EMRASII
WG 9 “Urban Areas”

Dejan Trifunović, Seville, Spain, 08.-10. June 2010

Short range scenario
TEST 2

Experiment SET-UP

Orientation of the blast:
“PARALEL” TO THE GROUND

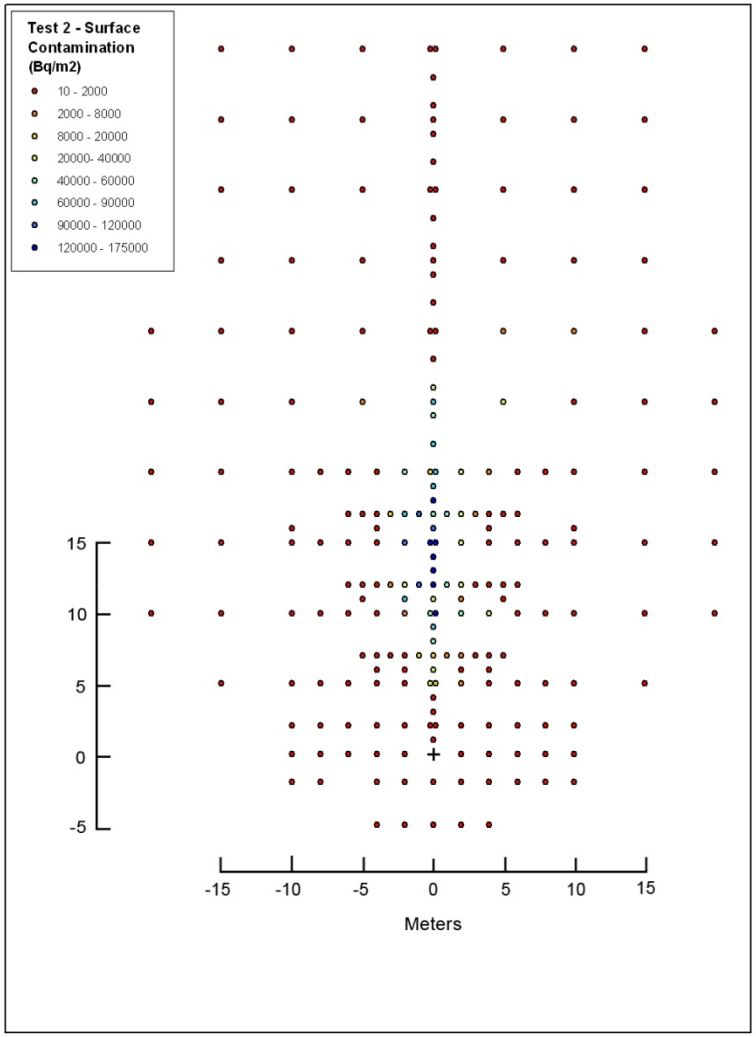
Modelling requirement:
Unbounded upwards

BACK BLAST WAVE – due to explosion set-up

Modelling requirement:
Unrestricted 360° geometry explosion

Experiment SET-UP
dispersion outcome

Shift of the maximum deposition location around explosion point forward for about 10 - 15 m.

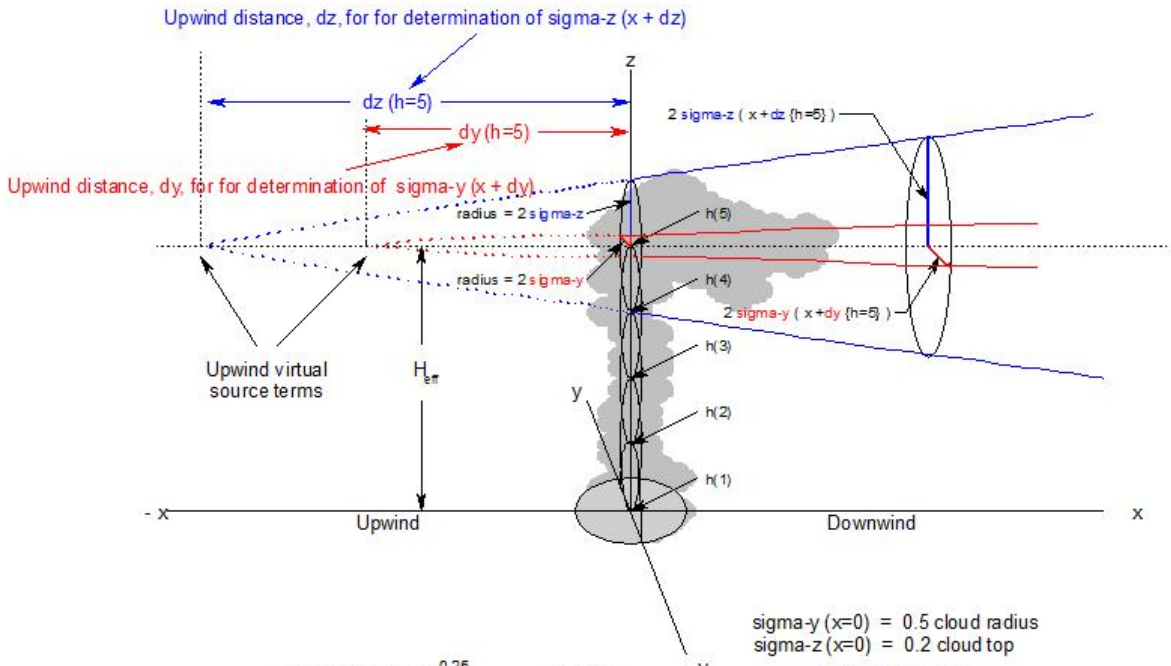


HotSpot model
Explosion geometry

Explosion (Non-nuclear)

Explosion

The release is partitioned as follows:



HotSpot model
Dispersion and Deposition

The following Gaussian model equations determine the atmospheric concentration of a gas or an aerosol :

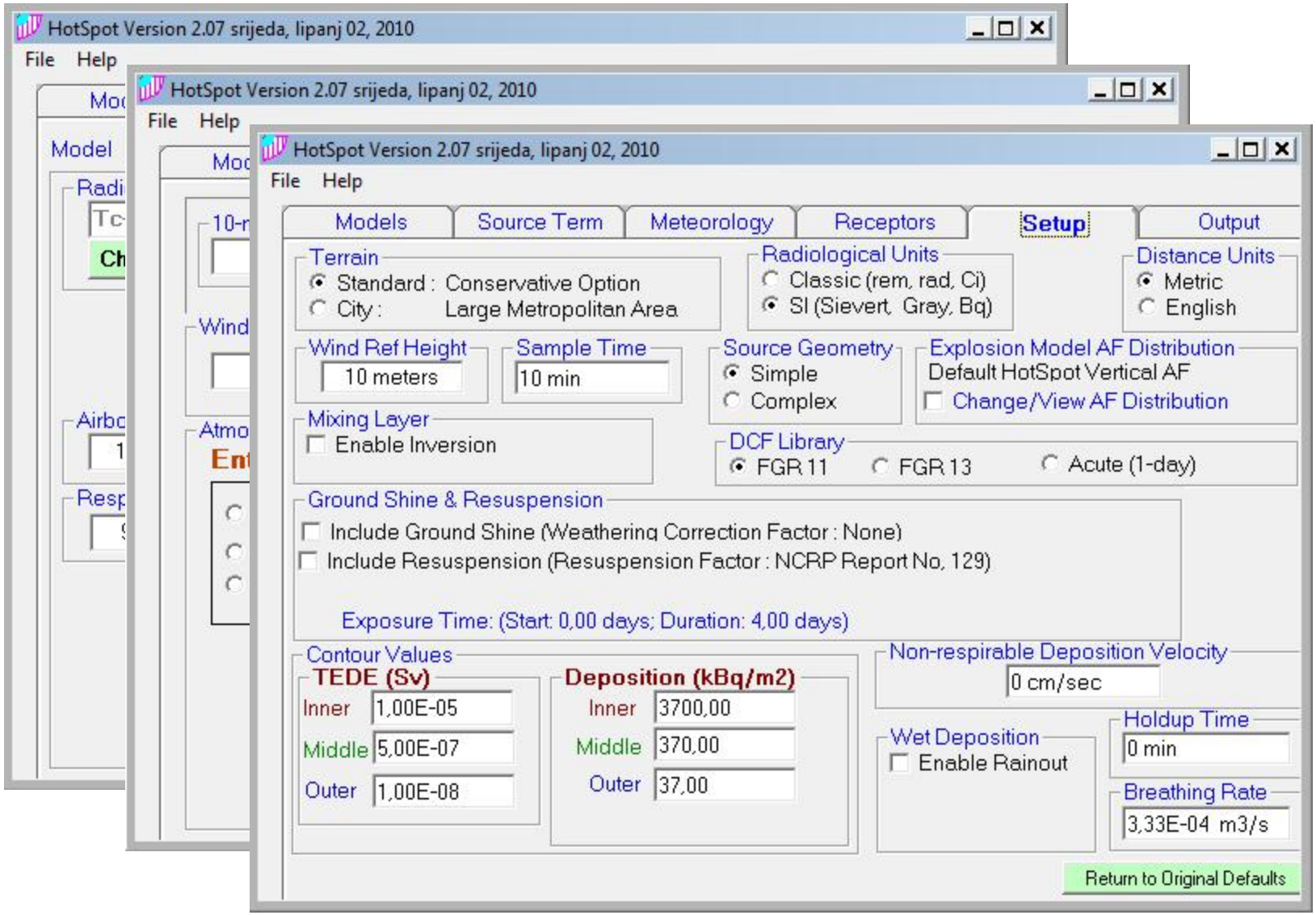
$$C(x,y,z,H)=\frac{Q}{2\pi\sigma_y\sigma_z u}\exp\left[-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2\right]\left\{\exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right]+\exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right]\right\}\exp\left[-\frac{\lambda x}{u}\right]$$

where—

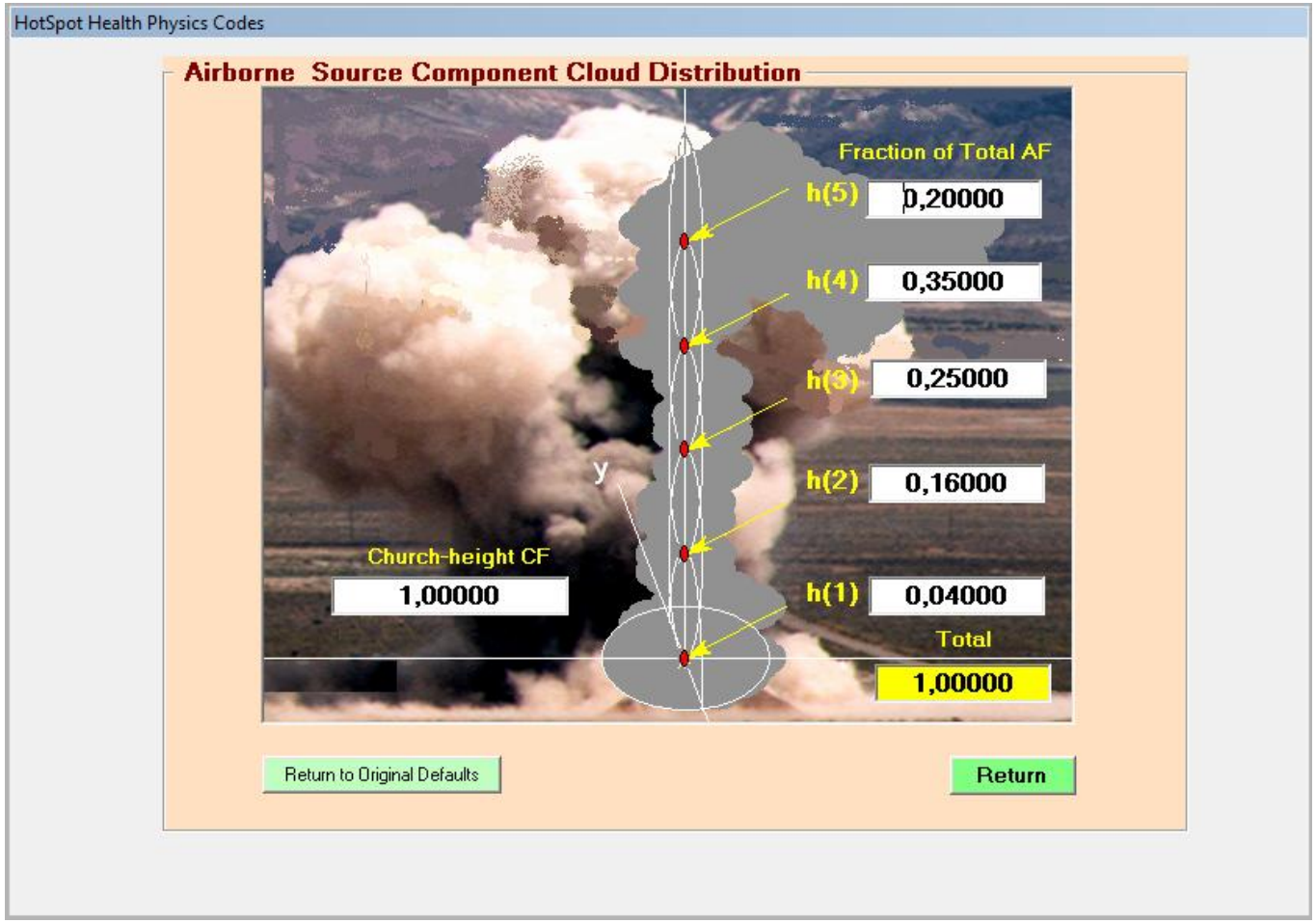
- C = Time-integrated atmospheric concentration (Ci-sec)/(m3).
- Q = Source term (Ci).
- H = Effective release height (m).
- λ = Radioactive decay constant (s−1).
- x = Downwind distance (m).
- y = Crosswind distance (m).
- z = Vertical axis distance (m).
- σy = Standard deviation of the integrated concentration distribution in the crosswind direction (m).
- σz = Standard deviation of the integrated concentration distribution in the vertical direction (m).
- u = Average windspeed at the effective release height (H), (m/s).
- L = Inversion layer height (m).

$$DF(x)=\left[\exp\int_0^x\frac{1}{\sigma_z(x)\exp\left[\frac{1}{2}\left(\frac{H}{\sigma_z(x)}\right)^2\right]}dx\right]^{-\frac{v}{u}\sqrt{\frac{2}{\pi}}}$$

HotSpot model INPUT

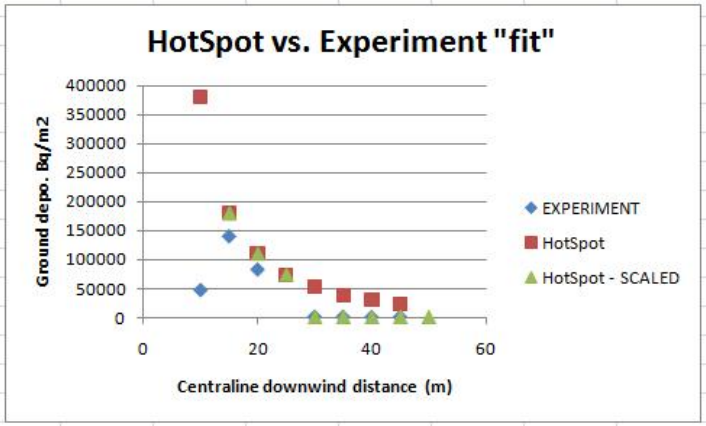


HotSpot Airborne Fraction DEFAULT

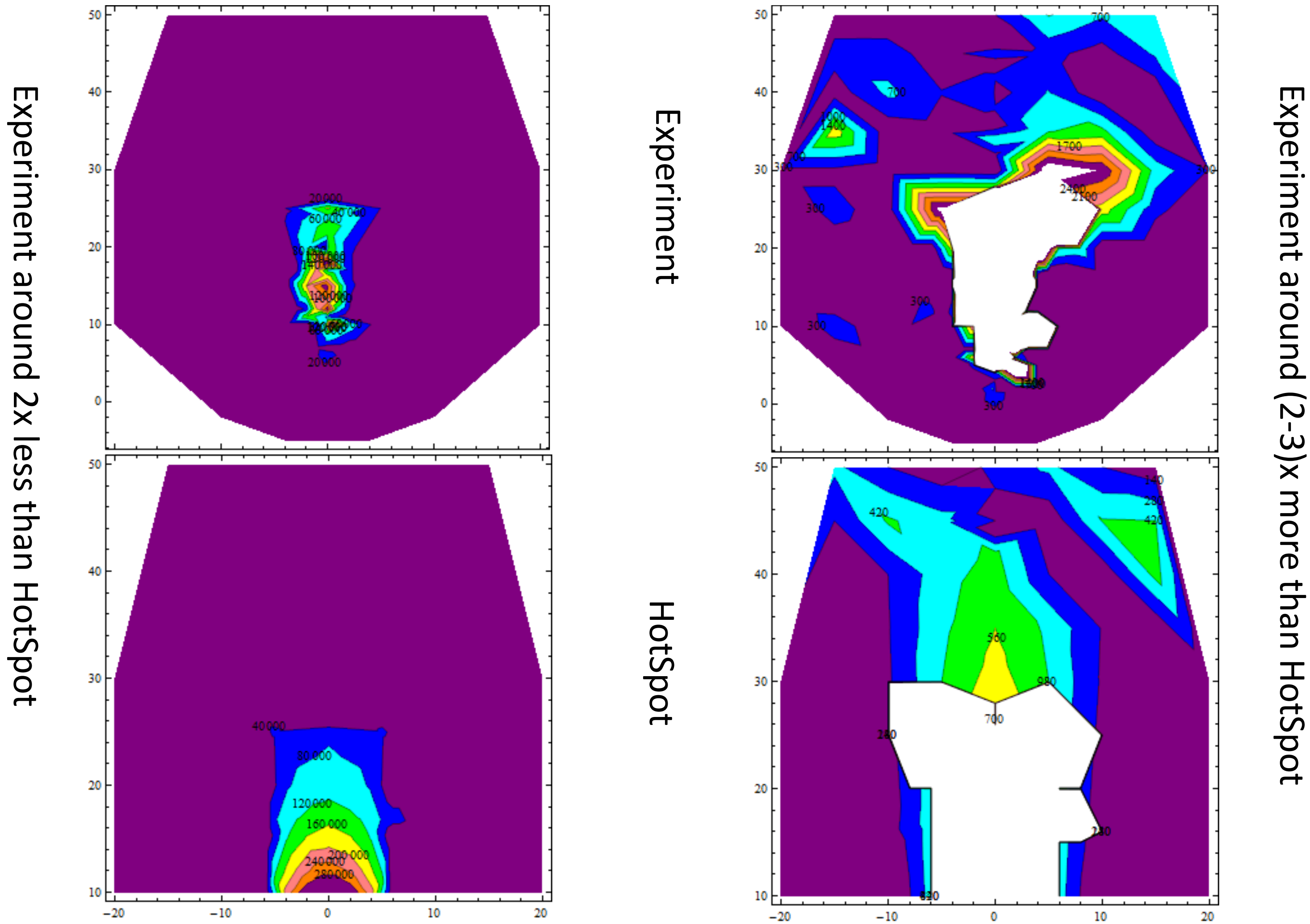


HotSpot “Calibration”

	B	C	D	E	F	G	H	I	J	K
0	6	35669,33								
0	7	8937,78								
0	8	46084,22								
0	9	67708,67								
0	11	37295,56								
0	12	161428,9								
0	13	120071,1								
0	14	144702,2		REMARK: HotSpot model is not defined for x = (-10, 10) m						
0	16	100433,3								
0	17	58722,89			1. Bq/m2					
0	18	170435,6		10	380000	46689,45				
0	19	86373,33		15	180000	139414,2				180000
0	22	77843,11		20	110000	82108,22				110000
0	24	58779,22		25	74000	72987,95		2. Bq/m2		74000
0	25	87196,67		30	53000	765,22		640		640
0	26	22883,33		35	39000	710,835		560		560
0	28	1270,22		40	31000	308,0733		500		500
0	32	260,22		45	24000	319,7033		440		440
0	34	993,67		50				400		400
0	35	428		1. Sample time:10 min; Respirable release fraction:97,5%; Non-respirable depo. velocity:40m/s						
0	36	136,89								
0	38	388,89		2. Sample time:10min; Respirable release fraction: 97,5%; Non-respirable depo. velocity: 0m/s; Respirable depo. velocity: 0,03m/s						
0	42	398,44								
0	44	181,56								
0	45	657,33								
0	46	120,22								
0	48	21,33								



EXPERIMENT vs. HotSpot COMPARISON



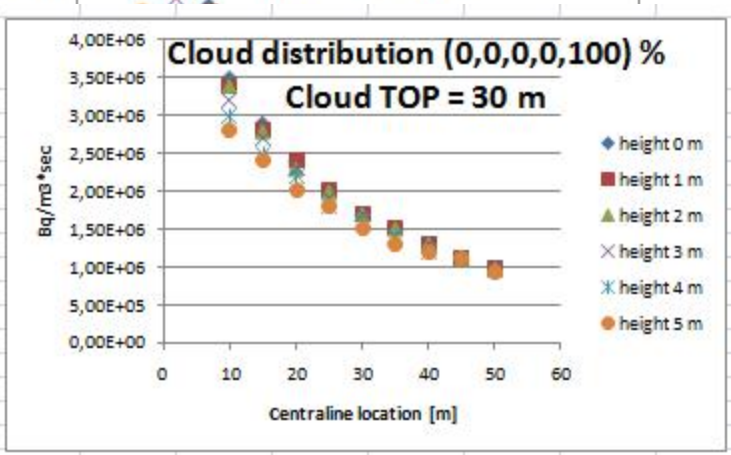
Plume Centraline Vertical Profile

Air concentrations

Air concentrations (Bq/m3 * s)

Cloud distribution: (0,0,0,0,100) %

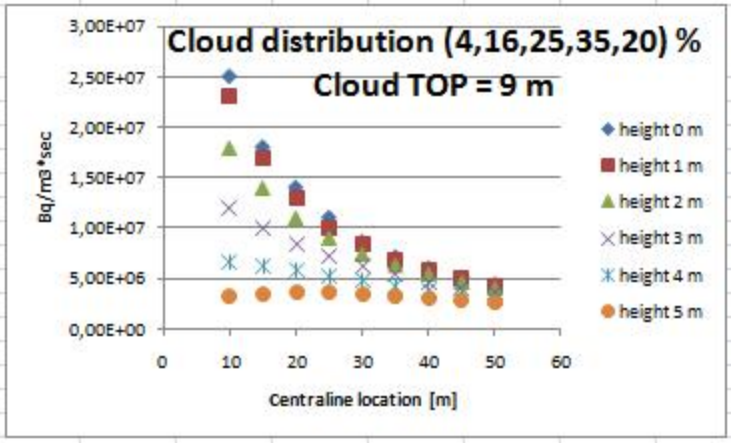
Location (m)		height (m)						
X	Y	0	1	2	3	4	5
0	0						
0	5						
0	10	3,50E+06	3,40E+06	3,40E+06	3,20E+06	3,00E+06	2,80E+06
0	15	2,90E+06	2,80E+06	2,80E+06	2,70E+06	2,50E+06	2,40E+06
0	20	2,40E+06	2,40E+06	2,30E+06	2,30E+06	2,20E+06	2,00E+06
0	25	2,00E+06	2,00E+06	2,00E+06	1,90E+06	1,80E+06	1,80E+06
0	30	1,70E+06	1,70E+06	1,70E+06	1,70E+06	1,60E+06	1,50E+06
0	35	1,50E+06	1,50E+06	1,50E+06	1,40E+06	1,40E+06	1,30E+06
0	40	1,30E+06	1,30E+06	1,30E+06	1,30E+06	1,20E+06	1,20E+06
0	45	1,10E+06	1,10E+06	1,10E+06	1,10E+06	1,10E+06	1,10E+06
0	50	9,90E+05	9,90E+05	9,80E+05	9,70E+05	9,60E+05	9,40E+05



Air concentrations (Bq/m3 * s)

Cloud distribution: (4,16,25,35,20) % - DEFAULT, CF = 1/3

Location (m)		height (m)						
X	Y	0	1	2	3	4	5
0	0						
0	5						
0	10	2,50E+07	2,30E+07	1,80E+07	1,20E+07	6,70E+06	3,20E+06
0	15	1,80E+07	1,70E+07	1,40E+07	1,00E+07	6,30E+06	3,50E+06
0	20	1,40E+07	1,30E+07	1,10E+07	8,40E+06	5,80E+06	3,60E+06
0	25	1,10E+07	1,00E+07	9,00E+06	7,20E+06	5,30E+06	3,60E+06
0	30	8,60E+06	8,30E+06	7,40E+06	6,20E+06	4,80E+06	3,40E+06
0	35	7,10E+06	6,90E+06	6,30E+06	5,40E+06	4,30E+06	3,20E+06
0	40	6,00E+06	5,80E+06	5,40E+06	4,70E+06	3,90E+06	3,00E+06
0	45	5,10E+06	5,00E+06	4,60E+06	4,10E+06	3,50E+06	2,80E+06
0	50	4,40E+06	4,30E+06	4,00E+06	3,60E+06	3,10E+06	2,60E+06



ZONE – 50%, 75%, 95%

- Source term deposited: ≈ 5 %
- Two different zones of deposition:

Zone 1: X (5, 25)m ; Y (-5, 5)m – 2,275E+05 Bq/m2

Zone 2: X (0, 50)m ; Y (-20, 20) m – 4E+03 Bq/m2

- Vertical profile considered:

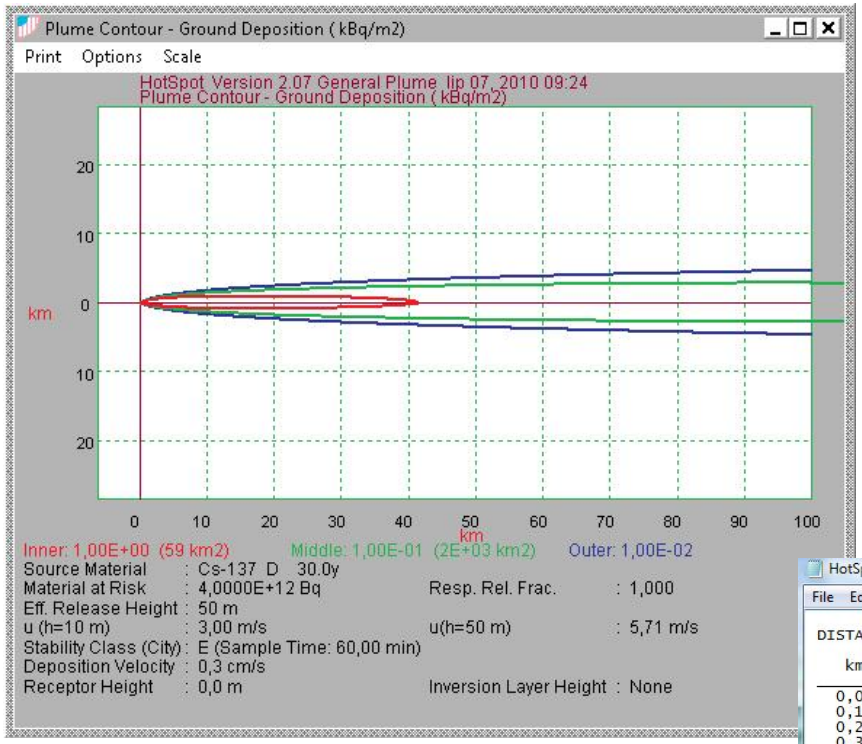
- Up to 5m with 10E+6 Bq/m3*sec

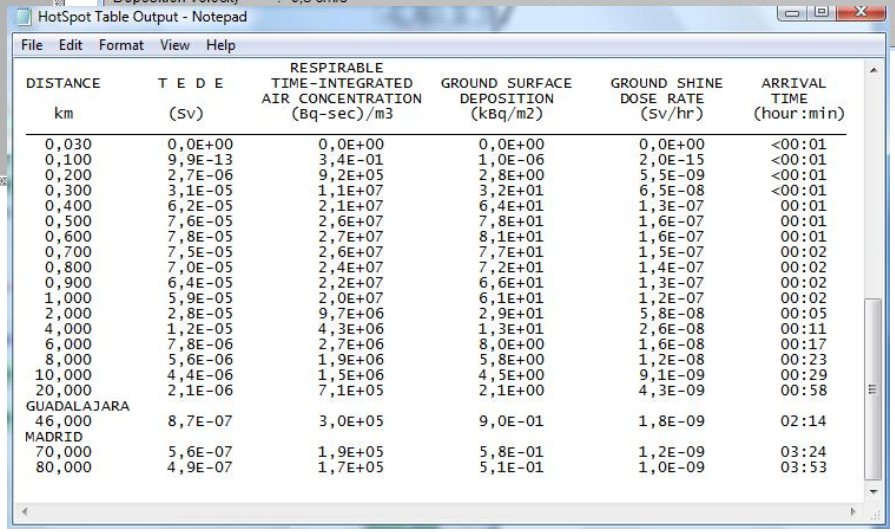
- Horizontal profile considered:

- y (-5, 5)m

- 50% - X (10, 20) m ; 75% - X (10, 25) m ; 95% - X (10, 30) m

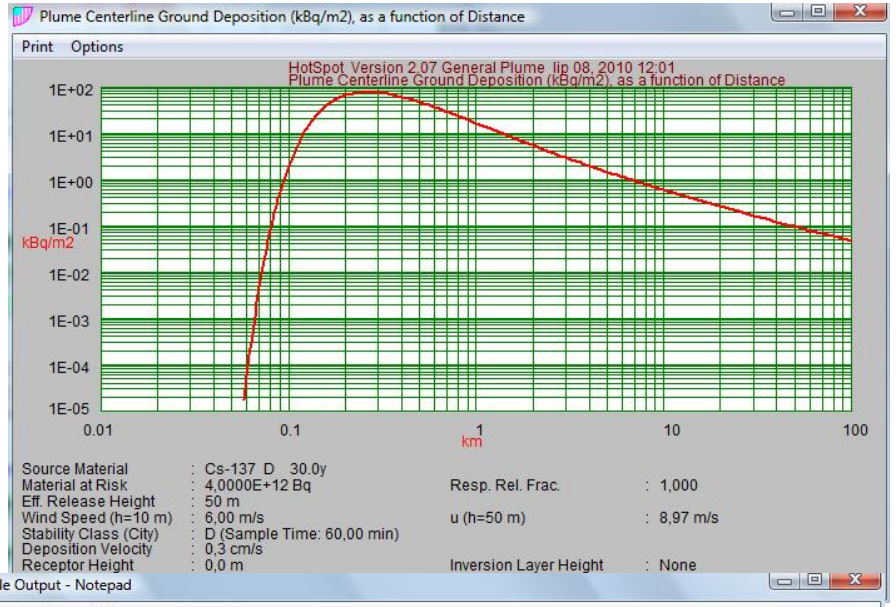
MID-RANGE – stable
Cs-137





DISTANCE km	T E D E (Sv)	RESPIRABLE TIME-INTEGRATED AIR CONCENTRATION (Bq-sec)/m3	GROUND SURFACE DEPOSITION (kBq/m2)	GROUND SHINE DOSE RATE (Sv/hr)	ARRIVAL TIME (hour:min)
0,030	0,0E+00	0,0E+00	0,0E+00	0,0E+00	<00:01
0,100	9,9E-13	3,4E-01	1,0E-06	2,0E-15	<00:01
0,200	2,7E-06	9,2E+05	2,8E+00	5,5E-09	<00:01
0,300	3,1E-05	1,1E+07	3,2E+01	6,5E-08	<00:01
0,400	6,2E-05	2,1E+07	6,4E+01	1,3E-07	00:01
0,500	7,6E-05	2,6E+07	7,8E+01	1,6E-07	00:01
0,600	7,8E-05	2,7E+07	8,1E+01	1,6E-07	00:01
0,700	7,5E-05	2,6E+07	7,7E+01	1,5E-07	00:02
0,800	7,0E-05	2,4E+07	7,2E+01	1,4E-07	00:02
0,900	6,4E-05	2,2E+07	6,6E+01	1,3E-07	00:02
1,000	5,9E-05	2,0E+07	6,1E+01	1,2E-07	00:02
2,000	2,8E-05	9,7E+06	2,9E+01	5,8E-08	00:05
4,000	1,2E-05	4,3E+06	1,3E+01	2,6E-08	00:11
6,000	7,8E-06	2,7E+06	8,0E+00	1,6E-08	00:17
8,000	5,6E-06	1,9E+06	5,8E+00	1,2E-08	00:23
10,000	4,4E-06	1,5E+06	4,5E+00	9,1E-09	00:29
20,000	2,1E-06	7,1E+05	2,1E+00	4,3E-09	00:58
GUADALAJARA					
46,000	8,7E-07	3,0E+05	9,0E-01	1,8E-09	02:14
MADRID					
70,000	5,6E-07	1,9E+05	5,8E-01	1,2E-09	03:24
80,000	4,9E-07	1,7E+05	5,1E-01	1,0E-09	03:53

MID-RANGE – neutral stability
Cs-137



HotSpot Table Output - Notepad

File Edit Format View Help

DISTANCE km	T E D E (Sv)	RESPIRABLE TIME-INTEGRATED AIR CONCENTRATION (Bq-sec)/m3	GROUND SURFACE DEPOSITION (kBq/m2)	GROUND SHINE DOSE RATE (Sv/hr)	ARRIVAL TIME (hour:min)
0,030	0,0E+00	0,0E+00	0,0E+00	0,0E+00	<00:01
0,100	1,9E-06	6,4E+05	1,9E+00	3,9E-09	<00:01
0,200	6,3E-05	2,2E+07	6,6E+01	1,3E-07	<00:01
0,300	7,3E-05	2,5E+07	7,5E+01	1,5E-07	<00:01
0,400	5,9E-05	2,0E+07	6,1E+01	1,2E-07	<00:01
0,500	4,5E-05	1,5E+07	4,6E+01	9,3E-08	<00:01
0,600	3,5E-05	1,2E+07	3,6E+01	7,2E-08	00:01
0,700	2,8E-05	9,6E+06	2,9E+01	5,7E-08	00:01
0,800	2,3E-05	7,8E+06	2,3E+01	4,7E-08	00:01
0,900	1,9E-05	6,5E+06	1,9E+01	3,9E-08	00:01
1,000	1,6E-05	5,5E+06	1,6E+01	3,3E-08	00:01
2,000	5,3E-06	1,8E+06	5,5E+00	1,1E-08	00:03
4,000	1,9E-06	6,5E+05	2,0E+00	3,9E-09	00:07
6,000	1,1E-06	3,8E+05	1,1E+00	2,2E-09	00:11
8,000	7,5E-07	2,6E+05	7,8E-01	1,5E-09	00:14
10,000	5,7E-07	2,0E+05	5,9E-01	1,2E-09	00:18
20,000	2,5E-07	8,7E+04	2,6E-01	5,2E-10	00:37
GUADALAJARA					
46,000	1,0E-07	3,5E+04	1,0E-01	2,1E-10	01:25
MADRID					
70,000	6,5E-08	2,2E+04	6,7E-02	1,3E-10	02:10
80,000	5,6E-08	1,9E+04	5,8E-02	1,2E-10	02:28