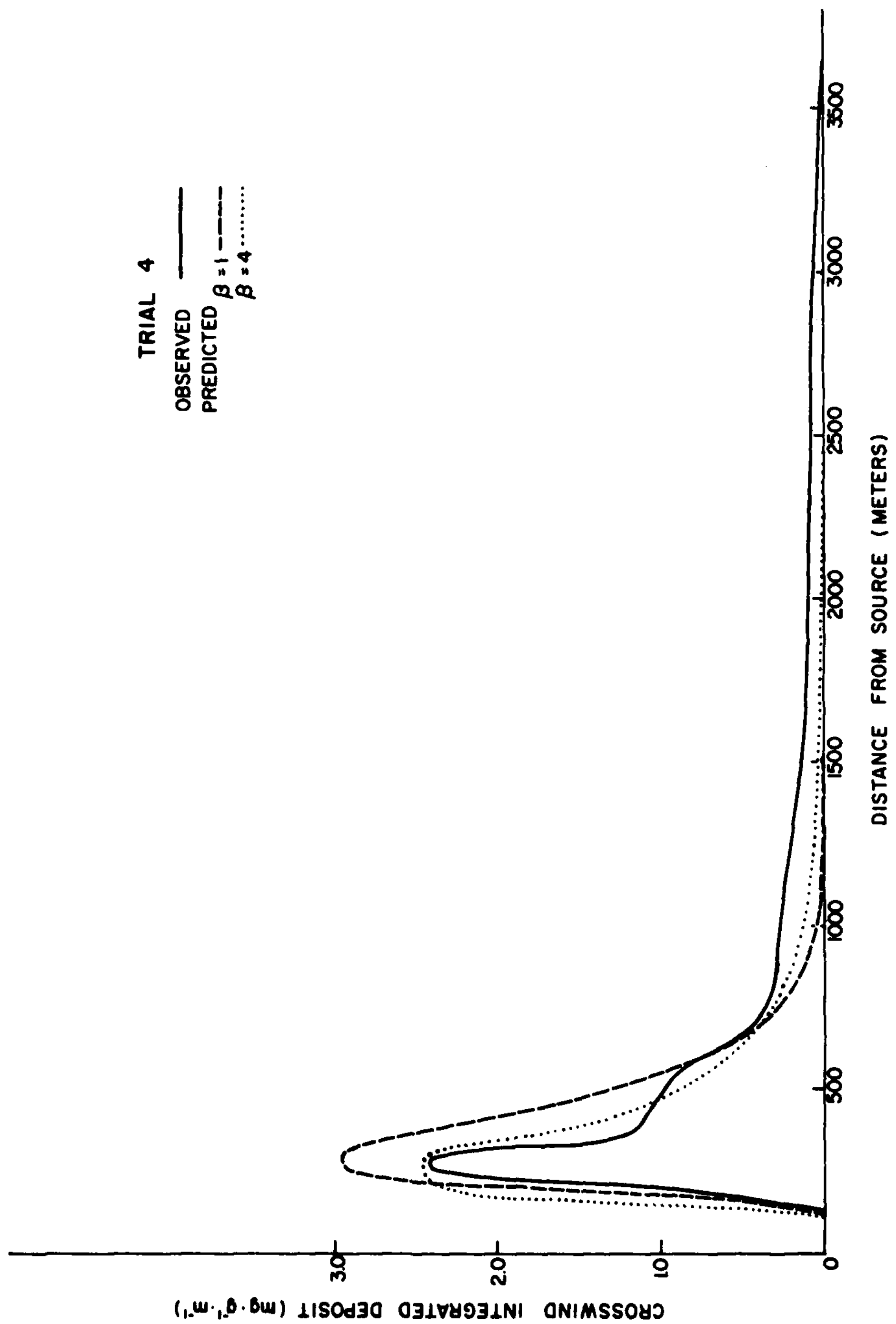


FIGURE 3 : OBSERVED AND PREDICTED CROSSWIND INTEGRATED DEPOSIT AS A FUNCTION OF DISTANCE

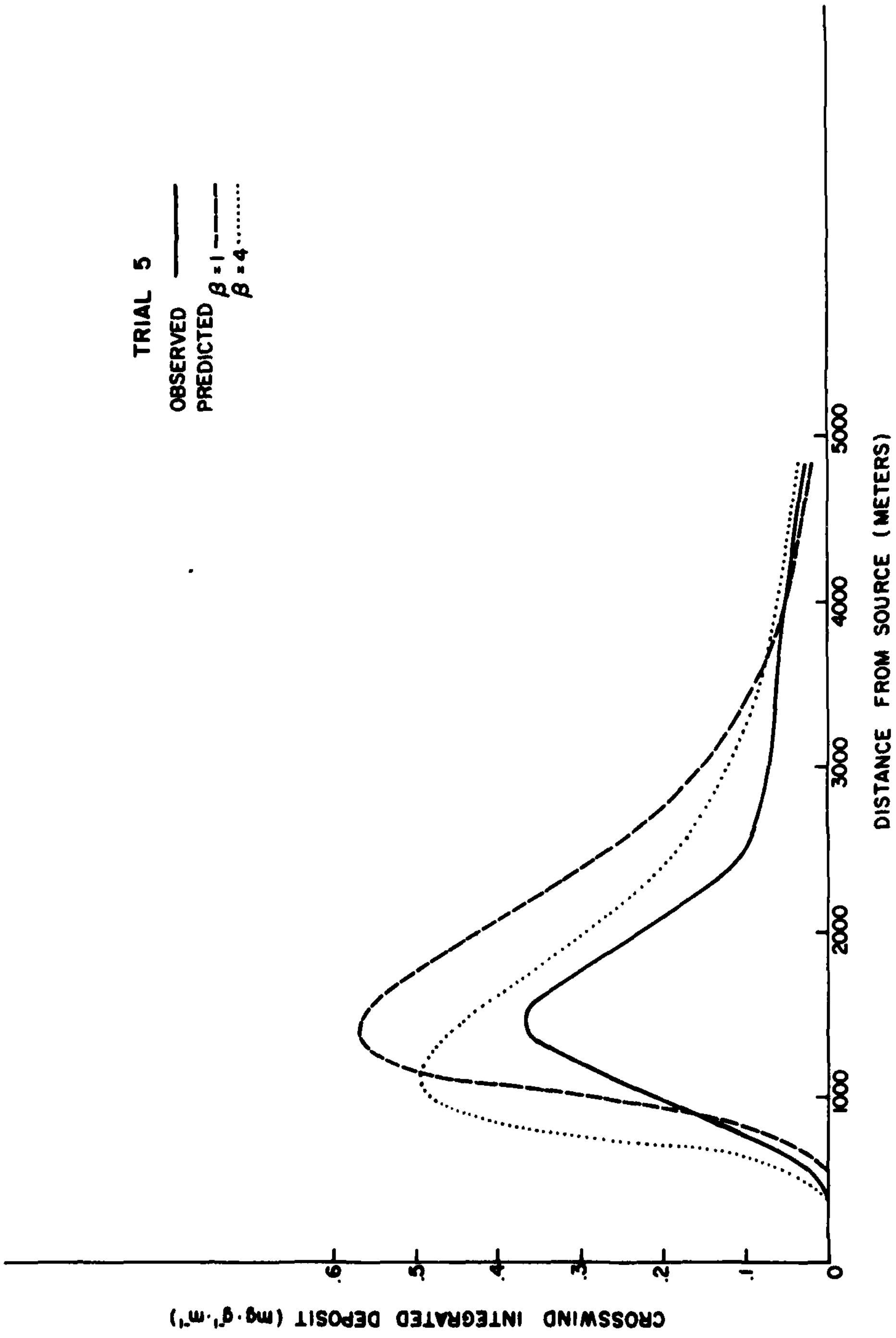


FIGURE 4: OBSERVED AND PREDICTED CROSSWIND INTEGRATED DEPOSIT AS A FUNCTION OF DISTANCE

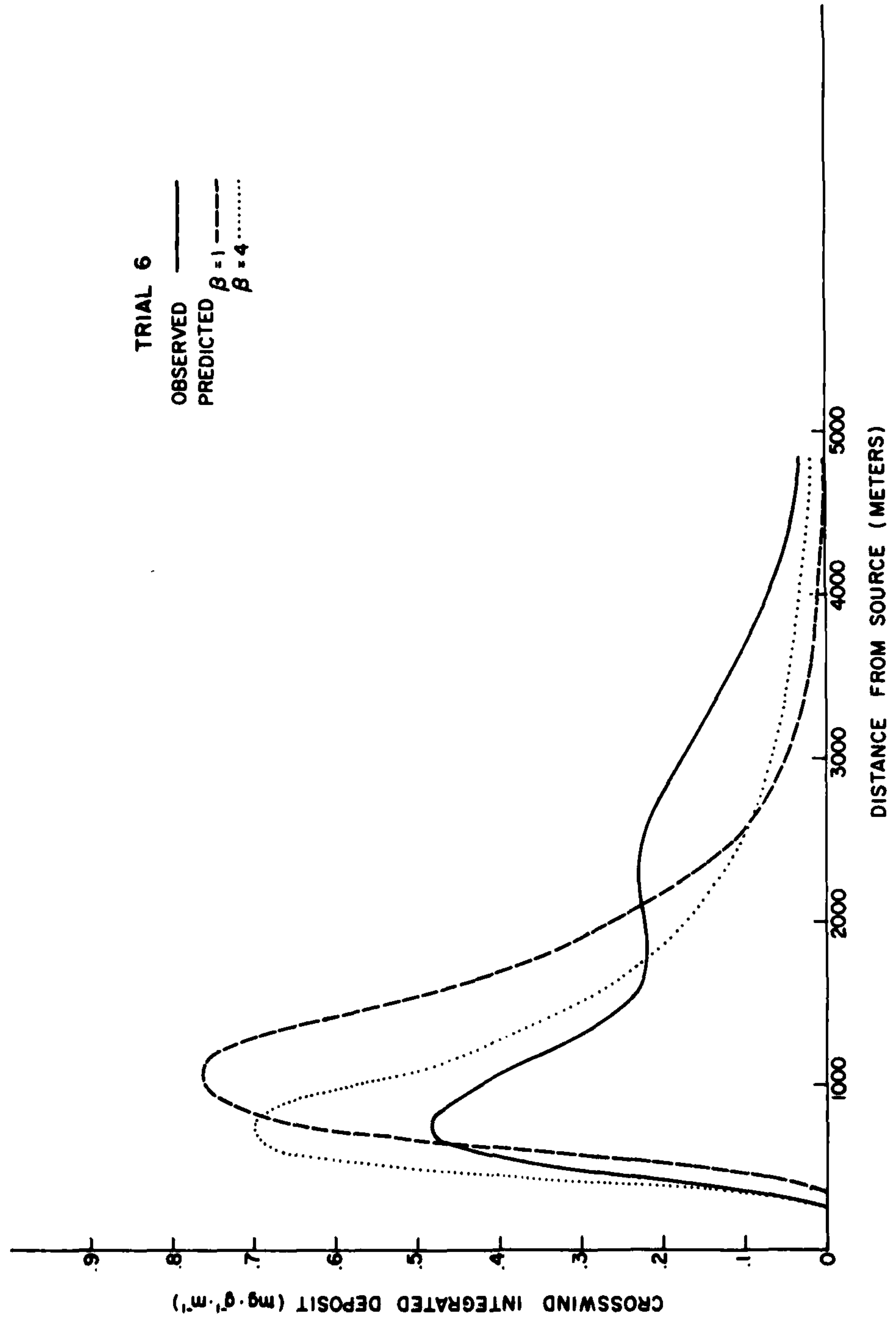


FIGURE 5 : OBSERVED AND PREDICTED CROSSWIND INTEGRATED DEPOSIT AS A FUNCTION OF DISTANCE

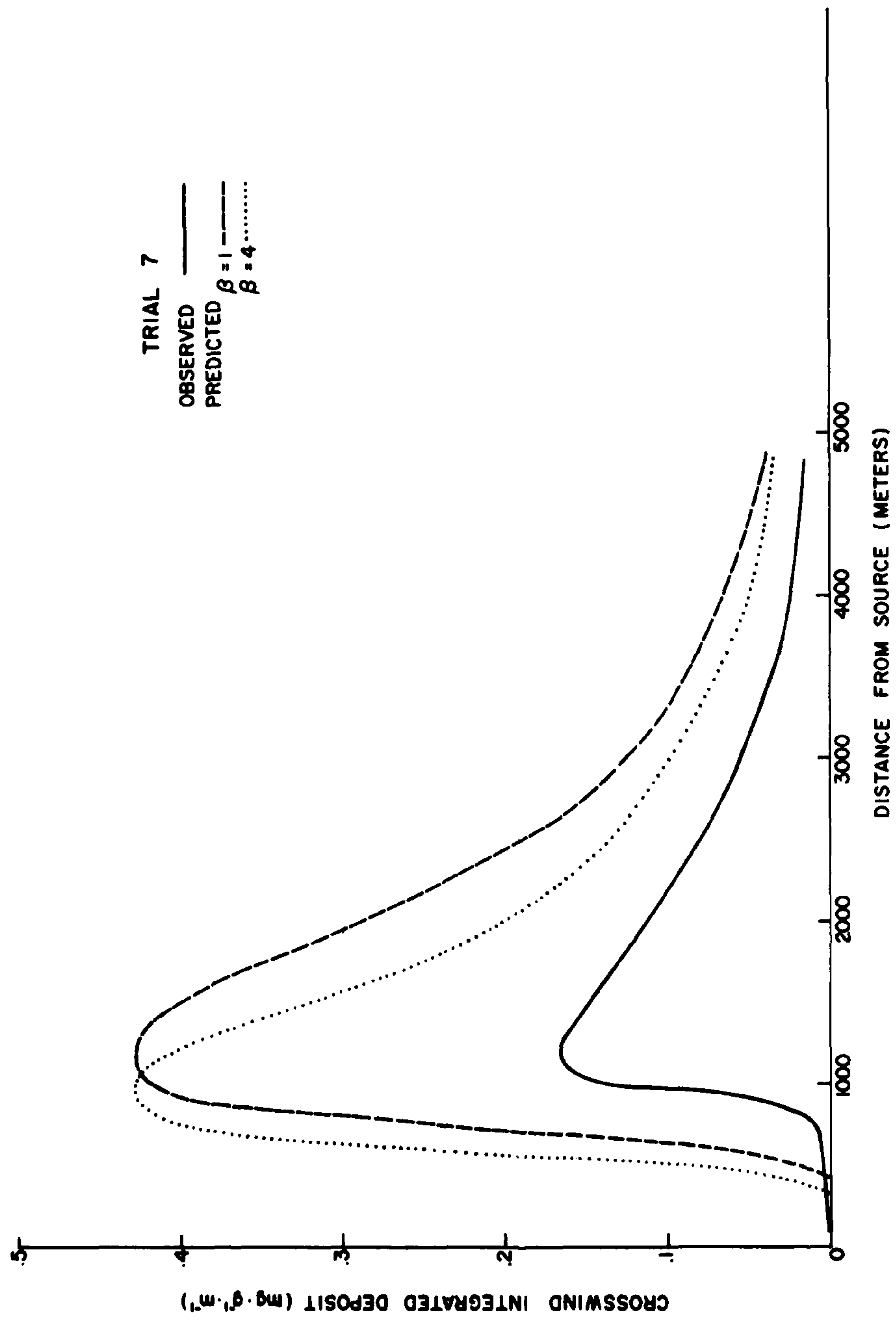


FIGURE 6 : OBSERVED AND PREDICTED CROSSWIND INTEGRATED DEPOSIT AS A FUNCTION OF DISTANCE

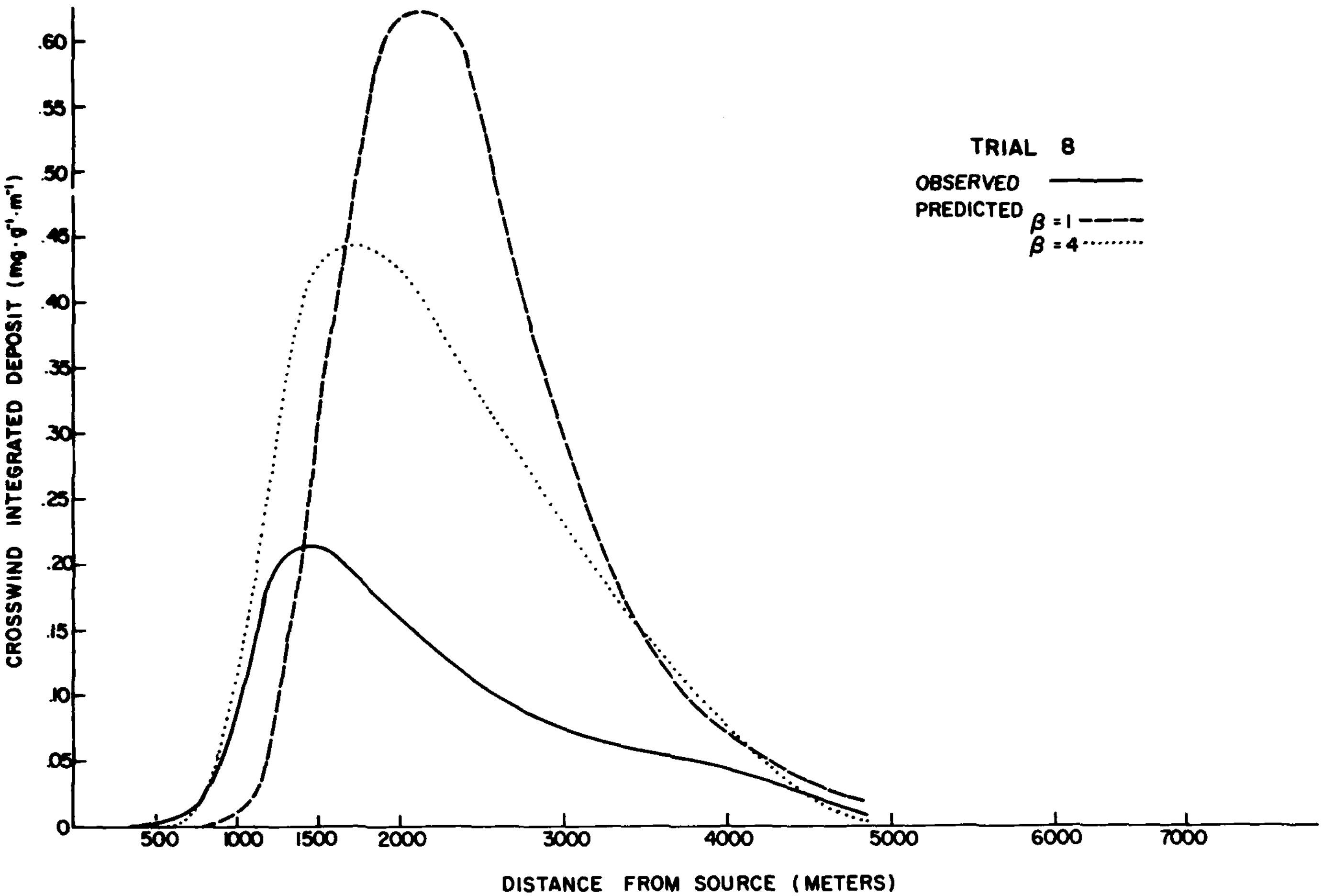


FIGURE 7 : OBSERVED AND PREDICTED CROSSWIND INTEGRATED DEPOSIT AS A FUNCTION OF DISTANCE

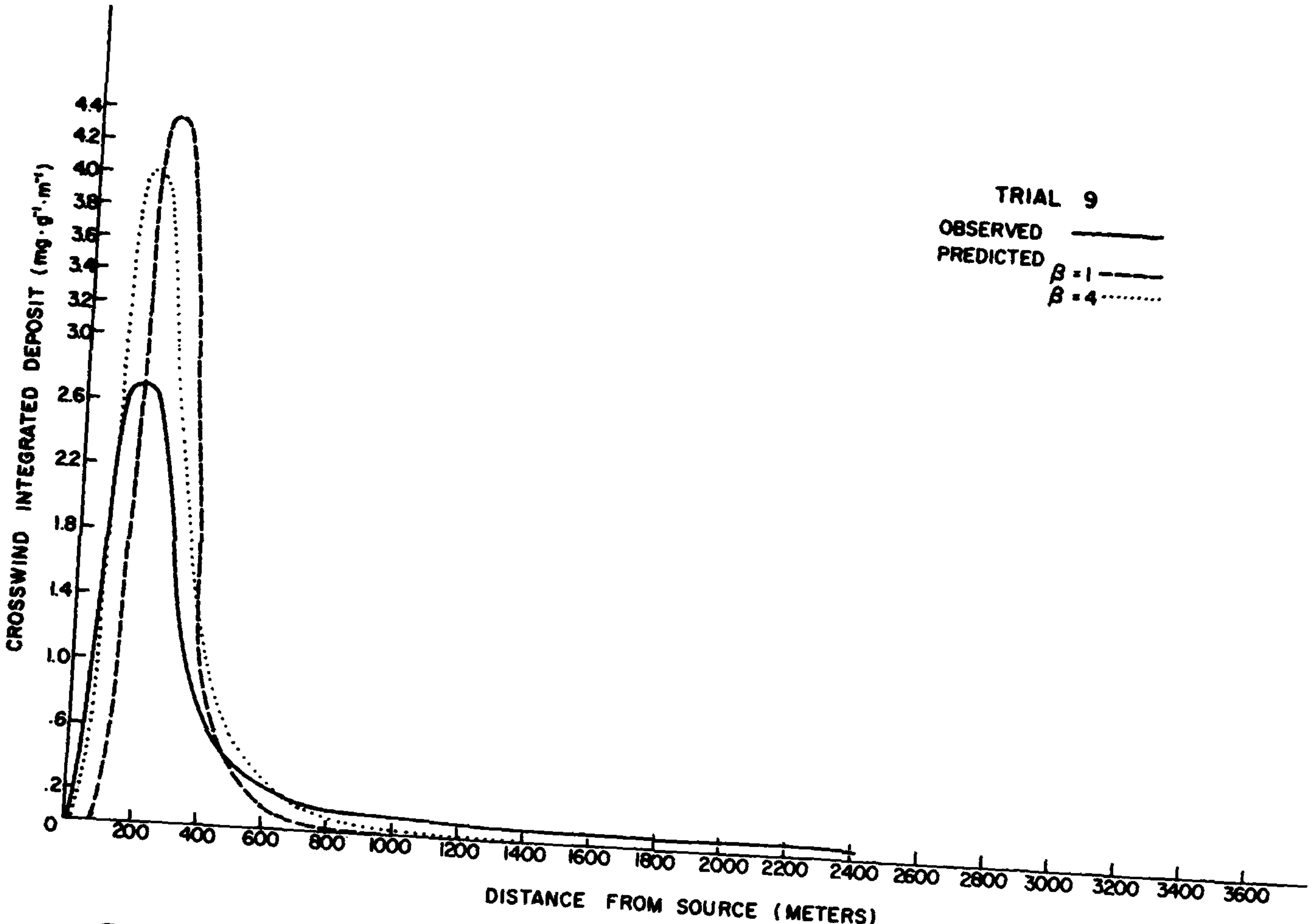


FIGURE 8 : OBSERVED AND PREDICTED CROSSWIND INTEGRATED DEPOSIT AS A FUNCTION OF DISTANCE

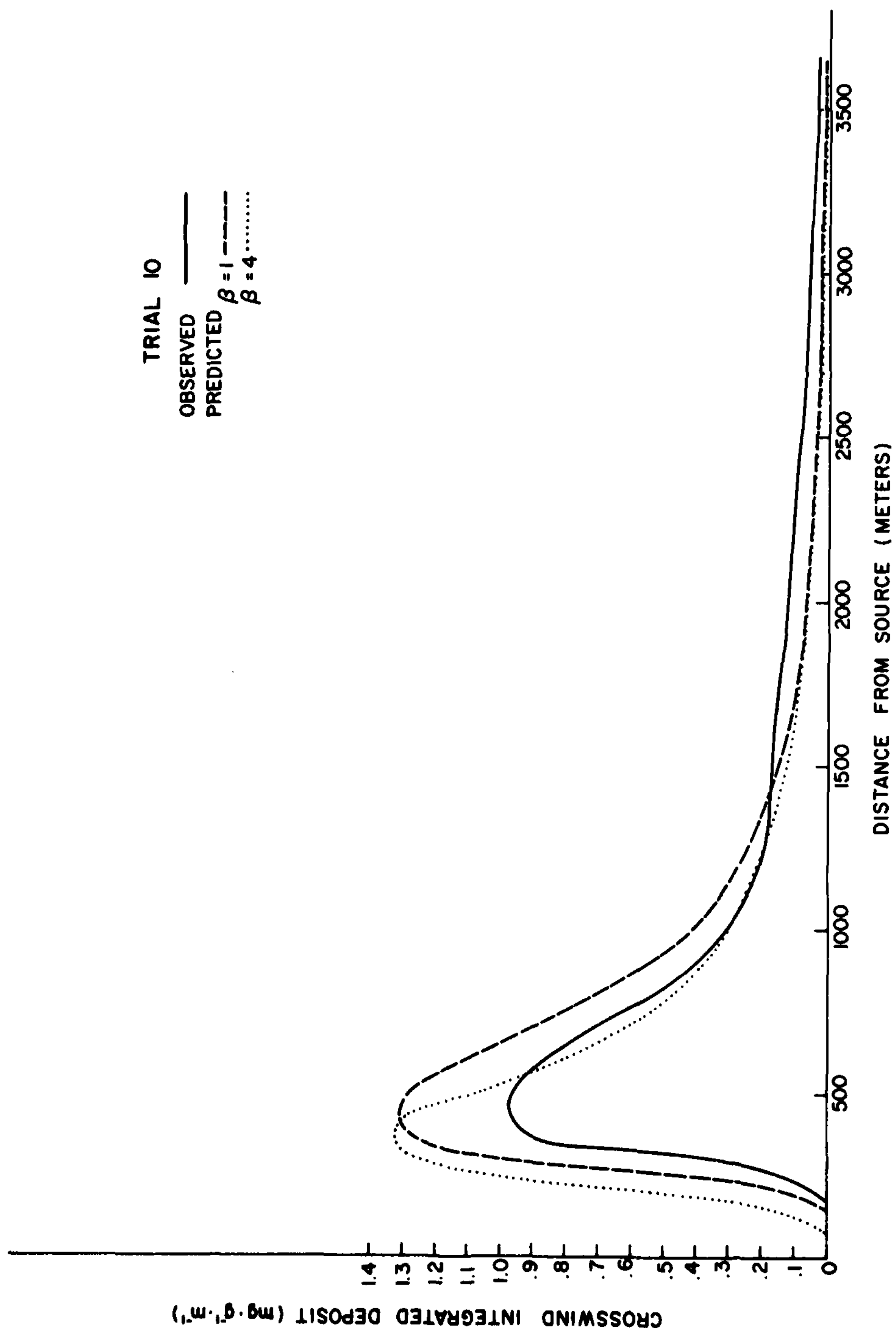


FIGURE 9 : OBSERVED AND PREDICTED CROSSWIND INTEGRATED DEPOSIT AS A FUNCTION OF DISTANCE

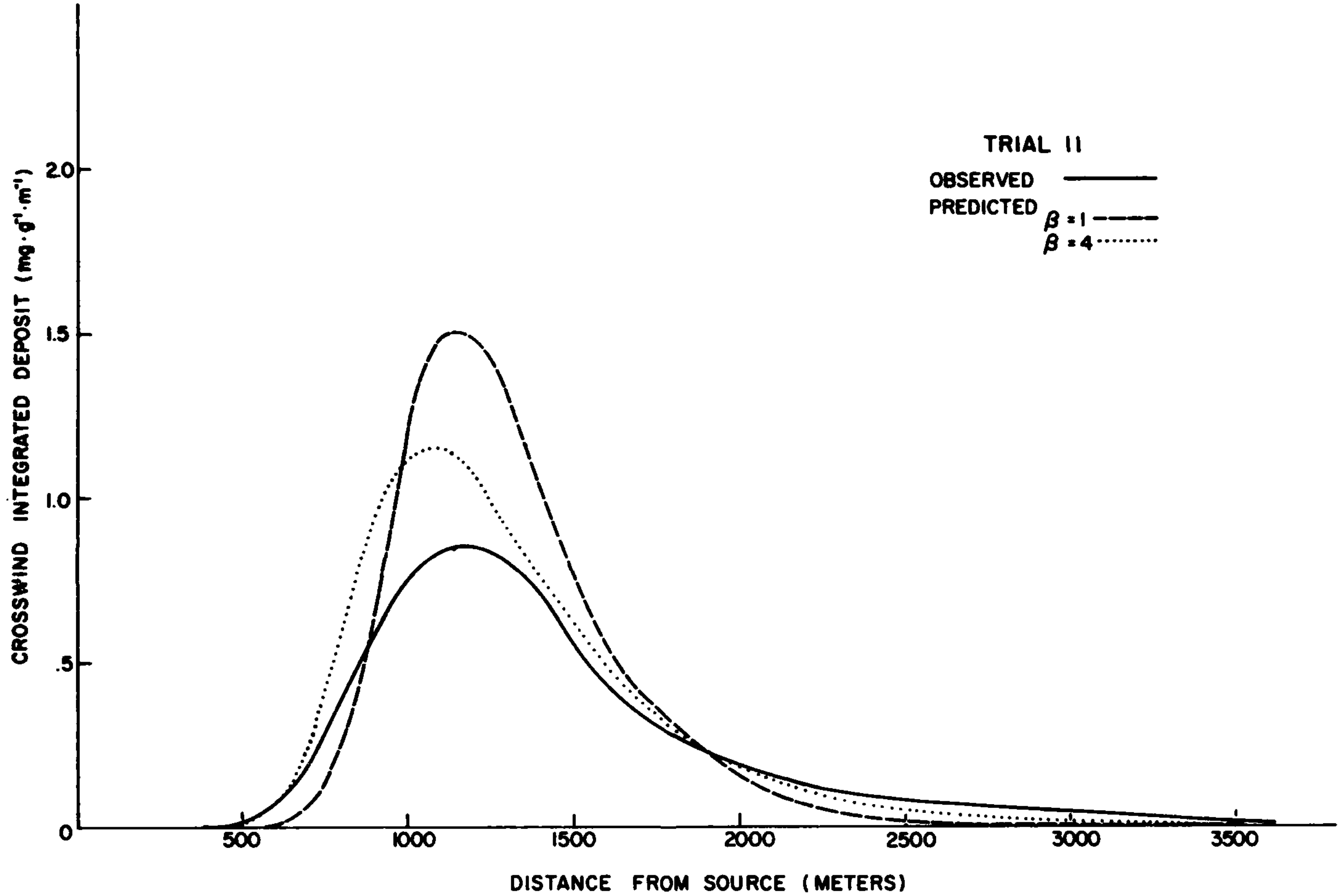


FIGURE 10 : OBSERVED AND PREDICTED CROSSWIND INTEGRATED DEPOSIT AS A FUNCTION OF DISTANCE

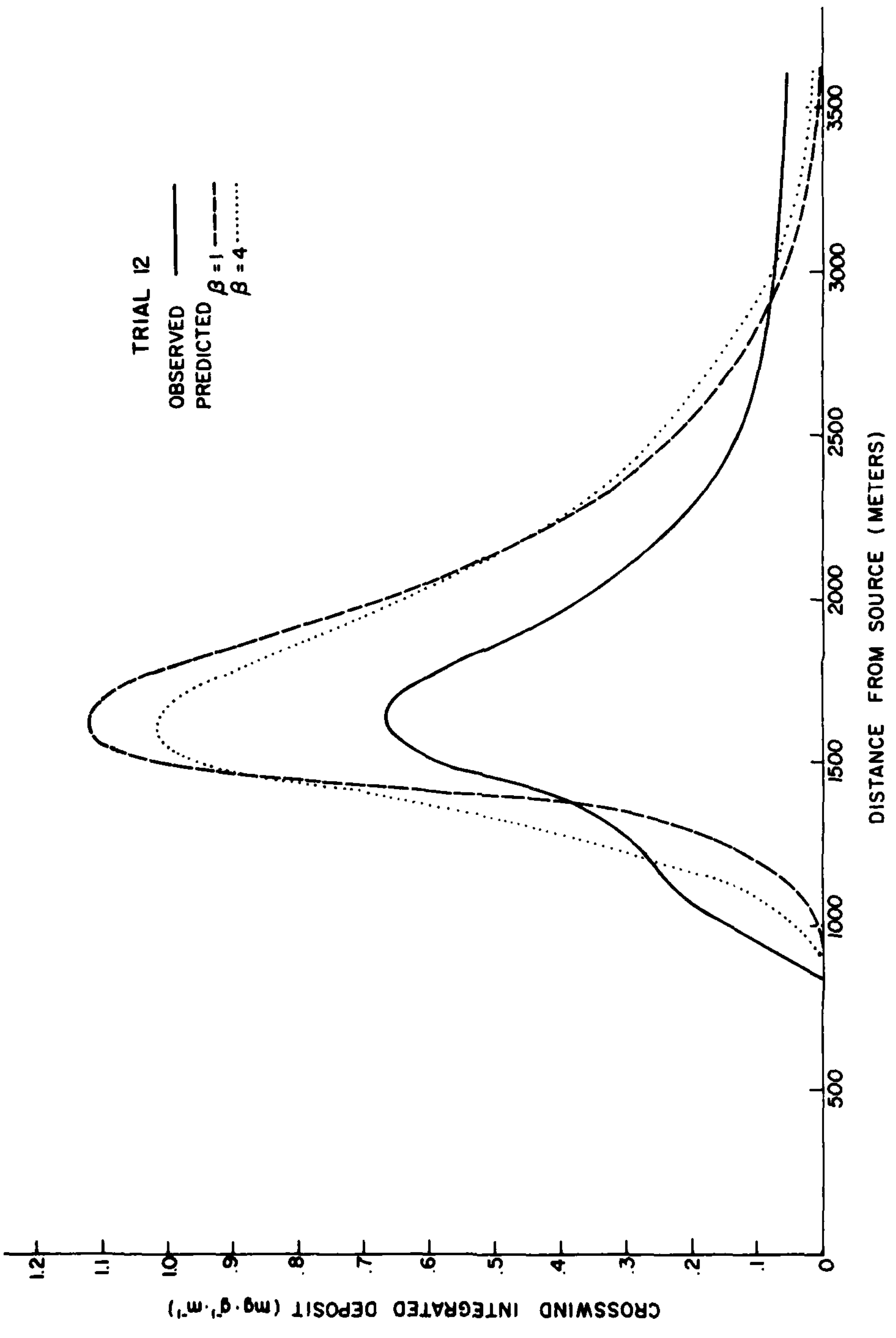


FIGURE 11: OBSERVED AND PREDICTED CROSSWIND INTEGRATED DEPOSIT AS A FUNCTION OF DISTANCE

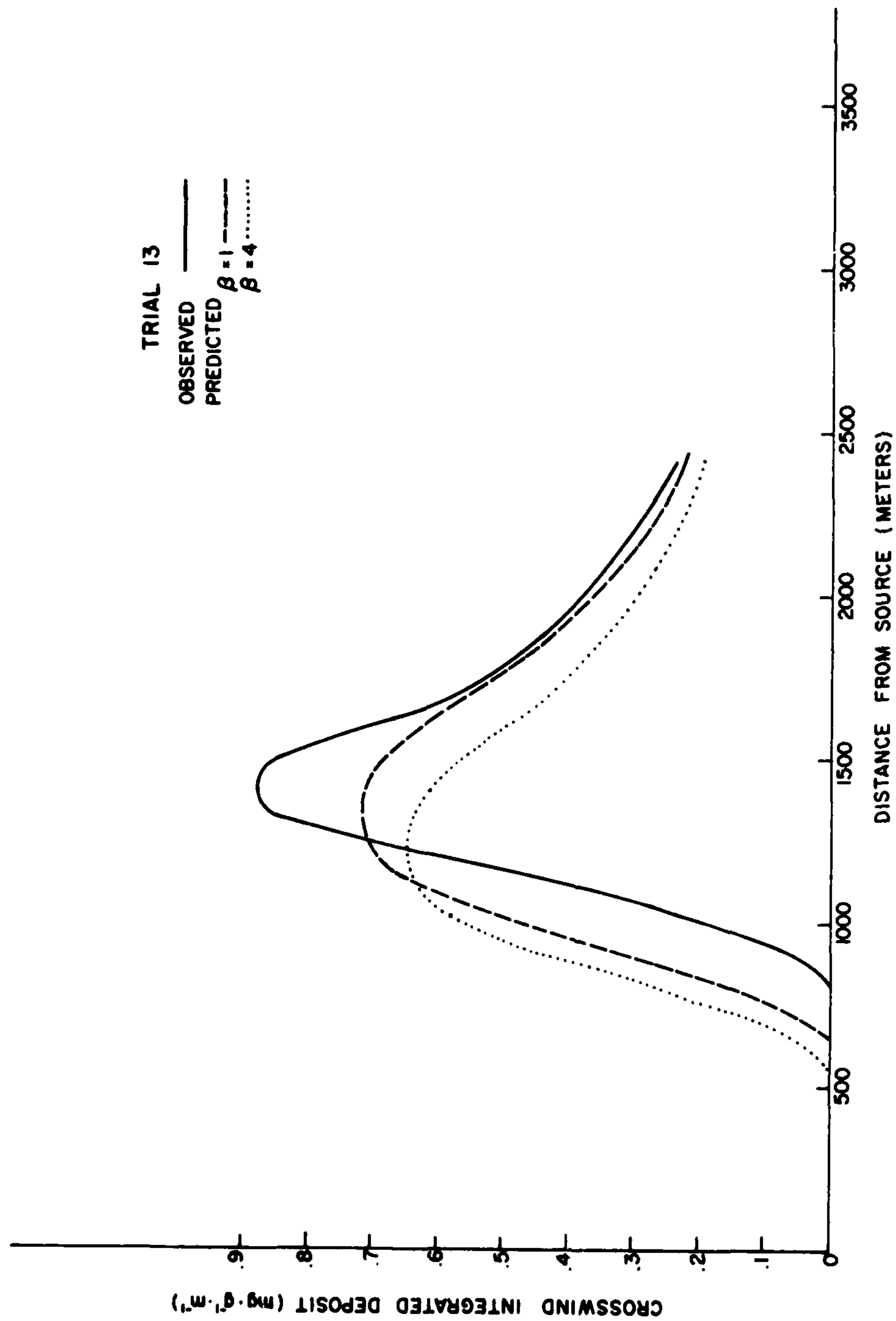


FIGURE 12 : OBSERVED AND PREDICTED CROSSWIND INTEGRATED DEPOSIT AS A FUNCTION OF DISTANCE

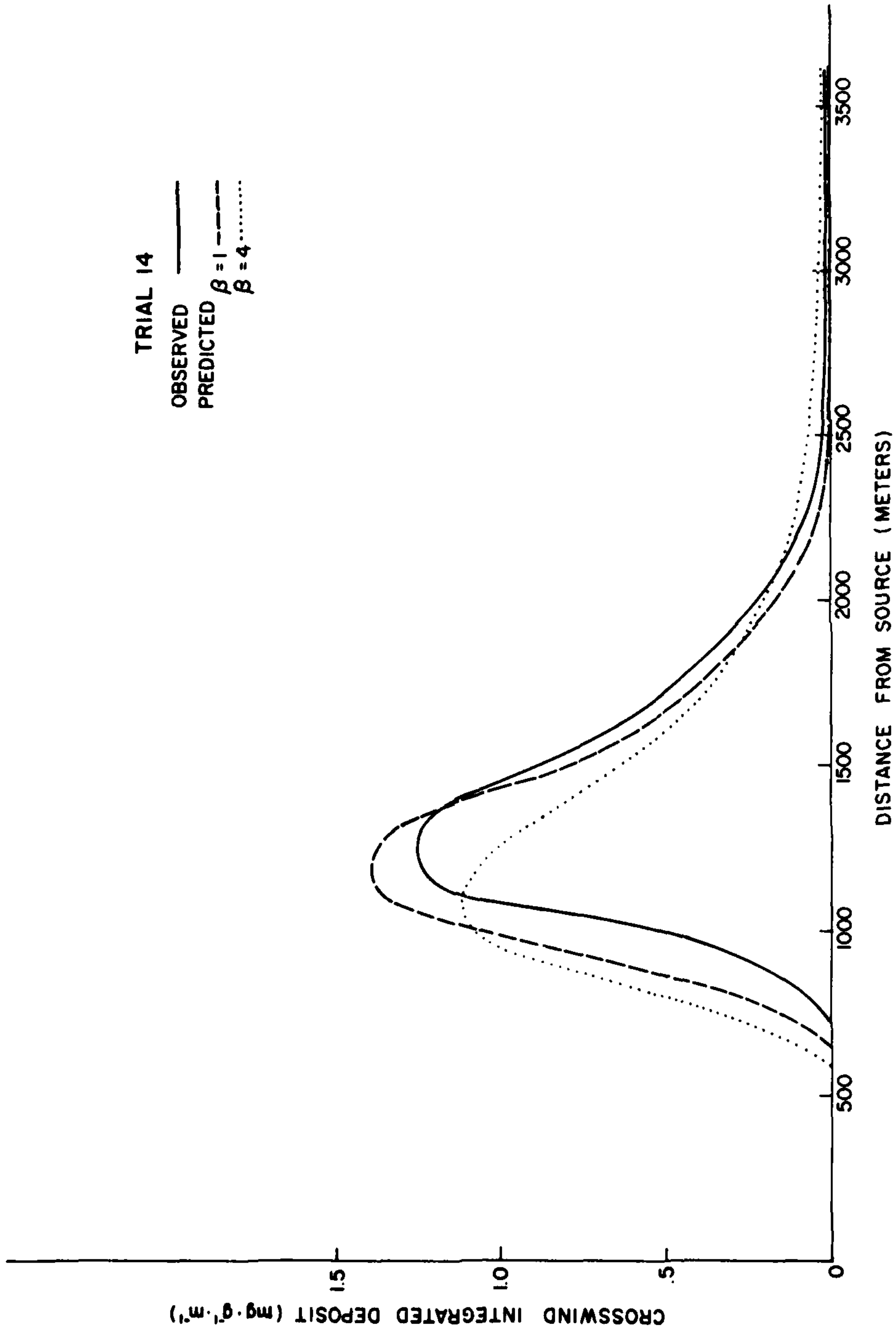


FIGURE 13: OBSERVED AND PREDICTED CROSSWIND INTEGRATED DEPOSIT AS A FUNCTION OF DISTANCE

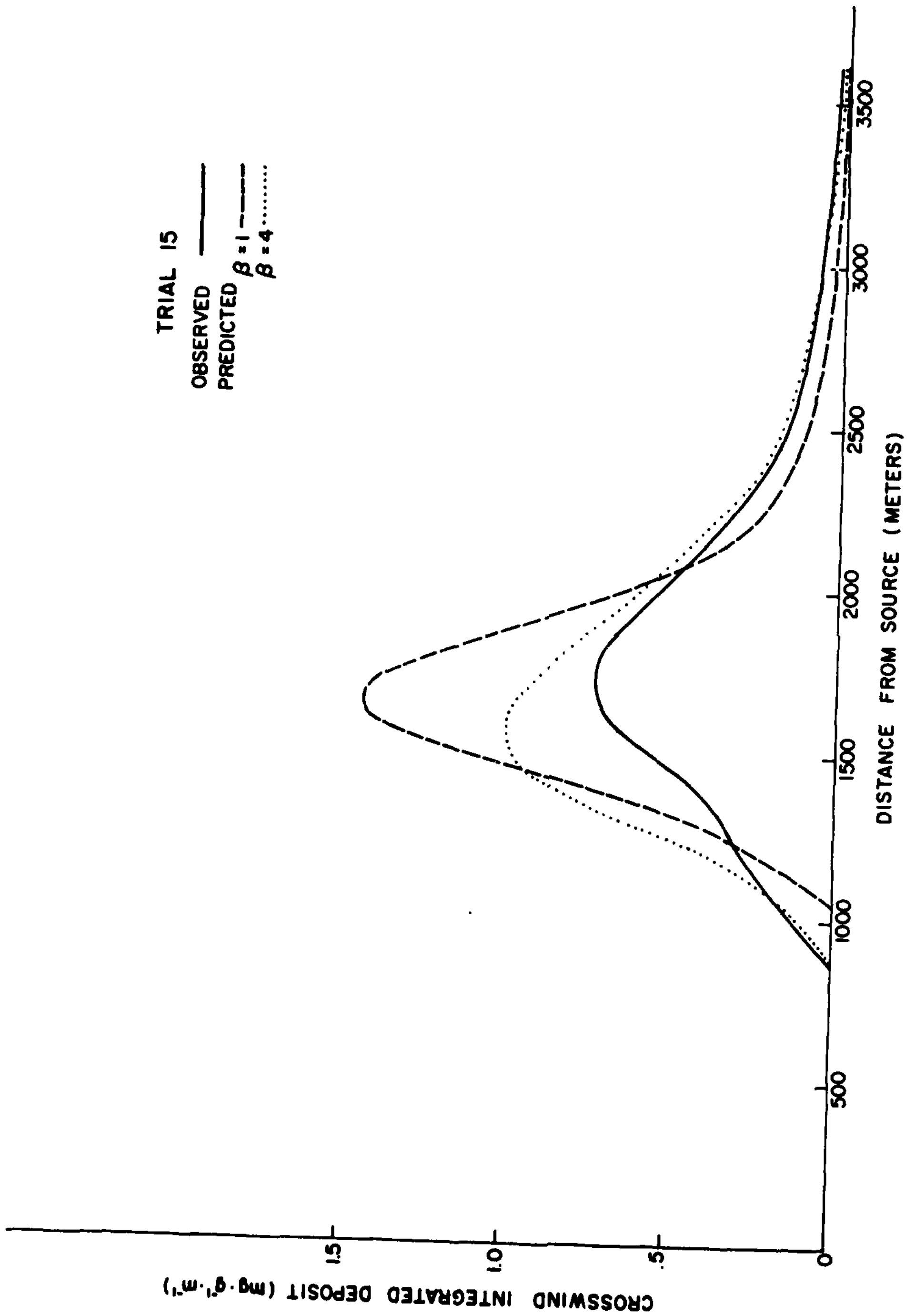
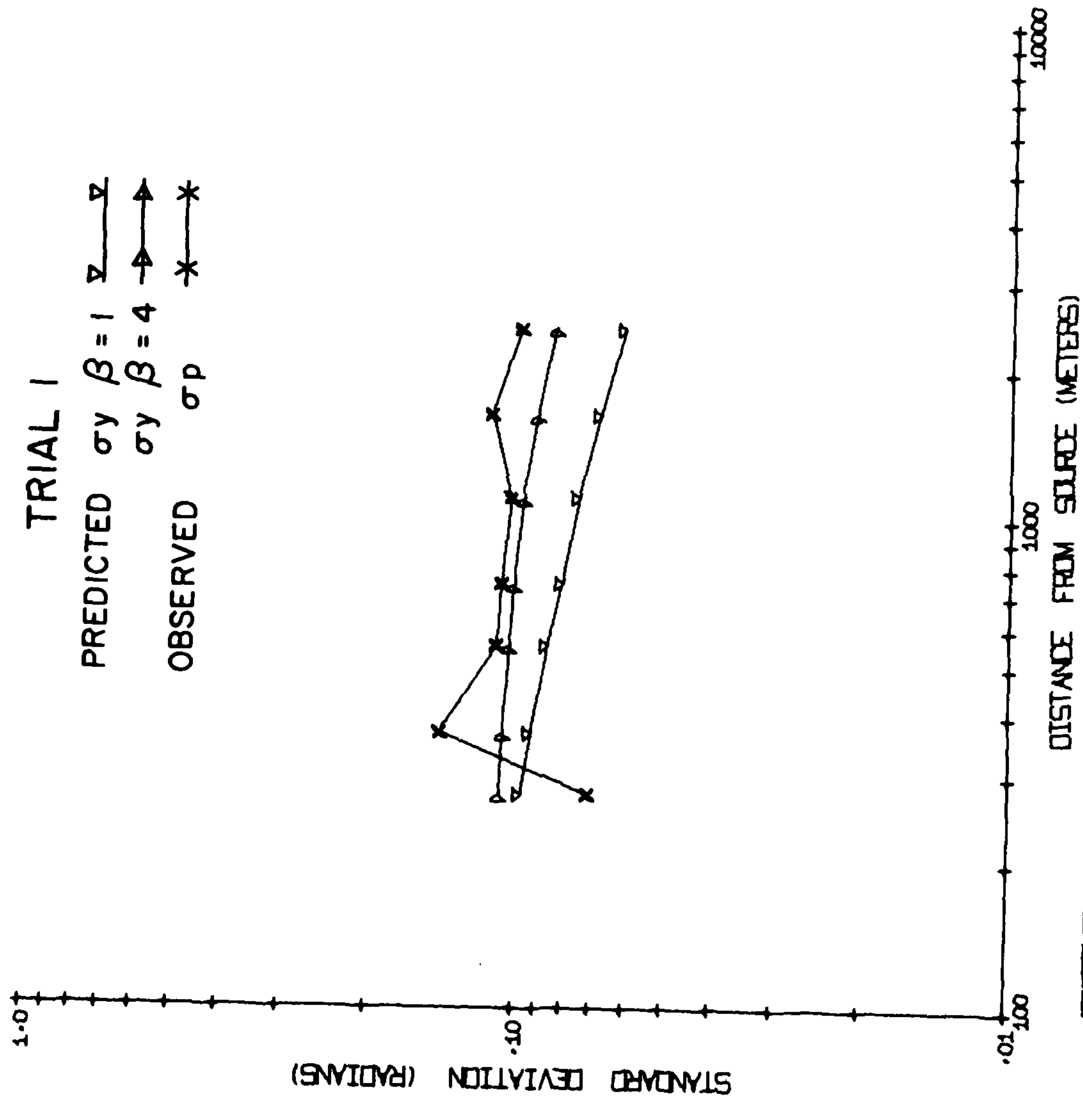
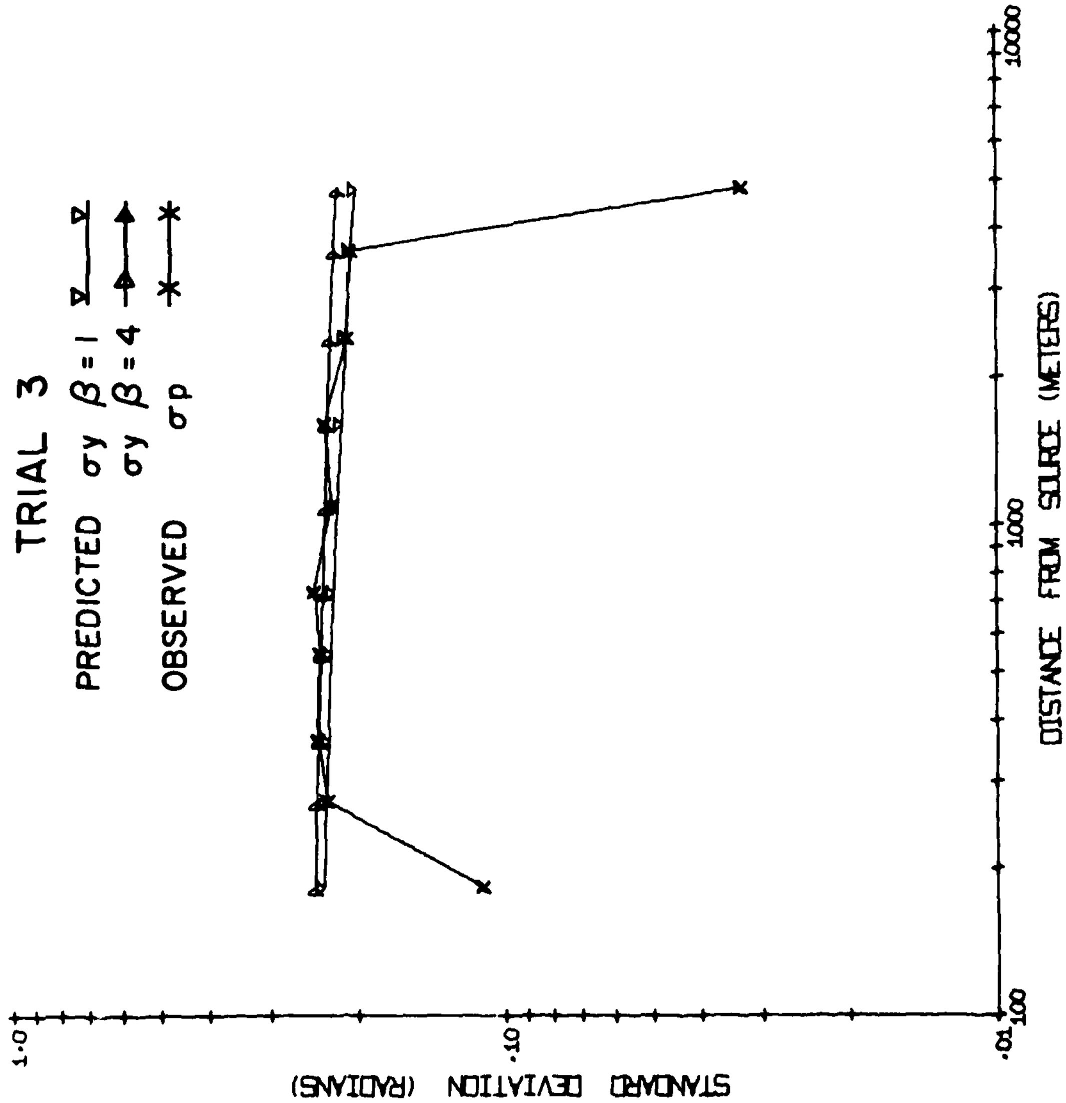


FIGURE 14 : OBSERVED AND PREDICTED CROSSWIND INTEGRATED DEPOSIT AS A FUNCTION OF DISTANCE



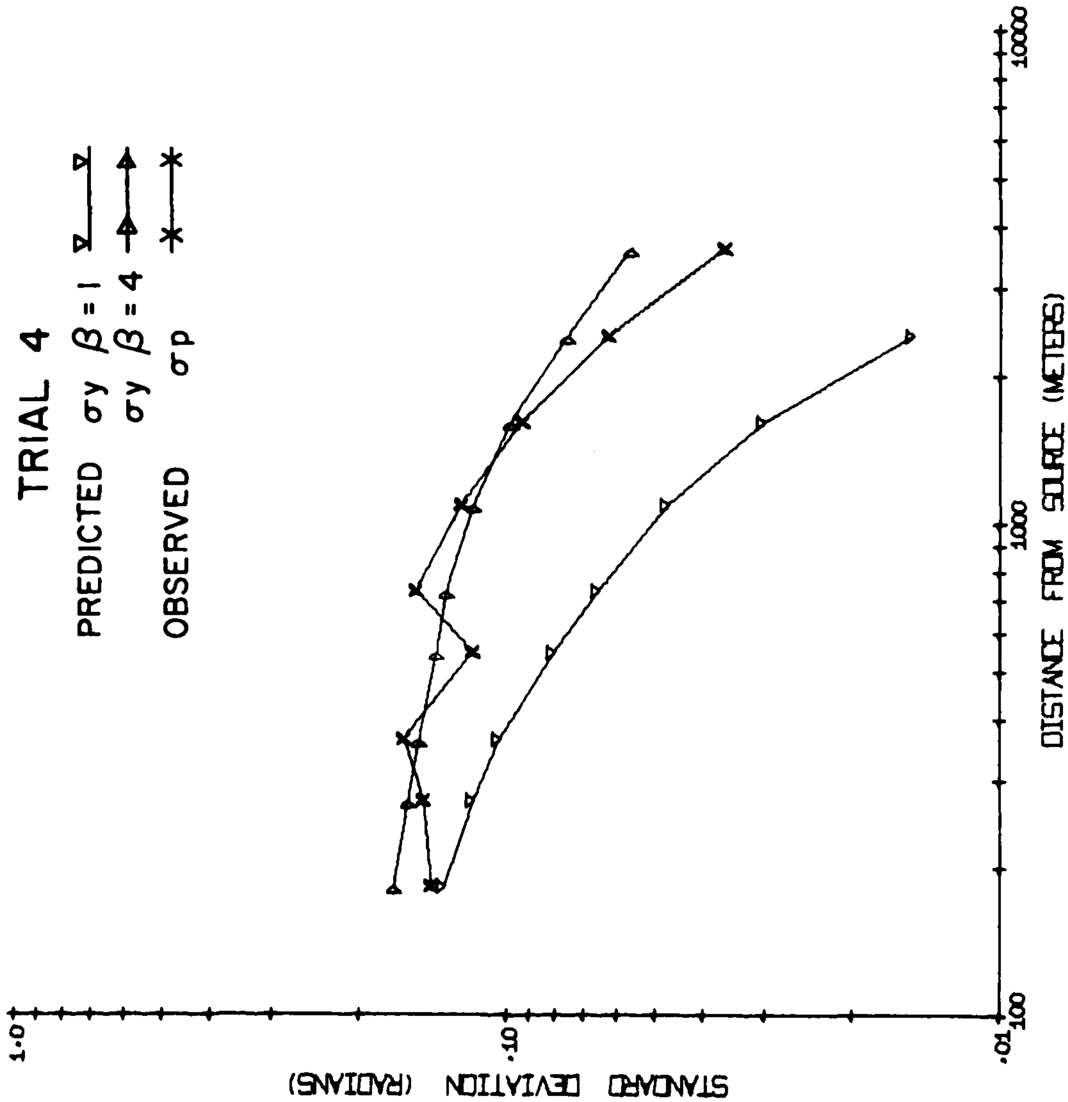
OBSERVED AND PREDICTED STANDARD DEVIATION OF DEPOSIT DENSITY

FIGURE 15



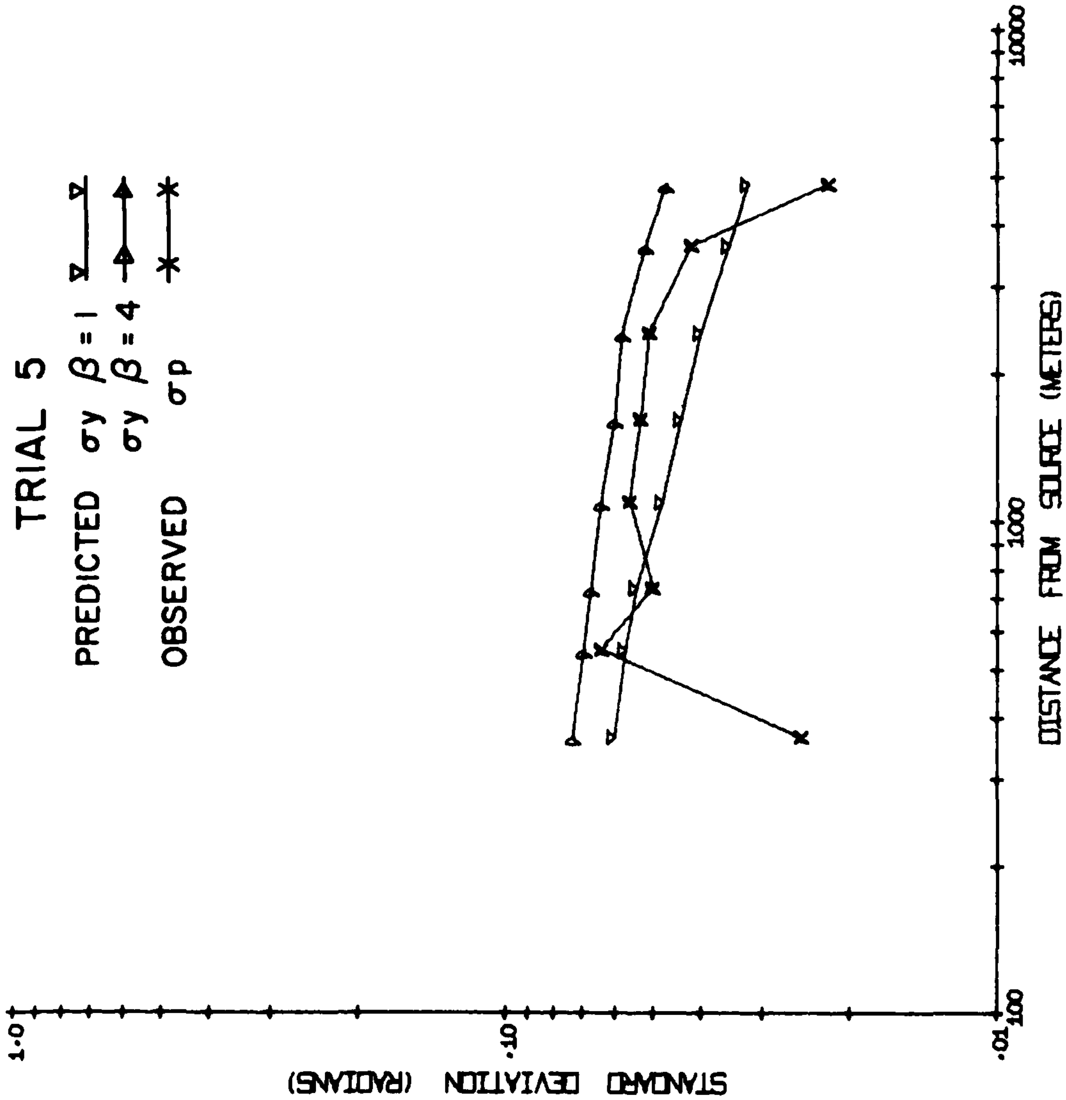
OBSERVED AND PREDICTED STANDARD DEVIATION OF DEPOSIT DENSITY

FIGURE 16



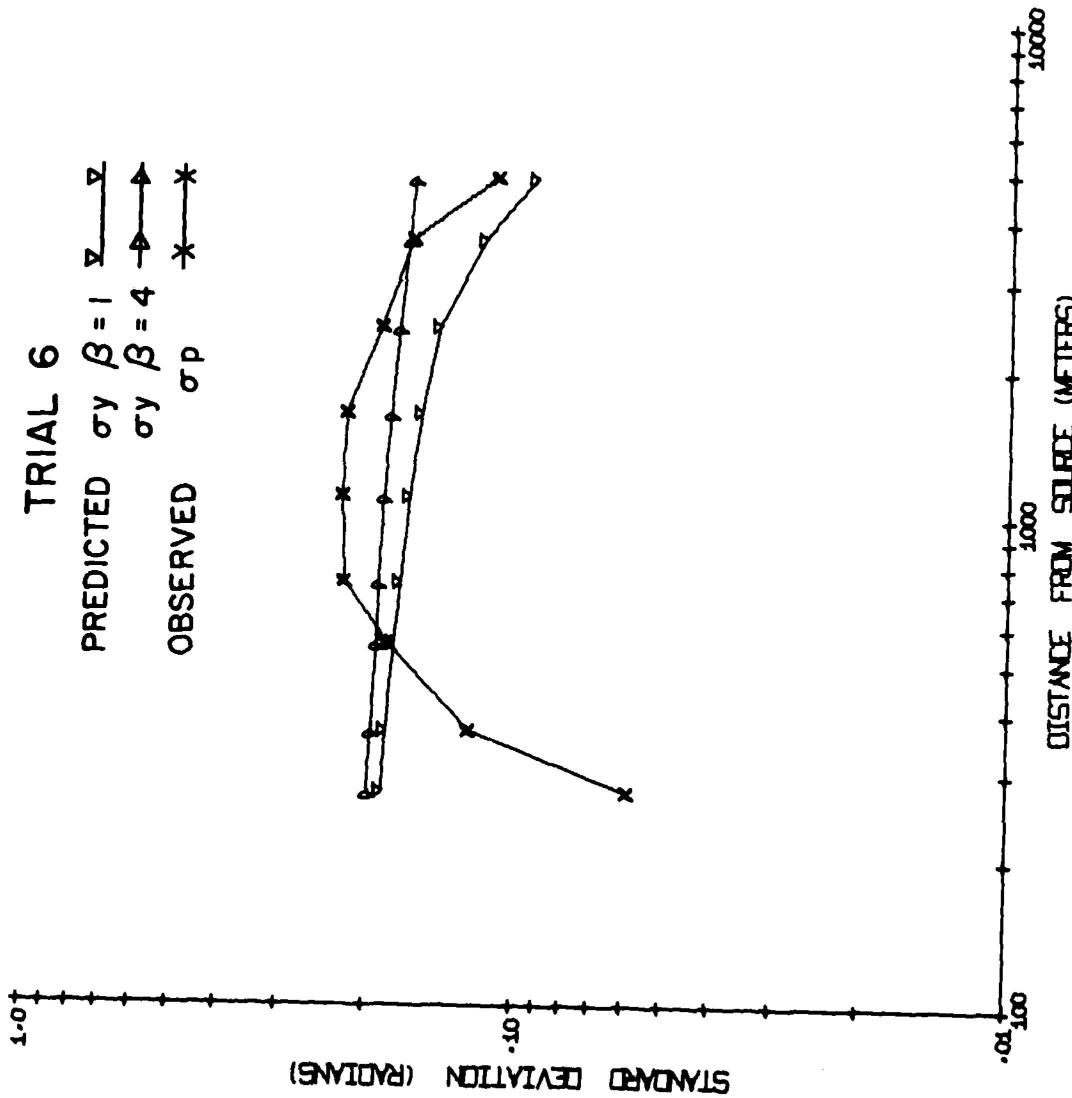
OBSERVED AND PREDICTED STANDARD DEVIATION OF DEPOSIT DENSITY

FIGURE 17



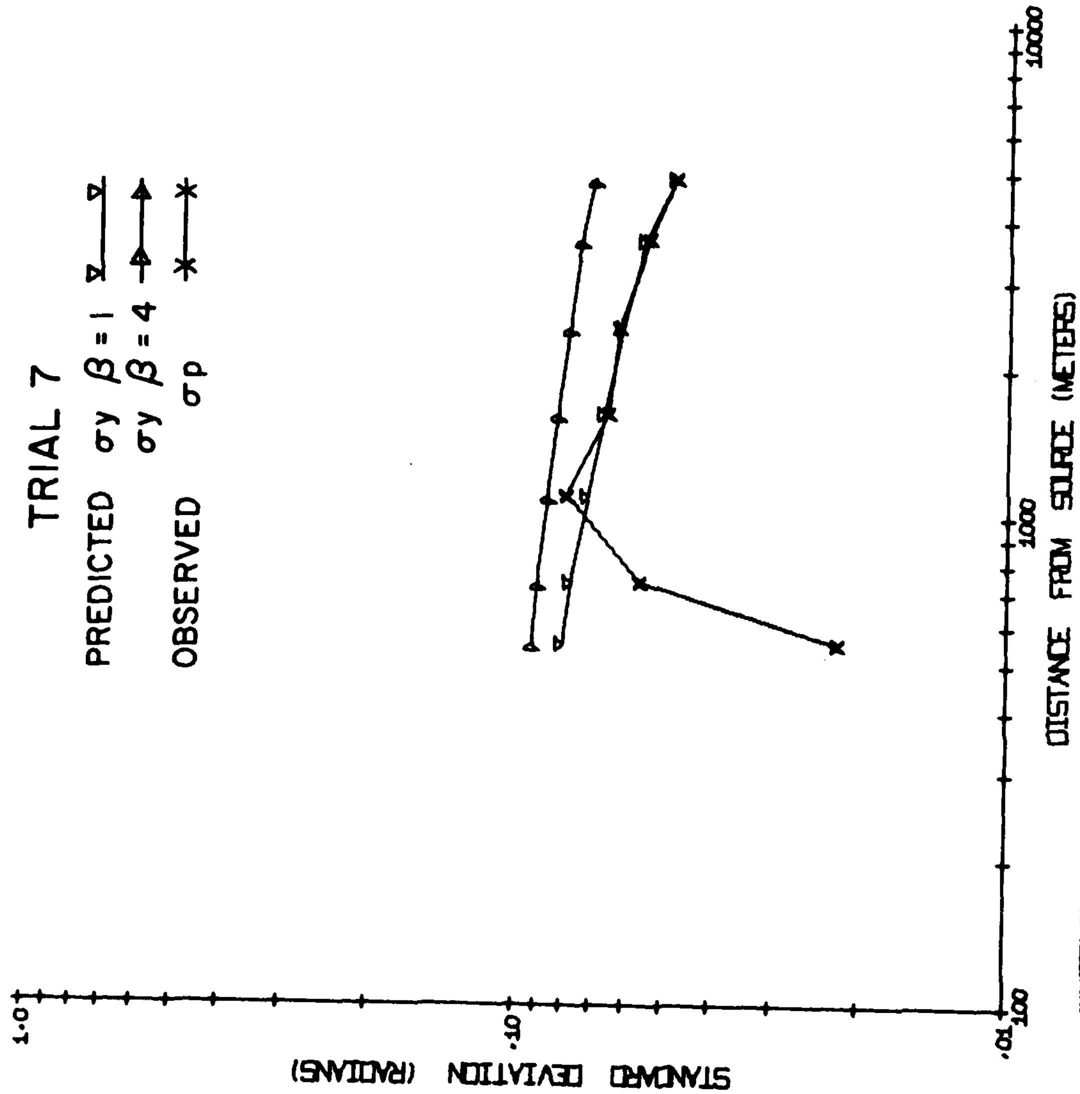
OBSERVED AND PREDICTED STANDARD DEVIATION OF DEPOSIT DENSITY

FIGURE 18



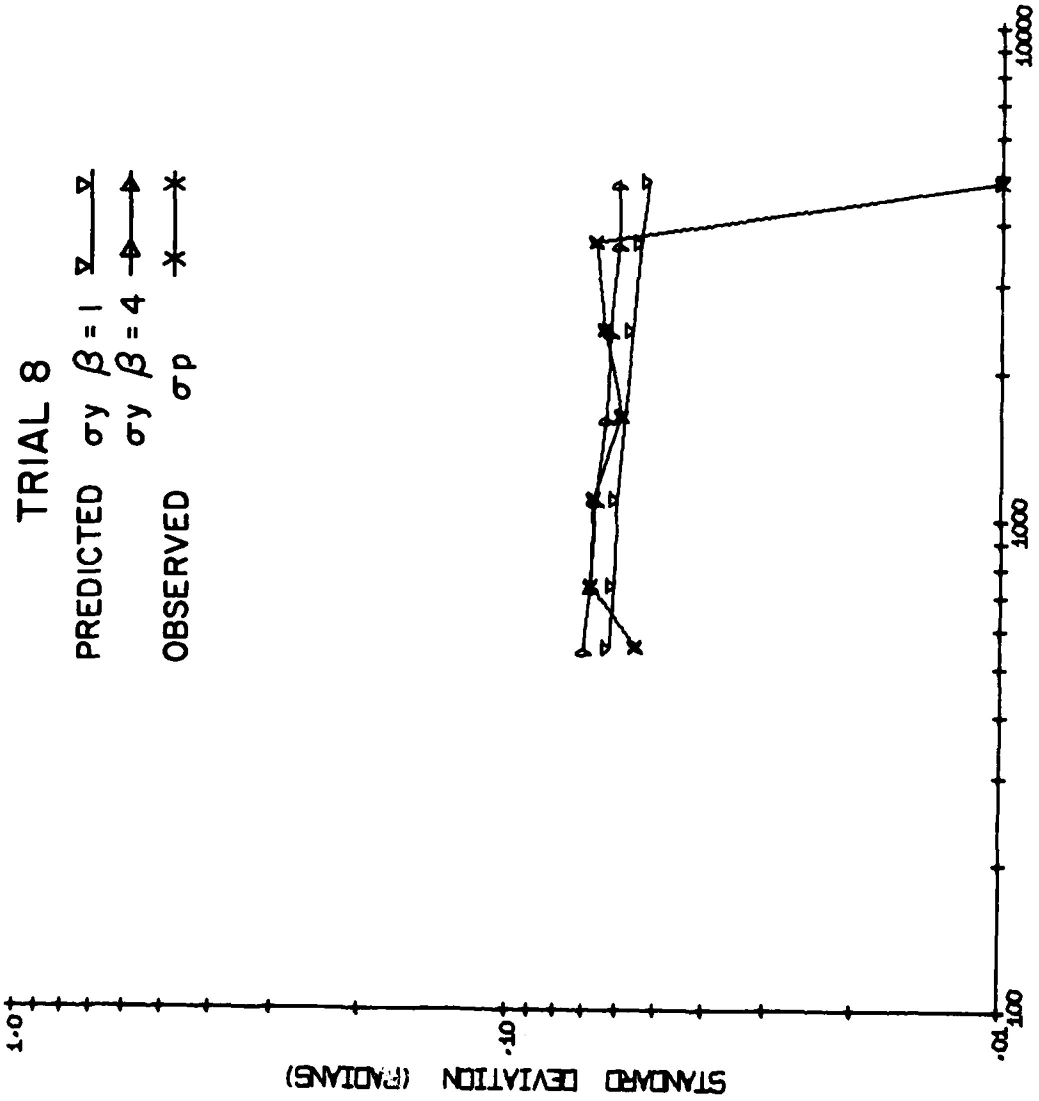
OBSERVED AND PREDICTED STANDARD DEVIATION OF DEPOSIT DENSITY

FIGURE 19



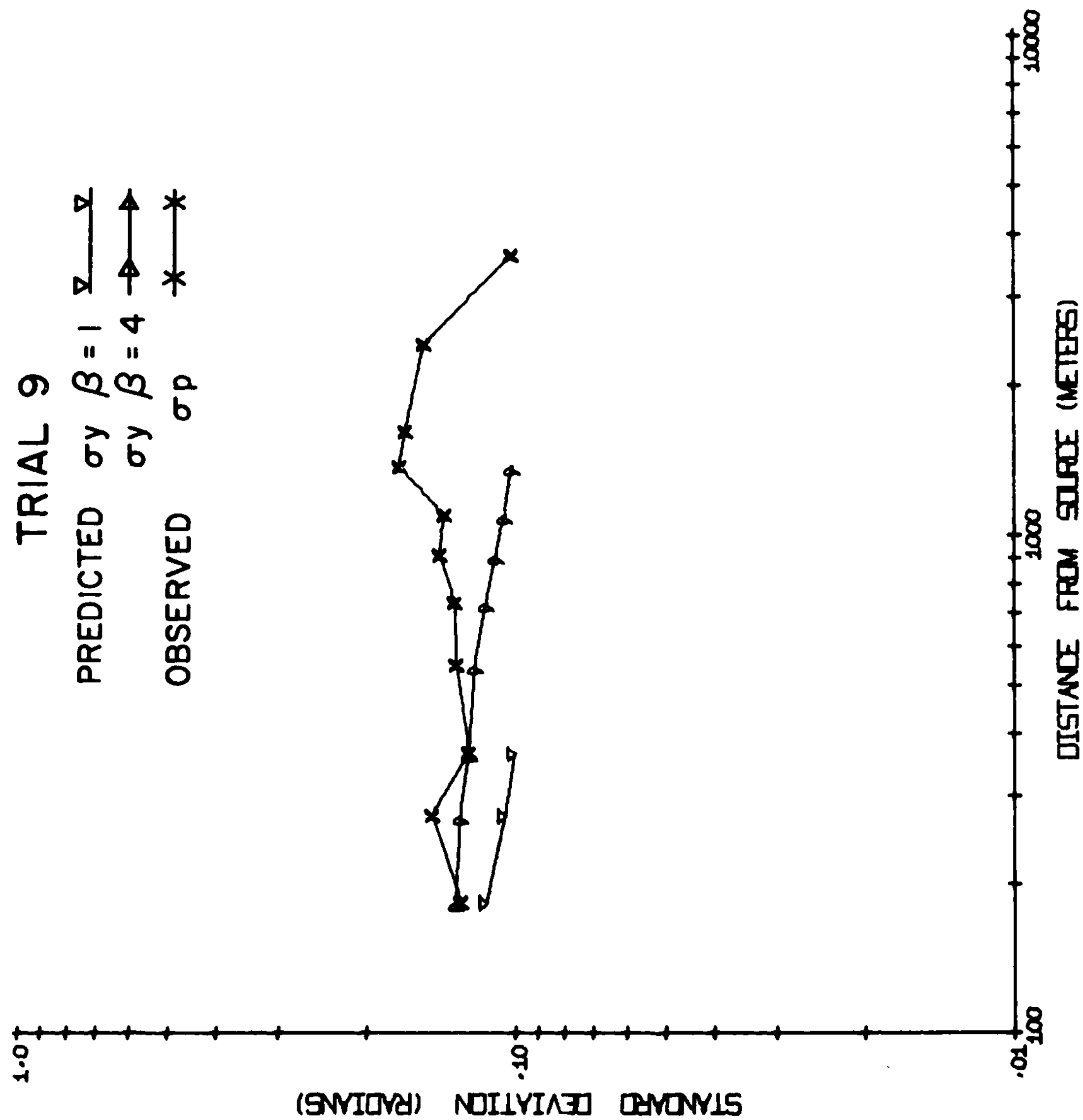
OBSERVED AND PREDICTED STANDARD DEVIATION OF DEPOSIT DENSITY

FIGURE 20



OBSERVED AND PREDICTED STANDARD DEVIATION OF DEPOSIT DENSITY

FIGURE 21

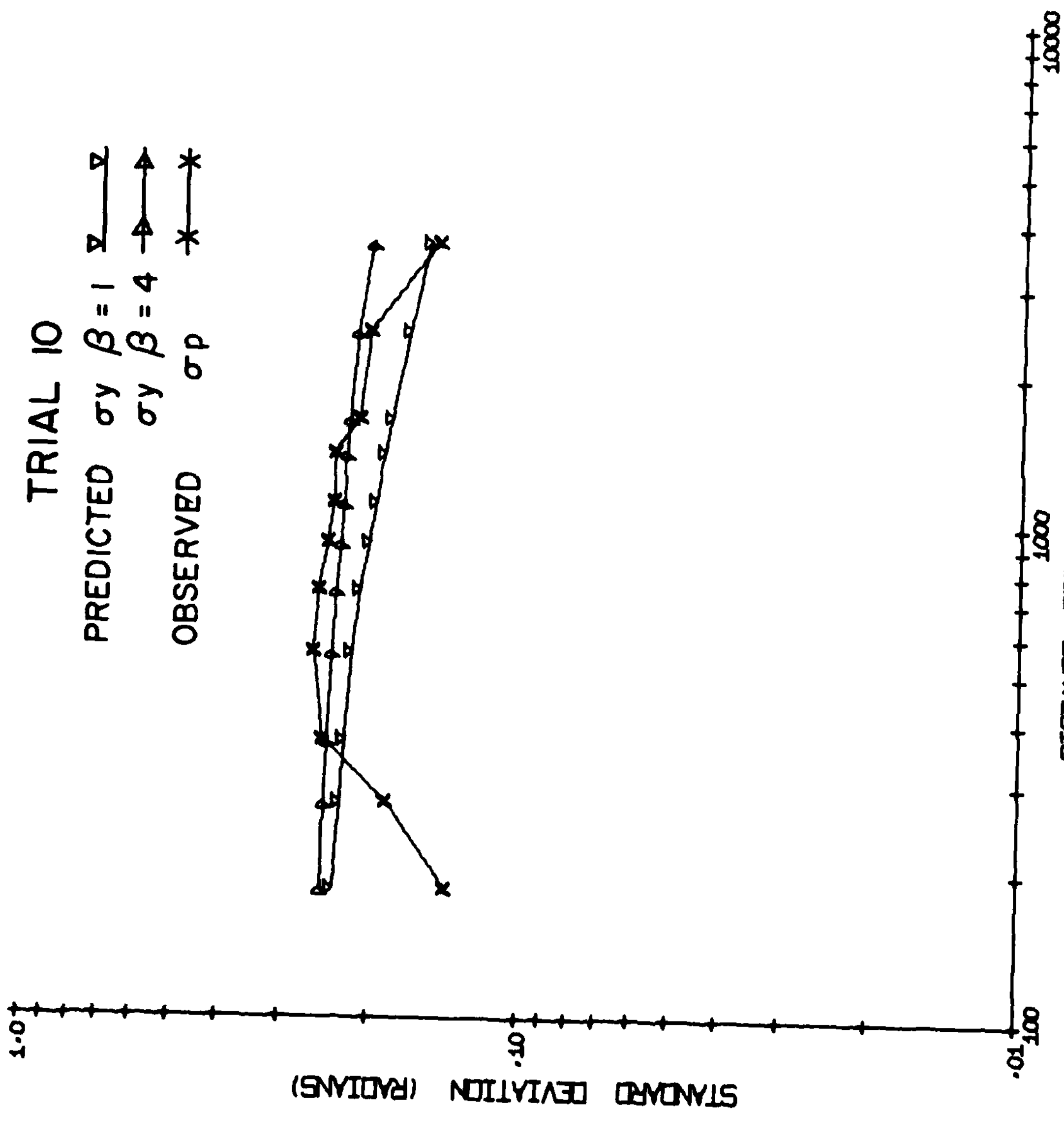


OBSERVED AND PREDICTED STANDARD DEVIATION OF DEPOSIT DENSITY

FIGURE 22

UNCLASSIFIED

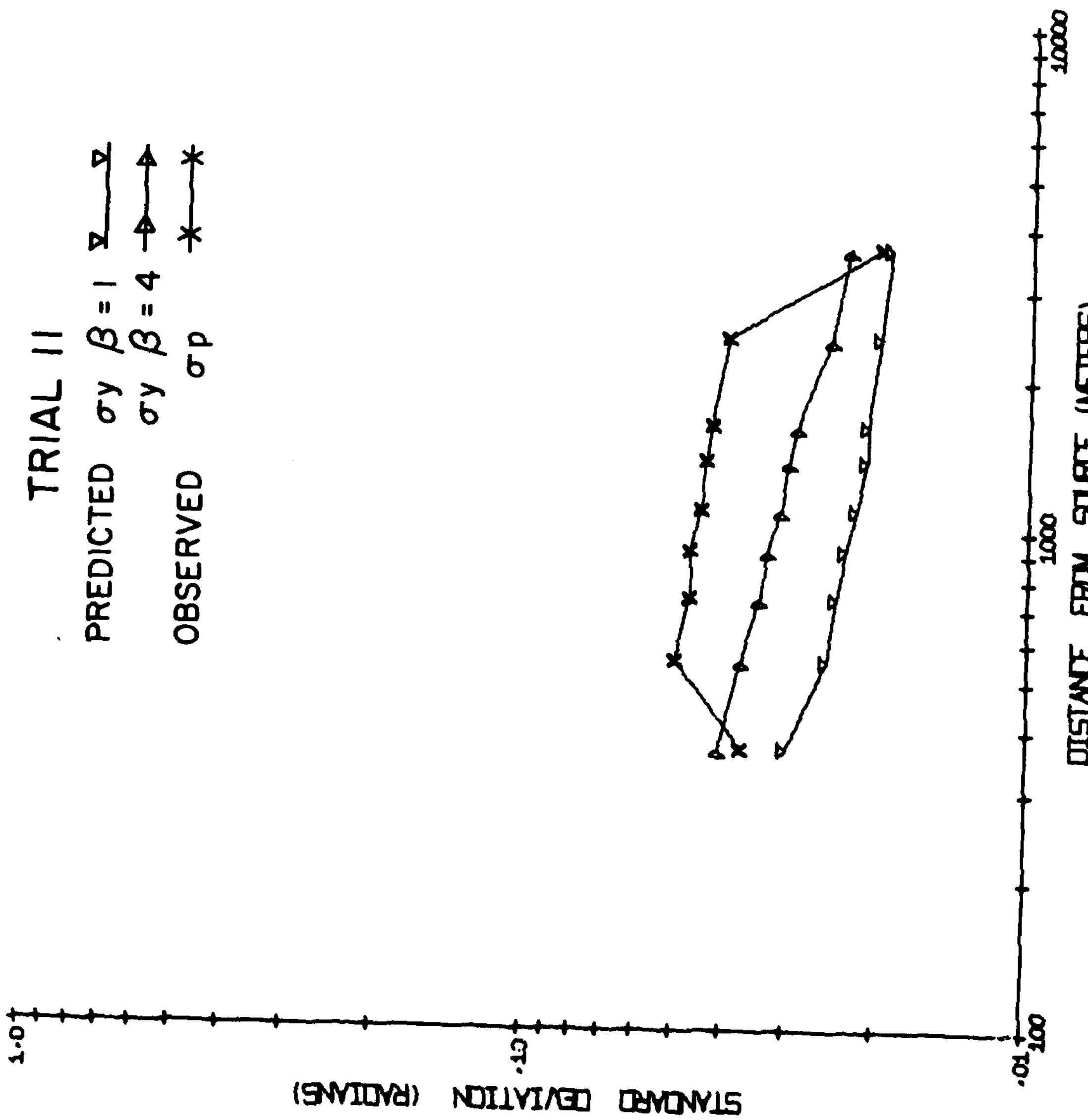
SR284



OBSERVED AND PREDICTED STANDARD DEVIATION OF DEPOSIT DENSITY

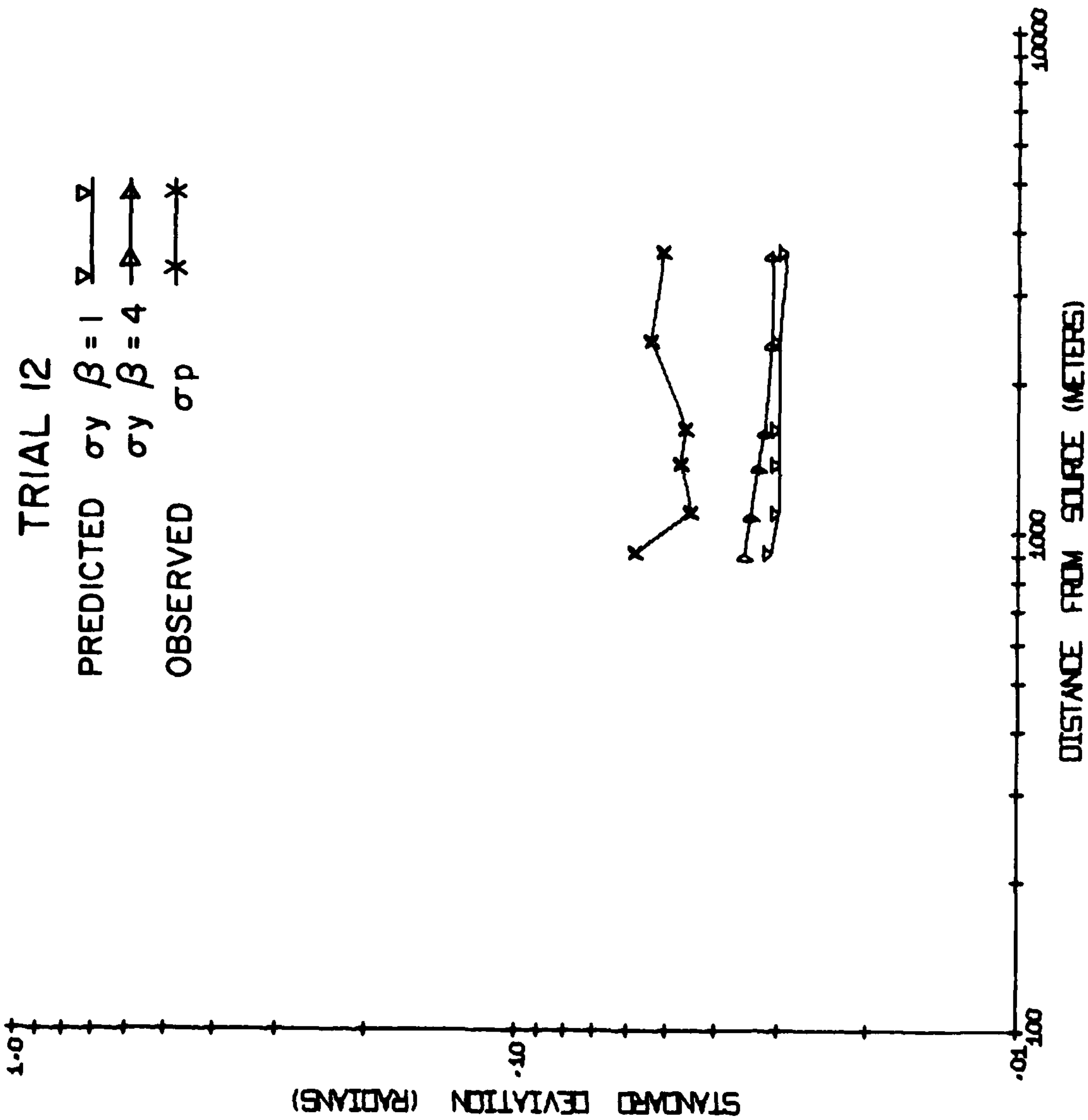
FIGURE 23

UNCLASSIFIED



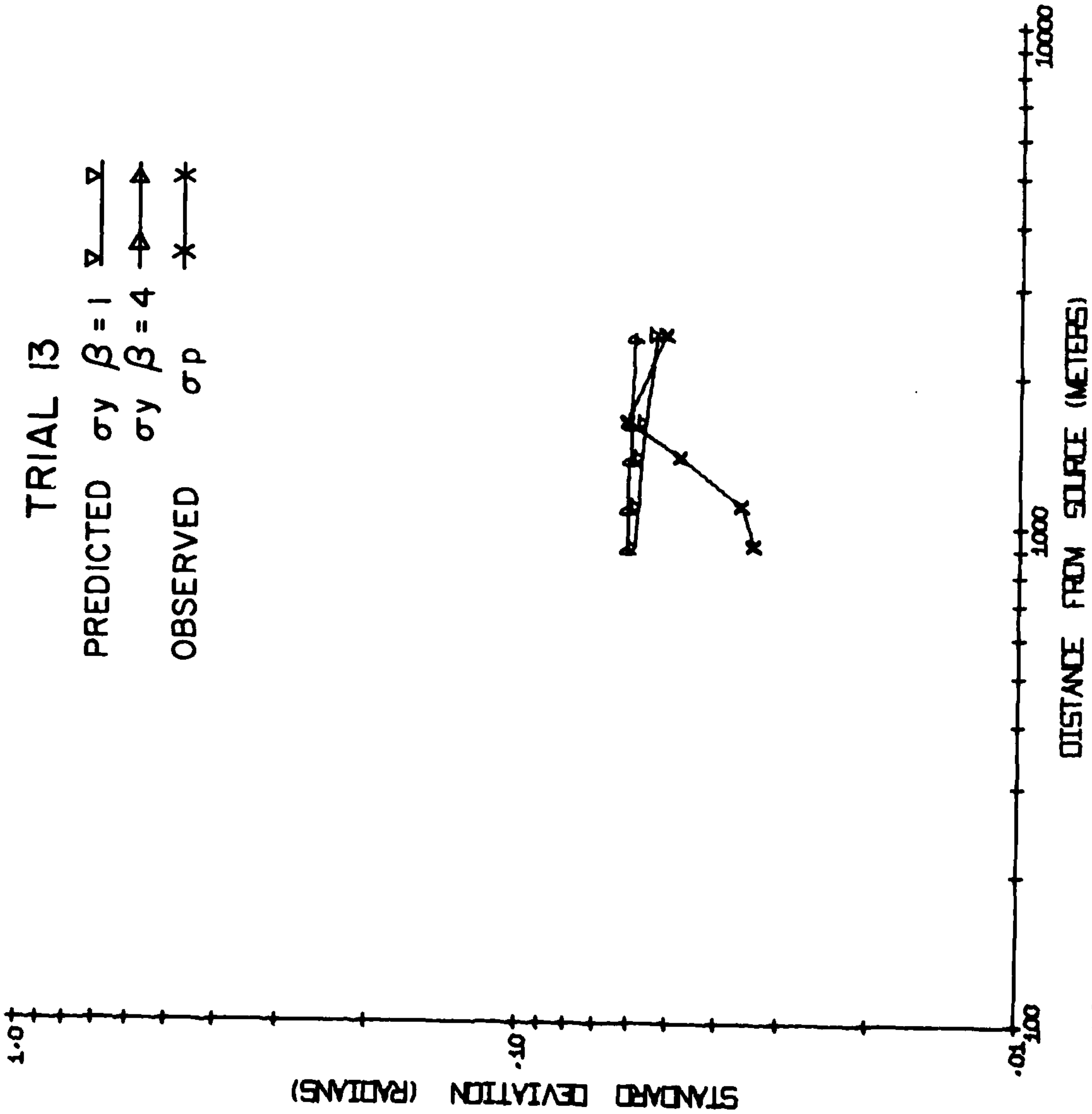
OBSERVED AND PREDICTED STANDARD DEVIATION OF DEPOSIT DENSITY

FIGURE 24



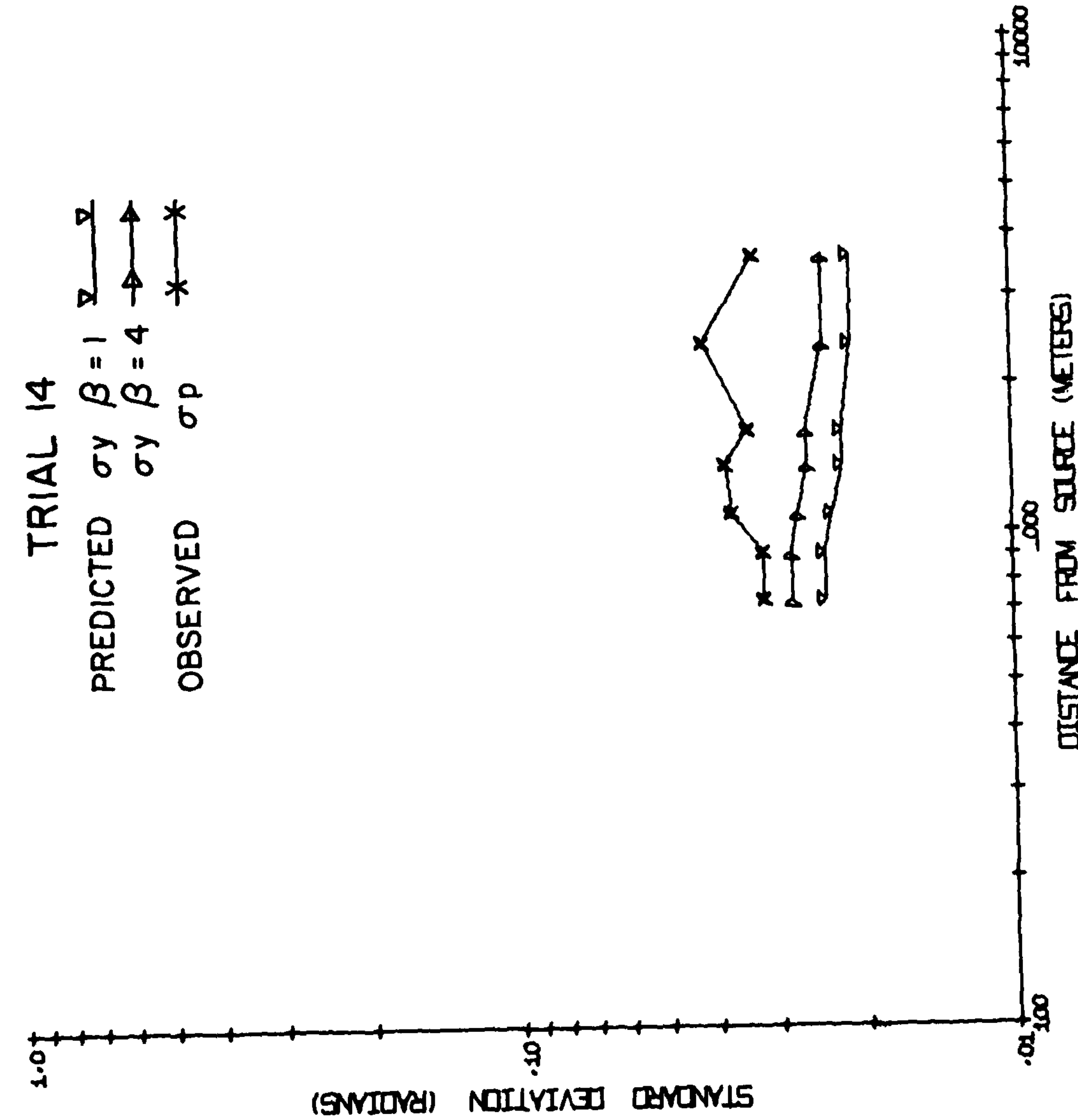
OBSERVED AND PREDICTED STANDARD DEVIATION OF DEPOSIT DENSITY

FIGURE 25



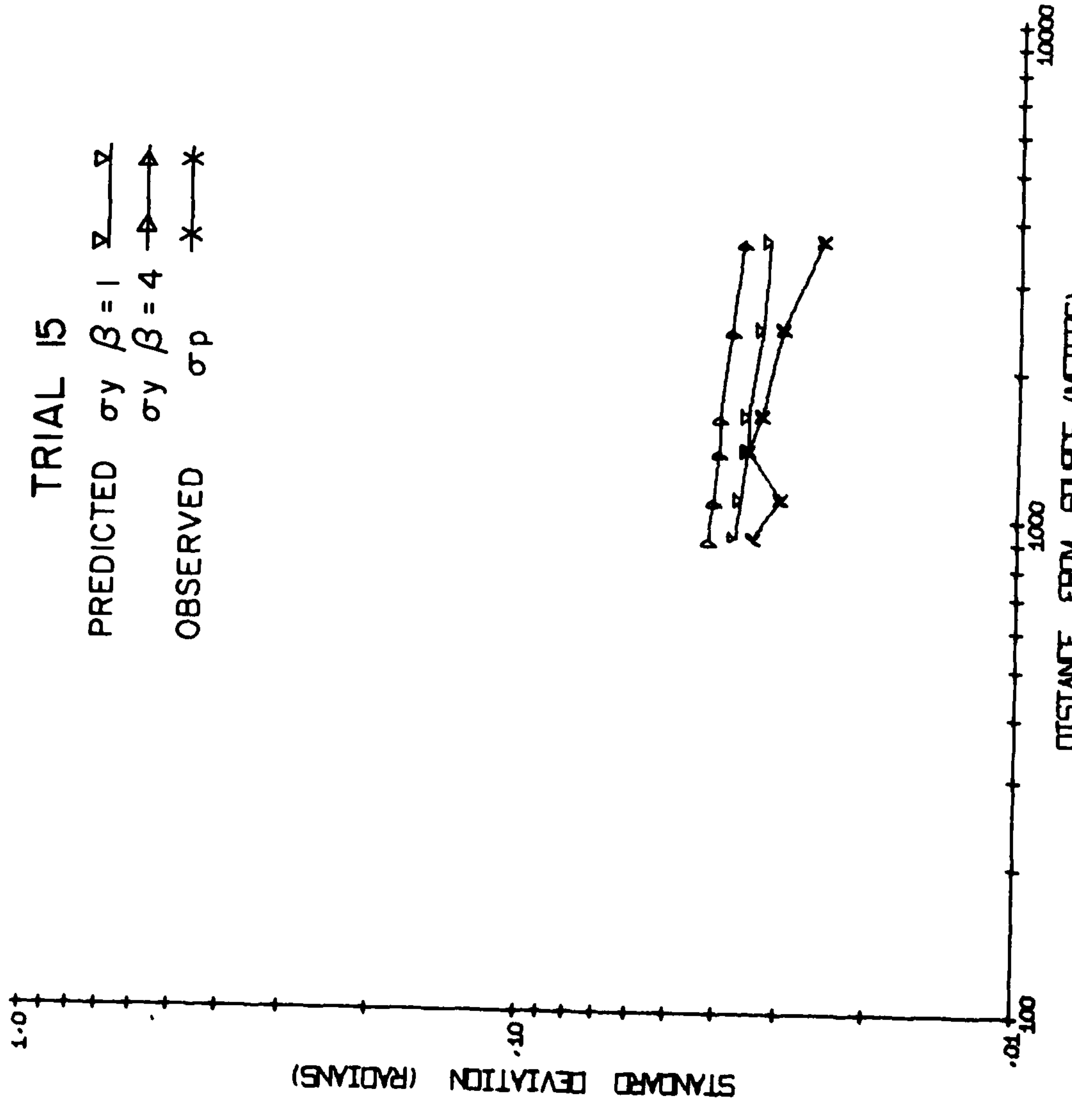
OBSERVED AND PREDICTED STANDARD DEVIATION OF DEPOSIT DENSITY

FIGURE 26



OBSERVED AND PREDICTED STANDARD DEVIATION OF DEPOSIT DENSITY

FIGURE 27



OBSERVED AND PREDICTED STANDARD DEVIATION OF DEPOSIT DENSITY
FIGURE 28

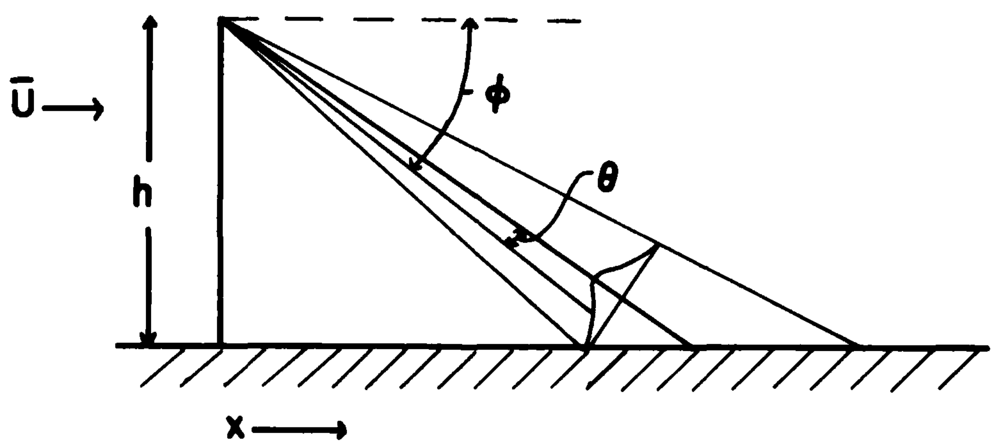


FIGURE 29 :GEOMETRY OF SIMPLE DIFFUSION MODELS

(WALKER, 1965)

APPENDIX A

OBSERVED DEPOSIT DENSITIES (mg/m^2)

APPENDIX A

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
1	99			.03									
	100			.00									
	101			.03									
	102			.00									
	103			.00									
	104			.07	.03								
	105			.07	.17								
	106			.10	.73								
	107			.17	.63	.10							
	108			.43	.43	.17		* .03					
	109			.89	12.52	6.52		* .17		.10			
	110		.10	2.19	85.83	29.31		* .66		.27			
	111		.10	79.87	177.72	64.77		* 2.32		.93			
	112		.20	134.01	153.28	64.57		* 6.29		1.89			
	113		.13	88.11	300.01	131.11		*14.24		.80			
	114		.20	314.71	600.41	186.36		*20.20		.19	.13		
	115		.30	518.55	*728.49	130.83		*20.53		10.10	1.72		
	116		.13	313.52	470.48	112.65		25.13		6.92	.38		

* Estimated

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
1 (Cont'd)	117		.13	203.15	183.28	130.93		24.60		* 5.17	.53		
	118			98.81	102.62	51.66		5.53		4.31	.96		
	119			71.13	54.24	10.83		5.89		1.13	.43		
	120			37.35	49.97	25.37		19.07		5.07	.60		
	121			8.58	15.86	19.11		3.74		5.33	1.22		
	122			3.84	58.91	1.99		.63		.93	.40		
	123			58.61	69.44	23.21		2.05		.53	.46		
	124			78.38	26.56	5.73		1.66		.53	.07		
	125			*69.54	*13.25	9.14		* .99		* .50	.07		
	126			*56.29	*13.25	3.64		* .66		* .40			
	127			*39.74	*13.25	.66		* .33		* .33			
	128			*19.87	* 9.93			* .17		* .17			
	129			* .66	* 4.96								
	130				* .66								

* Estimated

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
3	87		.23		.13								
	88		.13		.20								
	89		.23		.13							.07	
	90		.50		.10			.07		.10		.00	
	91		.50	.10	.10			.20		.10	.03	.00	
	92		.89	.13	.10			.10		.13	.00	.10	
	93		.23	.10	.13			.17		.07	.03	.00	
	94		.10	.07	.27			.30		.10	.07	.07	
	95		.07	.03	.30	.07		.27		.10	.10	.00	
	96		.13	4.37	5.33	3.68		.07		.13	.07	.20	
	97		.03	5.66	14.50	21.59		1.06		.17	.07	.03	
	98		.17	23.28	34.47	17.75		4.70		1.32	.30	.13	
	99		.23	32.48	71.12	32.18		5.20		1.26	.46	.60	
	100		.20	34.57	105.99	59.20		14.44		4.24	1.95	1.13	
	101	.23	.20	76.19	82.84	44.40		19.67		6.46	2.38	1.13	.27

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
3 (Cont'd)	102	.10	.07	62.98	81.75	34.67		13.28		5.93	2.45	.63	.36
	103	.07	.33	48.47	94.46	33.44		10.96		2.55	.53	.40	.10
	104	.10	.10	33.67	58.01	23.34		3.87		.60	.36	.10	.10
	105	.23	1.26	49.67	38.54	20.66		4.37		.27	.27	.03	.27
	106	.23	.20	51.75	31.49	14.80		4.34		1.03	.66	.17	.07
	107	.17	5.33	41.82	49.27	20.79		6.06		1.69	.60	.20	.03
	108	.07	.76	46.59	28.41	23.41		7.28		.63	.23	.07	.03
	109	.03	1.56	23.57	24.60	17.02		9.44		1.52	.23	.23	
	110	.03	2.45	18.31	26.36	5.36		6.19		3.15	.96	.23	
	111	.20	2.35	41.02	29.40	15.79		6.23		3.48	1.32	.20	
	112	.23	6.92	28.71	26.42	27.91		7.81		2.38	.93	.07	
	113	.07	.40	32.98	27.78	19.77		5.63		2.62	.56	.07	
	114		2.19	27.32	34.40	17.98		4.97		2.35	1.06	.23	
	115		.13	25.76	28.08	13.91		6.62		2.98	1.16	.53	
	116		.03	35.56	17.28	15.99		3.84		2.72	.36	.63	

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
3 (Cont'd)	117		.03	41.62	31.49	6.79		5.07		1.13	.10	.63	
	118		.03	53.34	33.54	16.16		3.31		1.23	.03	.50	
	119			37.45	47.38	17.35		3.21		.93	.03	.46	
	120			27.61	17.45	12.65		1.59		.40	.03	.66	
	121			23.44	11.26	5.00		1.19		.17	.07	.56	
	122			.13	1.13	2.22		.66		.10		.17	
	123			.13	2.42	1.06		.36		.10		.10	
	124			.03	.27	1.52		.13		.03		.03	
	125				.33	.13		.03					
	126				.00	.07							
	127				.20								
	128				.13								

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
4	83	.20											
	84	.56											
	85	.76											
	86	.60	.33	.10	.17								
	87	.63	.13	.17	.23	.17		.17					
	88	1.09	5.13	.20	.70	.07		.07					
	89	3.94	3.87	7.98	.56	1.03		.03					
	90	10.53	14.01	5.40	1.19	1.39		.10					
	91	13.34	16.03	9.77	2.62	2.38		.03					
	92	22.15	34.07	18.51	12.09	2.22		.03					
	93	28.81	28.38	24.57	8.28	2.05		.17					
	94	53.94	33.47	30.30	17.71	3.28		.30					
	95	127.04	51.55	36.16	15.73	7.22		1.16		.07			
	96	90.19	40.82	33.97	42.55	8.41		2.95		.17			
	97	36.95	66.75	44.50	35.86	9.24		3.48		.23			
	98	42.02	183.46	62.48	28.71	8.58		2.38		1.52			

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
4 (Cont'd)	99	88.70	167.17	64.86	37.15	11.19		3.24		2.58	.36		
	100	58.51	236.80	63.27	41.92	7.45		6.36		2.38	.63		
	101	68.34	227.27	68.87	40.33	11.49		3.94		2.62	.93	.03	
	102	114.92	200.15	90.69	34.17	12.15		5.23		2.28	2.38	.03	
	103	117.61	211.27	39.45	15.16	11.59		6.56		2.05	1.52	.36	
	104	77.58	151.97	18.18	14.90	5.00		6.09		1.99	.86	.26	
	105	70.52	107.67	34.67	4.80	3.21		3.64		.73	.76	.26	
	106	93.87	29.80	18.97	2.68	1.23		2.98		.86	.26	.10	
	107	48.67	32.38	19.07	.99	.93		1.72		.50	.10	.20	
	108	21.06	18.48	3.24	.20	.53		.63		.13	.03		
	109	11.59	17.38	7.38	.17	.23		.23		.20			
	110	16.06	18.74	.43	.03	.60		.13		.03			
	111	5.86	24.50	.20		.76		.10					
	112	8.01	10.26	.60		.43							
	113	.33	16.12	3.28		.33							
	114	.03	7.68	6.79		.40							

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
4 (Cont'd)	115		.89	1.89		.36							
	116		.03	.83		.03							
	117			.33									
	118			.00									
	119			.03									
5	90											.07	
	91											.03	
	92											.17	
	93				.17			.03		.07		.43	.20
	94				.76	.50		1.69		1.89		1.52	1.66
	95				.20	2.42		7.75		7.05	1.19	2.78	1.13
	96			.03	.86	7.05		13.77		14.10	3.74	1.99	.76
	97			.07	1.42	4.11		17.45		17.91	3.74	1.26	.33
	98			.03	2.22	12.88		17.65		18.57	2.98	.73	.10
	99				1.62	13.11		20.36		12.95	4.44	.60	.03

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
5 (Cont'd)	100				.60	2.91		7.91		4.54	1.62	.20	.03
	101				.00	.30		1.66		.73	.03	.07	
	102				.00	.10		.07		.20			
	103				.03								
	104				.03								
6	64												.03
	65												.00
	66												.00
	67												.03
	68												.00
	69												.00
	70												.00
	71												.00
	72												.00
	73											.07	.13

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
6 (Cont'd)	74											.10	.10
	75											.60	.13
	76											.73	.10
	77											.20	.13
	78											.56	.07
	79				.03	.07		.10		.40		.23	.07
	80			2.22	1.03	4.90		2.58		1.19		.53	.10
	81			.83	2.48	14.27		2.88		3.91	.46	.63	.10
	82			.50	24.53	11.92		5.26		2.72	1.66	.60	.96
	83			2.68	19.57	10.23		7.68		5.10	2.68	.53	.46
	84			28.41	26.52	18.24		8.18		4.83	2.52	.40	.30
	85			26.65	44.00	17.91		6.26		3.71	2.55	.56	.40
	86			17.35	17.02	8.87		4.67		4.60	2.19	.50	.36
	87			8.15	15.99	15.20		3.38		4.90	2.55	.86	.26
	88			10.26	12.28	10.93		2.85		3.61	2.55	1.23	.20

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
6 (Cont'd)	89		.10	39.43	15.59	6.85		8.71		1.52	3.01	.89	.23
	90		.07	13.05	12.12	15.59		8.64		2.68	3.31	1.42	.40
	91		.03	7.81	9.44	10.66		4.87		.46	3.08	1.23	.36
	92		.03	8.18	10.40	7.75		7.48		1.13	1.56	.33	.56
	93		.23	6.03	23.57	13.18		6.26		3.51	2.45	.93	.07
	94			8.41	21.79	21.36		7.81		1.99	2.05	1.32	.10
	95			4.30	38.94	12.58		7.68		6.36	1.32	1.52	.03
	96			5.33	7.05	21.82		10.03		2.15	1.66	.79	.07
	97			.23	9.77	16.16		11.82		3.21	2.15	.36	.03
	98			.17	15.00	27.98		11.59		2.28	3.74	.23	.07
	99				4.47	23.11		8.44		2.78	2.12	.56	.10
	100				2.32	12.61		11.39		3.54	.96	.79	.03
	101				.20	4.67		3.05		2.09	.20	.30	.03
	102				.10	8.71		8.31		.07	.13		.03
	103					1.75		5.07			.03		
	104					.17		.17					
	105							.07					

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
7	76												.10
	77												.13
	78												.60
	79												.46
	80												.13
	81											.13	.26
	82											.60	.50
	83											.96	.26
	84											1.32	.46
	85					.36		.33				.79	.30
	86					.10		2.58		.99	.20	.89	.10
	87					.30		3.48		1.99	.43	.63	
	88					.40		4.24		3.94	1.92	1.69	
	89					1.09		13.11		11.36	3.58	.56	
	90					6.66		8.01		10.76	3.87	.07	
	91					8.74		15.73		6.72	2.98	.10	

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
7 (Cont'd)	92				1.19	10.89		10.76		4.54	2.91		
	93				2.78	14.34		10.63		4.14	2.85		
	94				.76	8.34		8.94		2.45	.43		
	95					.83		2.58			.03		
	96					.03		.20					
8	85											.07	
	86											.20	
	87											.40	
	88											1.19	
	89									.03	.07	1.06	.03
	90							1.95		.46	.07	1.06	.03
	91					.03		2.15		1.82	.93	1.36	
	92				.23	.33		8.44		3.11	1.89	2.19	
	93				.76	.76		9.27		13.84	5.73	1.19	
	94				.63	3.05		9.64		9.57	4.27	1.49	

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
8 (Cont'd)	95				1.19	1.49		19.77		12.45	5.36	2.38	
	96				.53	.43		8.58		28.01	7.58	1.19	
	97				.46	1.89		6.06		9.64	1.79	.53	
	98				.17	2.62		1.82		2.65	1.95	.17	
	99				.03	.33		1.13		.33	.36		
	100					.03		.10			.07		
9	67	.03											
	68	.03											
	69	.06											
	70	.17											
	71	.93											
	72	.46											
	73	3.01											
	74	33.58											
	75	89.60	.23										

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
9 (Cont'd)	76	110.56	1.19										
	77	120.30	1.72	.13									
	78	99.94	8.84	3.68		.03		.06					
	79	39.54	37.95	4.87	2.12	.53	.30	.10	.06				
	80	28.91	55.03	22.32	4.80	1.39	.79	.23	.13	.06			
	81	25.76	42.12	21.89	4.24	1.49	.40	.30	.33	.06	.06		
	82	19.64	28.05	7.02	1.13	.66	.66	.06	.20	.10	0		
	83	17.68	32.58	4.07	1.52	.63	.56	.46	.13	.13	.13		
	84	17.91	26.69	5.36	1.75	.83	.30	.33	.40	.03	0		
	85	14.97	9.14	9.67	1.52	.30	.20	.20	.20	0	.13		
	86	22.75	5.23	3.08	2.02	.17	.20	.26	.13	.06	.03		
	87	12.55	5.20	.79	.30	.43	.50	.46	.17	.03			
	88	7.52	4.97	.33	.43	.10	.50	.40	0	.06			
	89	6.72	4.27	1.49	.89	.23	.26	.36	.10	0			
	90	9.01	1.72	1.09	1.13	.99	.36	.10	.36	.03			
	91	7.75	3.21	2.75	.73	.40	.06	.13	.03	.13			

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
9 (Cont'd)	92	2.52	7.25	1.39	.36	.10	.33	.13	0	.10			
	93	.33	2.62	.36	.17	.06	.06		.03				
	94	.17	.36	.10	.10	.06			.03				
	95	.03	.30	.13									
	96			.10									
	97			.06									
10	95			2.15	.03	.17							
	96			8.11	1.10	.83			.06				
	97		.03	3.77	6.76	2.62	.17	.17	.10				
	98		0	13.91	8.71	3.68	.33	.17	.26	.03			
	99		0	14.04	3.48	1.89	.70	.36	.30	.20	.07		
	100		5.63	4.21	3.34	4.21	4.97	.89	.46	.10	.26	.07	
	101		1.26	4.70	6.49	5.76	3.38	1.92	.23	.17	.26	.07	
	102		12.45	7.95	9.21	4.77	2.22	3.25	.86	.20	.13	.10	

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
10 (Cont'd)	103	.20	6.92	5.83	14.67	11.19	3.11	2.91	2.35	.60	.20	0	
	104	.30	4.77	14.70	15.07	16.72	2.22	2.09	.99	.30	.33	0	
	105	.03	1.72	18.34	25.17	4.40	3.34	2.22	1.03	.93	.56	.03	
	106	.13	11.95	77.19	22.45	10.07	3.25	1.72	.89	1.49	.50	0	
	107	.13	12.32	44.21	24.44	10.03	6.13	2.38	2.05	.96	.30	0	
	108	.06	9.87	46.99	23.28	7.22	3.15	2.78	1.59	.89	.66	.03	
	109	.03	7.52	36.66	18.68	5.43	5.00	2.72	1.82	1.26	.63	.17	
	110	.03	15.13	22.52	15.83	8.61	4.50	3.84	.70	1.06	.79	.10	
	111	.03	10.73	16.39	12.62	6.99	3.91	1.82	.50	.96	.99	.13	
	112	0	8.11	14.37	6.79	6.36	3.38	2.62	.96	1.06	.23	.23	
	113	.06	10.43	11.95	7.85	4.80	3.08	2.22	1.16	.89	.40	.30	
	114	.06	33.28	20.83	10.79	9.14	2.72	1.72	.56	.76	.63	.23	
	115	0	13.97	11.95	20.53	9.47	2.91	1.16	.53	.63	.33	.30	
	116	.20	3.44	16.72	30.30	20.76	6.42	4.21	.27	1.29	1.03	.23	
	117	.03	7.12	29.80	16.59	16.52	8.48	4.11	2.62	3.08	.70	.36	
	118		2.35	30.70	14.83	11.36	7.38	2.78	2.22	2.48	.33	.20	

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
10 (Cont'd)	119		2.15	50.86	10.76	5.46	7.52	3.58	3.18	1.79	.36	.13	
	120		2.88	23.68	11.32	14.24	4.11	2.75	2.81	2.28	.33	.10	
	121		5.03	23.81	34.67	10.36	3.18	.96	.40	5.30	.07	.13	
	122		1.19	20.89	36.66	11.95	5.03	2.91	1.06	5.30	.40	.10	
	123		6.95	27.12	25.43	10.56	6.29	3.05	.99	.40	.17	.13	
	124			2.28						.46		.07	
	125			.13						.46		.30	
	126									.13		.10	
11	101						.07	1.75	.60				
	102					.10	5.10	5.26	3.11	.66	.17		
	103				3.48	1.85	13.11	9.70	8.15	5.17	1.29		
	104			.50	3.77	6.75	25.13	22.68	20.69	9.93	1.19		
	105			.46	3.21	10.96	49.93	62.48	45.39	18.61	3.71	.26	
	106			.26	5.03	25.03	47.05	61.68	41.92	34.77	3.08	.43	

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
11 (Cont'd)	107			.23	2.52	29.30	27.45	29.77	49.86	13.71	.46	.10	
	108				.53	11.22	5.00	4.30	36.85	3.18		.07	
	109				.07	5.33	.17	.07	.07	.13			
	110					.36							
12	75											.20	
	76											.66	
	77											.93	
	78											1.46	
	79											.60	
	80											.40	
	81									.03		.70	
	82									.30		.79	
	83						.10	.99		8.11	.30	.29	
	84						4.23	9.54	15.79	24.57	2.15		
	85						3.61	16.99	17.98	34.58	3.54		

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
12 (Cont'd)	86						3.01	10.79	17.05	19.20	2.55		
	87						3.51	9.27	12.75	14.01	4.01		
	88						2.78	2.75	7.38	5.36	2.75		
	89						1.52	1.13	1.23	.30	.56		
	90						.20				.23		
13	69								.13	.07	.23		
	70								8.04	13.87	.03		
	71							.50	5.99	14.07	2.78		
	72						.33	.33	9.30	14.40	8.28		
	73						.36	.56	48.67	19.80	5.20		
	74						1.52	19.97	48.18	24.27	4.47		
	75						5.63	24.80	38.14	18.48	2.91		
	76						9.34	32.12	6.92	3.81	1.42		
	77						2.55	8.84	.07	.10	.10		

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
14	78											.13	
	79											0	
	80											.13	
	81											.26	
	82											.40	
	83							.33	.36	1.19		.07	
	84					.46	8.94	55.03	38.74	15.13	.33		
	85					.50	24.20	66.65	43.31	21.89	.43		
	86					1.23	32.85	99.13	87.41	51.25	.60		
	87					.26	7.68	33.08	43.31	17.70	1.29		
	88						2.12	7.32	10.33	1.42	.40		
	89							.30					

OBSERVED DEPOSIT DENSITIES (mg/m^2)

TRIAL NO.	SAMPLER NO.	DISTANCE FROM SOURCE (M)											
		182.9	274.3	365.8	548.6	731.5	914.4	1097.3	1371.6	1609.3	2414	3621	4828
15	91											.20	
	92											.56	
	93									.40		.96	
	94						.36	1.46	7.88	15.53	2.22	.60	
	95						3.21	16.99	25.09	39.80	9.11	.20	
	96						3.44	17.12	24.70	38.87	8.28	.03	
	97						2.95	9.34	14.54	15.60	2.88		
	98						.46	1.19	2.09	1.42	.36		
	99						.07	.07	.20	.07			

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The results of a series of field trials on the diffusion and ground deposition of 100 micron glass microspheres from a continuous point source at a height of 92 metres are discussed. The observed crosswind integrated deposit density as a function of distance from the source was used to test two prediction models. One of these models employs appropriately averaged standard deviations of vertical turbulence as the main parameter of atmospheric diffusion. The other is the steady state K-Theory diffusion model with a coefficient of eddy diffusivity which varies with height. In general, there was reasonably good agreement between the observed and predicted crosswind integrated deposit density as a function of distance, for the sloping plume model. However, the K-Theory model predicts a peak deposit much lower than observed and a more gradual decrease in the deposit density than observed.

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