HANDLING “DIRTY BOMB”- SCENARIOS WITH THE LAGRANGIAN PARTICLE MODEL LASAIR

12th International Conference on Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purposes

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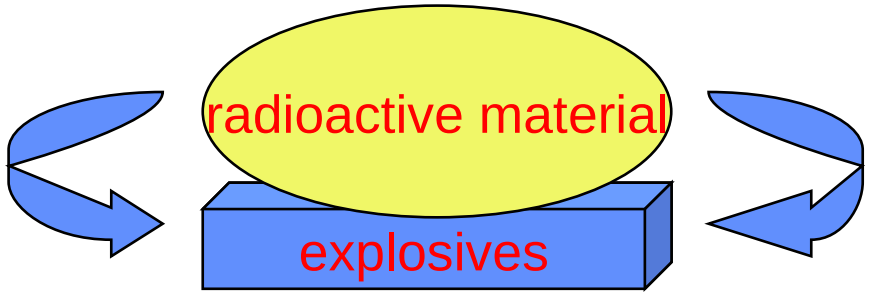
Definition of a “dirty bomb”

- IED Improvised Explosive Device
- RDD Radiological Dispersal Device
- RED Radiological Exposure Device
- IND Improvised Nuclear Device



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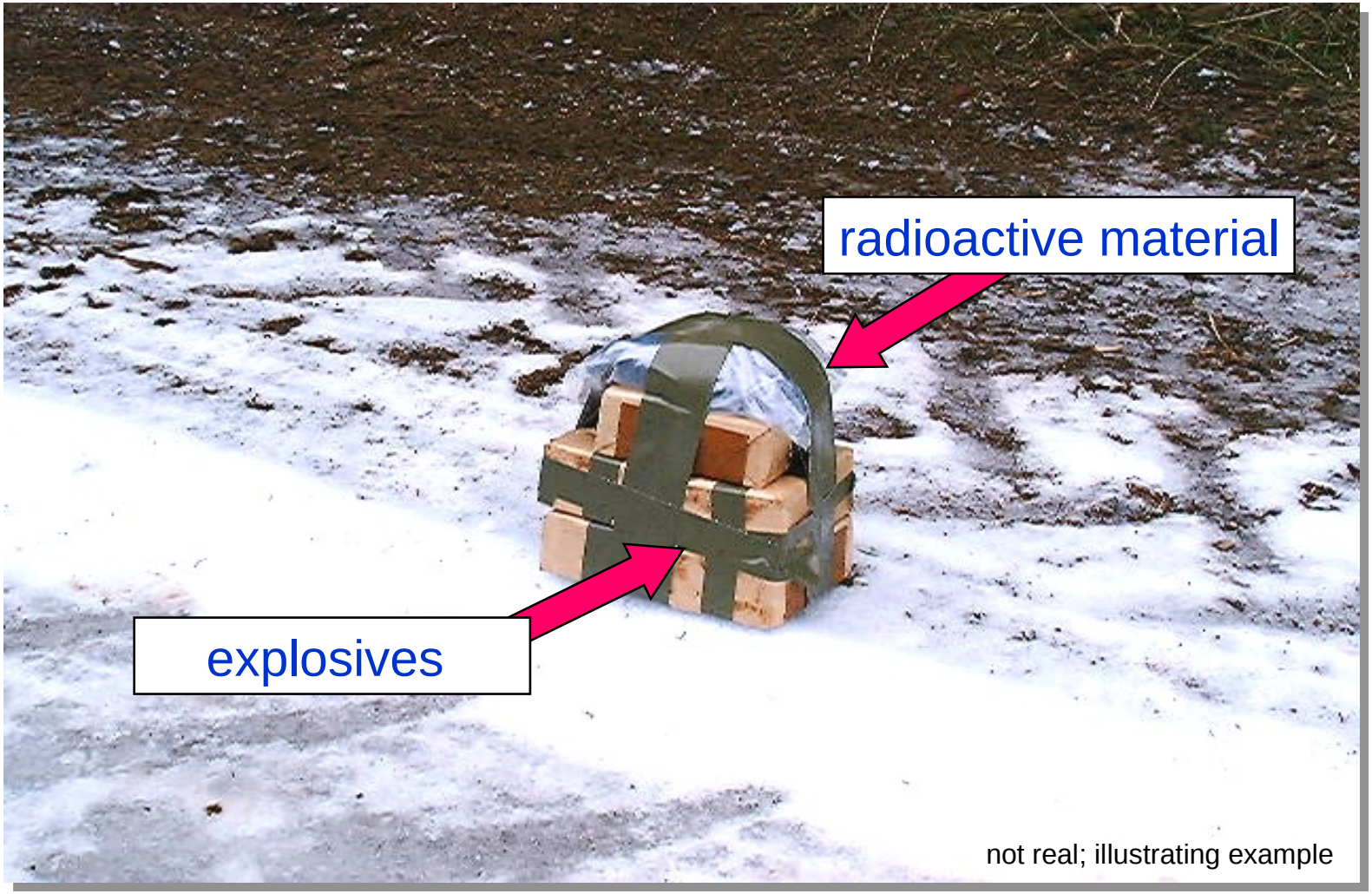
Example of a “dirty bomb”



picture: Thielen, GRS

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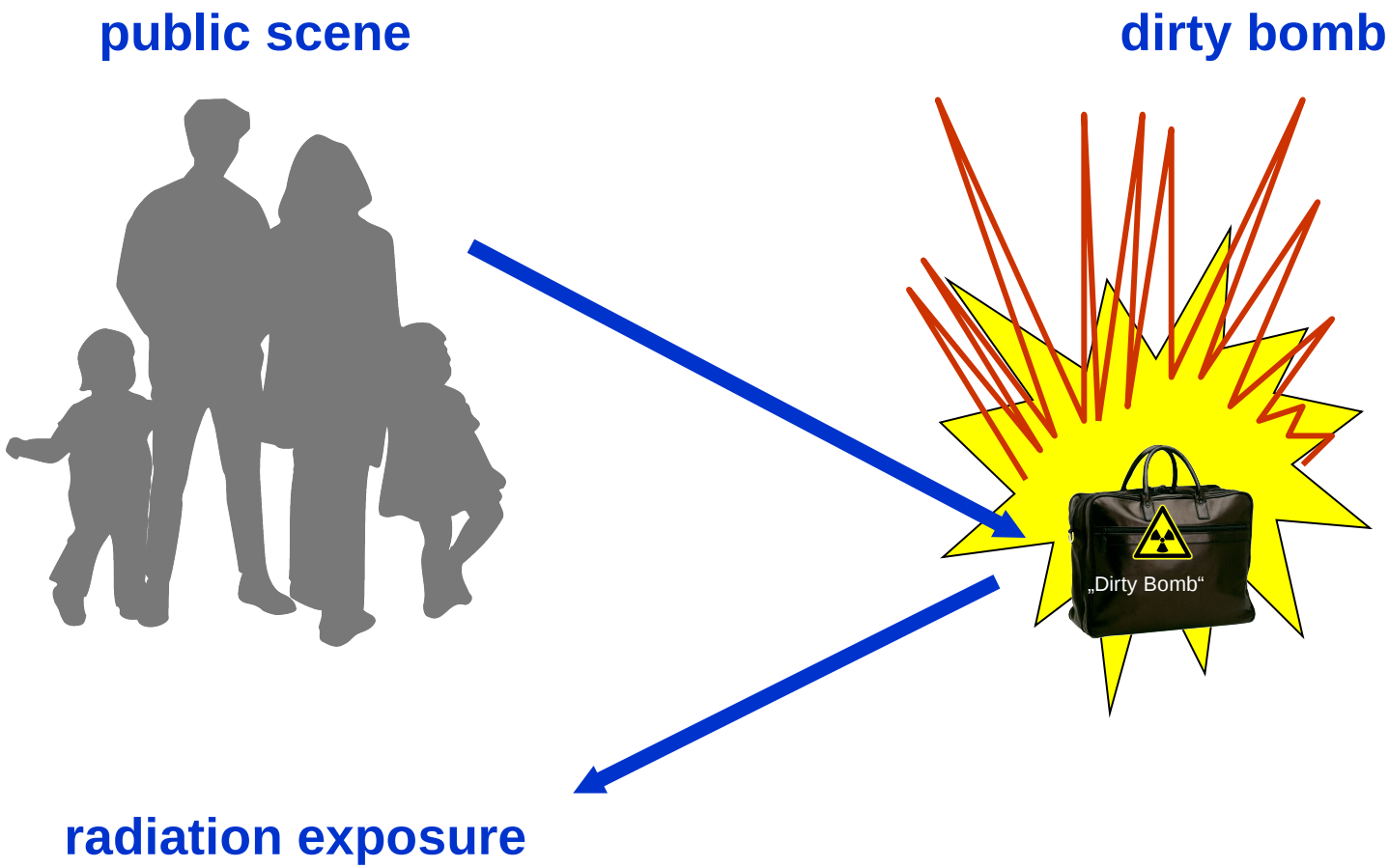
Effects after a „dirty-bomb“ explosion



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Questions in a „dirty-bomb“ scenario

- What‘s the size of the effected area?
- How long will the cloud be in that area?
- What is the amount of radiation exposure?
- Have people to be evacuated ?

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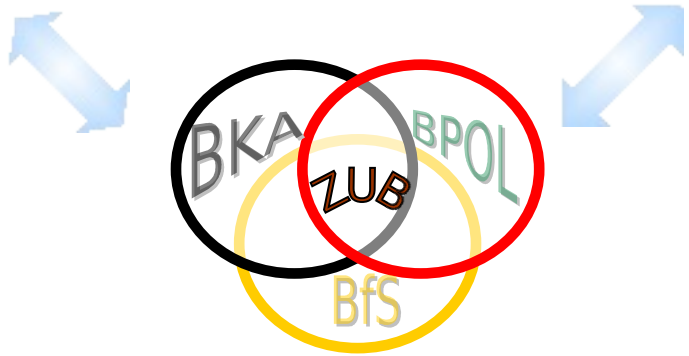
Solution: Federal Central Support Group for Serious Radiological and Terroristic Events „CSG“

Federal Criminal Police Office

Federal Police



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Some Extracted Tasks of the CSG

- **Forecast of dispersion and prognosis of radiation exposure**
- **Determination of meteorological dispersion conditions**
- **Assessment of radiological consequences after an explosion of a RDD**

LASAIR

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Acronym LASAIR

LASAIR

Programme for Lagrange-Simulation of the dispersion (*German: Ausbreitung*) and Inhalation of Radionuclides

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LASAIR Function and Aim

Task use of an expert systeme programme for scientific support of the CSG

Aim easy and rapid simulation of atmospheric dispersion of radioactive substances with

- diagnostic windfield-model
- Lagrange-Particle-Model

and the computation of the radiation exposure

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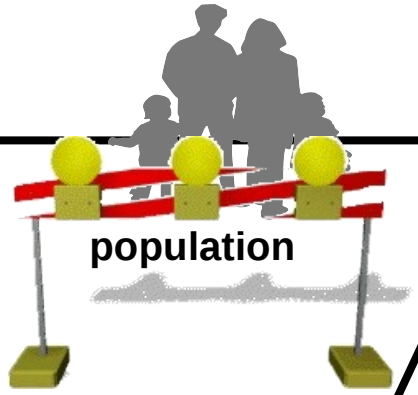
Example: „dirty bomb“ scenario



instantaneous release ? ? ?

exposed area

e.q. 5 mSv

police
deactivator

CSG, fire brigades

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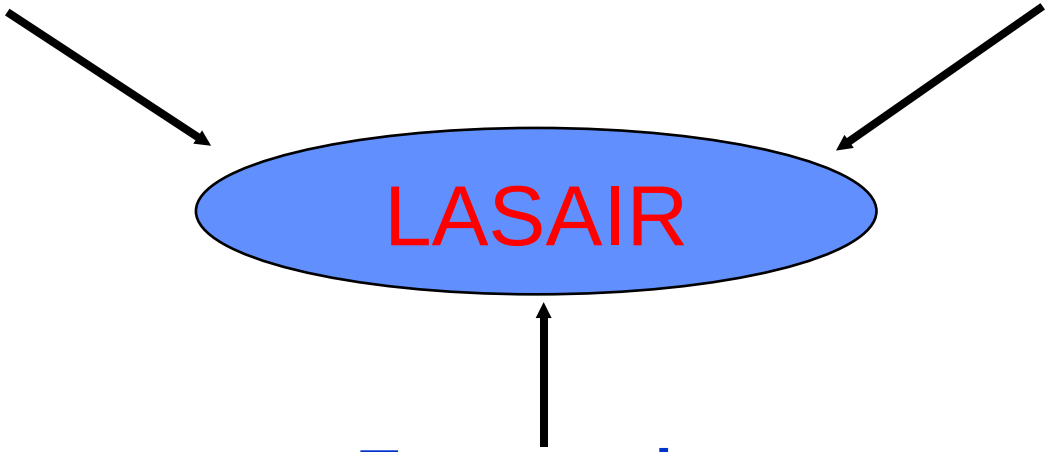
LASAIR input

Meteorology
- wind speed
- wind direction
- stability class

Release to the atmosphere
- short term release

  or
- continuous release



Topography
- individual roughness length
- 2 dimensional simulation

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LASAIR output

Radionuclides

- activity in base layer
- deposition to the surface
- cloud arrival time
- computed for time intervals
- simultan. for 5 radionuclides

Exposition

- inhalation
- groundshine
- cloudshine

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LASAIR features

- Lagrange particle model with 60.000 particles
- individual characterisation of the roughness length
- 2-dimensional flow model (no orographic structure)
- 5 radionuclides can be computed simultaneously
- user can choose out of approx. 860 radionuclides
- very quick response time (1 – 8 minutes)

LASAIR computation procedure

detection of a „dirty bomb“

↓

application of LASAIR (meteorology) with 1 Bq emission

↓

determination of radionuclides and measurement of activity

↓

application of LASAIR based on iterative improved measurements of activity

↓

radiation exposition

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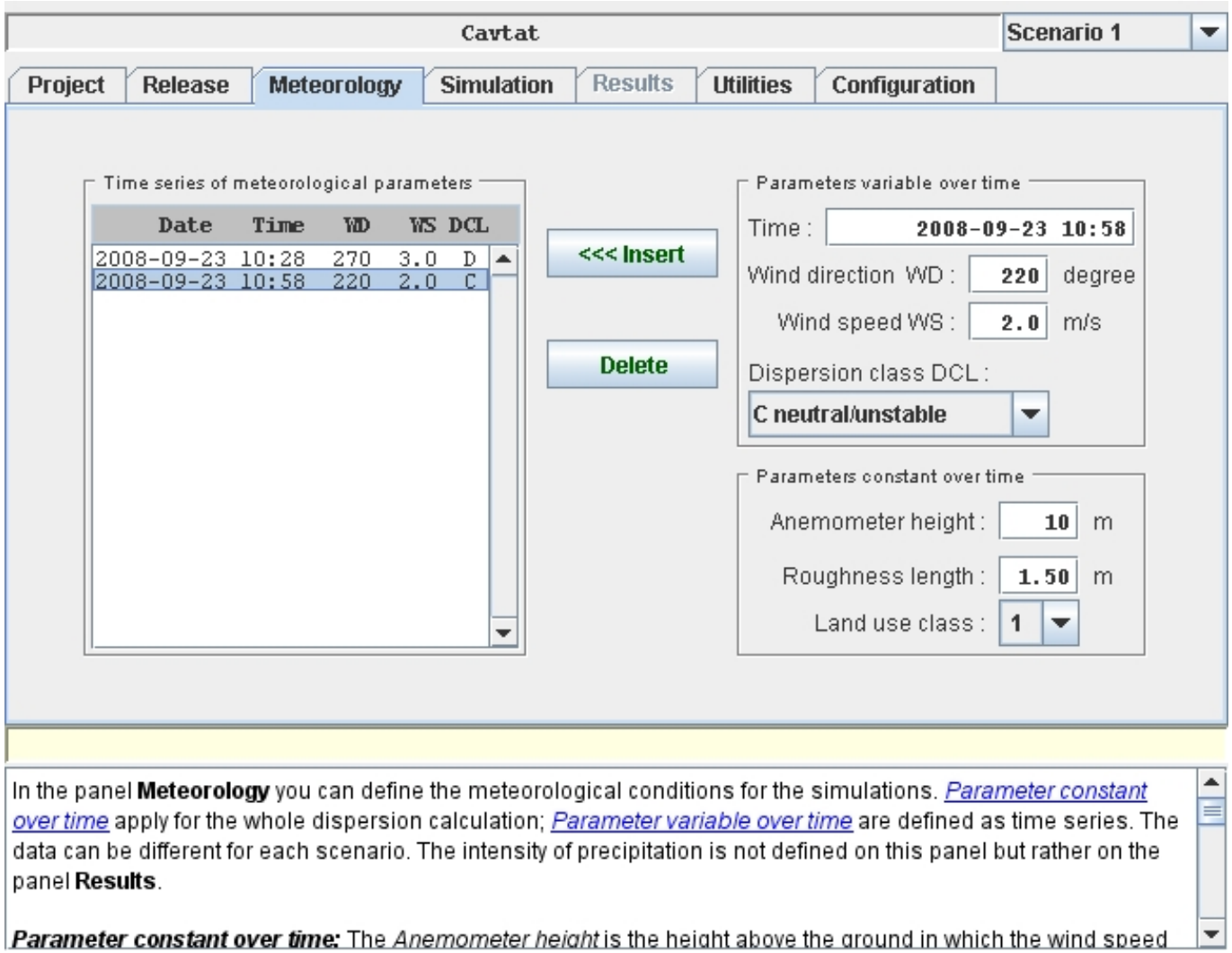
LASAIR main menue (meteorology)



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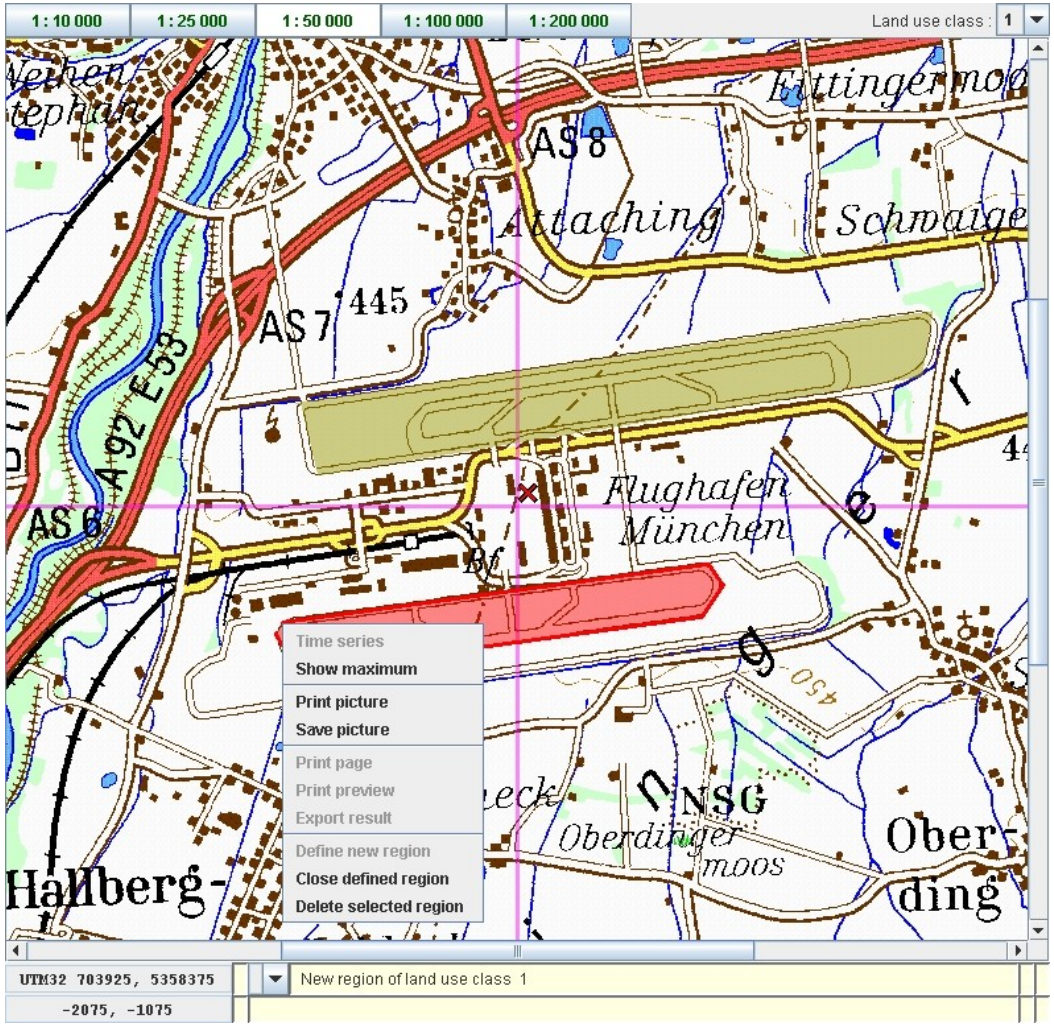
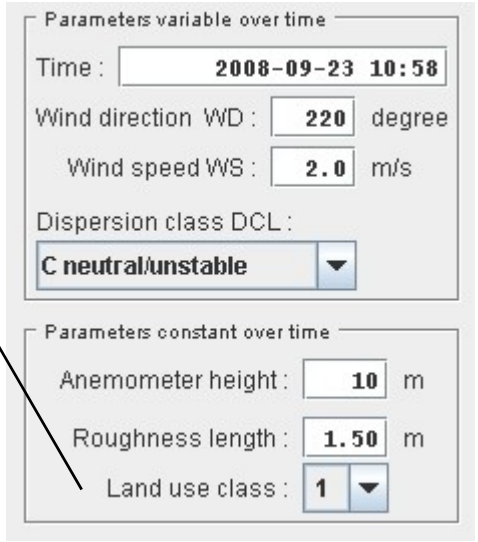
LASAIR main menue (indvidual roughness length)





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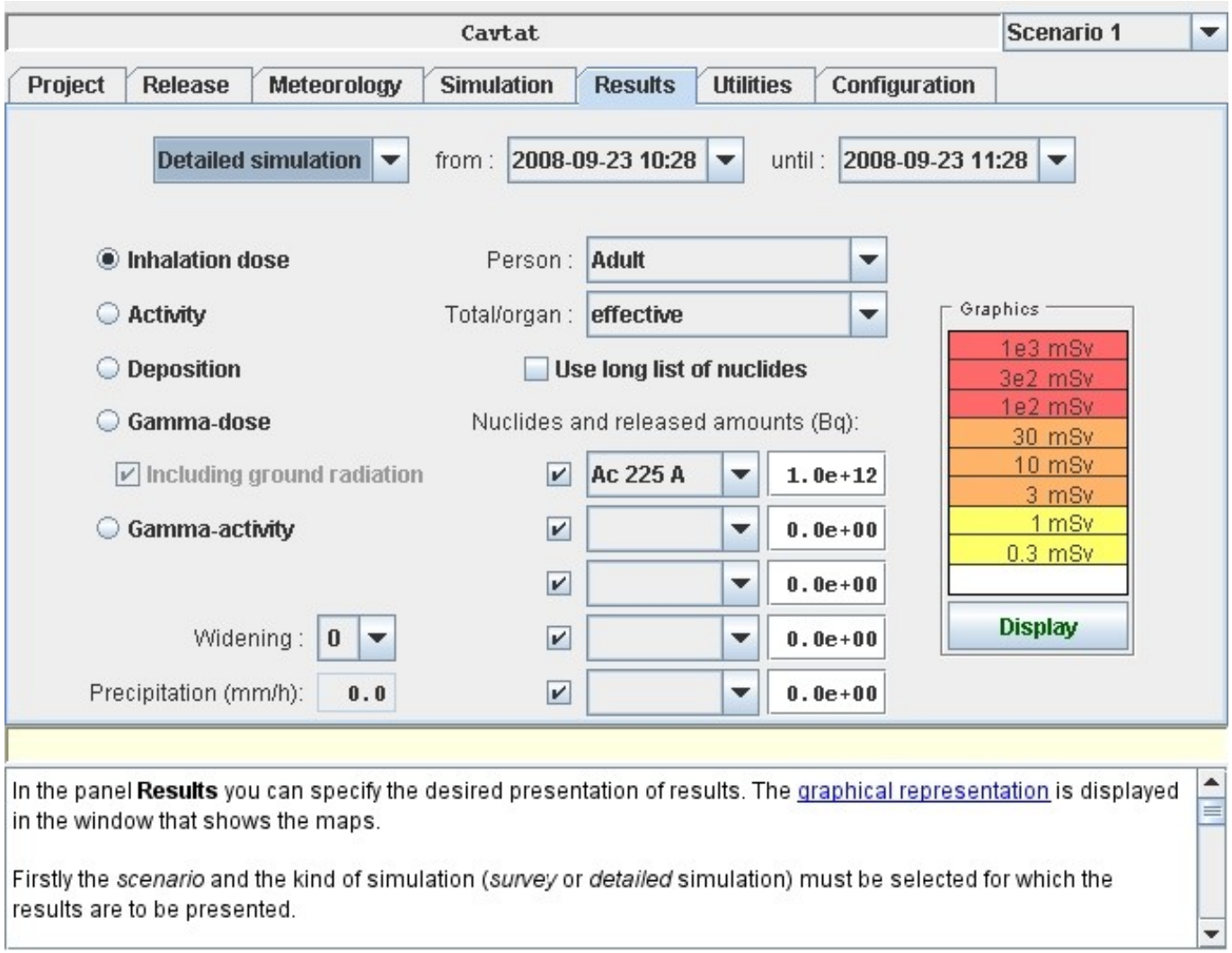
LASAIR main menue (results)



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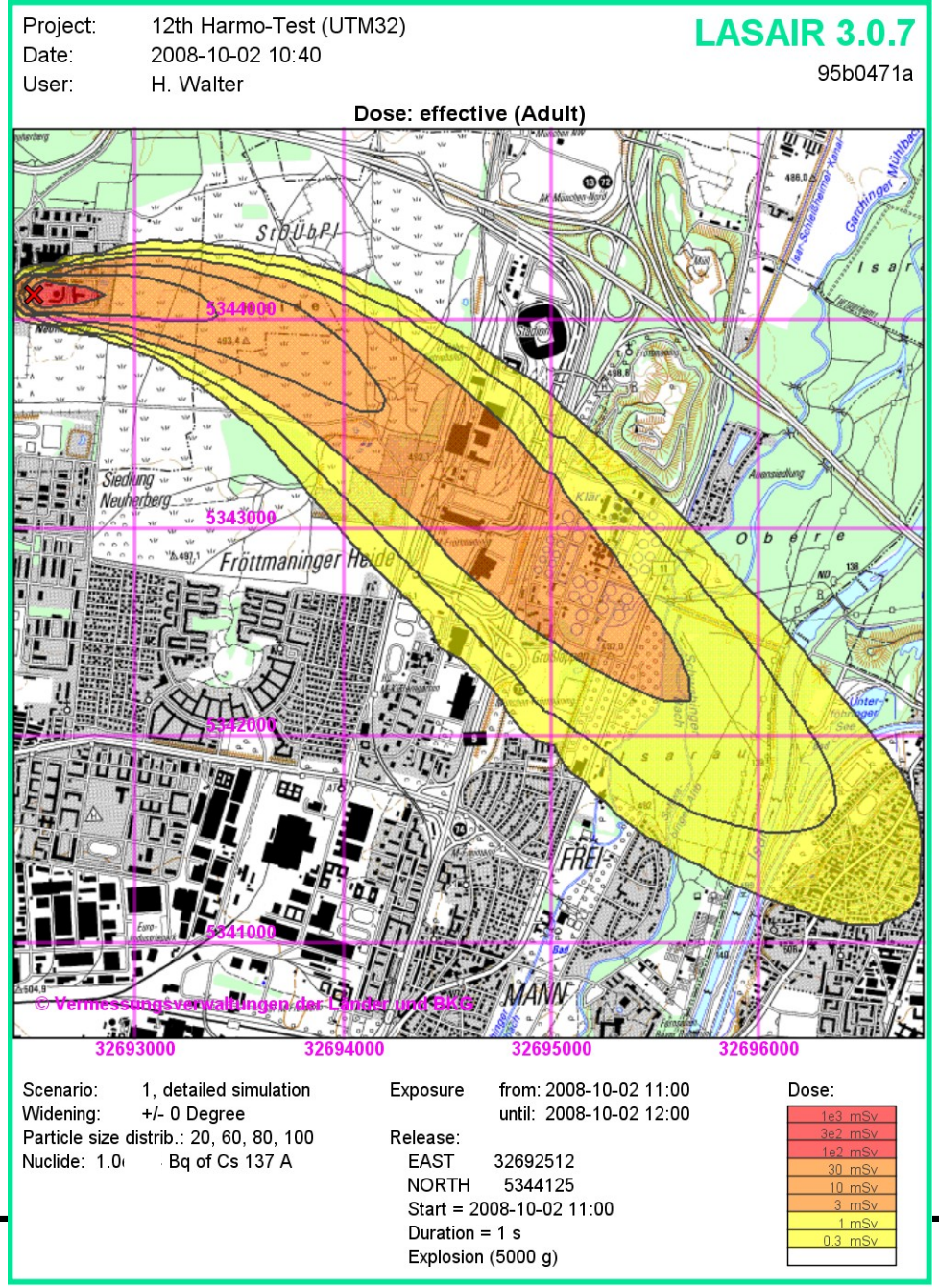
LASAIR
main menue (results)



Test, not real !

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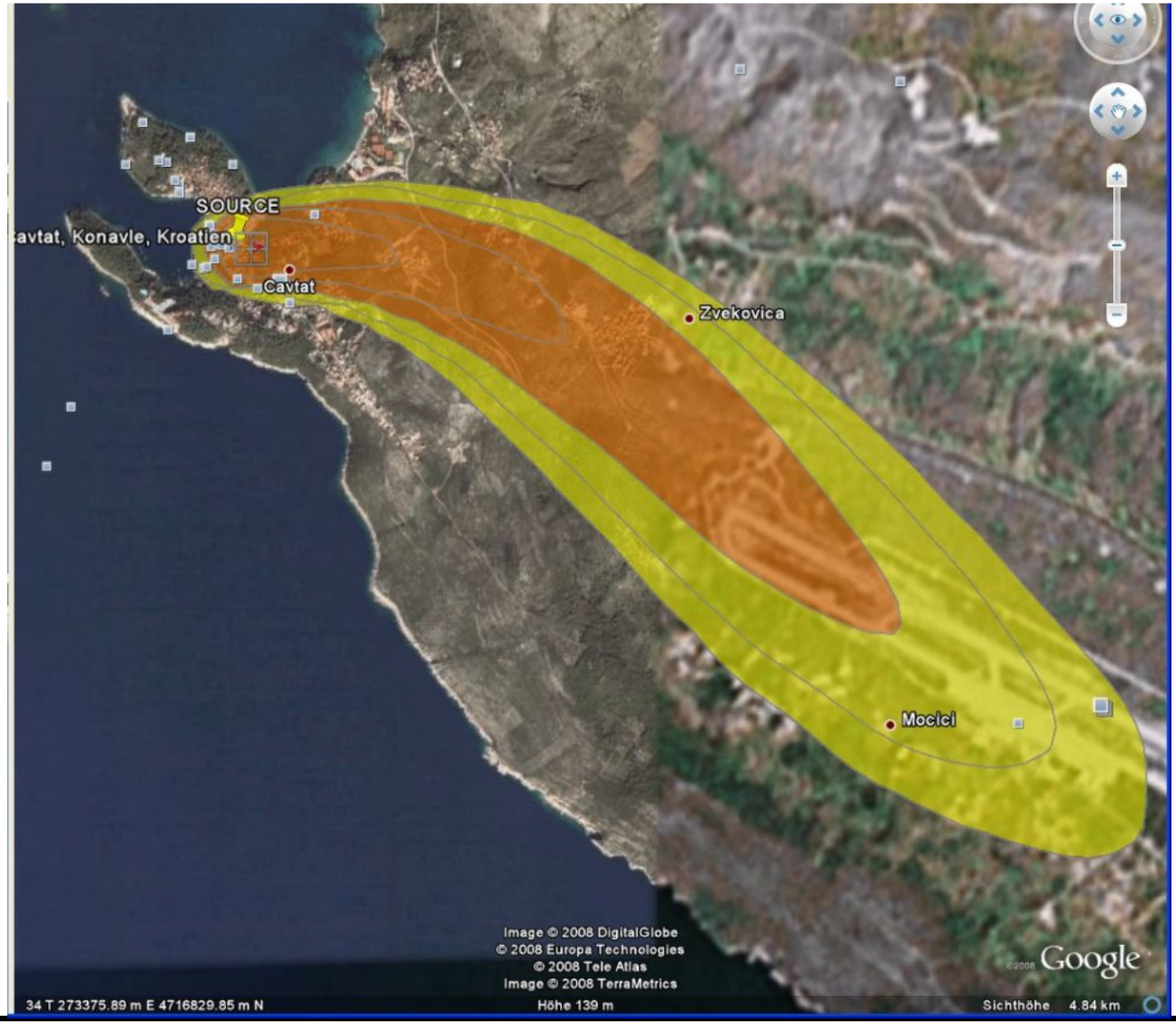
LASAIR main menue (results)



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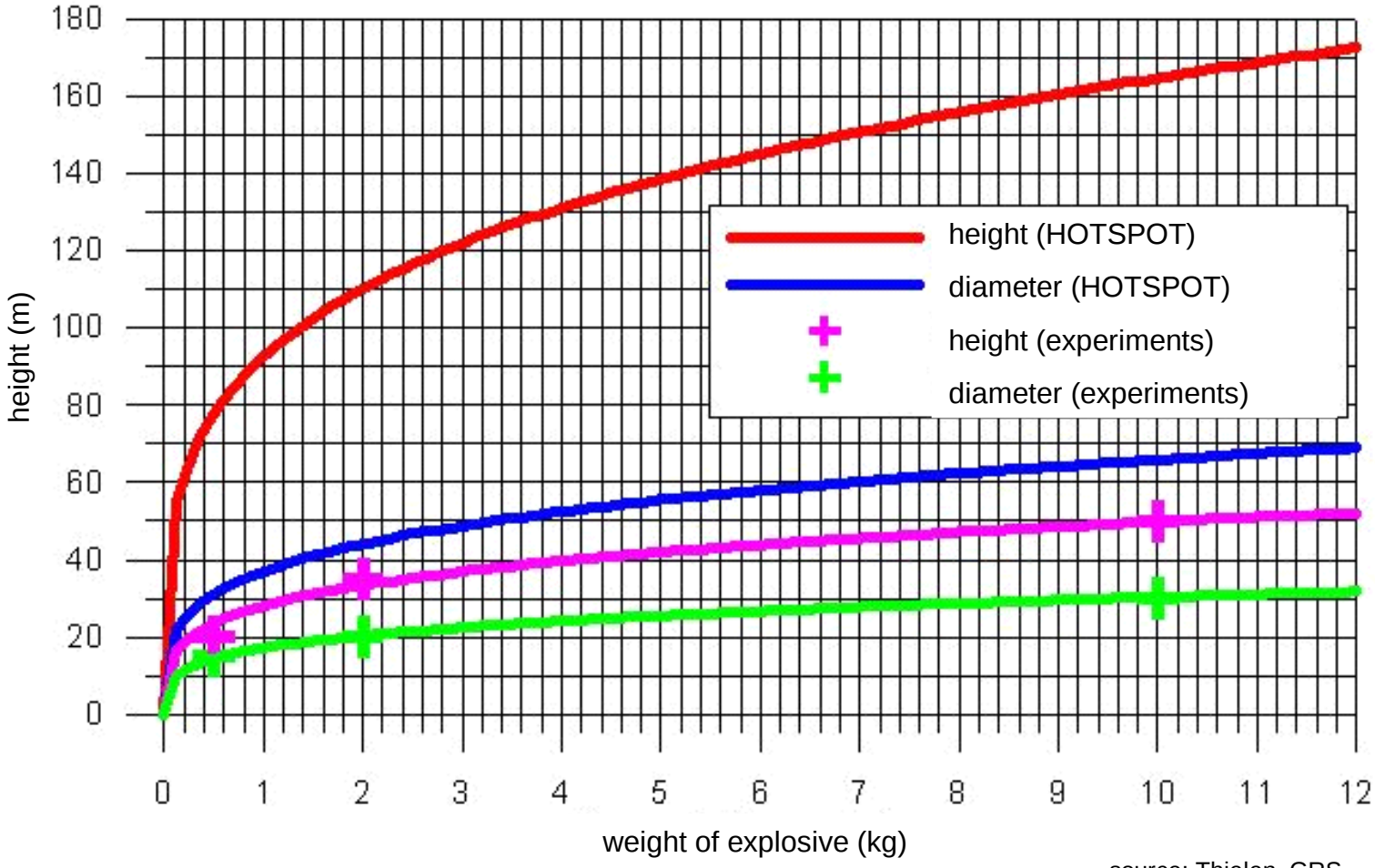
LASAIR special features

- **parameterisation of the individual cloud**

Initial cloud volumina
Parametrisation after experiments



source: Thielen, GRS

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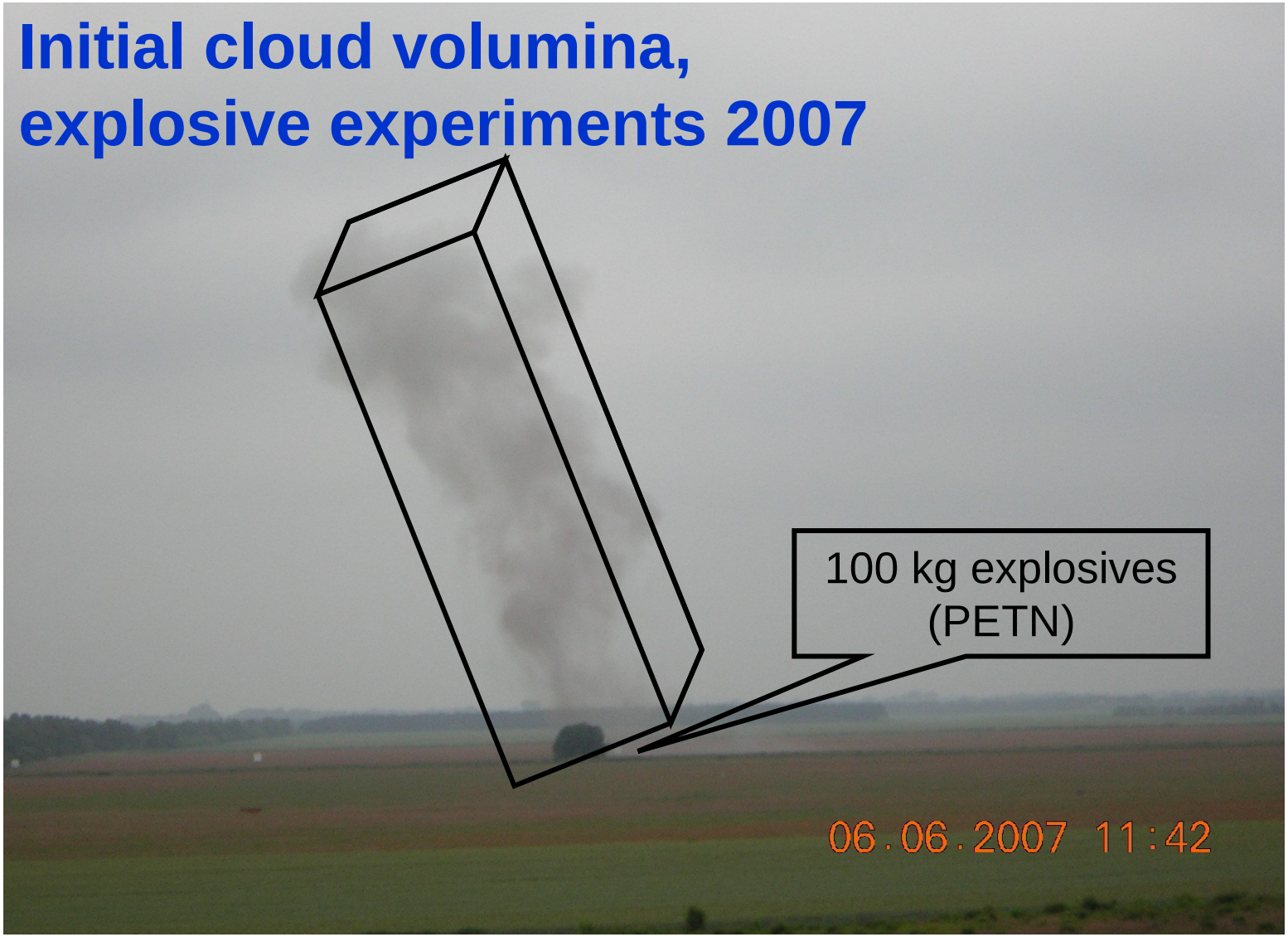
Initial cloud volumina, explosive experiments 2007



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LASAIR comparison to other models

HOTSPOT	**HOTSPOT 2.0.6**
HEAT	**Hazard Estimation After Tbm engagement (Version 5.5)**
LASAIR	**Lagr. Sim. of Dispersion and Inhalation of Radionuclides**
RODOS	**Real Time Online Decision Support System**
TATOO	**Threat Analysis Tool**

- **HOTSPOT, RODOS: Gaussian Models**
- **all others are Lagrange Particle Models**

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Meteorological Conditions for the comparison in case “C02”:

•wind speed	3 m/s
•wind reference height	10 m
•wind profile	adjusted to LASAIR boundary layer model for HEAT and TATOO, adjusted to windspeed in 10 m for HOTSPOT and RODOS
•wind direction	constant
•roughness length	0,2 m (varies in RODOS in the first three cells downwind)
•atmospheric stability	C, neutral to slightly unstable
•height of inversion	800 m (RODOS approximately 1000 m)

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Basic input parameters in the comparison for all models

•size of aerosols	90 %	$0 \leq x \leq 10\ \mu m$
•size of aerosols	10 %	$10\ \mu m < x$
•amount of explosives	n.n.	
•nuclide	Cs 137	
•dose coefficient	3.9×10^{-8} Sv/Bq	
•source activity	1.9×10^{13} Bq	
•breathing rate	3.8×10^{-4} m³/s	

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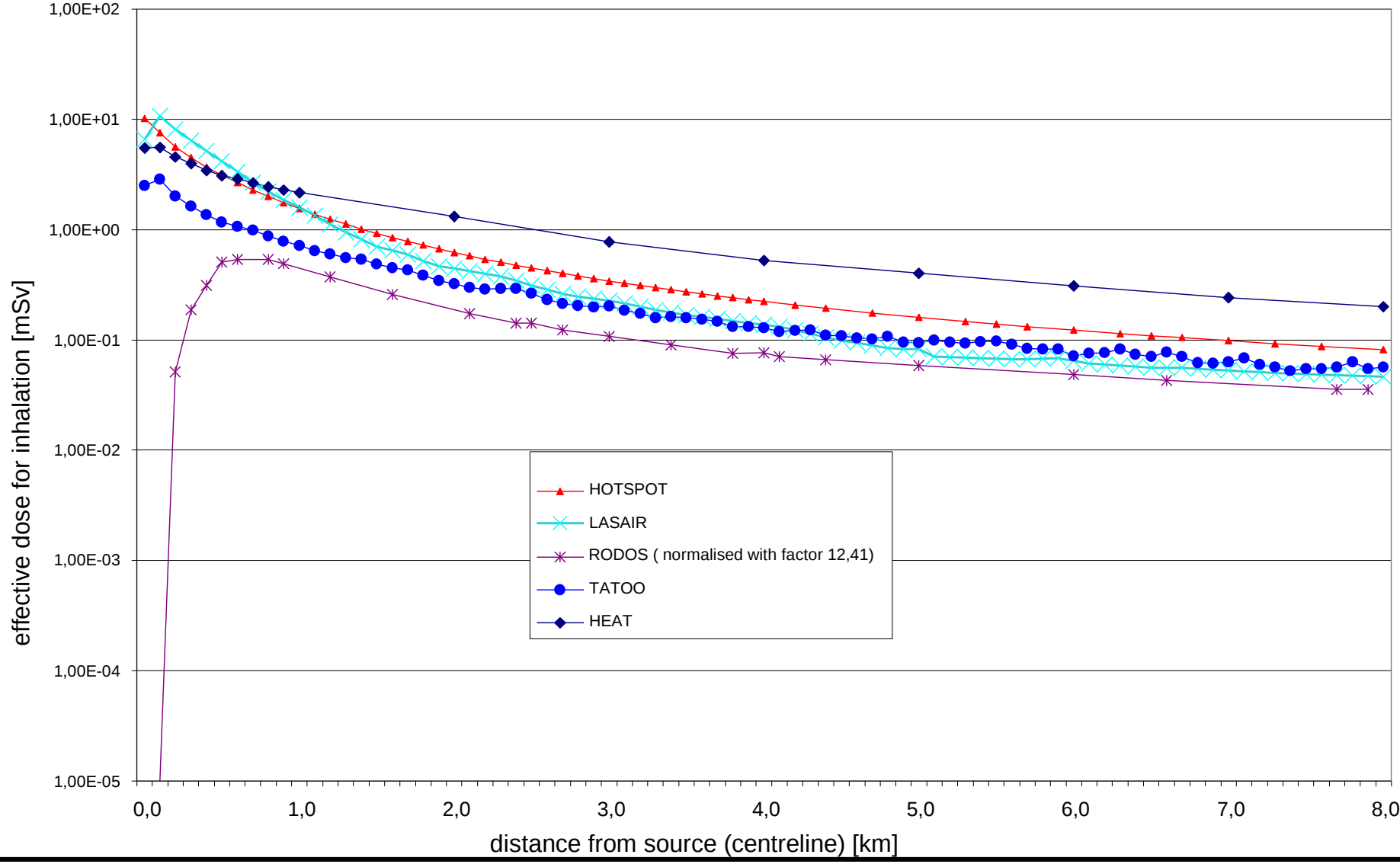
Comparison of different dispersion models



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Conclusions from the comparison

- four models show in general a very good agreement
- the models differ in the close vicinity downwind from the source
- no significant difference between GM and LPM
  (in this comparison!)
- the model RODOS differs to the others,
  but the main effects can be explained

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Conclusions for the model LASAIR

- the model LASAIR has been developed since several years
- has proved its ability during various applications and exercises
- it's a simple tool
- is easily to handle
- needs only basic relevant meteorological and radiological input information
- it is based on a powerful dispersion model (LASAT) (harmonisation process in Germany)
- runs on an ordinary laptop
- can be used either close to the site of crime or as a back office tool

- LASAIR is able to handle a "dirty bomb"-scenario and provides reasonable results compared to other models

but

- LASAIR output results are limited according to the input data (don't expect more than you put in !)

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Thanks for your interest in LASAIR

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