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SUMMARY

Dispersion tests were performed over the Bundefjorden, a side arm to the inner Oslofjord. A tracer gas, SF_6, was released from a sunken rock and sampled by a boat crossing the plume at a distance of 400 m. The sampling took place every 2 second at three levels along the mast.

Horizontal concentration distributions were little influenced by air stability, expressed by the air-water temperature difference, while vertical plume extention was at minimum during inversion conditions.

One observation made was the tendency of travelling lumps forming upper parts of the plume. The result was a slower decrease in maximum concentration with height than of mean crosswind concentration.

Statistical properties of the fluctuating concentration distribution relative to the center of gravity show that the most prominent feature is that when fluctuations are large, they are largest at the cloud center. Concentrations are either high throughout the whole cross section, or they are all low. The second most important feature is that with low concentrations near the plume center, concentrations near the border will be high.

TABLE OF CONTENTS

CONCENTRATION DISTRIBUTION IN A PLUME RELEASED OVER WATER

1 INTRODUCTION

Fire and explosions following an accidental gas release depends more on the instantaneous than on the mean concentration distribution. The purpose of the Bundefjord experiments was to study concentrations fluctuations in a plume released over water. The only similar experiments known to the author are those conducted over a Norwegian fjord, where fluorescent particles were released from an anchored boat, and sampling performed on another boat, crossing the plume repeatedly at a distance of 500 m (Eidsvik 1980). The experiments over the Bundefjord were similar, only this time the tracer used was sulphur hexafluoride (SF_6) and sampling took place at two or three different heights.

2 TEST SITE AND EXPERIMENTAL PROCEDURE

The experiments were performed over the Bundefjord, a side arm of the inner Oslofjord. The location is shown in Figure 1. The gas release took place mid-fjord from a platform erected on a sunken rock. Crosswind sampling was made between marker buoys at a distance of 400 m from the source. Release height was 2 m above sea level. Dual tracer technique was used in one test only to study the effect of release height on concentration distribution. Bromtrifluoromethane ($CBrF_3$) was then released at 3.8 m and SF_6 at 1.2 m above sea level. A motor driven sailing boat was used, with samplers placed at two or three different heights along the mast (Figure 2). The boat speed was about 5 m/s. Wind speed, at 2 m a.s.l., was measured at the release platform. During some experiments the University of Bergen recorded turbulence using sonic anemometers at the 2 m level.

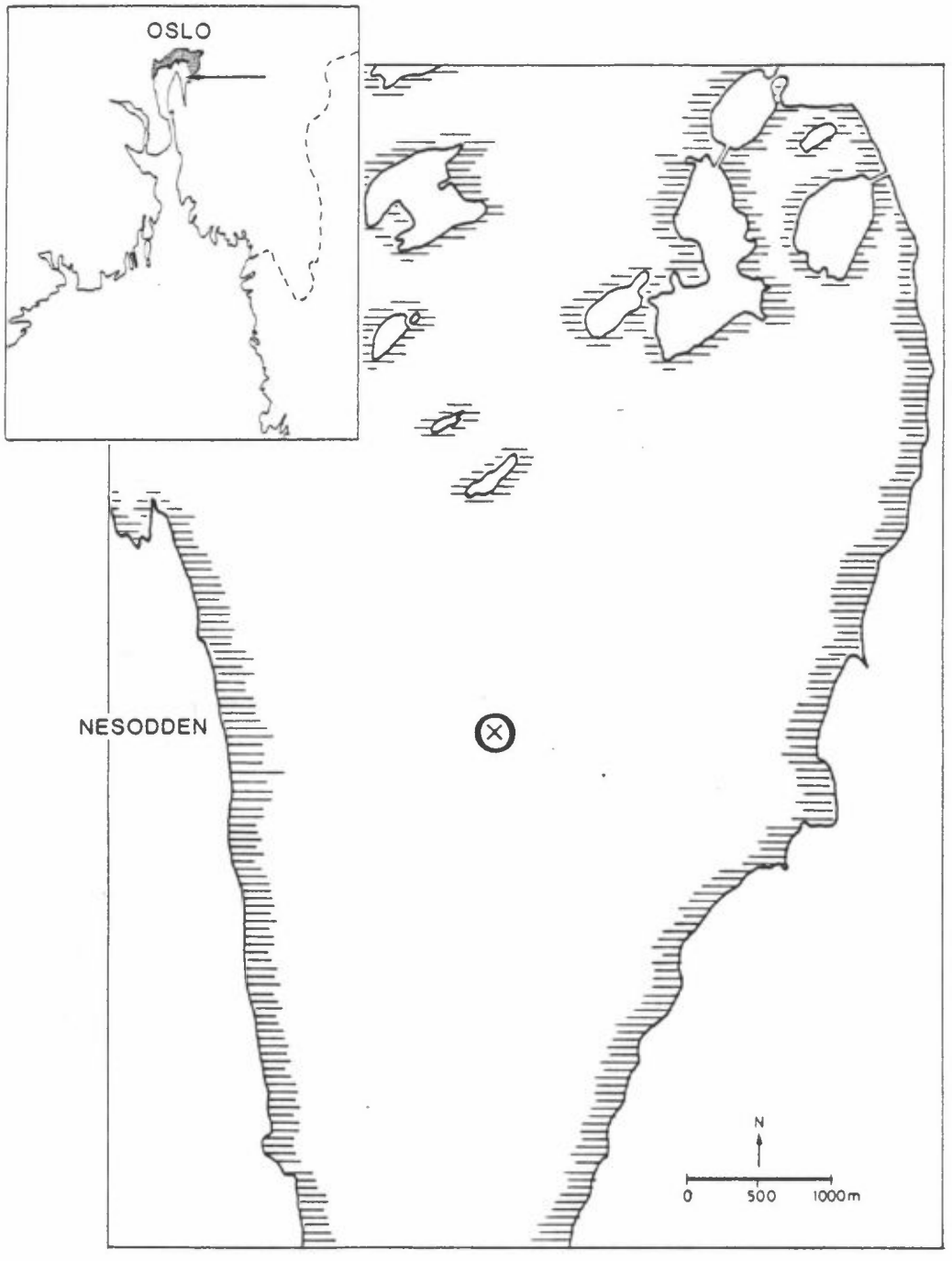
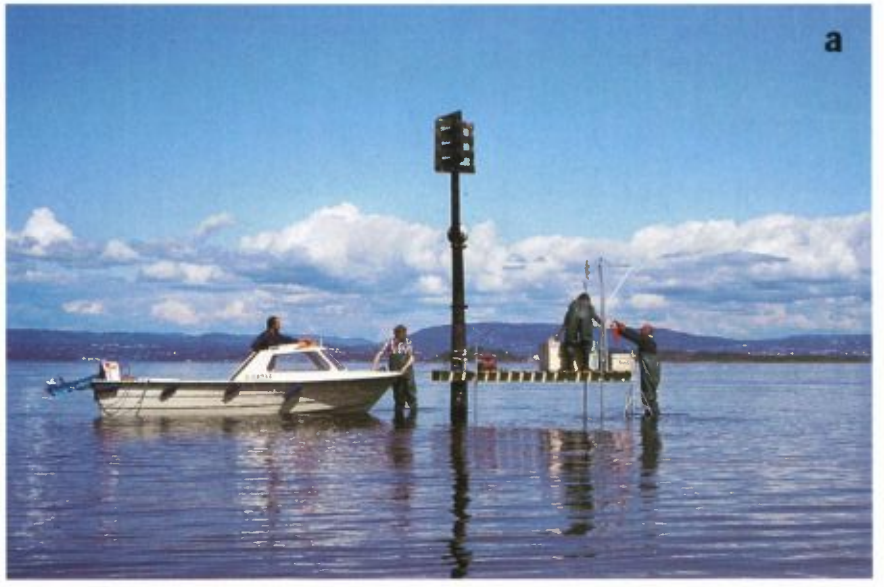


Figure 1: Bundefjorden - Location of platform on sunken rock.

Figure 2 shows:

a - Platforms on sunken rock. Turbulence instruments being installed.
b - Boat with sampling in mast at 3.1 m 7.1 m and 11.6 m above sea level.
c - Smoke release to visualize tracer plume
d - Sampling in mast - base plate with 90 syringes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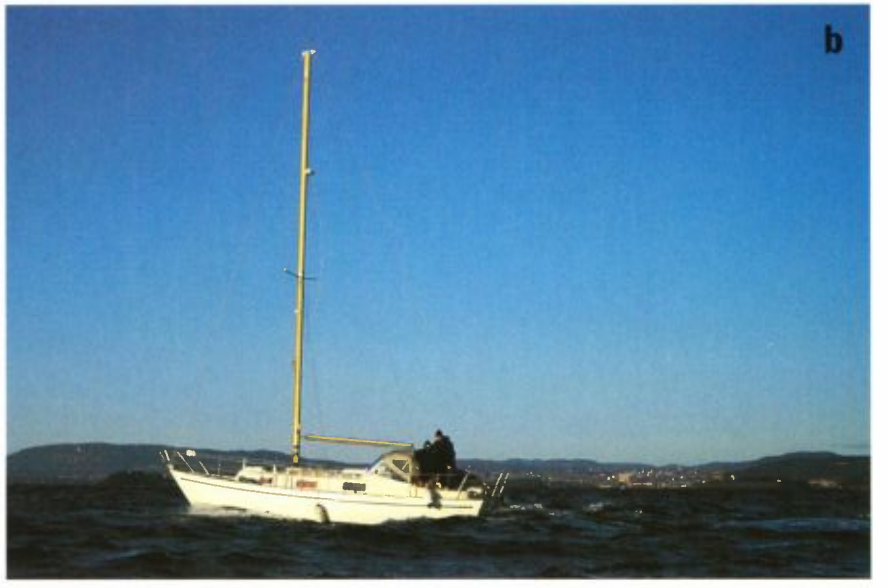
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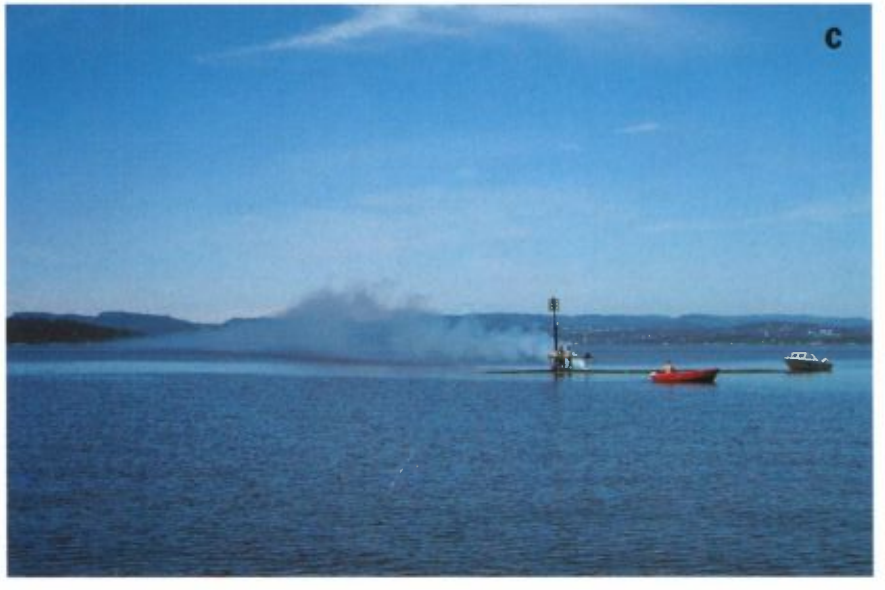
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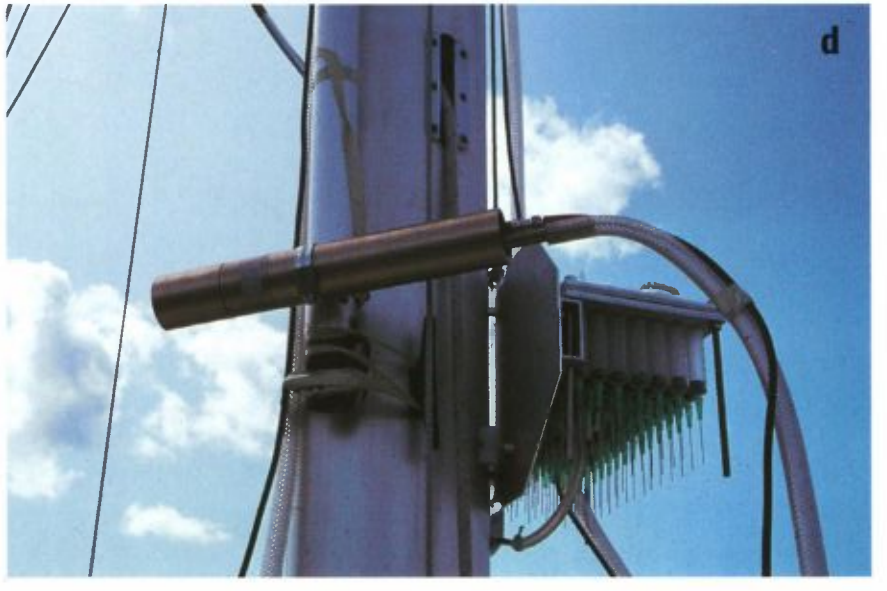
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3 THE SAMPLING EQUIPMENT (BY R. HEGGEN)

3.1 CONSTRUCTION GUIDELINES

The sampling equipment was constructed after the following guidelines:

Samplers were needed at 3 levels along the mast, at about 3, 7 and 12 meters above sea level. Sampling should take place simultaneously at all levels with 2 seconds intervals or less. Each individual sample should be taken within a time interval of 0.5 seconds.

As many samples as possible were wanted without any changing or rearranging of the equipment.

A means of logging the sampling points in time, and relating them to proper geographical locations, was also needed.

3.2 TECHNICAL DESCRIPTION

Plastic syringes of 5 ml volume were chosen as sample containers. In each syringe the plunger rod was discarded, but the rubber plunger itself was left in the syringe. 90 syringes were clamped in holes on a baseplate, arranged round a 90-position-valve. Vacuum bellows indexed the valve from position 1 to position 90, on command every 2 seconds from a repeating relay. Vacuum was connected to the 90-position valve and this sucked the plunger to the top of each syringe as the sampling progressed, thus leaving air samples in the syringes. Each syringe had a hypodermic needle connected to halt back-diffusion of the air sample. Three of these samplers were connected to the same pulse relay so that samples were taken simultaneously at the 3 vertical positions.

A counter connected to the pulse relay kept record of the number of samples taken. The counter, a microphone, a small tape recorder and a start-stop switch were all coupled together on an extension cord. This enabled the operator to move about giving comments to the tape recorder, which also picked up the clicks from the counter, thus logging the sampling positions

in time. Immediately after the last sample the equipment was taken down and a soft rubber plate was put on sealing all the 90 needle openings. Analysis of the 270 air samples by means of gas chromatographs took 3-4 hours, and was always done as soon as possible after each test (Heggen and Oehme, 1982).

4 EXPERIMENTAL PROCEDURES AND DATA COLLECTED

Tests were performed during 3 different periods: October/November 1983, June 1983, and October 1983. Table 1 gives a list of the 17 tests carried out. Detailed data are given in Appendix A.

Table 1: Diffusion tests over the Bundefjord. Wind speed in m/s. Temperature difference (air-sea) in degrees centigrade. Sampling heights in meters above sea level. σ_θ = standard deviation of wind elevation - degrees.

Test no	Date	No. of crossings	Sampling heights m	Release rate cc/min	Wind-direction	Wind-speed m/s	Temp. diff. air-sea ^{0}C	σ_θ deg.
1	1982-10-28	2	2.3, 7.6	250	SW	3.1	1.5	-
2	1982-10-28	8	2.3, 7.6	250	S	5.8	1.3	-
3	1982-11-04	3	2.3, 11.2	300	NE	4.6	-2.3	-
4	1982-11-04	3	2.3, 11.2	300	N	5.8	-2.5	-
5	1982-11-04	6	2.3, 11.2	300	NNW	6.6	-2.7	-
6	1983-05-30	5	3.1, 7.1, 11.6	300	S	1.9	0.5	-
7	1983-05-31	6	3.1, 7.1, 11.6	300	S	4.6	1.1	-
8	1983-06-01	7	3.1, 7.1, 11.6	200	SSW	4.5	2.1	2.0
9	1983-06-03	7	3.1, 7.1, 11.6	300	S	4.2	-1.5	2.4
10	1983-06-07	6	3.1, 7.1, 11.6	300	S	2.3	0.8	-
11	1983-06-14	6	3.1, 7.1, 11.6	300	S	7.1	1.1	-
12	1983-06-15	6	3.1, 7.1, 11.6	300	SE	7.5	-1.9	-
13	1983-06-16	6	3.1, 7.1, 11.6	300	NNW	4.6	0.3	-
14	1983-10-24	6	3.1, 7.1, 11.6	340	WNW	5.4	-0.8	3.3
15	1983-10-26	7	3.1, 7.1, 11.6	340	W	4.5	6.5	-
16	1983-10-27	7	3.1, 7.1, 11.6	340	S	4.0	2.5	4.6
17*	1983-10-28	6	3.1, 7.1, 11.6	340	N	6.5	-0.1	3.3

* Simultaneous release of 2850 cc $CBrF_3$/min at 3.8 m above sea level. SF_6 release at 1.2 m. Detailed data are given in Appendix A.

5 DATA EVALUATION - CONCENTRATION DISTRIBUTIONS

All concentrations are normalized to a release rate of 300 cc/min, and to a wind speed of 1 m/s. In the following we will only consider traverses where practically the whole plume was traversed. When necessary, missing observations are estimated by interpolation in order to calculate crosswind standard deviation and integrated concentration.

Standard deviation of horizontal and vertical wind fluctuations were calculated at the University of Bergen from their sonic anemometer recordings.

5.1. SAMPLING AT TWO HEIGHTS

Table 2 shows mean and weighted mean values of maximum normalized concentrations (CM), standard deviations (σ_y) and crosswind integrated concentrations (CI).

Incomplete traverses are omitted. The ones used in each test are noted by their traverse number. Sampling heights were 2.3 m and 76. m in the first two tests, then the upper level was lifted to 11.2 m.

Maximum concentration, standard deviation of horizontal concentration distribution and crosswind integrated concentration all decrease with height. The only exception is test 1, where the mean concentration at 7.6 m exceeds the one at 2.3 m; and test 2, where standards deviations are equal at the two heights.

With sampling at two heights only, no further effort is made to express the vertical distributions. However, a scaling height is defined as the equivalent height of a plume with constant concentration in the vertical, equal the one at 2.3 m. Weighted mean height becomes 14 m. Test 1 is then left out. It gave an unrealistic low value in the single traverse made.

Table 2: Simultaneous sampling at two heights. Mean and weighted mean maximum normalized concentration, horizontal standard deviation, and crosswind integrated concentration, CI.
Ri = Modified Richardson number. H = Scaling height (see text).

	2.3 m			7.6 m			11.2 m				
Test No. (traverse no.)	Max. conc. ppt	St.dev. m	CI ppt.m	Max. conc. ppt	St. dev. m	CI ppt.m	Max. conc. ppt	St. dev. m	CI	Ri	H
1 (1)	$4.6.10^{3}$	11.3	$5.8.10^{4}$	$3.7.10^{3}$	7.6	$7.4.10^{4}$				0.16	[86]
2 (2,3)	$3.8.10^{4}$	7.9	$7.3.10^{5}$	$2.4.10^{4}$	7.9	$3.7.10^{5}$				0.04	7
3 (1,2,3)	$1.1.10^{4}$	10.4	$2.6.19^{5}$				$6.9.10^{3}$	9.1	$1.3.10^{5}$	-0.11	19
4 (1)	$1.3.10^{4}$	6.4	$1.7.10^{5}$				$2.3.10^{3}$	5.7	$3.8.10^{4}$	-0.07	29
5 (1,4,6)	$1.7.10^{4}$	8.5	$5.0.10^{5}$				$4.6.10^{3}$	5.5	$1.6.10^{5}$	-0.06	10
Mean (10 traverses)	$1.8.10^{4}$	9.0	$4.0.10^{5}$								
Mean (9 traverses) (No.1 omitted)	$1.9.10^{4}$	8.8	$4.3.10^{5}$								
Max	$4.6.10^{4}$	11.3	$1.6.10^{5}$	Max.conc: Test 2, run 2 max ST.D: Test 1, run 1							
Min	$4.6.10^{3}$	4.8	$1.3.10^{4}$	Min.conc: Test 1, run 1, min ST.D: Test 2, run 2							

Ri is a modified Richardson number, $\Delta T/U^2$, where ΔT is the temperature difference air/water and U is the wind speed.

5.2 SAMPLING AT THREE HEIGHTS

5.2.1 Mean values

Some of the traverses are omitted in the statistical treatment, due to incomplete crossings. The remaining 50 traverses, with a total of 778 data points from 12 different tests, are listed in Table 3. See Appendix A for details.

Table 3: Traverses used in statistics - sampling at 3 heights.

	Test no.	Traverse no.	Number of datapoints*	
	6	1,3	18+16	= 34
	7	1,3,4,5,6	14+23+12+12+20	= 81
	8	1,2,3,4,5,6,7	19+20+17+23+17+13+18	= 127
	9	2,3,5	16+23+21	= 60
	10	1,2	18+15	= 33
	11	1,2,5	19+14+11	= 44
	12	2,3,4	16+14+22	= 52
	13	1,2,4,6	16+9+14+9	= 48
	14	1,2,3,4,5	9+13+11+12+22	= 67
	15	1,2,3,4,5,6	9+9+12+13+15+13	= 71
	16	1,2,3,4,5,6	14+12+10+20+18+18	= 92
	17	2,4,5,6	27+13+19+10	= 69
Total	12	50		778

* An estimated value is used when a datapoint is missing.

Table 4 shows mean and weighted mean values of maximum concentrations, standard deviations and crosswind integrated concentrations.

The maximum concentration and crosswind integrated concentration in test 15 are omitted, due to leakage of SF_6 during the release.

Table 4: Simultaneous sampling at 3 heights. Mean and weighted maximum concentrations, horizontal standard deviations and crosswind integrated concentrations (CI).

Test No.of runs	3.1 m			7.1 m			11.6 m		
	Max conc. ppt	St.dev. m	CI ppt.m	Max. conc. ppt	St.dev. m	CI ppt.m	Max. conc. ppt	St.dev. m	CI ppt.m
6 (2)	$1.6.10^{3}$	13.4	$1.9.10^{5}$	$3.5.10^{3}$	9.5	$9.0.10^{4}$	$2.5.10^{3}$	8.7	$4.2.10^{4}$
7 (5)	$1.3.10^{4}$	12.3	$2.9.10^{5}$	$8.7.10^{3}$	11.3	$1.8.10^{5}$	$4.6.10^{3}$	9.7	$1.3.10^{5}$
8 (7)	$1.2.10^{4}$	12.6	$3.3.10^{5}$	$1.0.10^{4}$	10.1	$1.5.10^{5}$	$5.1.10^{3}$	8.4	$6.5.10^{4}$
9 (3)	$2.6.10^{4}$	17.8	$4.3.10^{5}$	$2.1.10^{5}$	14.6	$3.1.10^{5}$	$2.2.10^{4}$	11.2	$2.9.10^{5}$
10 (2)	$2.0.10^{4}$	8.5	$4.0.10^{5}$	$1.9.10^{4}$	9.3	$3.2.10^{5}$	$8.0.10^{3}$	3.0	$5.6.10^{4}$
11 (3)	$1.3.10^{4}$	10.0	$1.9.10^{5}$	$8.4.10^{3}$	10.3	$1.3.10^{5}$	$7.0.10^{3}$	9.3	$1.1.10^{5}$
12 (3)	$1.1.10^{4}$	13.6	$2.5.10^{5}$	$1.0.10^{4}$	13.8	$2.0.10^{5}$	$1.0.10^{4}$	11.3	$1.4.10^{5}$
13 (4)	$9.3.10^{3}$	6.8	$1.4.10^{5}$	$1.1.10^{4}$	7.8	$1.4.10^{5}$	$1.2.10^{4}$	8.5	$1.4.10^{5}$
14 (5)	$1.9.10^{4}$	9.2	$3.8.10^{5}$	$2.1.10^{4}$	6.0	$3.0.10^{5}$	$1.7.10^{4}$	5.6	$1.8.10^{5}$
15 (6)		5.6			6.1			3.3	
16 (6)	$1.8.10^{4}$	9.1	$3.4.10^{5}$	$1.3.10^{4}$	7.8	$1.8.10^{5}$	$8.0.10^{3}$	9.0	$1.3.10^{5}$
17a(4)	$3.1.10^{4}$	10.3	$5.7.10^{5}$	$2.3.10^{4}$	11.3	$4.7.10^{5}$	$2.2.10^{4}$	9.9	$3.3.10^{5}$
17b(2)*	$2.8.10^{4}$	16.9	$6.0.10^{5}$	$1.8.10^{4}$	17.9	$3.4.10^{5}$	$2.0.10^{4}$	14.1	$2.1.10^{5}$
Weighted mean	$1.4.10^{4}$	10.4	$2.9.10^{5}$	$1.2.10^{4}$	9.4	$2.2.10^{5}$	$9.3.10^{3}$	8.0	$1.5.10^{5}$

*Release of $CBrF_3$, not included in weighted mean.

One should expect concentrations to decrease with height, and so did the crosswind integrated values. Maximum concentrations, however, occurred in some cases above the 3.1 m level, not only in individual traverses, but also as mean values. Examples are tests 9 and 13. Another feature in the vertical distribution is the effect of travelling humps, forming parts of the upper cloud. This results in a slower decrease with height of maximum concentration than of the crosswind integrated concentration. The ratio between the maximum concentrations at 11.6 m and 2.3 m is 0.49 compared to 0.39 for the integrated concentration values. With observations at three levels, corresponding values in the mean maximum concentrations are 0.48 and 0.80 for the 11.2 m and 7.6 m levels with respect the 3.1 m level. For the integrated concentrations the ratios are 0.30 and 0.70 respectively. The variations of ratios with heights are shown in Figure 3.

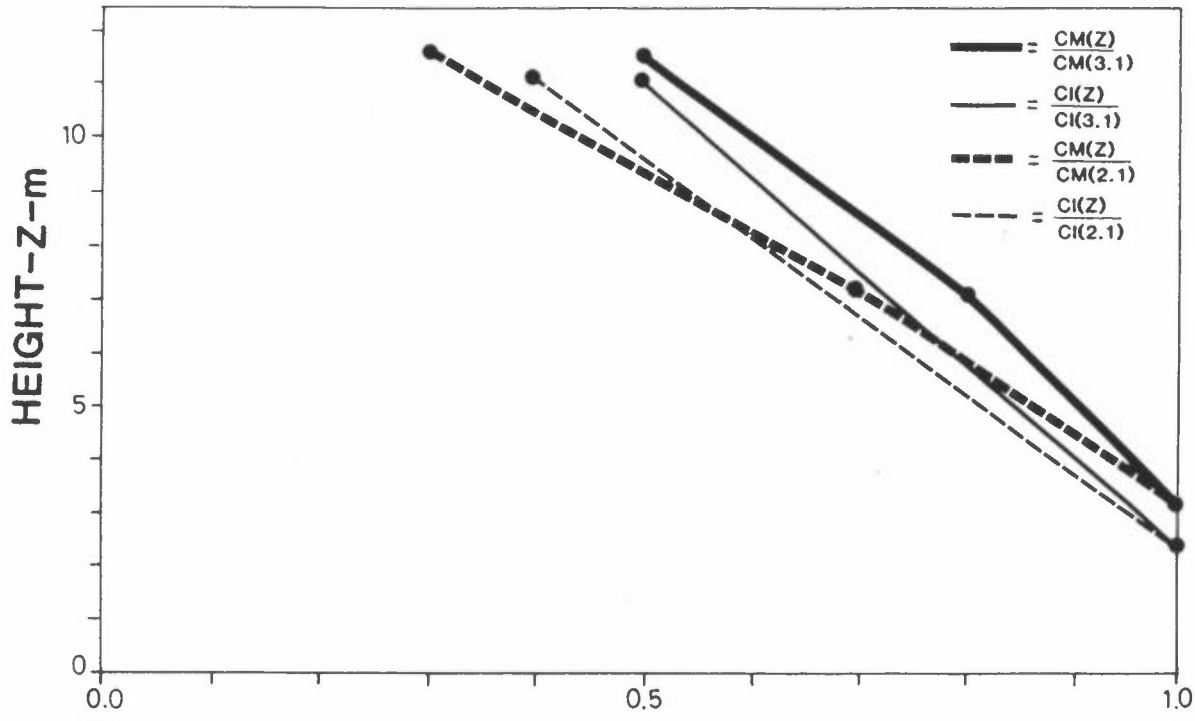

Figure 3: Variation of relative maximum concentrations with height.

The simultaneous releases of SF_6 at 1.2 m and $CBrF_3$ at 3.8 m during two traverses show the same distribution of maximum concentrations with height, with the lowest observed value at the medium level. The unusual large standard deviations in the traverse 17b were also observed in the two SF_6 plumes in 17a. Data from two traverses only are too few to draw definite conclusions, other than that large fluctuations in concentrations are confirmed by these individual observations. The $CBrF_3$ samplings are not included in later statistics.

Figure 4 shows cumulative frequency distributions of the maximum concentrations (normalized). The logarithmic values show fairly straight lines. The median value decreases with height while the standard deviation increases. The 3.1 m curve is steeper than the other two, which both consist of fairly large amounts of low concentrations compared to the 3.1 m curve.

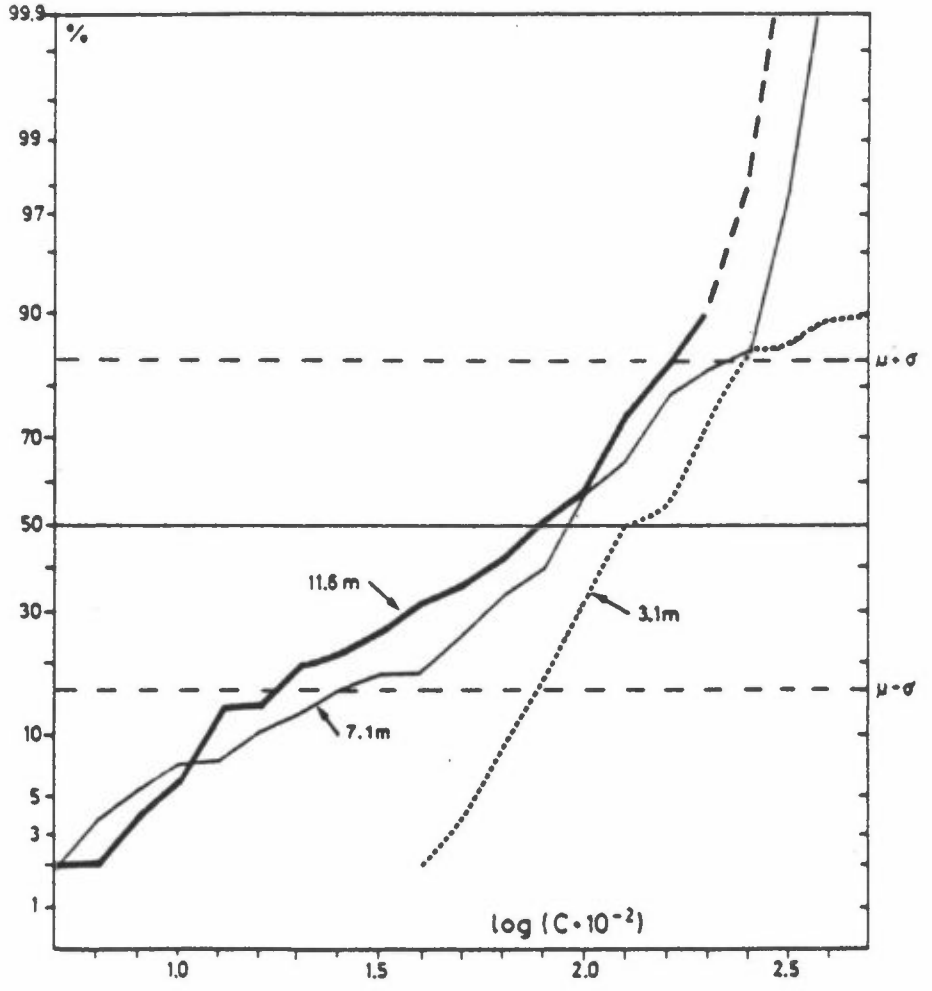

Figure 4: Cumulative frequency distribution of maximum concentrations.

5.2.2 Vertical concentration distribution

To improve accuracy in estimates of the vertical distribution, concentration values at 1 m are estimated assuming a Gaussian distribution, and the cloud height estimated from a vertical plot. The standard deviation, σ_z, is then computed. Cloud height, H 1/10, is defined as the height to 1/10 of the maximum concentration. Monin (1959) gives the following expression for cloud height

$$HM = \sigma_E x$$

where $\sigma_E = \sqrt{\overline{w}^2/u}$ - w is the fluctuating vertical wind speed and x the distance from the source.

Table 5 shows the height to the center of gravity, the standard deviation and cloud heights, together with observed turbulence data. Included is also the Monin-Ubukhov stability parameter, L. We here take into account the water vapour flux as done by Nieuwstadt, using his approximations over water (Nieuwstadt 1977):

$$L = \frac{170u^{*3}\ T}{u[(T-TW) + 0.61\ T\ (q-qw)]}$$

where u* = friction velocity, T = air temperature, TW = water temperature, q = specific humidity of the air, qw = specific humidity of saturated air at temperature TW.

In test 14, 16 and 17 the vertical velocities from the sonic anemometer reading are believed to be somewhat too large. This results in unrealistic high values of HM compared to H 1/10, the other cloud height parameter.

Table 5: Height, to the center of gravity, HCg, standard deviation, cloud heights (H 1/10 and HM) and turbulence parameters.
L = Monin-Obukhov stability parameter.
w = fluctuating vertical wind speed.
U_1 the corresponding mean wind speed.

Test no. (No. of traverses)	HCg	H 1/10	σ_z	$\overline{w}^2$	U_1	σ_E	HM	Ri	$1/L.10^3$
	m	m	m	m/s	m/s	degrees	m		
6 (2)	5.0	14	6.2					0.14	-0.49
7 (5)	4.7	16	6.2					0.05	1.9
8 (7)	4.6	13	5.9	0.23	6.7	1.9	13.7	0.10	-3.2
9 (3)	5.2	15.5	6.6	0.15	3.8	2.2	15.8	-0.09	1.0
10 (2)	4.6	12	5.7					0.15	-0.80
11 (3)	5.5	25	7.3					0.02	-1.3
12 (3)	5.3	23	7.2					-0.03	-0.54
13 (4)	6.1	30	8.1					0.01	-1.8
14 (5)	5.6	17	7.0	0.35	5.4	(3.7)	26	-0.02	-0.92
15 (6)	3.4	12.5	4.1					0.32	-5.9
16 (6)	5.0	17	6.5	0.41	5.1	4.6	32	0.16	-2.0
17 (4)	5.2	16	6.5	0.36	6.4	3.3	22.5	-0.002	-1.1
Weighted mean	5.0	17	6.3						

5.2.3 Correlations

Table 6 shows mean values, horizontal standard deviations and extreme values of the different parameters. The correlations between the mean concentrations and the different parameters from Table 6 are shown in Table 7. The maximum concentration at 3.1 m is well correlated with the stability parameters and with the vertical standard deviation σ_z. One might have expected the maximum concentration, CM, to be correlated with the crosswind integrated concentration, CI, and CI with σ_z, but this is not the case. Otherwise, correlations are as expected, as for instance between stability parameters.

Table 6: Mean, standard deviation and extreme values.
CM = Maximum normalized concentration - at 3.1 m.
CI = Crosswind integrated concentration - at 3.1 m.
RI = Modified Richardson number = $\Delta T/u^2$.
ΔT = Air temp (T) - sea surface temp (TW).
σ_y = Standard deviation - crosswind horizontal concentration distribution.
σ_z = Standard deviation - vertical concentration distribution.
HCg= Height of center of gravity.
L* = $1/L \cdot 10^3$ where L = Monin Obukhov Length.

	Mean	St.dev.	Max	Min
CM	2.2	2.3	9.1	.16
CI	3.0	1.3	5.7	1.2
σ_y	10.8	3.4	17.8	5.6
σ_z	6.4	.99	8.1	4.1
HCg	5.0	.67	6.1	3.4
H 1/10	17.6	5.6	30.0	12.0
ΔT	.88	2.2	6.5	-1.9
RI	.67	1.1	3.2	-0.9
L*	-1.4	1.9	1.6	-5.9

Table 7: Correlation coefficients.

L*	1.0								
RI	-.80	1.0							
ΔT	-.91	.90	1.0						
σ_y	-.60	-.57	-.61	1.0					
σ_z	-.61	-.79	-.74	.19	1.0				
HCg	.69	-.80	-.77	.18	.98	1.0			
H 1/10	.15	-.48	-.35	-.16	.83	.75	1.0		
CM	-.62	.58	.71	-.44	.74	.36	.36	1.0	
CI	.49	-.41	-.43	.33	.03	.12	-.40	-.13	1.0
	L*	Rl	ΔT	σ_y	σ_z	HCg	H 1/10	CM	CI

5.3 DISCUSSION

5.3.1 Comparison with Gaussian distribution

In a Gaussian distribution the standard horizontal deviation, σ_y, may be expressed as:

$$\sigma_y = \frac{CI}{CM} \cdot \frac{1}{2\pi}$$

Table 8 presents calculated values using this expression and observed values from Table 2 and Table 4.

Table 8: Mean standard horizontal deviation. Observed and calculated (Gaussian).
Ratio = observed/ calculated.

	From Table 2			From Table 4		
	2.3 m	7.6 m	11.2 m	3.1 m	7.1 m	11.6 m
No. obs.	9	3	7	50	50	50
Gaussian Observed	9.0 8.8	7.1 7.8	9.3 6.8	8.3 10.4	7.3 9.4	6.4 8.0
Ratio	0.98	1.10	0.73	1.25	1.29	1.25

The few observations from Table 2 indicate a close to Gaussian distribution at the two lowest levels and a more narrow one at the upper level. The more numerous observations from table 4 show a almost constant ratio at all three levels, indicating a wider than Gaussian distributions. However, the real maximum concentration may have been higher than observed and the distributions therefore closer to Gaussian. While the distribution in a single plume traverse may be far from Gaussian, the mean distribution of a number of traverses will be close to Gaussian.

5.3.2. Comparison with results from other experiments

In the 15 similar conducted tests in a Norwegian fjord, already mentioned, the mean of 180 plume crossings gave σ_y = 11 m at a distance of 500 m. The air was unstable during 1 test, near neutral during 8, and stable during 2 tests. During 4 tests there was a temperature inversion. However, σ_y showed no marked variation with stability, but maximum concentrations doubled during inversion conditions. When we assume $\sigma_y = ax^p$, and P = 0.85 for near neutral conditions over water (Hosker 1974), a= 0.056. At a distance of 400 m we would get σ_y = 9.1 m, a value close to what was observed over the Bundefjord.

Similar plume crossings with boats conducted by Brookhaven National Laboratories (Raynor et al., 1978) gave $\sigma_y = 0.06\ x^{0.88}$ in near neutral air, that is $\sigma_y = 11.7$ m at a distance of 400 m. Corresponding values were 14 m in stable air and 13 m in unstable air.

Over the Bundefjord the standard deviation σ_y, depended very little on the temperature difference air/water. The mean weighted values varies from 9.8 m in stable and unstable stratification to 9.3 m during the neutral conditions.

Corresponding values of the vertical standard deviation, σ_z, are 5.8 m in the stable cases and 6.9 m in the neutral cases. The relative few unstable cases give $\sigma_z = 6.9$ m. Brookhaven sampled only at one level and had to estimate σ_z from mass continuity. Their values, adjusted to a distance of 400 m, gives 11.6 m in unstable air, 6.2 m in near neutral and 5.5 m in stable air. Except for the unstable case, they are in good agreement with our observations.

6 CONCENTRATION DISTRIBUTION

6.1 DISTRIBUTION AT A FIXED LOCATION RELATIVE TO THE CENTER OF GRAVITY

The probality of concentration at fixed spatial location is normally discussed in terms of the probality of vanishing concentration, F(0), and the distribution of nonzero concentration, B(C). Alignment of the different traverses relative to the cloud center along the same horisontal line requires adjustments and interpolations. Interpolated data in specified gridpoints within the cloud will therefore almost always be different from zero. To estimate F(0) interpolation between gridpoints is therefore not made. A zero concentration is simply moved to the nearest gridpoint. Figure 5 shows the probability of zero concentration to be small near the cloud center, $y<\sigma_z$, and large outside, $y>2\sigma_y$. The assymetry indicated is probably not significant.

Figure 6 indicates that the concentration distribution B(C) is reasonably approximated by a lognormal distribution. This is accordance with previous

experience. The distribution may therefore as a first approximation be discussed in terms of the parameters lnC and σ_* of the lognormal distribution.

$$B(C) = \frac{1}{\sqrt{2\pi}\sigma_* C} \exp\left[-\frac{1}{2\sigma_*^2}(\ln C - \ln C_0)\right]$$

Since $\bar{C} = \int_0^\infty CB(C)dC$ and $(C-\bar{C})^2 = \int_0^\infty (C-\bar{C})^2 B(C)dC$, B(C) may also be discussed in terms of the mean concentration and the standard deviation, more readily assigned to physical interpretation than C and σ_*. The mean concentration distribution in Figure 7 appears almost Gaussian as expexted. The relative variability illustrated in Figure 8, is of order 1 inside the cloud, as estimated by Eidsvik (1981). The maximum variability is at distance $y \geq 2\sigma_y$ and not at the cloud center.

6.2 SPATIAL VARIATIONS

The simultaneous variations at all points, the spatial variation, will be discussed in terms of emphirical orthogonal functions (Eidsvik, 1980).

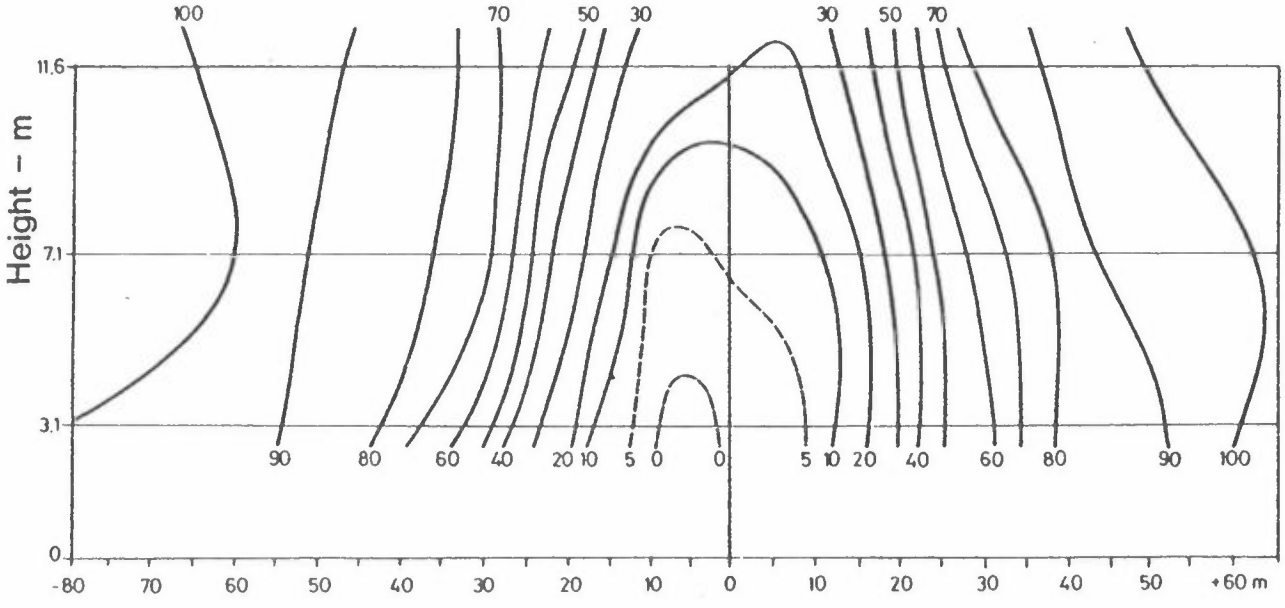

Figure 5: Probability of vanishing concentration relative to distance from center of gravity. Looking along wind direction.

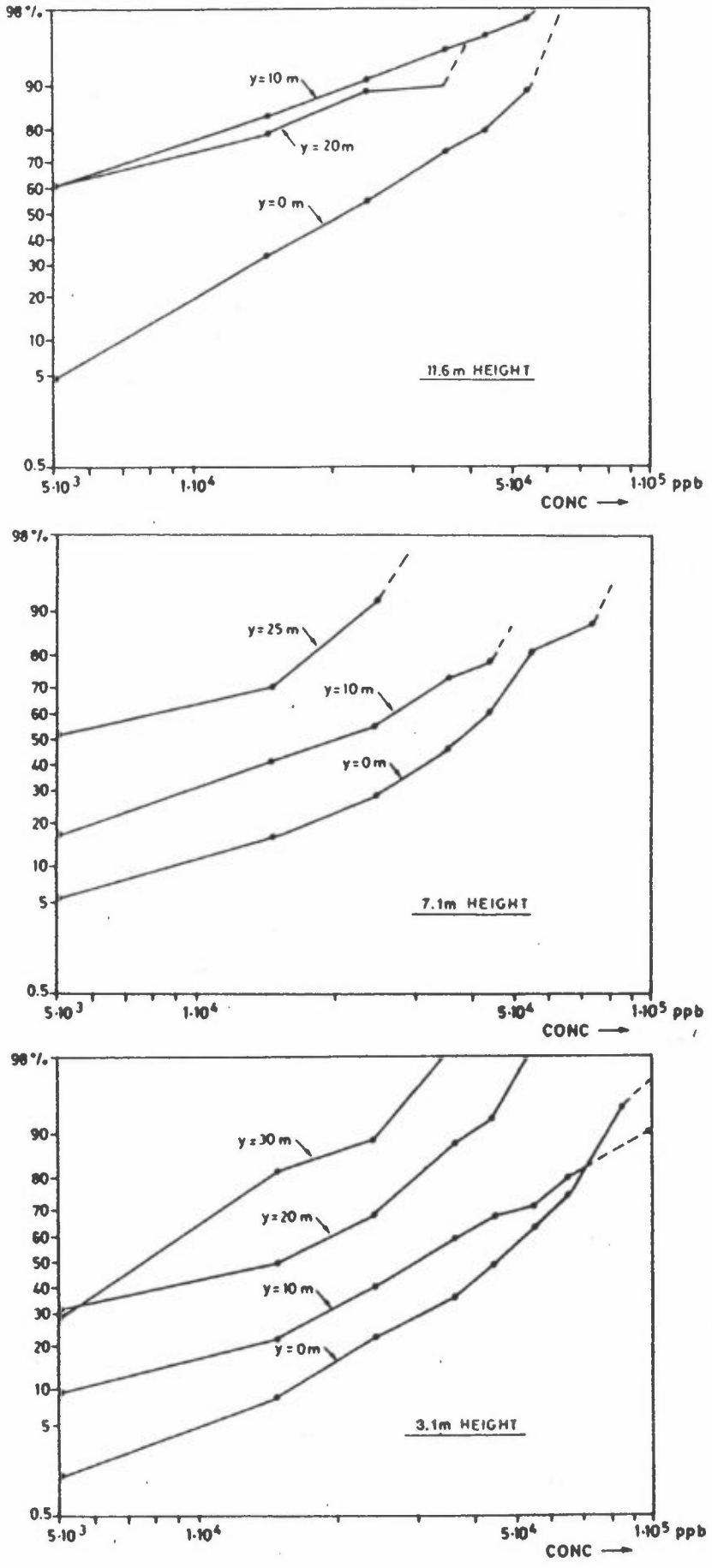

Figure 6: Cumulative frequency distribution of non-zero concentrations relative to the center of gravity. y = distance from center.

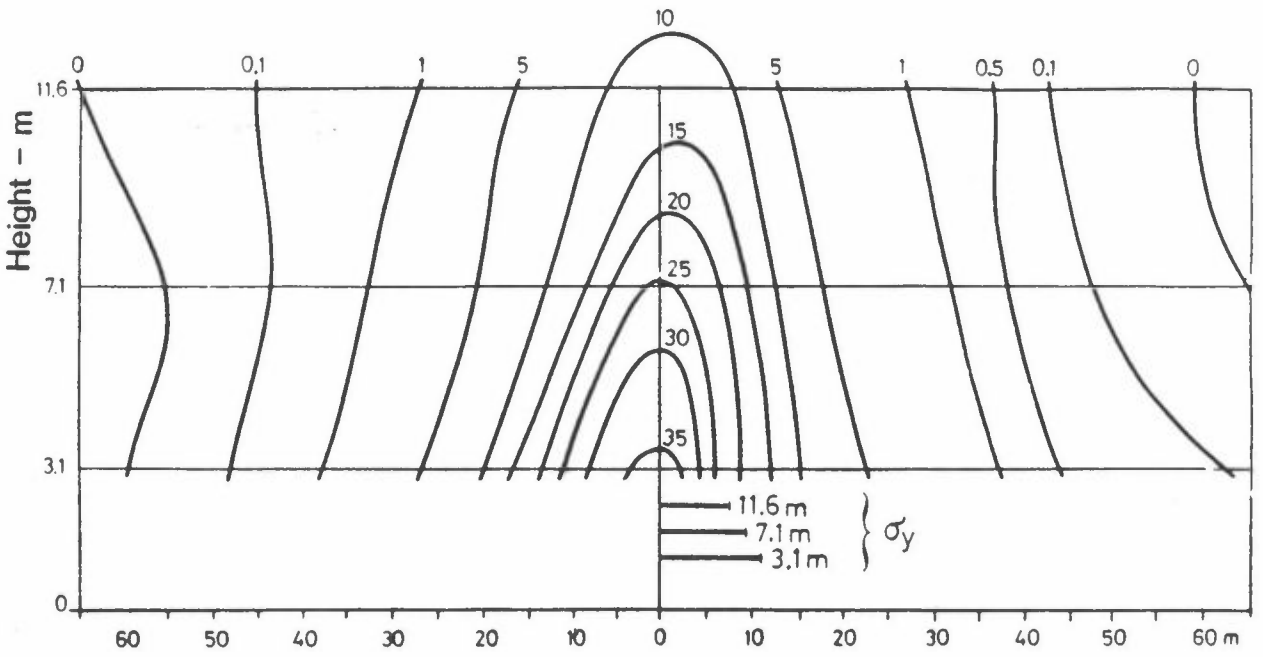

Figure 7: Mean cross-section relative to center of gravity for each traverse. Concentrations normalized to a release of 300 cc/min. and wind speed of 1 m/s. Unit: 10^2 ppt. Looking in the wind direction.

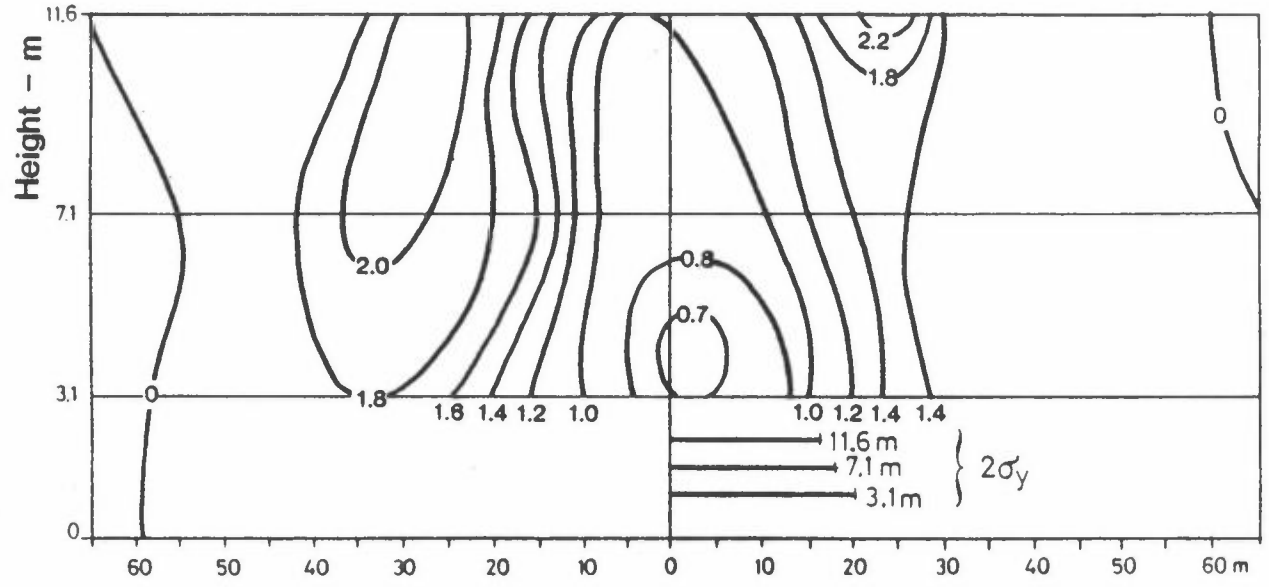

Figure 8: Distribution of standard deviation/mean concentration. Looking in the wind direction.

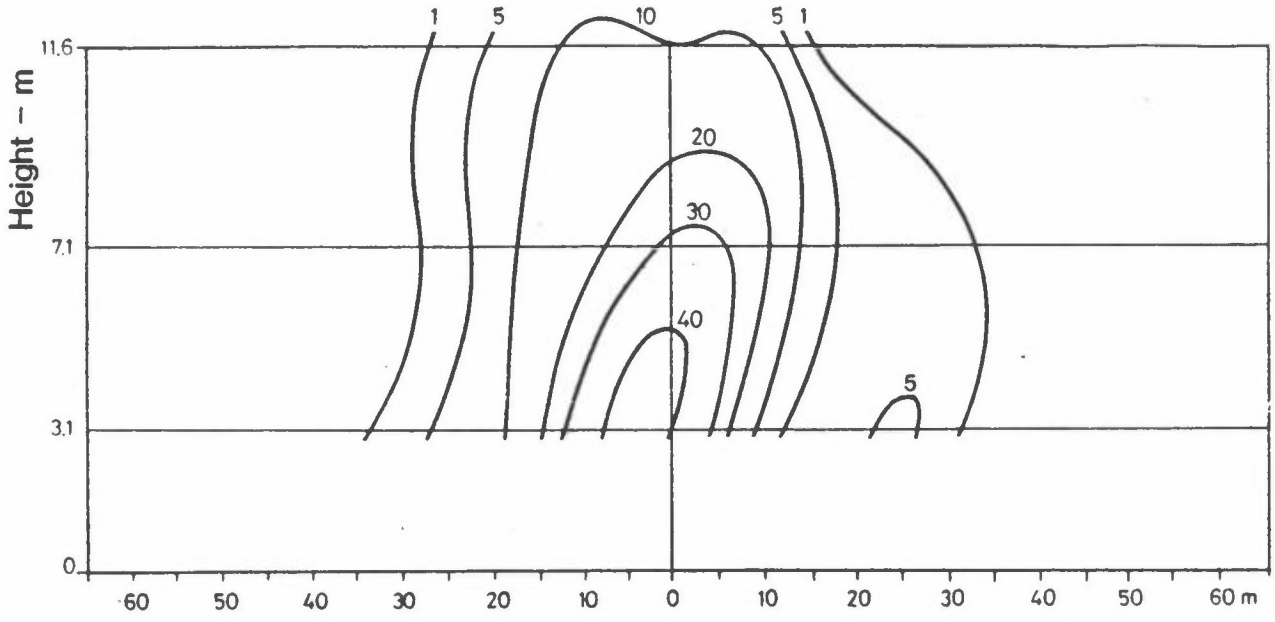

Figure 9: Empirical orthogonal function associated with the largest eigenvalue.

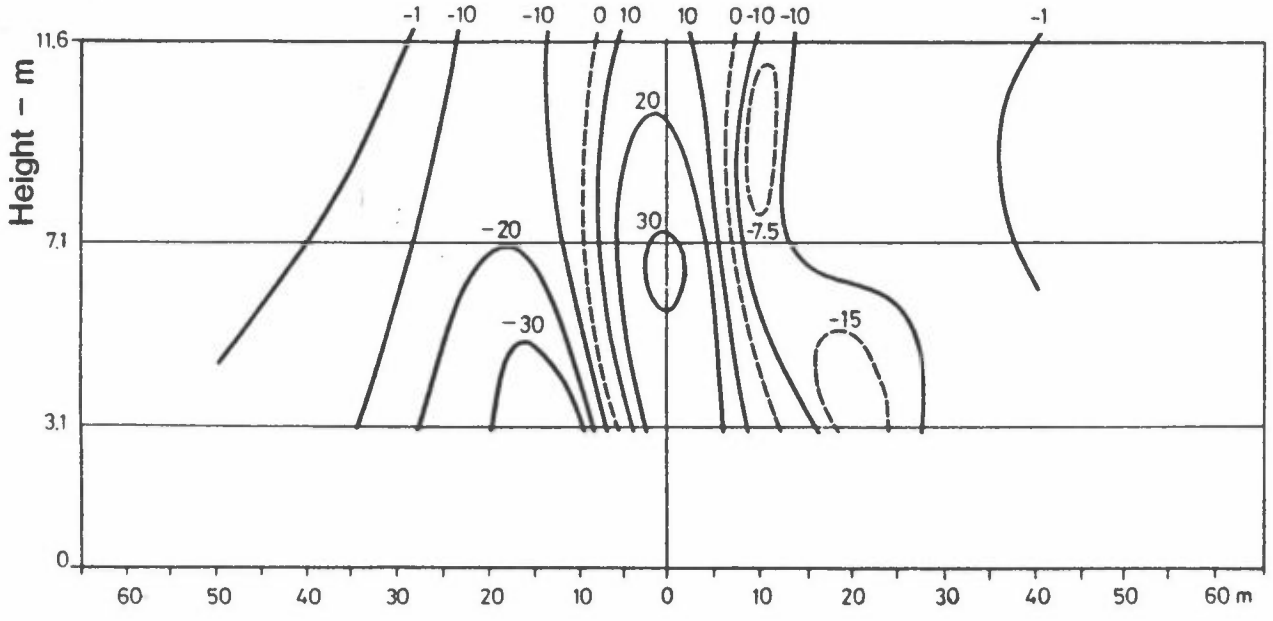

Figure 10: Empirical orthogonal function associated with the second largest eigenvalue.

The fluctuations $C'(y,z) = C(y,z) - C(y,z)$ is represented as a set of emphirical orthogonal functions $e_k(y,z)$.

$$C'(y,z) = \sum_{k=1}^{n} a_k \, e_k \, (y,z)$$

When this sum is arranged according for the magnitude of $\lambda_k = \overline{a_k \cdot a_k}$ this representation is as effective as possible. It may be shown that λ_k and $e_k(y,z)$ are the eigenvalue and eigenfunction of the covariance matrix: $\{C'(y,z)C'(y',z')\}$.

It turns out that most information about $C'(y,z)$ is associated with the first few eigenfunctions.

The first and most important feature is shown in Figure 9. It is associated with the largest scale of the $C'(y,z)$ field. When the fluctuations are large, they are large throughout the whole crossection with maximums fluctuations near the cloud center.

The second most important feature is shown in Figure 10: When concentrations are high near the center they are low near the boundaries. This reflects the tendency for a narrow plume with high concentrations, or a wide plume with low concentrations.

7 CONCLUSIONS

The horizontal crosswind distribution of instantaneous concentrations were far from normally distributed during single traverses, while the mean of several traverses in each test was close to Gaussian. The corresponding standard deviation seemed to be fairly independent of the temperature difference air/water, while the standard deviation in the vertical distribution has a minimum in inversion layers.

Values of σ_y agrees well with values obtained in over water dispersion tests performed by Brookhaven.

Maximum concentrations decrease less with height than the crosswind integrated concentrations. The reason is belived to be travelling lumps forming the upper part of the plume observed in the simultaneously released smoke plumes.

Statistical properties of the fluctuating concentration distribution relative to the center of gravity show that when fluctuations are large, they are large throughout the whole cross section. This is the most prominent feature. High concentrations near the plume center and low concentrations near its border is the second most important feature.

8 REFERENCES

Eidsvik, K.J. (1980) Estimates of concentration fluctuations in an instantaneous plume. Atmos. Environ., 14, 1365-1369.

Heggen, R. and Oehme, M. (1982) Columns for simultaneous gas chromotographic determination of ppt levels of the atmospheric tracers sulphur hexafluoride and bromotrifluormethane in ambient air samples. J. Chrom., 243, 168-172.

Hosker, R.P. (1974) A comparison of estimation procedures for over-water plume dispersion. I: Proc. of the symp. on atmos. diff. and air poll. Santa Barbara, 1974. Boston, Am. Met. Soc. pp. 281-288.

Monin, A.S. (1959) Smoke propagation in the surface layer of the atmosphere. Adv. Geophys., 6, 331-343.

Nieuwstadt, F.T.M. (1977) The dispersion of pollutants over a water surface. 8th. Int. Tech. Meeting on Air Poll. Modelling. Louvain-La-Neuve, Belgium.

Raynor, G.S., Brown, R.M., SethuRaman, S. (1978) A comparison of diffusion from a small island and an undisturbed ocean site. J. Appl. Meteorol., 17, 129-139.

APPENDIX A

BOAT SAMPLING DATA

Concentration values are in ppt.

Time between sampling positions multiplied by the boat speed gives corresponding distance in meters.

A leakage of SF6 occurred 28 October 1983 in test 15. The given concentrations are therefore too high. Relative values, however, are believed to be correct.

TEST NO :1
DATE :82.10.28
TIME :1510-1515
RELEASE :250 CC/MIN
HEIGHT OS SENSORS :2.3 M,7.6 M
DISTANCE :375 M
BOAT SPEED :3.1 M/S
SAMPLING DISTANCE :6.2 M,
WIND DIRECTION :SW
WIND SPEED :3.1 M/S AT 1.2 M
AIR TEMPERATURE :9.3 C
REL HUMIDIY :83 %
SEA TEMPERATURE :7.8 C
STABILITY CATEGORY :D/E
CLOUD COVER/WEATHER:5/8-SUN

START :1510
DIRECTION :SE

REL DIST-S	CONCENTRATION - PPT 2.3 M	7.6 M
20	21	0
22	20	0
24	14	0
26	11	0
28	10	0
30	10	22
32	16	964
34	58	373
36	203	867
38	852	997
40	1249	10
44	10	0
46	5	0
48	5	0
50	5	0
52	17	0
54	20	0
56	5	0

START :1513
DIRECTION :SE

REL DIST-S	CONCENTRATION - PPT 2.3 M	7.6 M
10	124	135
12	97	243
14	107	565
16	609	556
18	661	79
20	8	0
22	8	0
24	5	0
26	7	0
28	18	0
30	11	0
32	5	0
34	13	0
36	12	0
38	5	0
40	5	0

TEST NO	:2
DATE	:82.10.28
TIME	:1550-1606
RELEASE	:250 CC/MIN
HEIGHT OS SENSORS	:2.3 M,7.6 M
DISTANCE	:400 M
BOAT SPEED	:3.1 M/S
SAMPLING DISTANCE	:6.2 M,
WIND DIRECTION	:S
WIND SPEED	:5.8 M/S AT 1.2 M
AIR TEMPERATURE	:9.1 C
REL HUMIDIY	:80 %
SEA TEMPERATURE	:7.8 C
STABILITY CATEGORY	:D/E
CLOUD COVER/WEATHER	:6/8-SUN

START :1550
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 2.3 M	7.6 M
10	183	0
12	589	43
14	2416	89
16	5250	2971
18	2954	3349
20	1313	2759
24	167	500

START :1552
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 2.3 M	7.6 M
25	734	852
23	1773	2221
21	4308	3036
19	3254	17
17	737	5
15	199	0
13	76	0

START :1554
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 2.3 M	7.6 M
15	5	33
17	4500	1930*
19	6656	3827
21	5427	296
23	3186	1681
25	1870	*1714
27	550	1364
29	371	83

START :1556
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 2.3 M	7.6 M
30	2576	1473
28	2532	212
26	887	874
24	1590	973
22	65	5
20	5	26

START :1558
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 2.3 M	7.6 M
20	2610	2713
22	2302	3753
24	2962	2705
26	2083	3675
28	1937	2938
30	646	622
32	167	114
34	17	69
36	5	5

START :1600
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 2.3 M	7.6 M
44	1618	27
40	2294	1828
36	3113	1658
34	1298	82
32	396	5
28	32	0
26	15	0

START :1602
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 2.3 M	7.6 M
33	8	0
32	305	0
37	172	5
39	837	82
41	2093	234
43	2870	843
45	1092	1480
47	1415	1119

START :1604
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 2.3 M	7.6 M
46	1188	1263
44	1899	80
42	760	2169
40		1527

TEST NO	:3
DATE	:82.11.04
TIME	:1200-1210
RELEASE	:300 CC/MIN
HEIGHT OS SENSORS	:2.3 M,11.2 M
DISTANCE	:385 M
BOAT SPEED	:2.6 M/S
SAMPLING DISTANCE	:5.1 M,
WIND DIRECTION	:NØ
WIND SPEED	:4.6 M/S AT 1.2 M
AIR TEMPERATURE	:5.2 C
REL HUMIDIY	:35 %
SEA TEMPERATURE	:7.5 C
STABILITY CATEGORY	:C
CLOUD COVER/WEATHER	:1/8-SUN

START :1200
DIRECTION :NW

REL DIST-S	CONCENTRATION - PPT 2.3 M	11.2 M
2	0	0
4	84	0
6	59	0
8	86	0
10	323	0
12	5	0
14	5	0
16	60	313
18	553	506
20	660	225
22	381	111
24	1312	180
26	1393	491
28	2121	636
30	1491	459
32	400	488
34	201	76
36	10	0
40	0	0
44	0	0
48	0	0

START :1203
DIRECTION :SE

REL DIST-S	CONCENTRATION - PPT 2.3 M	11.2 M
60	0	0
58	0	0
56	0	0
54	0	0
52	0	0
50	0	0
48	0	0
46	0	0
44	503	432
42	2442	512
40	1493	975
38	365	0
36	191	0
34	339	0
32	5	0
30	0	0
28	0	0

START :1206
DIRECTION :NW

REL DIST-S	CONCENTRATION - PPT 2.3 M	11.2 M
2	0	0
4	0	0
6	0	0
8	2708	961
10	3258	1735
12	3133	1332
14	3282	2917
16	2385	714
18	1996	2541
20	1128	878
22	584	15
24	290*	0
26	0	0
28	0	0
30	0	0
32	0	0
34	0	0

TEST NO :4
DATE :82.11.04
TIME :1400-1408
RELEASE :300 CC/MIN
HEIGHT OS SENSORS :2.3 M,11.2 M
DISTANCE :375 M
BOAT SPEED :2.6 M/S
SAMPLING DISTANCE :5.1 M,
WIND DIRECTION :N
WIND SPEED :5.8 M/S AT 1.2 M
AIR TEMPERATURE :5.0 C
REL HUMIDIY :52 %
SEA TEMPERATURE :7.5 C
STABILITY CATEGORY :C
CLOUD COVER/WEATHER:1/8-SUN

START :1400
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 2.3 M	11.2 M
0	0	0
2	0	0
4	0	59
6	0	214
8	141	397
10	1426	389
12	659	241
14	2172	5
16	890	0
18	307	0
20	0	0
22	0	0
24	0	0
26	0	0
28	0	0
30	0	0
32	0	0
34	0	0
36	0	0

START :1403
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 2.3 M	11.2 M
0	1119	85
2	463	0
4	296	54
6	298*	253
8	301	0
10	405	0
12	202*	0
14	0	0

START :1405
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 2.3 M	11.2 M
0	0	0
2	0	0
4	107	0
6	567	0
8	969	0
10	1863	0

TEST NO :5
DATE :82.11.04
TIME :1545-1605
RELEASE :300 CC/MIN
HEIGHT OF SENSORS :2.3 M,11.2 M
DISTANCE :275 M
BOAT SPEED :2.6 M/S
SAMPLING DISTANCE :5.1 M,
WIND DIRECTION :NNW
WIND SPEED :6.6 M/S AT 1.2 M
AIR TEMPERATURE :4.8 C
REL HUMIDIY :58 %
SEA TEMPERATURE :7.5 C
STABILITY CATEGORY :C
CLOUD COVER/WEATHER:0/8-CLEAR
START :1545
DIRECTION :ENE

REL DIST-S	CONCENTRATION - PPT 2.3 M	11.2 M
2	0	0
4	0	0
6	0	0
8	0	65
10	0	0
12	0	0*
14	14	0*
16	71	71*
18	780	283*
20	830	159
22	920	689
24	316	899
26	0	45

START :1548
DIRECTION :WSW

REL DIST-S	CONCENTRATION - PPT 2.3 M	11.2 M
-	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	20	-
	1020	-
	3617	-
	267	591
	0	798
	0	0
	0	0

START :1551
DIRECTION :ENE

REL DIST-S	CONCENTRATION - PPT 2.3 M	11.2 M
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	17	0*
	1068	0*
	3026	0*
	3306	0*
	765	35

START :1555
DIRECTION :WSW

REL DIST-S	CONCENTRATION - PPT 2.3 M	11.2 M
-	0	0
-	0	0
	10	0
	785	72
	2465*	1153
	4146	210
	5226	616
	961	0
	0	0
	0	0
	0	0
	0	0
	0	0

START :1558
DIRECTION :ENE

REL DIST-S	CONCENTRATION - PPT 2.3 M	11.2 M
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	621	0
	4522	0
	5068	0
	4845	10
	2180	3502
	2049	502

START :1601
DIRECTION :WNW

REL DIST-S	CONCENTRATION - PPT 2.3 M	11.2 M
	0	0
	0	0
	0	0
	0	0
	179	0
	3632	103
	5318	638
	3344	435
	1500	10
	2993	0
	3362	0
	4135	0
	4007	0
	2978	0
	2181	0
	65	0
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0
	0	0

TEST NO :6
DATE :83.05.30
TIME :1240-1250
RELEASE :300 CC/MIN
HEIGHT OS SENSORS :3.1 M,7.1 M,11.6 M
DISTANCE :390 M
BOAT SPEED :3.1 M/S
SAMPLING DISTANCE :6.1 M,
WIND DIRECTION :S
WIND SPEED :1.9 M/S AT 1.2 M
AIR TEMPERATURE :12.8 C
REL HUMIDIY :73 %
SEA TEMPERATURE :12.3 C
STABILITY CATEGORY :E
CLOUD COVER/WEATHER:6/8-HAZE

START :1240
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
6	1831	0	0
8	2137	0	0
10	1220	3170	85
12	4473	1608	24
14	4055	1250	14
16	2833	909	39
18	1470	660	16
20	529	652	0
22	40	0	0
24	0	0	0
26	0	0	0
28	0	0	0
30	0	0	0
32	0	0	0
34	0	0	0
36	0	0	0
38	0	0	0

START :1242
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
6	0	0	0
8	0	0	0
10	0	0	0
12	0	0	0
14	0	0	0
16	0	0	0
18	0	0	0
20	0	0	0
22	0	0	0
24	0	0	0
26	0	0	0
28	0	0	0
30	0	0	146
32	0	887	191
34	94	3213	42
36	507	3126	2289

START :1244
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
36	0	0	0
34	0	0	0
32	0	0	0
30	295	81	0
28	550*	53	129
26	807*	963	1073
24	1063	1573	1067
22	1844	1718	1324
20	2224	1524*	2528
18	2426	1330	1014
16	609	15	0
14	283	58	0
12	117	38	0
10	112	0	0

START :1247
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
3	0	0	0
5	0	0	0
7	0	34	0
9	0	0	0
11	0	0	0
13	0	0	0
15	0	0	0
17	0	0	0
19	0	0	0
21	0	0	0
23	0	0	0
25	0	0	0
27	0	0	0
29	214	0	0
31	383	0	0
33	148	0	0
35	146	0	0
37	467	30	0
39	374	0	0
41	1473	0	0
43	1059*	0	0
45	645	0	0
47	1031	114	1279
49	2104	0	1867

START :1249
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
42		0	0
40	0	0	0
38	0	0	0
36	0	0	0
34	0	0	0
32	0	0	0
30	0	0	0
28	0	0	0
26	0	0	1337
24	269	447	3829
22	1386	700	1759
20	1664	2875	458
18	2656	4705	1152
16	772	288	576*
14	2825	1092	0
12	1482	1988	0

TEST NO :7
DATE :83.05.31
TIME :1155-1215
RELEASE :300 CC/MIN
HEIGHT OS SENSORS :3.1 M,7.1 M,11.6 M
DISTANCE :400 M
BOAT SPEED :3.1 M/S
SAMPLING DISTANCE :6.1 M,
WIND DIRECTION :S
WIND SPEED :4.6 M/S AT 1.2 M
AIR TEMPERATURE :14.3 C
REL HUMIDIY :68 %
SEA TEMPERATURE :13.2 C
STABILITY CATEGORY :D/E
CLOUD COVER/WEATHER:6/8-DISTANT RAINSHOWERS

START :1155
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
6	18	1005	97
8	27	1176	1581
10	1020	2239	389
12	1923	2346	2764
14	3327	189	2654
16	127	142	21
18	0	7	10*
20	0	0	0
24	0	0	0

START :1157
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
18	0	0	0
20	29	0	60
22	18	27	462
24	164	1568	230*

START :1159
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
-6	841	10	0
-4	689	0	23*
-2	1759	760	46
0	1921	1064	875
2	2101	1558	1319
4	2466	1331	554
6	1860	1673	409
8	1909	1215	1904
10	1189	533	969
12	1211	1181	1242
14	1973	1459	231
16	390	115	0
19	75	20	0
21	11	0	0

START :1201
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
-22	0		0
-20	0	0	0
-18	0	0	0
-16	0	0	0
-14	0	0	0
-12	0	0	0
-10	0	0	0
-8	0	0	0
-6	0	0	0
-4	0	0	0
-2	0	0	
0	8	0	0
2	327	328	36
4	636	33	285*
6	533	196*	534*
8	1397	359	784
10	1599	190*	107
12	1931	22	634
14	0	0	0
16	0	0	0
18	0	0	0
20	0	0	0

START :1204
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
26	0	0	0
24	0	0	0
22	0	0	0
20	0	0	0
18	225	62	0
16	147	250	0
13	2329	1430	0
11	3112	1362	0
9	3984	3888	0
7	1258	749	69
5	834	27	264
3	0	0	0
1	0	0	0

START :1214
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
-6	0	0	0
-4	0	0	0
-2	0	0	0
0	0	22	10
2	0	87	116
4	178	132	0
6	937	955	0
8	229	81	0
10	1358	108	0
12	195	41	0
14	50	51	0
16	166	2071	453
18	483	59	0
20	2316	12	0
22	488	0	0
24	792	0	0
26	419	0	0
28	0	0	0
30	0	0	0
32	0	0	0
34	0	0	0
36	0	0	0
38	0	0	0
40	0	0	0
42	0	0	0
44	0	0	0
46	0	0	0

TEST NO :8
DATE :83.06.01
TIME :1200-1212
RELEASE :300 CC/MIN
HEIGHT OS SENSORS :3.1 M,7.1 M,11.6 M
DISTANCE :400 M
BOAT SPEED :3.1 M/S
SAMPLING DISTANCE :6.1 M,
WIND DIRECTION :SSW
WIND SPEED :4.5 M/S AT 1.2 M
AIR TEMPERATURE :16.7 C
REL HUMIDIY :52 %
SEA TEMPERATURE :14.6 C
STABILITY CATEGORY :D/E
CLOUD COVER/WEATHER:3/8-SUN

START :1200
DIRECTION :WNW

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
29	538	0	0
27	688	29	0
25	1249	50	0
23	1736	50	0
21	846	26	0
19	1270	38	25
17	1483	455	30
15	4876	1746	836
13	3779	0	146
11	500	40	15
9	98	0	15
7	15	0	0

START :1202
DIRECTION :ESE

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
2	500*	0	0
4	1006	22	0
6	2021	1014	0
8	2518	388	525
10	1466	1748	1845
12	884	603	122
14	520	0	0
16	990	492	61
18	220	212	0
20	478	377	296
22	169	190	788
24	99	84	56
26	12	0	0

START :1204
DIRECTION :WNW

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
47	10	0	0
45	10	0	98
43	572	310	779
41	362	1793	2289
39	1278	2130	32
37	1389	155	0
35	918	430	0
33	648	0	0
31	135	0	0
29	10	0	0
27	12	0	0
25	10	0	0

START :1206
DIRECTION :ESE

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
-1	10	85	491
1	567	409	572
3	74	841	550
5	982	933	39
7	846	498*	26*
9	479	63	12
11	566	124	254
13	967	2427	467
15	1672	1423	19
17	1753	619	35
19	2646	269	10
21	373	171	0
23	38	0	0

START :1208
DIRECTION :WNW

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
26	0	0	0
23	0	0	0
21	0	0	12
19	37	280	0
17	316	0	0
15	38	0	0
13	562	31	13
11	1551	619	268*
9	1459	388	524
7	3017	2321	929
5	2390	27	0
3	1869	322	0
1	1916	0	0
-1	501	10	0

START :1210
DIRECTION :ESE

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
6	86	44	9
8	979	1006	86
10	4213	2213	1789
12	5993	4366	911
14	1936	1321	219
16	752	158	0
18	146	0	0*
20	26	0	0

START :1212
DIRECTION :WNW

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
29	0	0	0
27	0	0	0
25	0	0*	0
23	0	0	0
21	0	0	0
19	0	0	0
17	47	75	0
13	200	173	0
11	350	371	97
9	504	380	157
7	926	47	301
5	2422	2576	165
3	2238	1660	0
1	2171	744	0
-1	1547	73	0
-3	1936	0	0
-5	66	0	0

TEST NO :9
DATE :83.06.03
TIME :1135-1200
RELEASE :300 CC/MIN
HEIGHT OS SENSORS :3.1 M,7.1 M,11.6 M
DISTANCE :400 M
BOAT SPEED :2.1 M/S
SAMPLING DISTANCE :4.7 M,
WIND DIRECTION :S
WIND SPEED :4.2 M/S AT 1.2 M
AIR TEMPERATURE :11.7 C
REL HUMIDIY :99 %
SEA TEMPERATURE :13.2 C
STABILITY CATEGORY :C/D
CLOUD COVER/WEATHER:OVERCUST/LIGHT DRIZZLE

START :1135
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
17	77	34	22
19	76	47	33
21	70	38	10
24	181	457	629

START :1138
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
37	47	30	16
35	54	24	16
33	38	32	20
31	49	31	27
29	128	40	26
27	86	50	7
25	170*	496	43
23	251	117	19
21	130	30	18
19	424	64	23
17	575	60	105
15	1272	567	1266
13	1494	979	1207
11	5599	3340	53
9	327	117	25

START :1143
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
10	793	79	25
12	604	118	26
14	1676	42	30
16	1507	133	14
18	1574	356	534
20	1597	81	23
22	390	96	352
24	88	765	1936
26	80	2072	6053
28	118	1384	6870
30	2998	2152	1091
32	827	1672	1550
34	358	1027	3753
36	1100	1575	624
38	56	81	35
40	65	45	25
43	54	35	28
45	62	41	7
47	53	46	36
49	52	49	11

START :1147
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
46	105	37	13
44	107	51	34
42	45	113*	22
40	369	175	18
38	3804	527	663
36	2897	3530	2004
34	1270	274	54
32	1205	149	32
29	5568	8590	34
27	6573	3055	18
25	6491	317	34
23	3061	638	11
21	4530	2207	20

START :1150
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
6	57	44	20
8	49	143	173
10	155	749	122
12	898	275	1340
14	1236	120	927
16	3450	2128	7596
18	3622	9225	547
20	8229	6017	135
23	9623	4412	1238
25	3786	748	28
28	1574	519	0
30	651	1465	31
32	941	531	38
34	107	179	24
36	56	47	31
38	51	33	27
40	88	46	12
42	86	63	25
44	76	42	24
46	64	36	26

START :1155
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
-6	53	43	23
-4	36	37	26
-2	79	50	123
0	45	47	70*
2	52	34	17
4	47	35	954
6	43	61	446
8	56	2096	945
10	108	2164	632
12	44	232	2897
14	192	3228	3836
16	4668	4002	3872
18	4571	6421	1391
20	-	-	-

START :1157
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
	56	39	25
	56	44	23*
	62	30	22
	48		38

TEST NO :10
DATE :83.06.07
TIME :1237-1250
RELEASE :300 CC/MIN
HEIGHT OS SENSORS :3.1 M,7.1 M,11.6 M
DISTANCE :400 M
BOAT SPEED :2.1 M/S
SAMPLING DISTANCE :4.6 M,
WIND DIRECTION :S
WIND SPEED :2.3 M/S AT 1.2 M
AIR TEMPERATURE :15.8 C
REL HUMIDIY :72 %
SEA TEMPERATURE :15.0 C
STABILITY CATEGORY :D/E
CLOUD COVER/WEATHER:3/8-SUN

START :1237
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
61	0	0	0
59	0	0	0
57	0	0	0
54	0	0	0
51	0	0	0
49	0	0	0
47	0	0	0
44	0	0	0
42	0	0	0
40	0	11	522
37	0	1654	220
35	8	4128	0
33	40	1019	0
31	389	1412	0
29	1364	3810*	0
26	3462	6209	0
24	6789	8130	0
22	8632	5415	0
20	7246	4050	0
18	7791	163	0
16	6778	125	0
14	4373	16	0
12	2854	0	0
10	1041	0	0
8	116	0	0
6	59	0	0

START :1240
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
17	0	0	0
19	0	0	0
21	0	0	0
23	31	0	0
25	233	0	0
28	1992	268	0
30	3867	1577*	0
32	6814	2886	0
34	8467	4385	0
37	5030	6437	332
39	4031	8368	6098
41	889	7269	4030
43	190	3141	180
45	29	1123	239
48	0	88	39

START :1242
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
59	27	1093*	4715
57	43	2186	6850
55	0	416	4871
53	1501	2792	2664
51	1644	2700	3000
49	1046	720	210
47	932	607	14
45	1116	971	0
43	1823	1051	0
41	1862	1190	0
39	1782	560	0
37	3077	72	0
35	1874	40	0

START :1244
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
34	0	8	0
36	0	0	0
38	0	0	0
40	0	0	0
42	0	0	0
44	62	0	0
46	1830	157	0
48	4278	122	0
50	5996	324	0
52	4939	4780	4958
54	4374	4987*	83
56	3484	5193	5465
58	2136	6805	56

START :1247
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
44	0	0	0
42	0	0	0
40	0	42	474
38	84	1491	2555
36	38	2015	4204
34	25	4098	4000
30	146	3810	1402
28	1392	3746	1260
25	6254	4418	2090
23	6507	4353	123
21	6119	4577	0
19	2039	1207	0

START :1250
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
13	0	8	0
15	0	0	0
17	0	0	0
19	0	0	0
21	7	0	0
23	40	0	0
25	288	0	0
27	1263	0	0
29	3810	0	0
31	6993		

TEST NO :11
DATE :83.06.14
TIME :1110-1130
RELEASE :300 CC/MIN
HEIGHT OS SENSORS :3.1 M,7.1 M,11.6 M
DISTANCE :400 M
BOAT SPEED :2.1 M/S
SAMPLING DISTANCE :4.8 M,
WIND DIRECTION :S
WIND SPEED :7.1 M/S
AIR TEMPERATURE :16.3 C
REL HUMIDIY :53 %
SEA TEMPERATURE :15.2 C
STABILITY CATEGORY :D/E
CLOUD COVER/WEATHER:4/8-SUN

START :1110
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
148	0	0	0
146	0	0	0
143	0	0	0
141	0	0	0
139	0	242	42
136	190	152	42
134	255	119	0
131	216	155	0
128	397	105	9
125	446	64	101*
123	1562	556	12
121	1006	43	125
118	26	209	298*
116	165	445	471
113	587	780	467
111	264	412	298*
109	425	89	435

START :1113
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
82	0	0	0
84	0	0	0
87	0	0	0
89	0	0	0
92	0	0	0
94	0	0	0
96	97	0	0
98	333	246	178
102	1572	239	170
104	1068	1022	231
106	2496	738	172
108	1470	1068	189
110	1010*	904	934
112	551	390	68
114	59	0	625

START :1116
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
143	1675	729	0
141	1641	116	827
139	2426	16	43
137	2530	262	0
135	2741	168	0
133	1684	370	14
131	2062	355	9

START :1119
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
68	0	0	0
70	0	0	0
72	0	0	0
74	0	0	0
76	0	0	0
78	66	40	690
80	755	77	0
82	516	657	0
84	774	1167	151
86	652	909	648*
88	799	130	1144
90	784	586	758
92	822	317	0
94	707	235	0

START :1122
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
142	0	0	0
140	0	0	0
138	0	0	0
136	0	0	0
134	0	0	0
132	0	54	0
130	150	30	0
128	1195	449	135
126	1160	812	945
124	1361	1712	1220
122	349	951	797
120	394	928	1540
118	446	152	0

START :1124
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
86	15	0	0
88	0	0	0
90	0	0	0
92	328	0	132
94	419	0	0
96	879	0	0
98	821	95	0
100	1030	70	0
102	1464	0	0
104	736	0	0
106	678	57	0
108	641	46	0
110	701	0	0
112	668	5	0
114	480	380	10
116	824	431	11
118	333	0	0
120	514	136	617
122	1051	119	539*
124	808	495	460
126	923	854	400*
128	100	662*	340
130	116	469	400*
132	178	692	528

TEST NO :12
DATE :83.06.15
TIME :1035-1150
RELEASE :300 CC/MIN
HEIGHT OS SENSORS :3.1 M,7.1 M,11.6 M
DISTANCE :400 M
BOAT SPEED :2.1 M/S
SAMPLING DISTANCE :4.4 M,
WIND DIRECTION :SØ
WIND SPEED :7.5 M/S
AIR TEMPERATURE :13.4 C
REL HUMIDIY :70 %
SEA TEMPERATURE :15.3 C
STABILITY CATEGORY :C
CLOUD COVER/WEATHER:5/8-DISTANT RAINSHOWERS

START :1035
DIRECTION :NE

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
42	0	315	724
44	0	523	639
46	161	635	69
48	163	1097	260
50	33	1098*	366
52	1104	1099	430
54	98	182	98
56	57	122	0
58	0	56	0
60	138	74	0
62	0	0	0
64	0	0	0
66	0	0	0
68	0	0	0

START :1038
DIRECTION :SW

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
53	0	0	0
51	40	0	0
49	0	0	0
47	292	0	0
45	35	0	190
43	33	47	48
41	145	356	0
39	706	377	0
37	648	376	0
35	315	103	0
33	520	0	0
31	939	54	0
29	788	295	0
27	700	0	149
25	1188	0	0
23	82	0	0

START :1140
DIRECTION :NE

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
54	0	0	0
56	0	0	0
58	0	0	0
60	0	0	0
62	0	0	302
64	44	207	1570
66	46	1027	1132
68	976	872	170
70	1617	550	1115
72	849	1392	744
74	1421	832	86
76	1048	509	180
78	761	185	717
80	785	294	0

START :1143
DIRECTION :SW

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
83	0	522	0
81	875	52	0
79	614	263	595
77	370	619	824
75	454	529	32
73	1168	777	1760
71	1178	10	968
69	553	42	1234
67	662	204	233
65	350	782	1057
63	1113	1650	0
61	1585	0	0
59	262	296	531
57	1302	1663	1061
55	612	197	28
53	449	386	0
51	645	1133	0
49	1246	1335	0
47	934	1180	0
45	1376	1016	98
43	478	734	0

START :1047
DIRECTION :NE

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
13	0	0	0
15	7	0	0
17	74	177	-
19	690	878	-
21	1684	1607	-
23	1447	1690	-
25	1616	1285	-
27	1160	80	-
29	0	0	-
31	542	0	-

START :1050
DIRECTION :SW

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
19	0	0	-
17	0	0	-
15	0	0	-
13	0	0	-
11	0	0	-
9	0	0	-
7	0	0	-
5	11	53	-
3	46	1037	-
1	281	214	-
-1	635	10	-
-3	118	172	-
-5	0	300	-
-7	415	781	-

TEST NO :13
DATE :83.06.16
TIME :1210-1226
RELEASE :300 CC/MIN
HEIGHT OS SENSORS :3.1 M,7.1 M,11.6 M
DISTANCE :400 M
BOAT SPEED :2.1 M/S
SAMPLING DISTANCE :4.5 M,
WIND DIRECTION :NNW
WIND SPEED :4.6 M/S
AIR TEMPERATURE :15.8 C
REL HUMIDIY :58 %
SEA TEMPERATURE :15.5 C
STABILITY CATEGORY :C/D
CLOUD COVER/WEATHER:7/8 -

START :1210
DIRECTION :ENE

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
-35	0	1139	1317
-33	30	1401	965
-31	925	694	1380
-29	2055	321	690*
-27	162	29	0
-25	1450	125	40
-23	1322	1588	265
-21	687	2626	2756
-19	1422	1300	1752
-17	2763	266	4101
-15	207	0	0
-13	190	0	0
-11	0	0	0
-9	0	0	0
-7	0	0	0
-5	0	0	0
-3	0	0	0
-1	0	0	0
1	0	0	0
3	0	0	0

START :1213
DIRECTION :WSW

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
13	0	0	0
11	0	0	10
9	0	1259	1138*
7	1183	1332	2265
5	389	48	949
3	180	52	15
1	0	30	8
-1	0	0	0
-3	0	0	0
-5	0	0	0
-7	0	0	0

START :1215
DIRECTION :ENE

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
0	0	0	0
2	0	0	0
4	0	0	0
6	0	0	0
8	0	0	0
10	0	0	0
12	0	0	0
14	0	0	0
16	0	0	0
18	0	42	369
20	0	257*	544*
22	0	472	719
24	0	432	0

START :1218
DIRECTION :WSW

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
33	0	0	0
31	0	0	0
29	0	0	0
27	0	0	448
25	37	65	319*
23	563	443	190
21	1451	692	106
19	385	287	76
17	551	412	162*
15	1120	684	247
13	1015	915	111
11	560	1247	0
9	534	70	0
7	20	0	0
5	9	0	0
3	33	0	0
1	0	0	0

START :1221
DIRECTION :ENE

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
-61	132	407	817
-59	694	1613	1247*
-57	1846	1131	1676
-55	1443	332	345
-53	657	443	0
-51	113	304	0
-49	25	0	0
-47	0	0	0
-45	0	0	0
-43	0	0	0

START :1224
DIRECTION :WSW

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
3	0	0	0
1	0	0	0
-1	0	0	0
-3	0	0	0
-5	0	0	0
-7	0	0	0
-9	0	0	0
-11	0	0	0
-13	0	0	0
-15	0	0	0
-17	0	0	0
-19	0	0	0
-21	0	10	0
-23	33	917	348
-25	1244	2788	1854*
-27	2713	3112	3360
-29	2604	3983	1638
-31	2463	628	837*
-33	68	31	16

TEST NO :14
DATE :83.10.24
TIME :1240-1300
RELEASE :340 CC/MIN
HEIGHT OS SENSORS :3.1 M,7.1 M,11.6 M
DISTANCE :400 M
BOAT SPEED :3.4 M/S
SAMPLING DISTANCE :6.8 M,
WIND DIRECTION :WNW
WIND SPEED :5.4 M/S
AIR TEMPERATURE :7.2 C(2M)
REL HUMIDIY :38 %
SEA TEMPERATURE :8.0 C
STABILITY CATEGORY :B/C
CLOUD COVER/WEATHER:CLEAR

START :1240
DIRECTION :NNE

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
-	0	0	
-	0	28	0
	429	400*	0
	3828	3200	5044
	6041	5719	805
	4290	390	0
	0	0	0

START :1243
DIRECTION :SSW

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
-	0	0	0
-	-	0	-
-	1000*	142	50*
-	2852	3089	853
-	3000	3280	2637
-	1509	1198	1120
-	455	16	19
-	131	96	20
-	-	-	0
-	0	0	0

START :1246
DIRECTION :NNE

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
-	0	0	0
-	0	0	216
-	0	0*	0
-	0	409	2730
-	432	595	225
-	487	300*	112*
-	285	6	0
-	0	0	0

START :1249
DIRECTION :SSW

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
-	0	0	0
-	0	0	20
-	0	253	292
-	0	87	1270*
-	4755	3233	2251
-	2979	7371	2677
-	1200*	643	21
-	280	17	10*
-	0	0	0

START :1252
DIRECTION :NNE

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
-	0	0	0
-	1160	0	0
-	928	0	0
-	0	0	0
-	407	122	338
-	3457	500*	0
-	953	0	0
-	0	1349	0
-	426	3685	176
-	4195	2838	623
-	5963	4859	4565
-	5048	2590	771
-	1437	201	150*
-	54	0	0*
-	13	0	0
-	0	0	0

START :1255
DIRECTION :SSW

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
-	0	0	0
-	103	0	102
-	1398	2073	556
-	3005*	3018	3566
-	3500*	3993	4710
-	1848	122	0
-	3010	521	3956
-	4841	4070*	2095*
-	2860*	7635	233
-	882	4507	1138
-	-	-	-
-	-	-	-

TEST NO :15
DATE :83.10.26
TIME :1252-1312
RELEASE :340 CC/MIN
HEIGHT OS SENSORS :3.1 M,7.1 M,11.6 M
DISTANCE :380 M
BOAT SPEED :2.7 M/S
SAMPLING DISTANCE :5.4 M,
WIND DIRECTION :W
WIND SPEED :4.5 M/S
AIR TEMPERATURE :14.7 C(1M),16.3 C(3M
REL HUMIDIY :49 %
SEA TEMPERATURE :8.2 C
STABILITY CATEGORY :E/F
CLOUD COVER/WEATHER:1/8 - SUN

START :1252
DIRECTION :N

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
68	0	0	0
66	0*	0*	0*
64	0	0	0
62	0	119	0
60	3411	614	0
58	17000	5651	0
56	22000	0	0
54	285	0	0
52	278	0	0
50	0	0	0

START :1254
DIRECTION :N

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
14	0	0	0
-	-	-	-
24	0*	0	0
26	7	246	62*
28	0	7879	19900
30	122	10600	9500
32	6113	831	88
34	1494	2672	136
36	50	404	0

START :1302
DIRECTION :S

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
12	0	0	0
14	0	10	0
16	690*	878	0
18	3112	3941	0
20	9178	1655	0
22	26000	8331	80
24	15000	348	15
26	1411	4162	3967
28	4293	844	17
30	988	38	0
32	0	0	0
34	0	0	0

START :1305
DIRECTION :N

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
30	11600	48	0
28	14000	3154	0
26	32000	28000	0
24	1916	2692	0
22	0	4816	7772
20	0	2469	5116
18	0	619	0
16	0	842	58
14	0	0	878

START :1307
DIRECTION :N

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
14	0	0	0
16	14	0	0
18	280	0	0
20	1176	0	0
22	1636	0	0
24	2288	0	0
26	26500	1534	0
28	15500	301	0
30	35000	573	0
32	16500	7762	0
34	10150	646	0
36	108	0	0
38	0	0	0
40	0	0	0

START :1309
DIRECTION :S

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
44	246	366	0
42	985	1821	0
40	4384	1020*	0
38	9835	226	38
36	16000	1998	0
34	4430	0	0
32	10000	0	0
30	1412	0	0
28	0	0	0
26	0	0	0

START :1312
DIRECTION :N

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
16	0	0	0
-	-	-	-
34	0	0	0
36	225	0	0
40	35000	1289	0
44	15000*	2527	0
46	1900*	0	0
48	155	505	307

TEST NO :16
DATE :83.10.27
TIME :1202-1225
RELEASE :340 CC/MIN
HEIGHT OS SENSORS :3.1 M,7.1 M,11.6 M
DISTANCE :400 M
BOAT SPEED :2.7 M/S
SAMPLING DISTANCE :5.4 M,
WIND DIRECTION :S
WIND SPEED :4.0 M/S
AIR TEMPERATURE :10.8 C(1M),11.2 C(2M),11.2 C(4M)
REL HUMIDIY :84 %
SEA TEMPERATURE :8.3 C
STABILITY CATEGORY :E/F
CLOUD COVER/WEATHER:4/8 - SUN

START :1202
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
46	0	0	0
48	0	0	0
50	0	0	0
52	0	676	0
54	1013	1045	636
56	2846	2540	25
58	5299	4232	138
60	5695	99	149
62	951	75	0
64	259	19	38
66	276	46	267
68	0	10	139
70	0	0	87

START :1205
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
72	0	0	0
-	-	-	-
62	0	0	0
60	0	0	118
58	10	393	1460
56	10	1939	3639
54	3083	2876	3460
52	1365	3050*	1908
50	3854	3225	453
48	2120*	2309	938
46	387	291	0
44	0	0	0

START :1208
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
26	108	202	385
28	56	694	1277
30	82	417	1849
32	4085	434	203
34	6077	2070	1076
36	3382	293	33
38	0	0	0
-	-	-	-
50	0	0	0

START :1212
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
54	0	0	0
52	7	0	0
50	32	0	0
48	159	0	0
46	0	0	0
44	89	0	0
42	1103	0	0
40	2719	0	0
38	721	25*	0
36	125	66	0
34	134	961	149
32	2296	552	557
30	2457	2183	1940*
28	1964	134	0
26	1071	0	0
24	170	0	0
22	68	0	0

START :1218
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
24	236	454	27
22	2654	1735	2020
20	7080	6426	1302
18	7735	4260	4562
16	3517	3508*	776
14	2262	2757	1020
12	1252	2273	1774
10	895	446	0
8	296	533	1043
6	230	179	175
4	145	353	0
2	27	58	137
0	119	0	203

START :1222
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
12	756	0	0
14	81	0	0
16	224	0	0
18	4206	51	0
20	4645	706	137
22	3802	506	828*
24	5066	1099	1396
26	4209	4147	2353
28	884	1827	1362
30	1068	4593	111
32	-	-	227
34	133	2379	108
36	245	48	0

START :1225
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
86	5542	-	-
84	4438	0	454
82	2343	1027	50
80	2204*	216	0
78	2064	1885	1040

TEST NO :17
DATE :83.10.28
TIME :1251-1307
RELEASE :340 CC SF6/MIN AT 1.2M - 2850 CC C8rF3/MIN AT 3.8M
HEIGHT OS SENSORS :3.1 M,7.1 M,11.6 M
DISTANCE :400 M
BOAT SPEED :3.1 M/S
SAMPLING DISTANCE :6.2 M
WIND DIRECTION :N
WIND SPEED :6.5 M/S
AIR TEMPERATURE :7.8 C AT 1M, 7.8 C AT 4M
REL HUMIDIY :61 %
SEA TEMPERATURE :7.9 C
STABILITY CATEGORY :D
CLOUD COVER/WEATHER:1/8

START :1251
DIRECTION :W

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M	CONCENTRATION - PPT - C8rF3 3.1 M	7.1 M	11.6 M
34	0	0	0	0	0	0
-	-	-	-	0	0	0
46	0	0	0	95	0	5
48	0	0	3	43	0	0
50	0	0	0	0	0	0
52	26	0	0	0	39	0
54	87	0	4	224	0	0
56	68	30	41	291	0	166
58	233	1635	797	3387	9210	953
60	3	790	945	17325	3338	0
62	98	917	2366	13995	5059	168
64	1542	3768*	2740*	15146*	1453*	8403
66	4494*	6620	3118	16297	24005	11301*
68	3488*	1127	3066	17432	5632	9450*
70	1182	967	2822	23253	7862	7603
72	618	993	1503	12752	8737	4661
74	1404	1117	2056	16559	7808	6990
76	327	2727	635	3160	11134	1063

START :1255
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M	CONCENTRATION - PPT - C8rF3 3.1 M	7.1 M	11.6 M
78	200	0	0	808	0	0
76	135*	0	0	460*	0	85
74	69	0	0	114	0	0
72	65*	0	0	63*	0	0
70	60	51	187	122	275	1254
68	728	192	91	2084	1102	370
66	511	1414	21	2441	8622	0
64	2435	434	115	13275	3428	2103
62	1608	788	129	8811	4755	2086
60	1648	4375	5020	9843	18278	20463
58	2071	495	268	10657	3295	1459
56	2336	379	135	13200	1675	476
54	5430	738	31	27777	3119	192
52	4216	3378	2750	18785	14107	9988
50	4098	3465	2235	18003	14503	7609
48	3085	572	22	11294	2050	100
46	894	6	0	2849	0	0
44	13	5	0	0	0	0

START :1258
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
46	0	0	0

64	0	0	0
66	0	283	0
68	731	268	2194
70	537	516	2819

START :1301
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
16	0	0	0
18	0	0	3
20	0	1390*	1168
22	1589	2782	2637
24	7453	263	0
26	4990	2627	564
28	2019	3671	657
30	47	3187	849
32	42	1129	222
34	0	0	0
36	0	0	0

START :1303
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
0	74	-	0
2	0	0	0
4	0	0	0
6	0	0	0
8	141	0	0
10	1250	68	64
12	2536	156	0
14	1238	2483	1389
16	2383	661	885
18	3605	2067	0
20	90	0	0
22	131	0	0

START :1306
DIRECTION :E

REL DIST-S	CONCENTRATION - PPT 3.1 M	7.1 M	11.6 M
34	0	0	0
-	-	-	-
28	0	0	0
26	0	0	208
24	0	2186	1137
22	5090	2906	4079
20	3024	1393	1550
18	1076	1875	0
16	70	0	0
14	0	0	0
-	-	-	-
8	0	0	0

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TITTEL
Concentration distribution in a plume released over water

PROSJEKTLEDER
Y. Gotaas

NILU PROSJEKT NR.
O-8577

FORFATTER(E)

Yngvar Gotaas

TILGJENGELIGHET
A

OPPDRAGSGIVERS REF.

OPPDRAGSGIVER (NAVN OG ADRESSE)
British Petroleum Limited
Britannic House, Moore Lane
EC2Y 9BU, London

3 STIKKORD (à maks. 20 anslag)
Spredningsforsøk | Grenselag | Konsentrasjonsvar.

REFERAT (maks. 300 anslag, 7 linjer)
Kontinuerlig utslipp av sporstoff over sjø viser liten variasjon av instantan skybredde med temperaturforskjellen luft/vann. Konsentrasjonsvariasjoner relativt til tyngdepunktet viser i første rekke en tendens til puffdannelser. Enten er konsentrasjonen høy i hele tverssnittet, eller lav over det hele. Dernest kommer tendens til høye konsentrasjoner nær sentret og lave ved kanten, eller omvendt.

TITLE Concentration distribution in a continuous plume -
- diffusion ecperiment over water

ABSTRACT (max. 300 characters, 7 lines)
Continuous release of tracer over water shows relative small variations of instant plume width. With temperature difference air/sea. Concentration variation relative to center of gravity in a cross-section show tendency of travelling lumps. Either concentrations are high throughout the cross-section, or they are low all over. The recent mass important is the tendency of high continuous near the center and low at the boundaries, or vice versa.

* Kategorier: Åpen - kan bestilles fra NILU A
Må bestilles gjennom oppdragsgiver B
Kan ikke utleveres C