

Modelling of Scenario 1 experimental explosion with Hotspot version 2.07



IAEA EMRAS II Urban Working group model comparison

Tom Charnock

8 June 2010

Simulation of scenario 1 with Hotspot v2.07*

<https://narak.llnl.gov/HotSpot/HotSpot.html>

Calibration against Test two

Blind run Test four

Only considering deposition

Calibration test two



Varied several inputs by trial and error to explore capabilities of the model:

Wind speed: either 0.33, 1.0, 1.5, 1.8 ms^{-1}

Explosive power: 0.04 or 0.004 lbs TNT equivalent or plume column height constrained to 12m

Respirable fraction (RF): 0.9, 0.99, 0.999
(i.e fraction by mass of particles $<1\mu\text{m}$)

Deposition velocity:

defaults for hotspot: 0.3 cms^{-1} RF 40 cms^{-1} non-RF

Stability category B

Vertical distribution: Hotspot default or uniform

Test two Stability category



Estimated category B (moderately unstable) but could have been A (very unstable)

From wind speed, cloud cover, time of day and day of year (see <http://www.hpa.org.uk/Publications/Radiation/NPRBArchive/NRPBW/SeriesReports/2002nrpbw019/> figure 9)

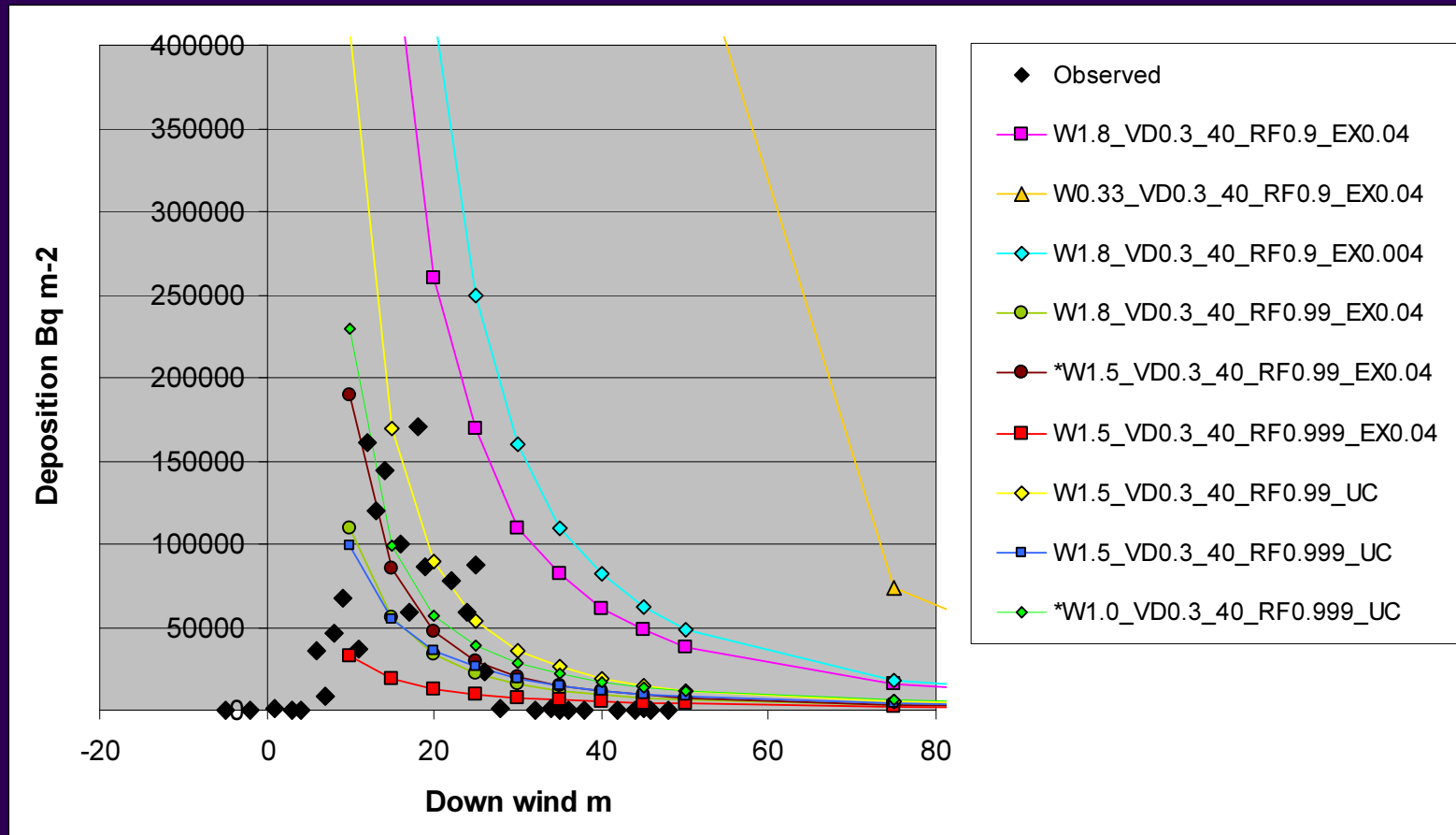


Inputs test two



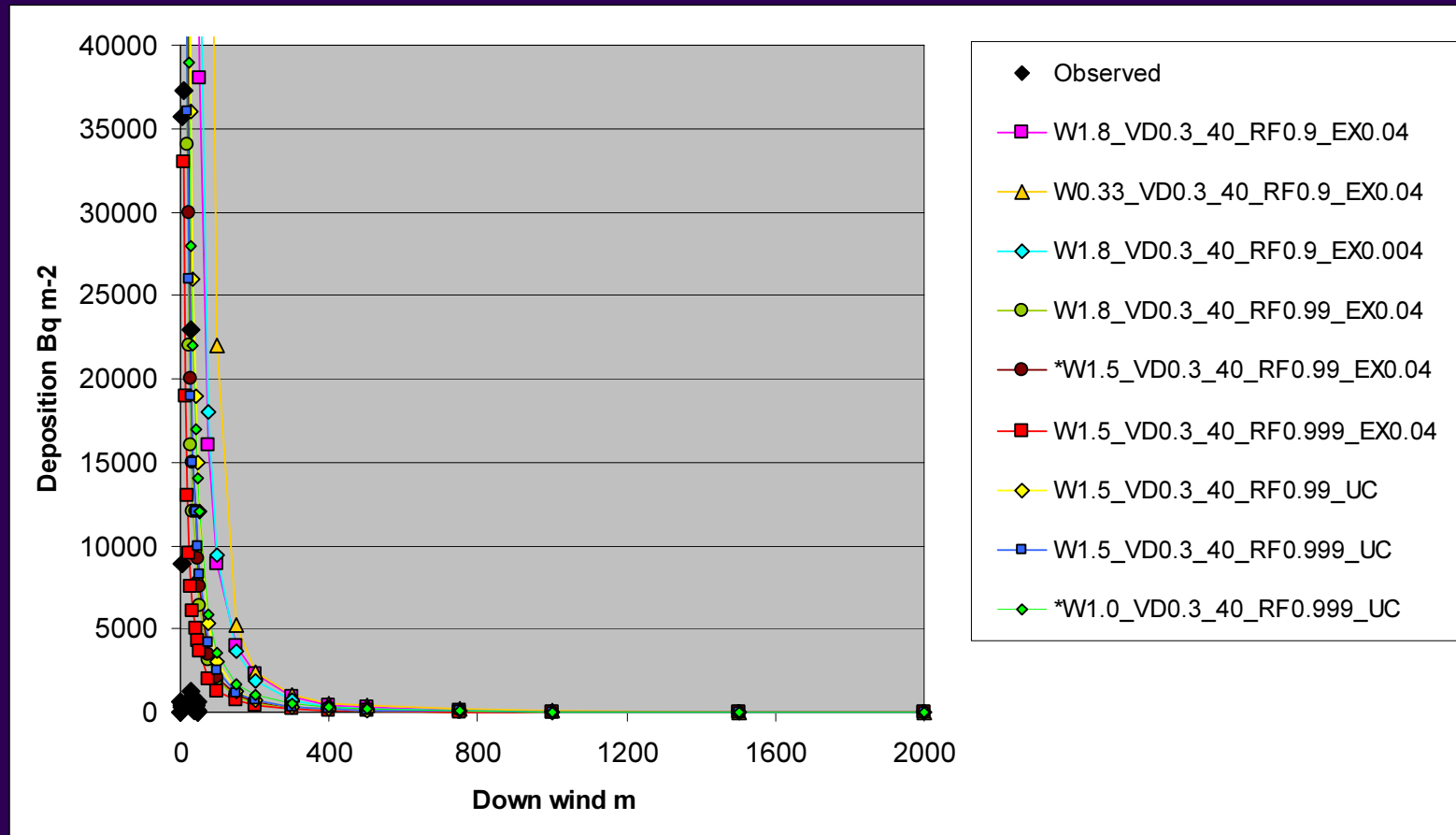
Run name	Wind speed ms ⁻¹	Respirable fraction	Deposition velocity RF/non-RF cms ⁻¹	Explosive TNT equivalent lbs	Vertical distribution
W1.8_VD0.3_40_RF0.9_EX0.04	1.8	0.9	0.3 / 40	0.04	Default
W0.33_VD0.3_40_RF0.9_EX0.04	0.33	0.9	0.3 / 40	0.04	Default
W1.8_VD0.3_40_RF0.9_EX0.004	1.8	0.9	0.3 / 40	0.004	Default
W1.8_VD0.3_40_RF0.99_EX0.04	1.8	0.99	0.3 / 40	0.04	Default
W1.5_VD0.3_40_RF0.99_EX0.04	1.5	0.99	0.3 / 40	0.04	Default
W1.5_VD0.3_40_RF0.999_EX0.04	1.5	0.999	0.3 / 40	0.04	Default
W1.5_VD0.3_40_RF0.99_UC	1.5	0.99	0.3 / 40	Constrained to 12 m	Uniform
W1.5_VD0.3_40_RF0.999_UC	1.5	0.999	0.3 / 40	Constrained to 12 m	Uniform
W1.0_VD0.3_40_RF0.999_UC	1.0	0.999	0.3 / 40	Constrained to 12 m	Uniform

Test two results, close in

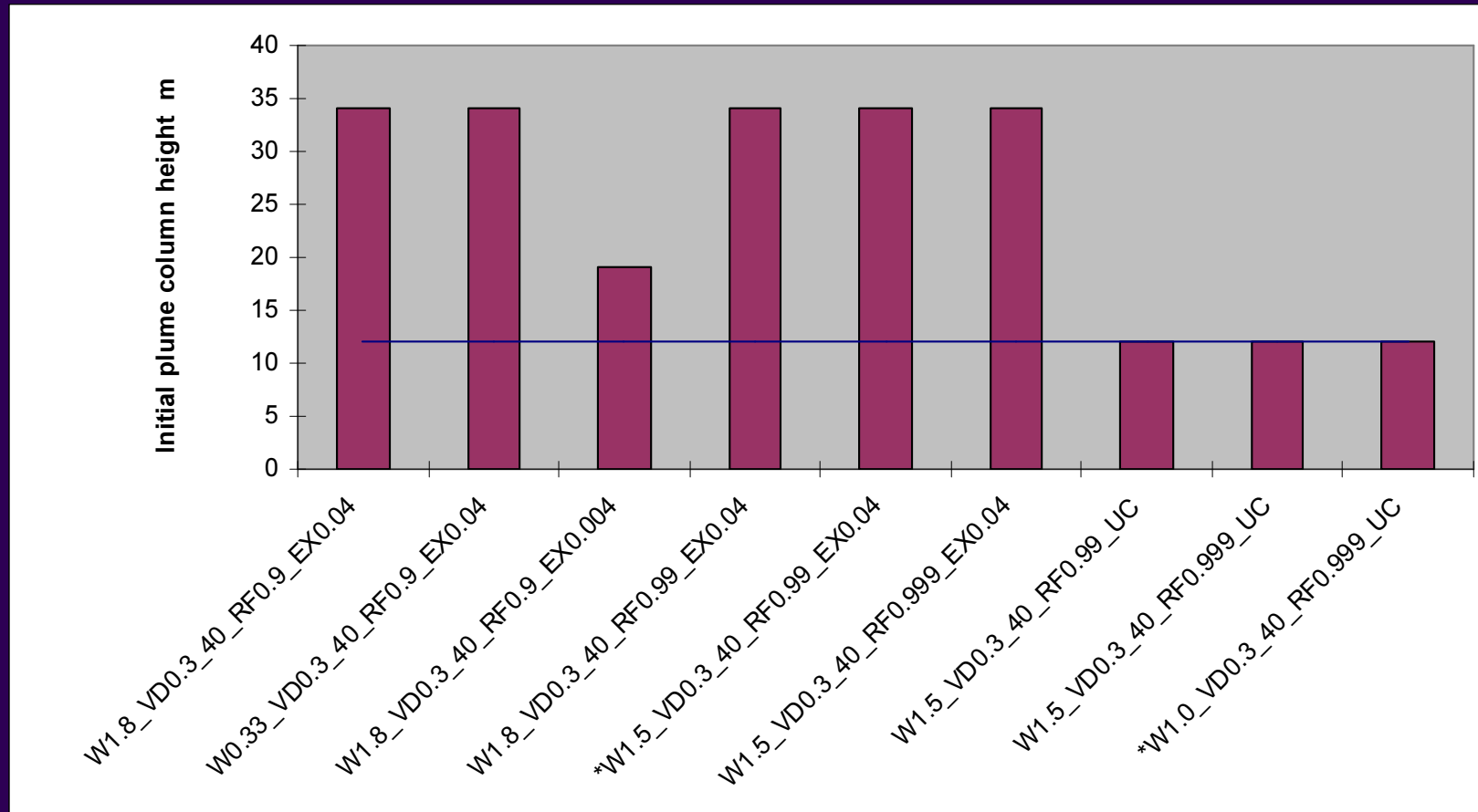


*Visually the best fit

Test two results, full extent



Test two, plume heights



Remarks on calibration using test two



Hotspot does not calculate deposition off axis or distances less than 10m downwind but it can plot contours (but mapping facility has bugs).

Hotspot estimated a greater plume height than the agreed default of 12m, no direct control of plume volume possible

Close in

Cannot show initial steep rise at 5m to 10m

Deposition very sensitive to wind speed

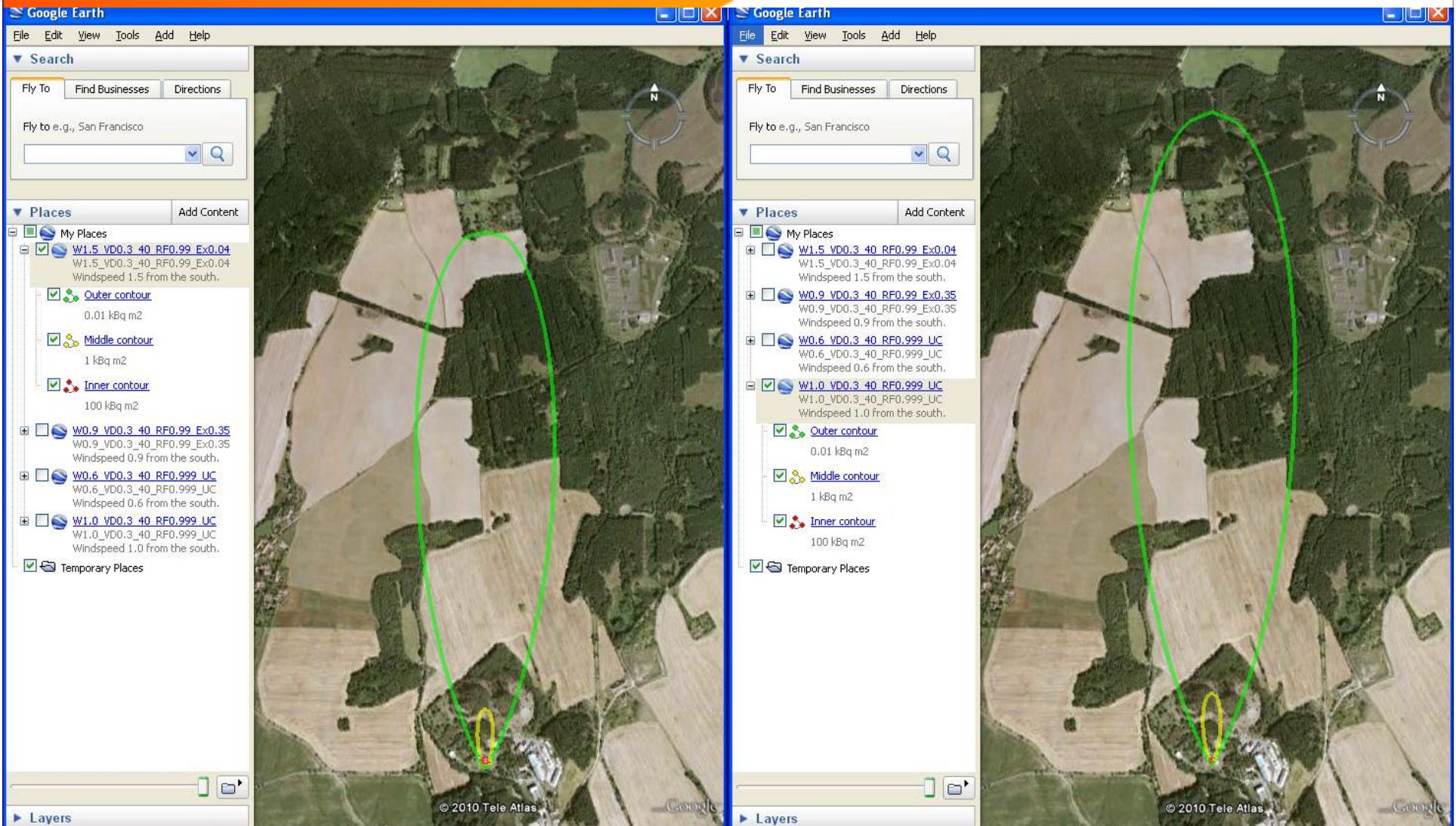
Difficult to achieve the sharp fall off at 30m, (Could adjust wind and RF further but this soon becomes an exercise in curve fitting!)

Further out

Deposition tends to converge (as expected with same deposition velocity and similar amounts of material)

Best fit (visually) are W1.5_VD0.3_40_RF0.99_EX0.04 (column height 34m) and W1.0_VD0.3_40_RF0.999_UC (constrained to 12m); e.g. maximum deposition at roughly correct distance and amount and falling off rapidly

Test two plume contours



W1.5_VD0.3_40_RF0.99_Ex0.04

W1.0_VD0.3_40_RF0.999_UC

© HPA

Test four (blind) inputs

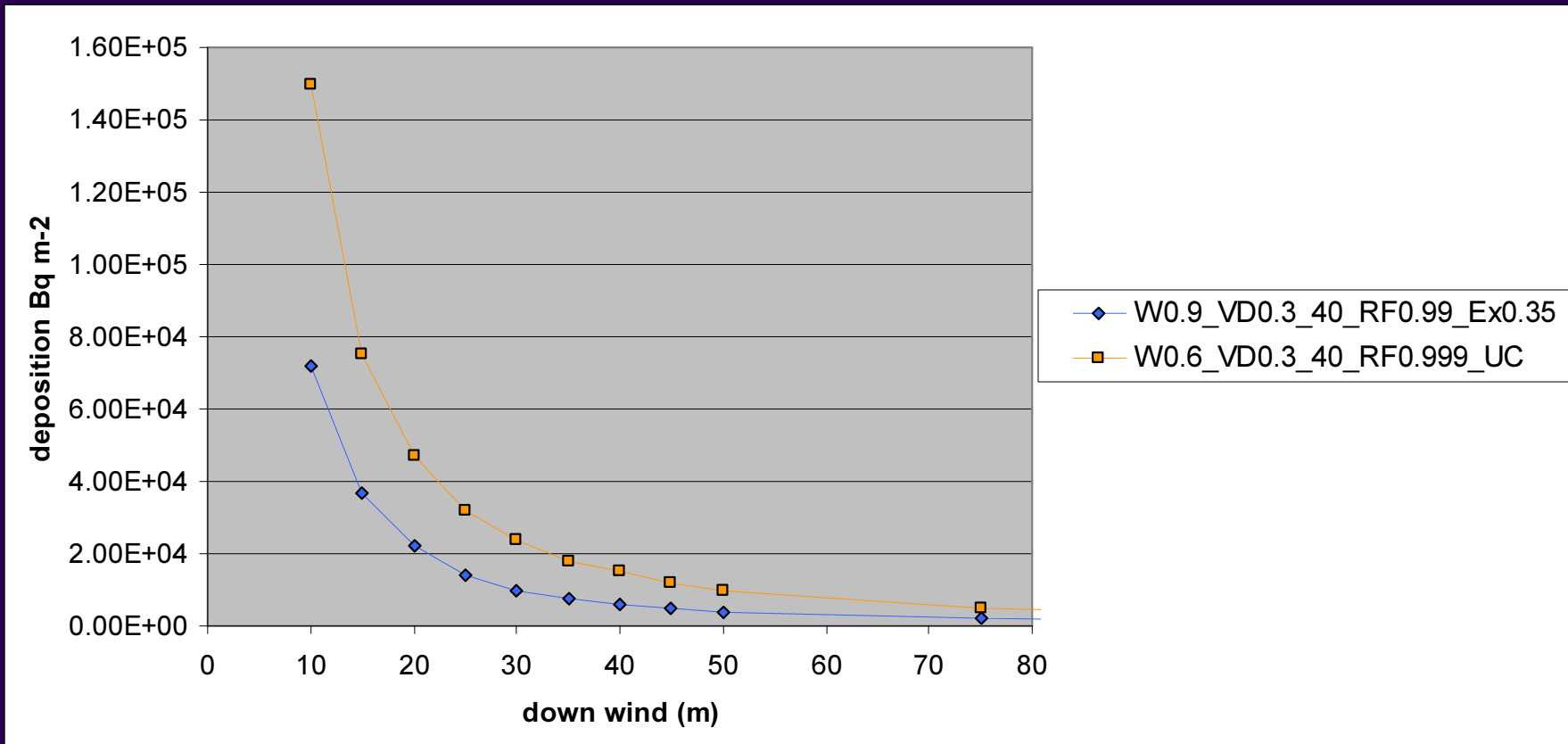


Stability category A

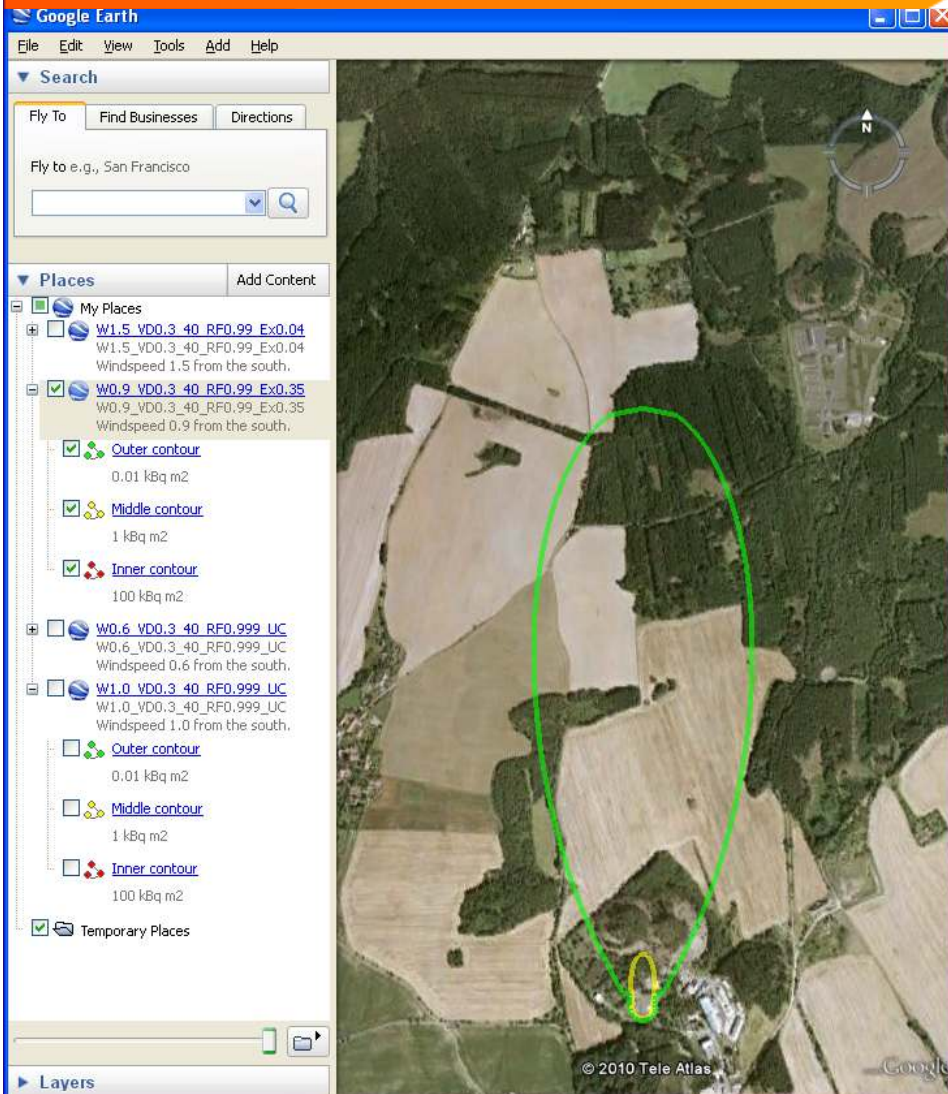
Run name	Wind speed ms ⁻¹	Respirable fraction	Deposition velocity RF/non-RF cms ⁻¹	Explosive TNT equivalent lbs	Vertical distribution
W0.9_VD0.3_40_RF0.999_Ex0.35	0.9	0.99	0.3 / 40	0.35*	Default
W0.6_VD0.3_40_RF0.999_UC	0.6	0.999	0.3 / 40	Constrained to 12 m	uniform

* This gives a plume column height of 58m!

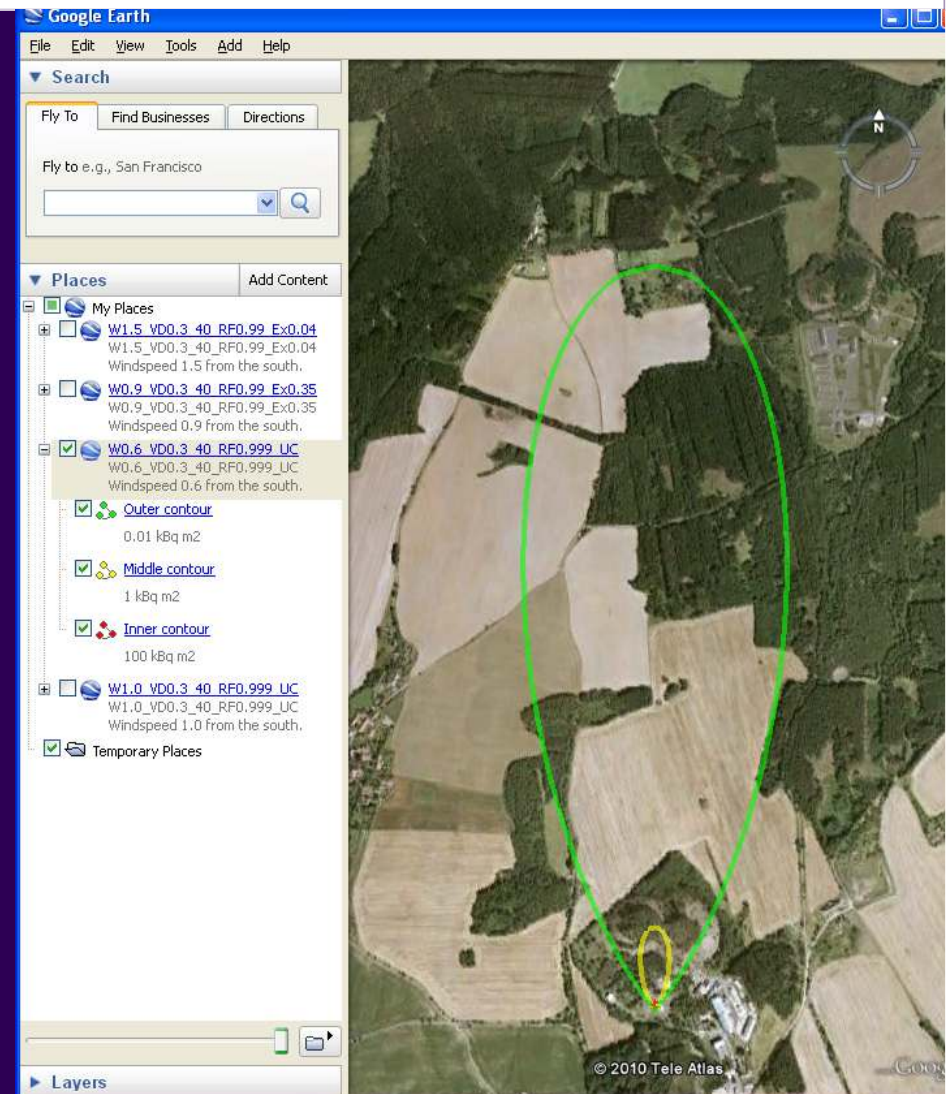
Test four downwind deposition close in



Test four plume contours



W0.9_VD0.3_40_RF0.99_Ex0.35



W0.6_VD0.3_40_RF0.999_UC © HPA