

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

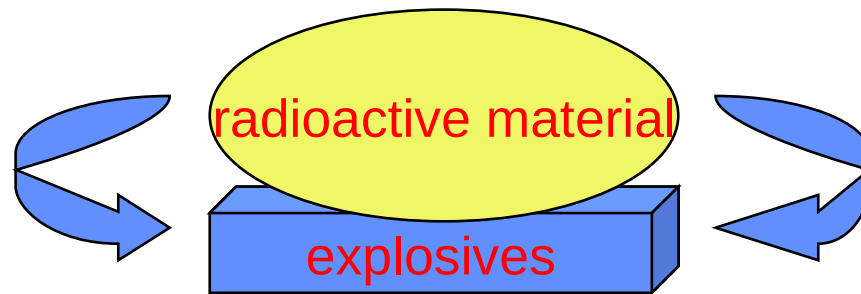
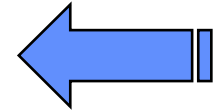
**12<sup>th</sup> International Conference on Harmonisation within  
Atmospheric Dispersion Modelling for Regulatory  
Purposes**

**Cavtat, Croatia, 06. - 09.10.2008**

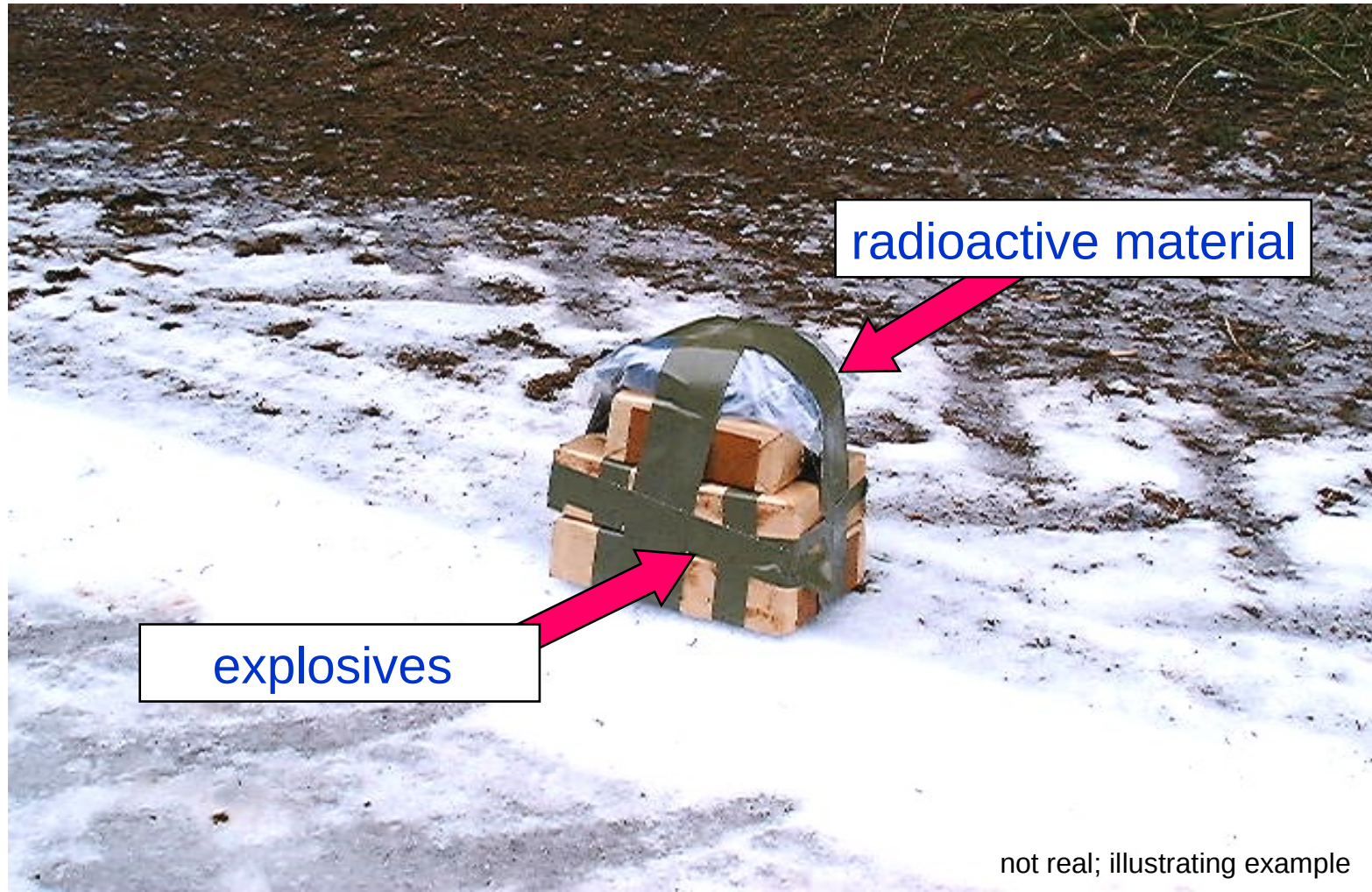
**Hartmut Walter  
Federal Office for Radiation Protection  
Ingolstädter Landstrasse 1  
D - 85764 Oberschleissheim  
Germany**

# Definition of a “dirty bomb”

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



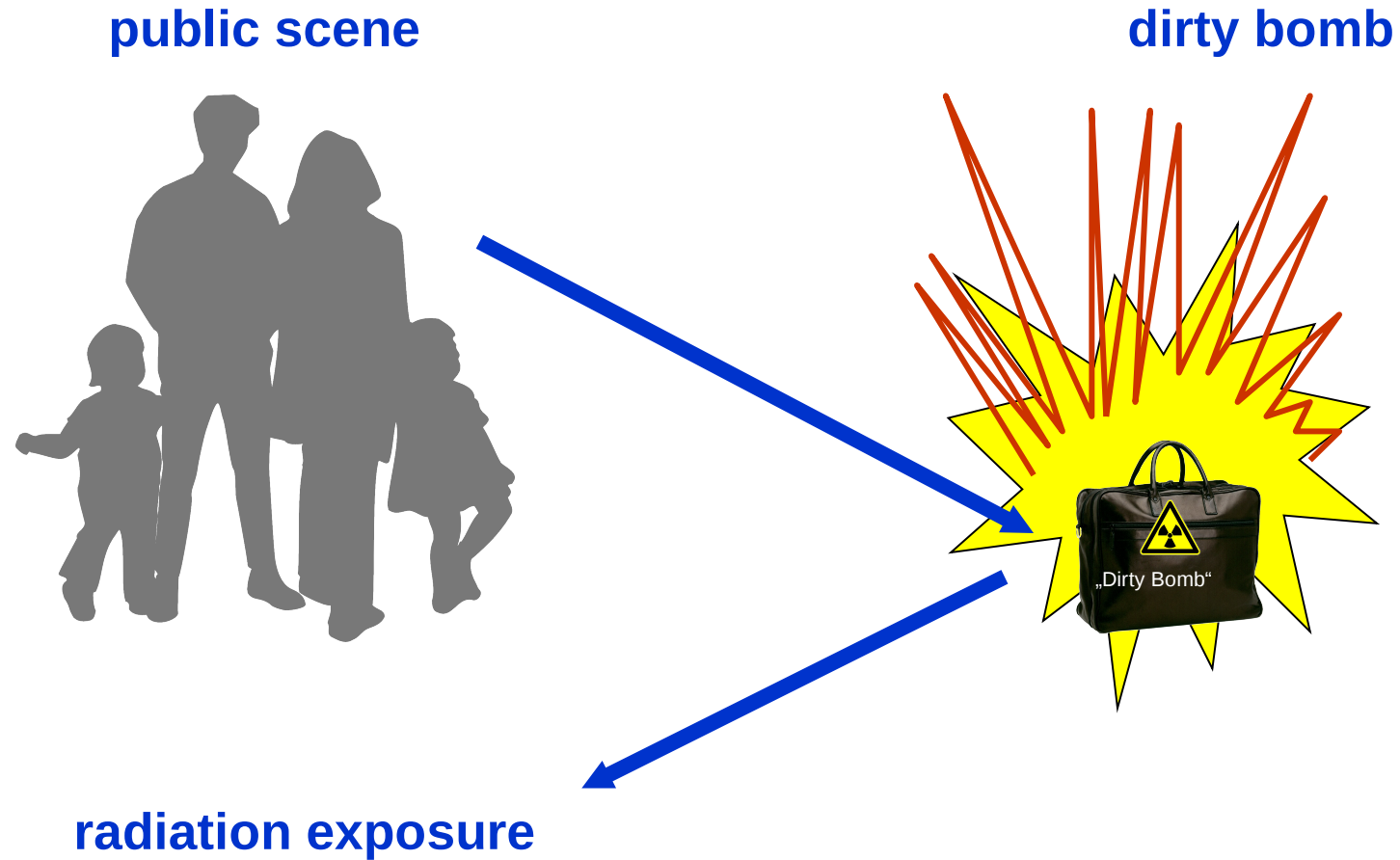
# Example of a “dirty bomb”



not real; illustrating example

picture: Thielen, GRS

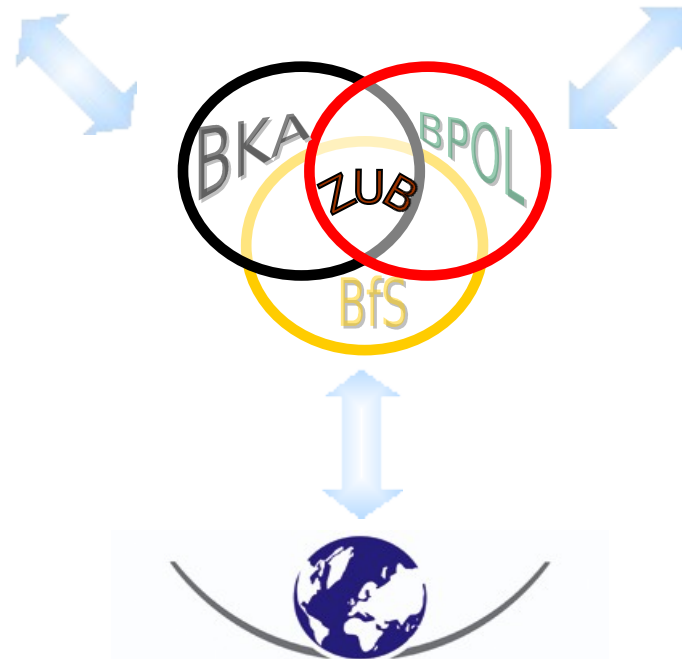
# Effects after a „dirty-bomb“ explosion



# 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 ?

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



**Bundesamt für Strahlenschutz  
Federal Office for Radiation Protection**

# 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**

# Acronym LASAIR

## LASAIR

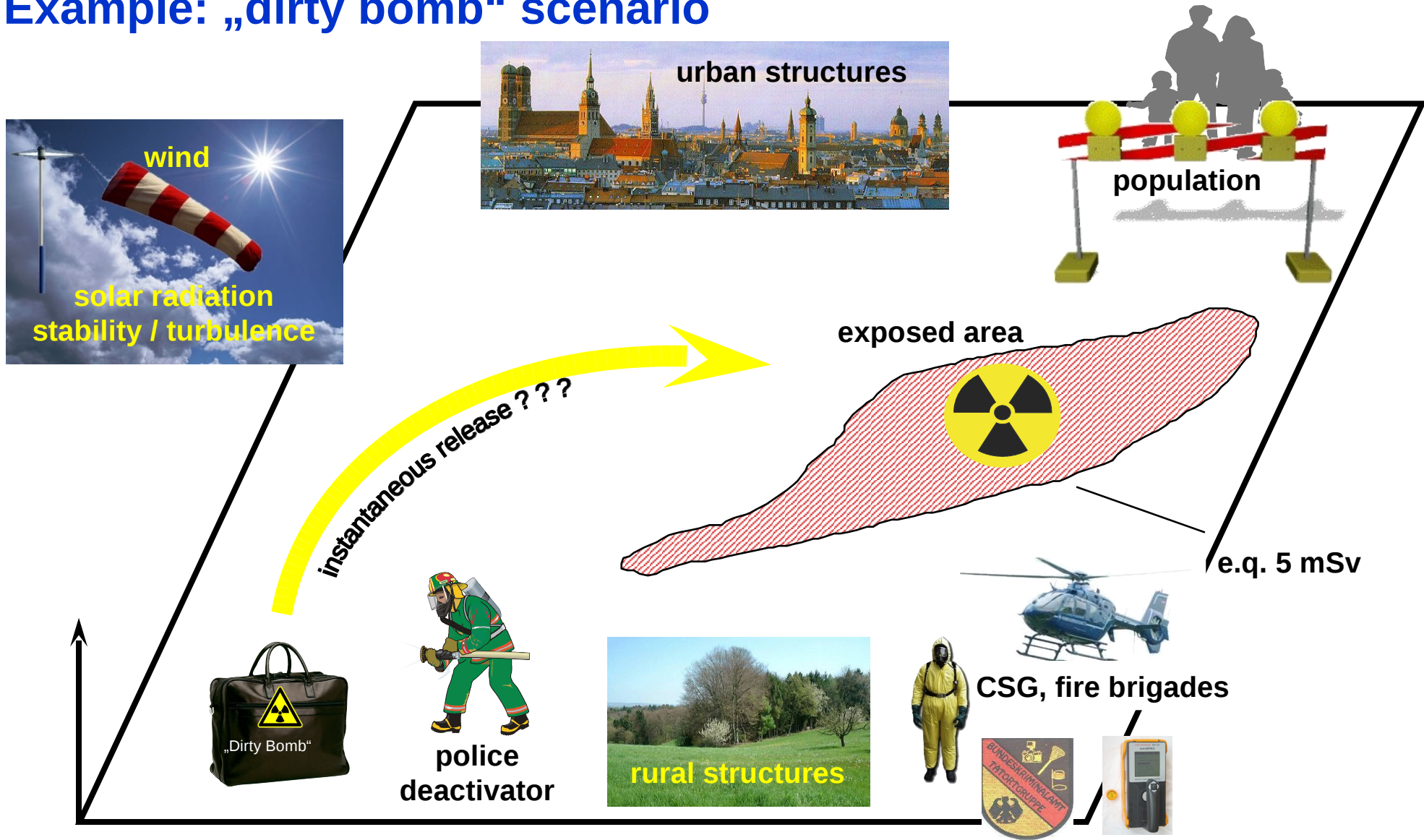
Programme for Lagrange-Simulation  
of the dispersion (*German: Ausbreitung*)  
and Inhalation of Radionuclides



# LASAIR Function and Aim

- Task** use of an expert system 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

# Example: „dirty bomb“ scenario



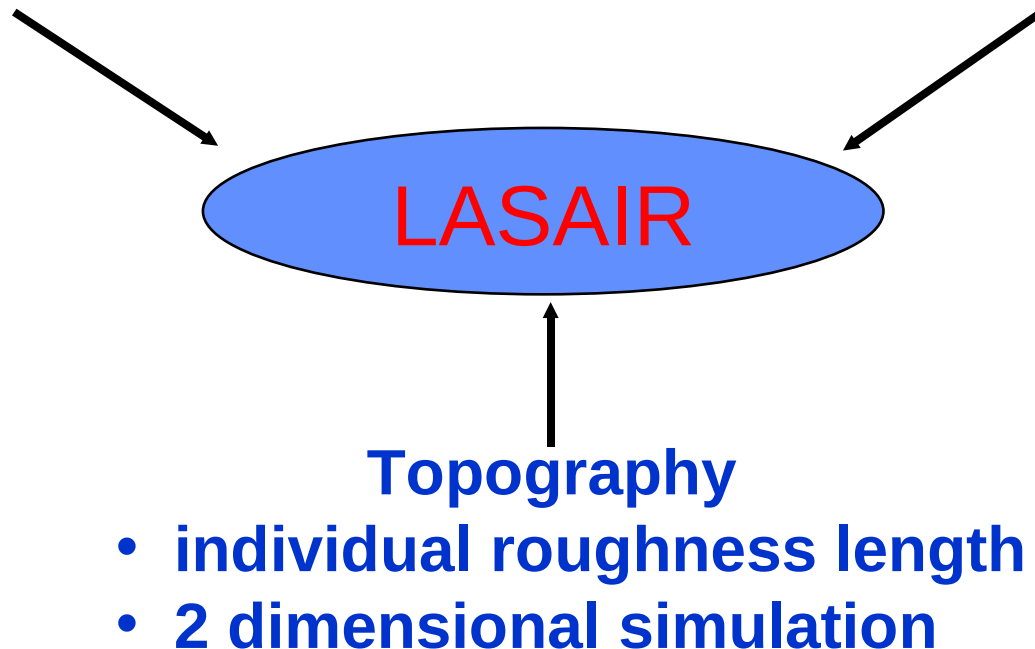
# LASAIR input

## Meteorology

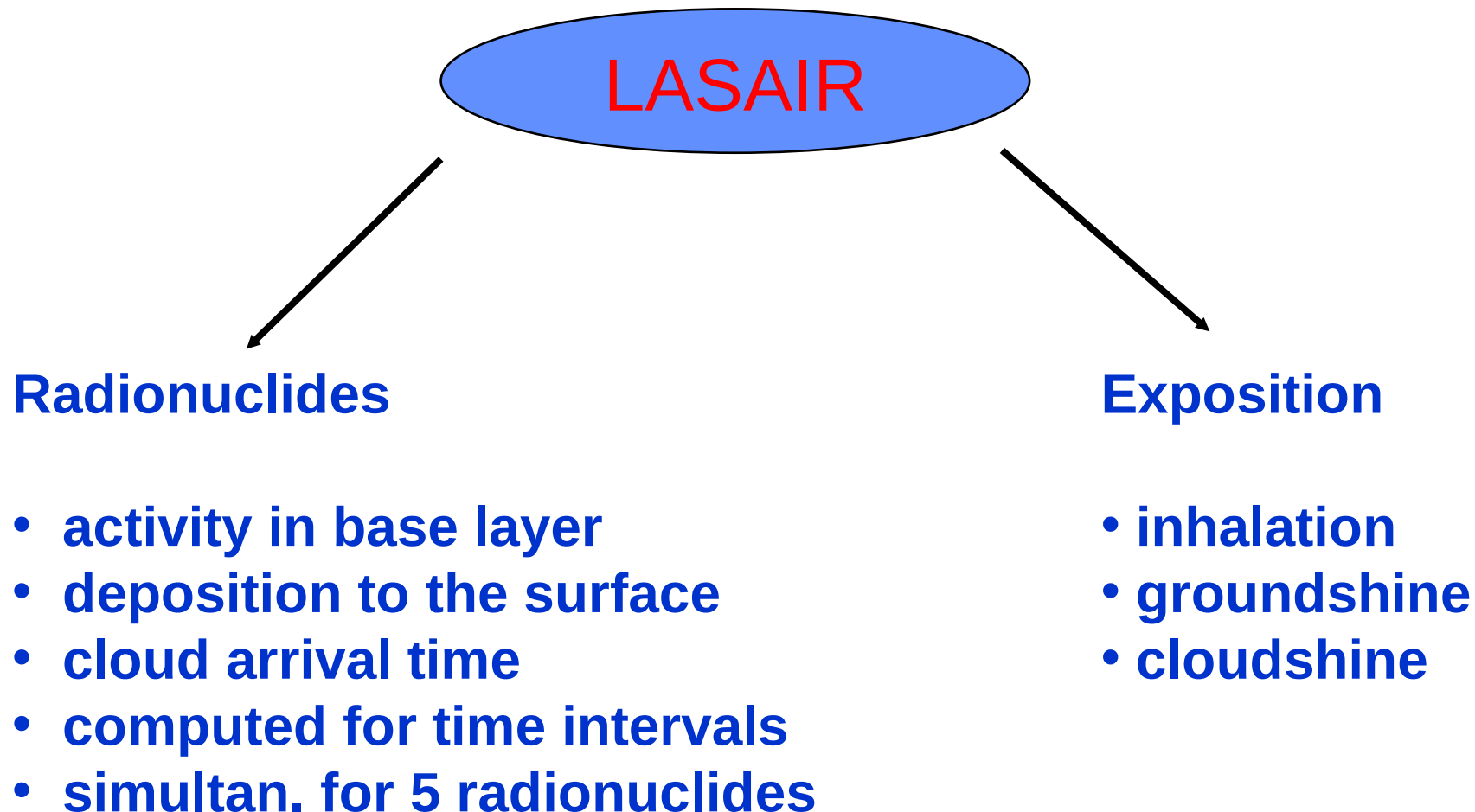
- wind speed
- wind direction
- stability class

## Release to the atmosphere

- short term release  
or
- continuous release



# LASAIR output



# 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

# LASAIR main menu (meteorology)

Cavtat Scenario 1

Project Release **Meteorology** Simulation Results Utilities Configuration

Time series of meteorological parameters

Date	Time	WD	WS	DCL
2008-09-23	10:28	270	3.0	D
2008-09-23	10:58	220	2.0	C

<<< Insert

Delete

Parameters variable over time

Time : 2008-09-23 10:58

Wind direction WD : 220 degree

Wind speed WS : 2.0 m/s

Dispersion class DCL : C neutral/unstable

Parameters constant over time

Anemometer height : 10 m

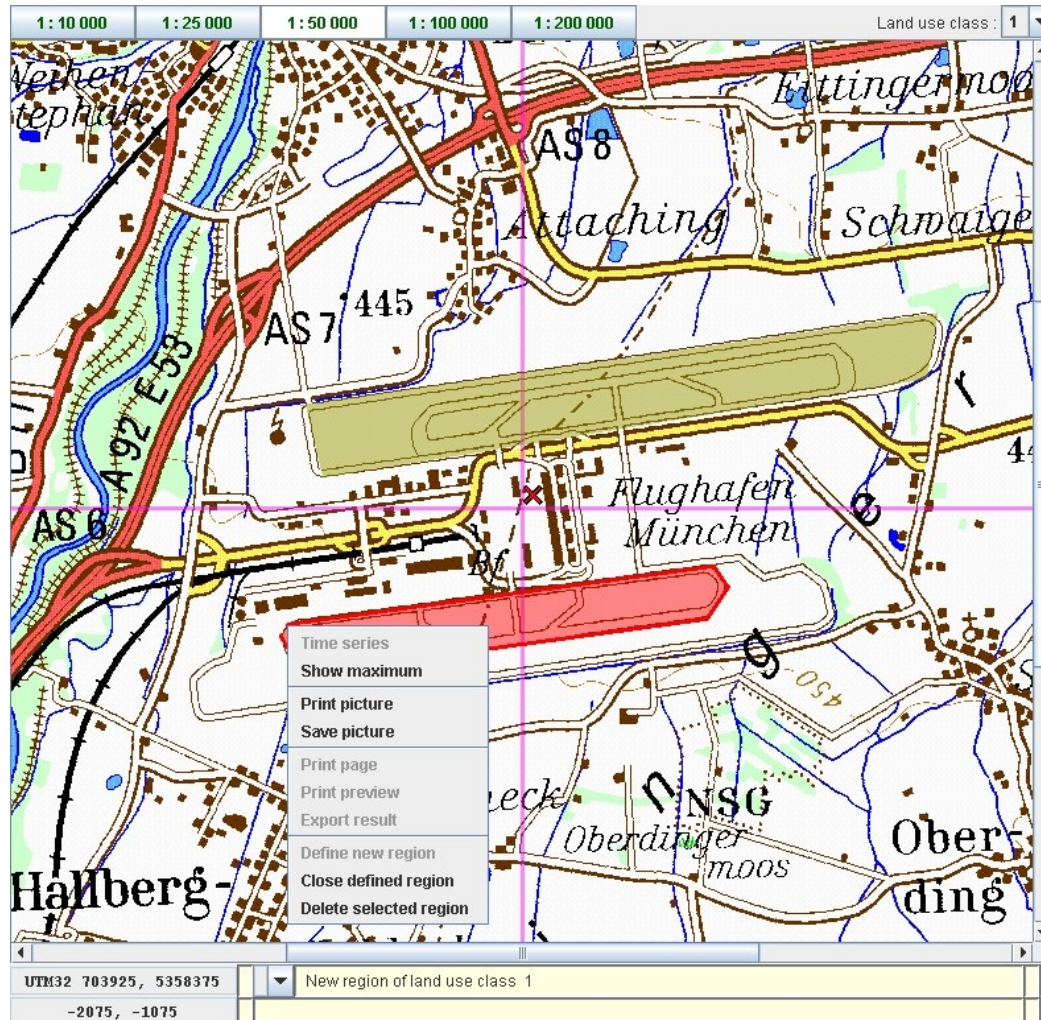
Roughness length : 1.50 m

Land use class : 1

In the panel **Meteorology** you can define the meteorological conditions for the simulations. [Parameter constant over time](#) apply for the whole dispersion calculation; [Parameter variable over time](#) are defined as time series. The data can be different for each scenario. The intensity of precipitation is not defined on this panel but rather on the panel **Results**.

**Parameter constant over time:** The *Anemometer height* is the height above the ground in which the wind speed

# LASAIR main menue (individual roughness length)



Parameters variable over time

Time : 2008-09-23 10:58

Wind direction WD : 220 degree

Wind speed WS : 2.0 m/s

Dispersion class DCL :  
C neutral/unstable

Parameters constant over time

Anemometer height : 10 m

Roughness length : 1.50 m

Land use class : 1



# LASAIR main menu (results)

Cavtat Scenario 1

Project Release Meteorology Simulation **Results** Utilities Configuration

Detailed simulation ▼ from: 2008-09-23 10:28 ▼ until: 2008-09-23 11:28 ▼

Inhalation dose Person: Adult ▼  
 Activity Total/organ: effective ▼  
 Deposition  Use long list of nuclides  
 Gamma-dose Nuclides and released amounts (Bq):  
 Including ground radiation  
 Gamma-activity

Widening: 0 ▼  
Precipitation (mm/h): 0.0

<input checked="" type="checkbox"/>	Ac 225 A ▼	1.0e+12
<input checked="" type="checkbox"/>	▼	0.0e+00
<input checked="" type="checkbox"/>	▼	0.0e+00
<input checked="" type="checkbox"/>	▼	0.0e+00
<input checked="" type="checkbox"/>	▼	0.0e+00

Graphics

1e3 mSv
3e2 mSv
1e2 mSv
30 mSv
10 mSv
3 mSv
1 mSv
0.3 mSv

Display

In the panel **Results** you can specify the desired presentation of results. The [graphical representation](#) is displayed in the window that shows the maps.

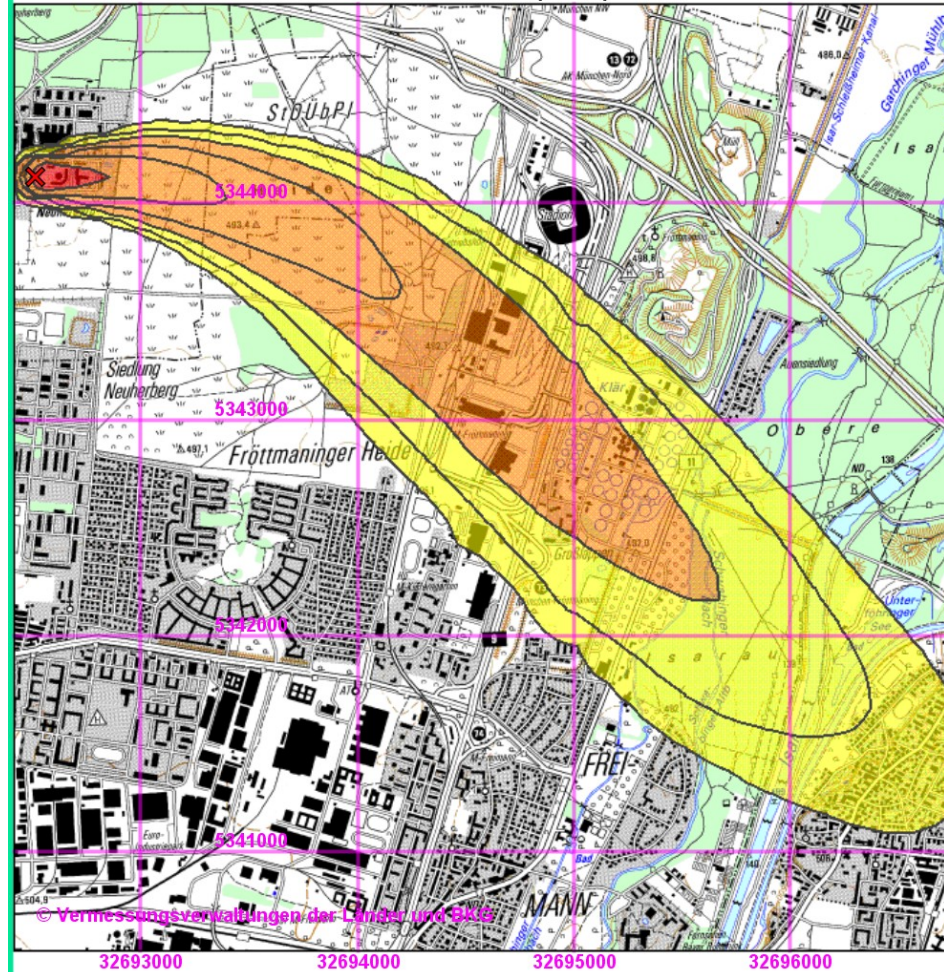
Firstly the *scenario* and the kind of simulation (*survey* or *detailed* simulation) must be selected for which the results are to be presented.

# LASAIR main menu (results)

Project: 12th Harmo-Test (UTM32)  
Date: 2008-10-02 10:40  
User: H. Walter

**LASAIR 3.0.7**  
95b0471a

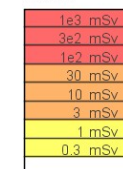
Dose: effective (Adult)



Scenario: 1, detailed simulation  
Widening: +/- 0 Degree  
Particle size distrib.: 20, 60, 80, 100  
Nuclide: 1.00 Bq of Cs 137 A

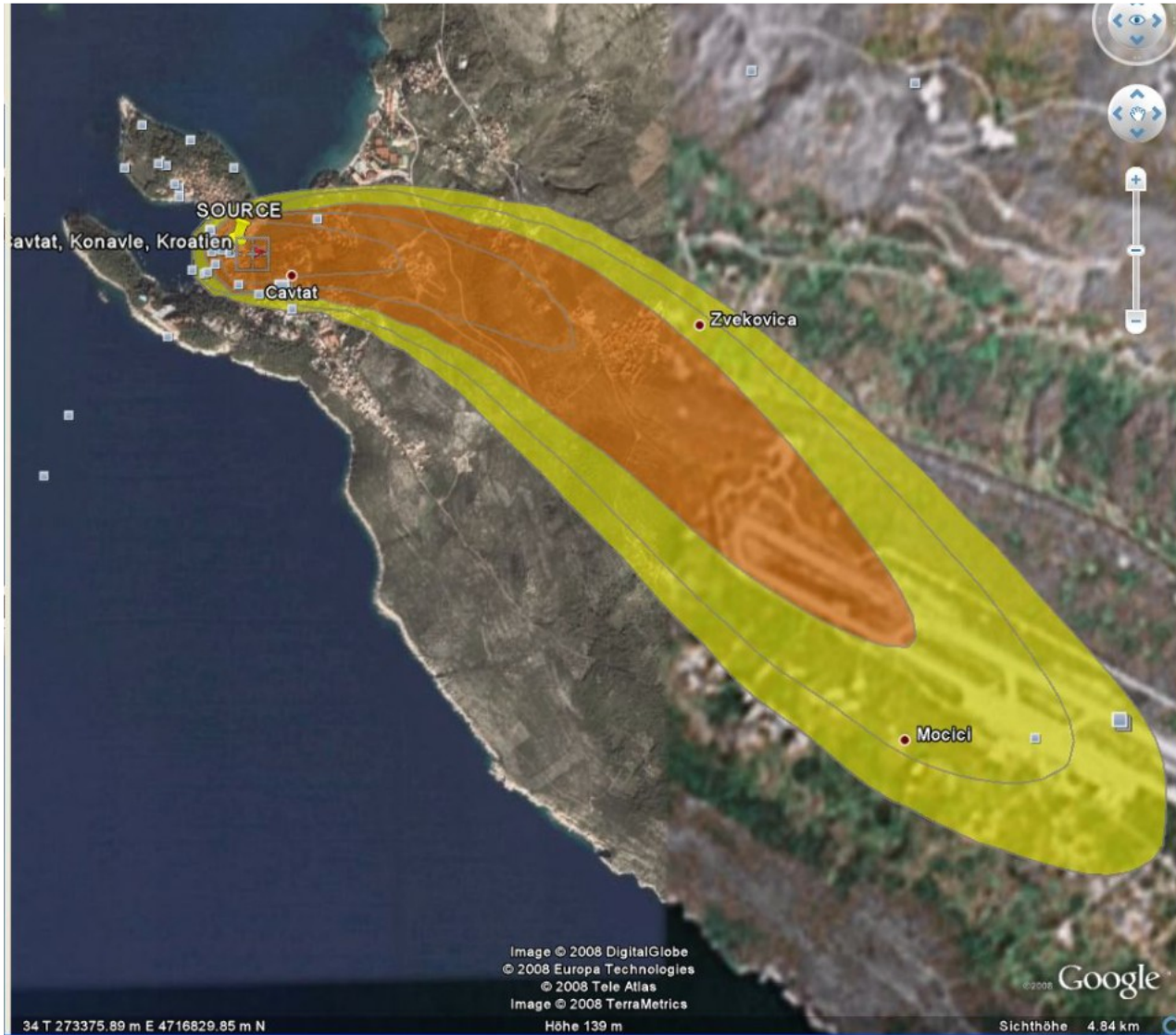
Exposure from: 2008-10-02 11:00  
until: 2008-10-02 12:00  
Release:  
EAST 32692512  
NORTH 5344125  
Start = 2008-10-02 11:00  
Duration = 1 s  
Explosion (5000 g)

Dose:



Test, not real!

# LASAIR main menu (results)



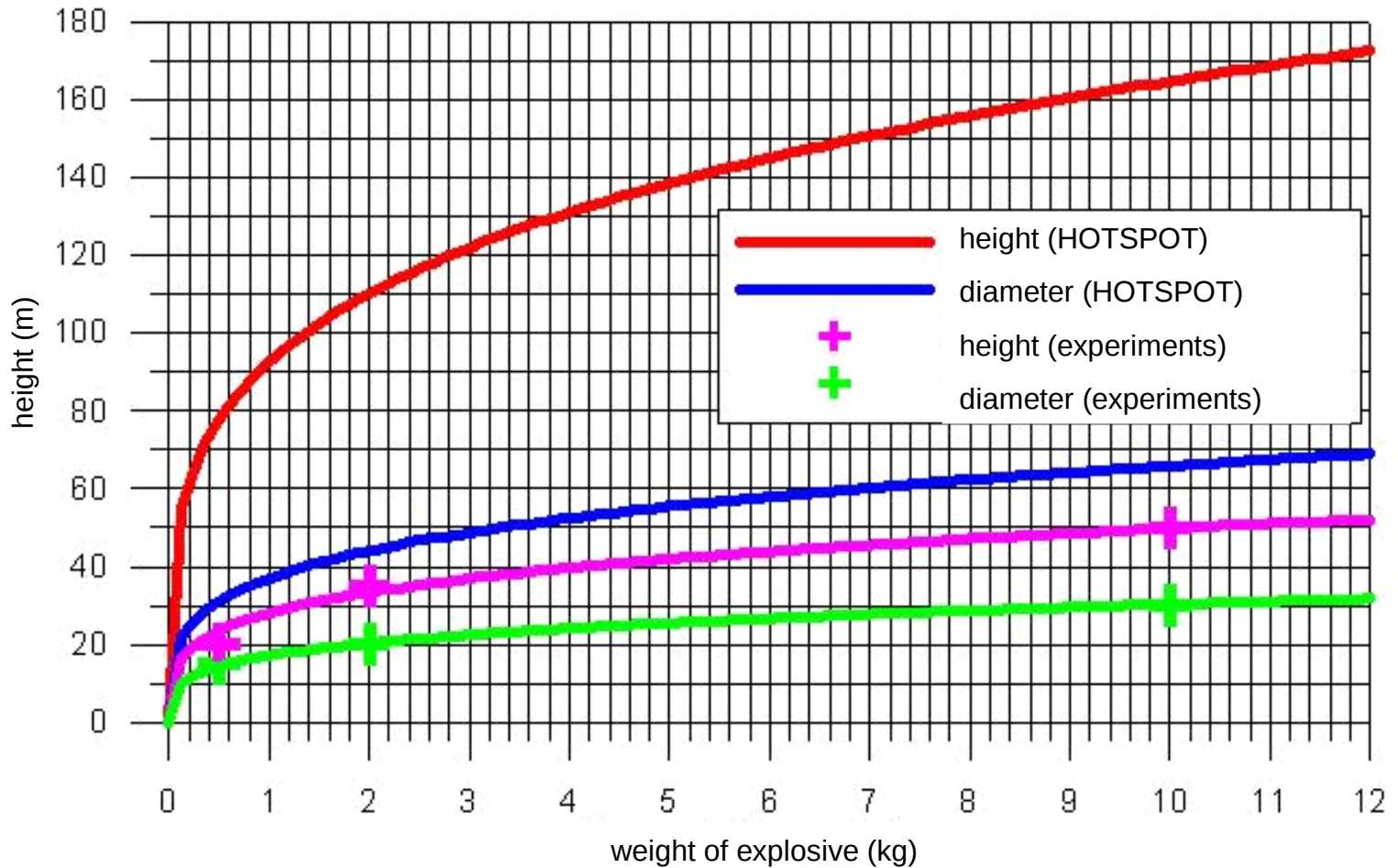
Test, not real !

# LASAIR special features

- parameterisation of the individual cloud

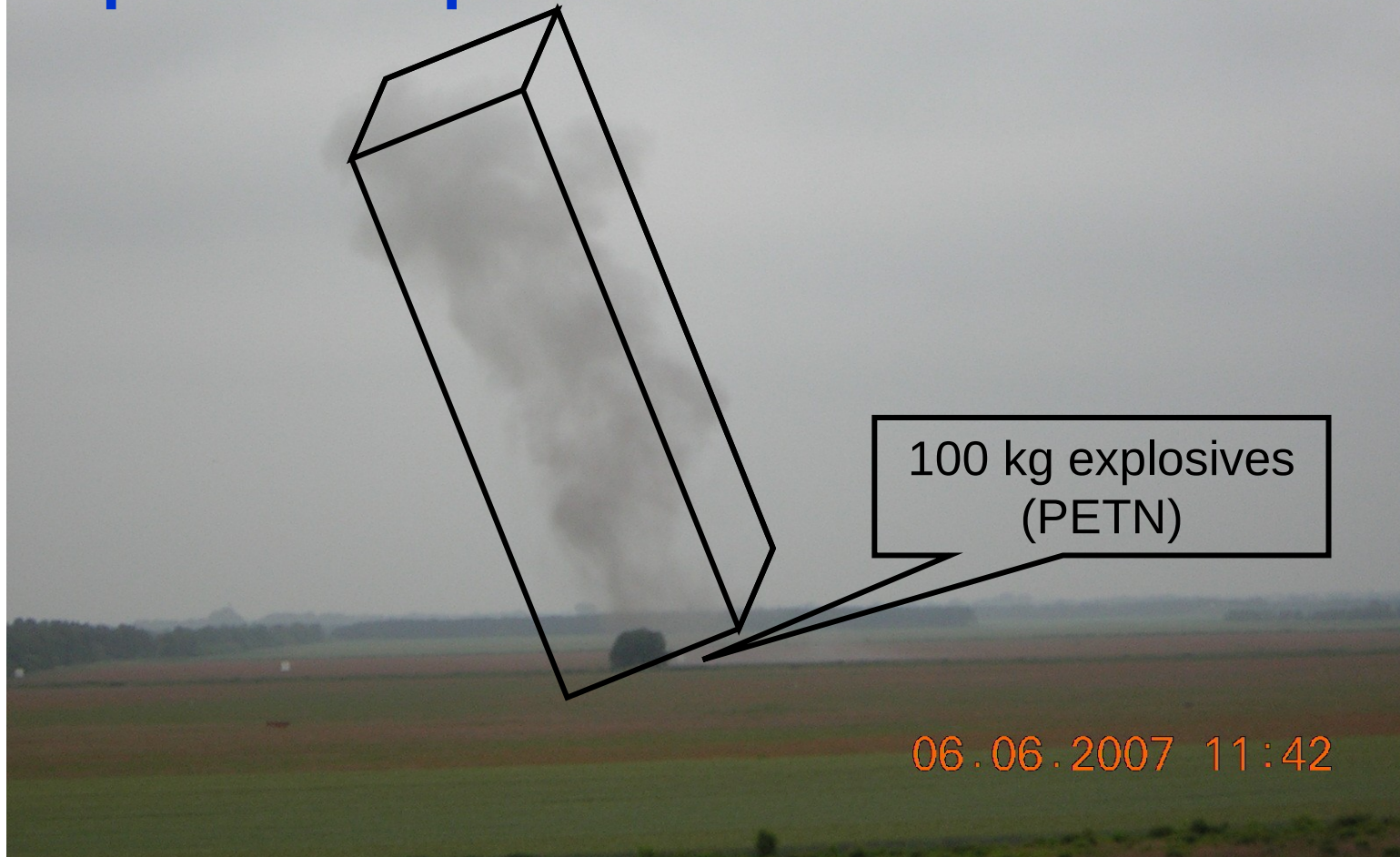
# Initial cloud volumina

## Parametrisation after experiments



source: Thielen, GRS

# Initial cloud volumina, explosive experiments 2007



# LASAIR comparison to other models

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

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

# Meteorological Conditions for the comparison in case “C02”:

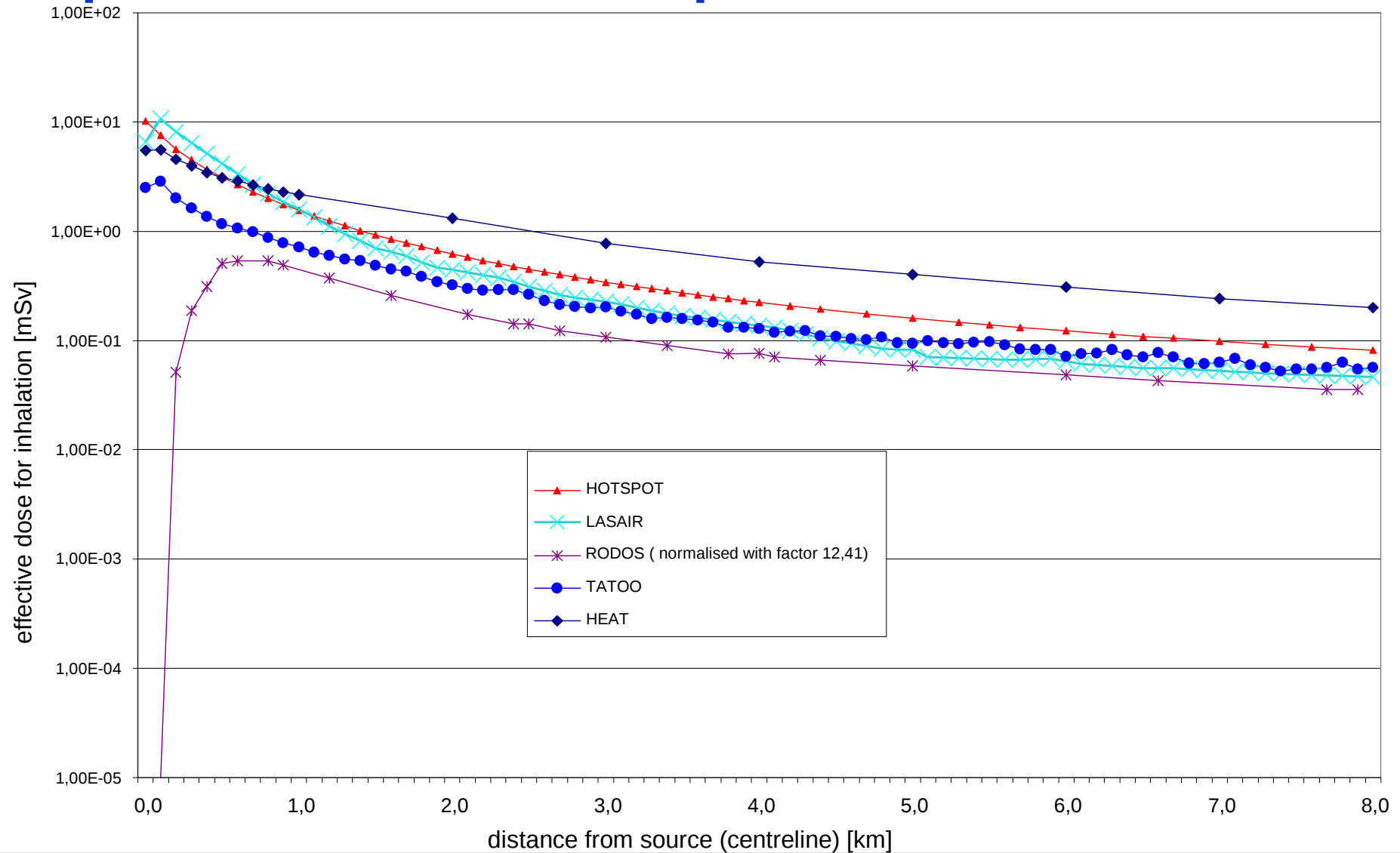
•wind speed	3 m/s
•wind reference height	10 m
•wind profile	adjusted to LASAIR boundary layer model for HEAT and TATOO, adjusted to windspeed in 10 m for HOTSPOT and RODOS
•wind direction	constant
•roughness length	0,2 m (varies in RODOS in the first three cells downwind)
•atmospheric stability	C, neutral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



# Basic input parameters in the comparison for all models

•size of aerosols	90 %	$0 \leq x \leq 10 \mu\text{m}$
•size of aerosols	10 %	$10 \mu\text{m} < x$
•amount of explosives	n.n.	
•nuclide	Cs 137	
•dose coefficient	$3.9 \times 10^{-8}$ Sv/Bq	
•source activity	$1.9 \times 10^{13}$ Bq	
•breathing rate	$3.8 \times 10^{-4}$ m <sup>3</sup> /s	

# Comparison of different dispersion models



# 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**

# 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 !)

Thanks for your interest in LASAIR

