

European Network on New Sensing Technologies for Air Pollution Control and Environmental Sustainability - *EuNetAir*

COST Action TD1105

Final Meeting at PRAGUE (CZ), 5-7 October 2016

New Sensing Technologies for Air Quality Monitoring

Action Start date: 01/07/2012 - Action End date: 15/11/2016 - EXTENSION: 15/11/2016

NEW VERSION OF THE BULGARIAN EARLY WARNING SYSTEM IN CASE OF NUCLEAR ACCIDENT OVER EUROPE



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WG3.2 and SIG4 member

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 **cost**
EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY



Scientific context and objectives in the Action

- **Background / Problem statement:**

New sensing technologies such as cost-effective micro-sensors based on gas-sensitive nanomaterials is critical for improving the monitoring of ambient air in urban, rural or remote sites, in traffic on road network. This improvement is important for validation of dispersion models of air-pollutants and evaluation of exposure of population. The model verification and data assimilation techniques applications are expected to improve AQ modeling and Chemical Weather forecast.

- **Brief reminder of MoU objectives:**

To monitor real-world environmental conditions with experimental campaigns to assess composition of indoor air (buildings: house and office) and outdoor air (urban areas and industrial sites) and to investigate how such data can be utilized in air pollution modeling;

- **Involvement:**

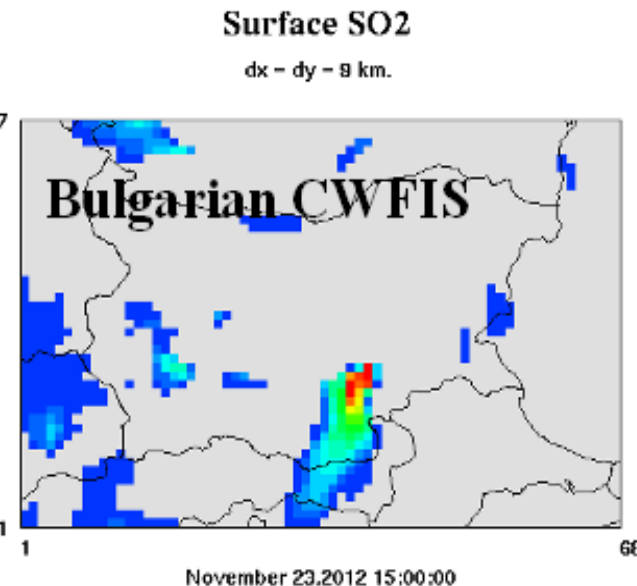
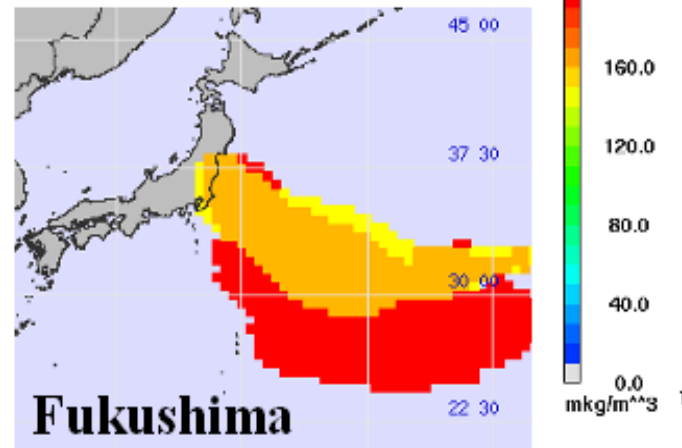
WG3.2: Air-quality modeling and chemical weather forecasting

SIG4: Expert comments for the Revision of the Air Quality EU Directive

Current research activities of the Partner (1/2)

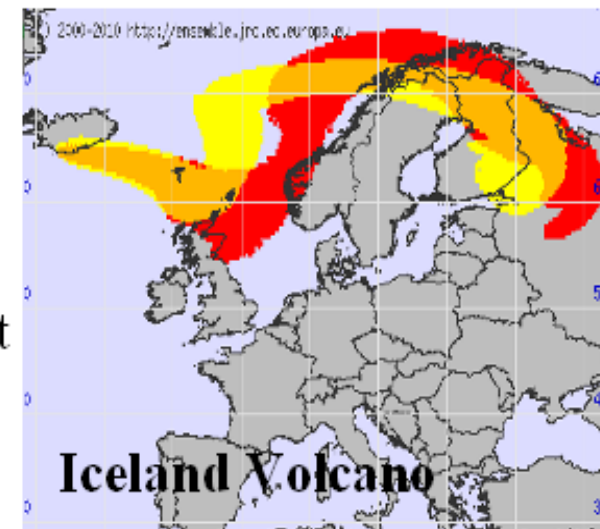
Current research topics at NIMH-BAS:

- Weather forecast
- Remote sensing
- Emergency response
- Climate, ecology
- Physics of the atmosphere
- Hydrological cycle
- Water management



EuNetAir related ongoing research topics:

- Creation and management of Early Warning System in Case of Nuclear Accident
- Studding and modeling of the Atmospheric Boundary Layer
- Chemical Weather Forecast – creation, managing, improvement validation of CWFSsystems



Research Facilities available for the Partner (2/2)

Research Facilities:

The Nuclear Emergency Response and Chemical Weather Forecast group works mainly with computational facilities – computers, printers, plotters, scanners. All necessary data is provided by other parties – meteorological centers (including Bulgarian one), European structures like EEA, EMEP, TNO; American NCEP, US EPA; Bulgarian Ministry of Environment and Waters.

List the main facilities

- A 48-core cluster (Infiniband link)
- Two 8-core workstations
- Three 2-core workstations
- Two powerful PCs
- Printers, scanner, notebooks



Suggested **R&I Needs** for future research

1. Development of a new version of Bulgarian CWF System for providing services to the authorities and to the community:

- New versions of main modules WRF, CMAQ, SMOKE, EMISS
- New inventory data base, produced by TNO
- Increasing number of key pollutants (O₃, NO₂, SO₂, PM₁₀, PM_{2.5}, CO).
- Calculating and presenting maps of Air Quality Index (AQI) (**innovation**)
- Maps of Dominant pollutant in AQI (**innovation**)
- Adding proper Thermal Comfort and Health Response Indexes (**innovation**)

2. Upgrade of Bulgarian Nuclear Emergency Response System (next slides)

- Use of a new operational meteorological data base – US NSEP GFS data
- Use of WRF and MCIP models to handle this data
- Calculate and visualize forward trajectories for 36 NPPs over Europe
- Calculate, visualize and animate pollution fields for the same NPPs
- Creation of a new web site to present these images

Bulgarian Emergency Response System (BERS)

context and objectives

Initiation: Gernobyl nuclear accident

- Intensive international activity: **ETEX, RTMOD, ENSEMBLE**
- **BERS created in the frame of ETEX**
- **BERS took part in all these inter-comparison exercises.**
- **Base version operates from 2001**
- **Used in many cases: Yugoslavian war, Iraq, Celopech accident**
- **Upgrades:**
 - **2007 – Exposure doses calculations**
 - **2010 – Iceland volcano eruption**
 - **2011 – Fukushima nuclear accident**

Main features of BERS – data flow chart

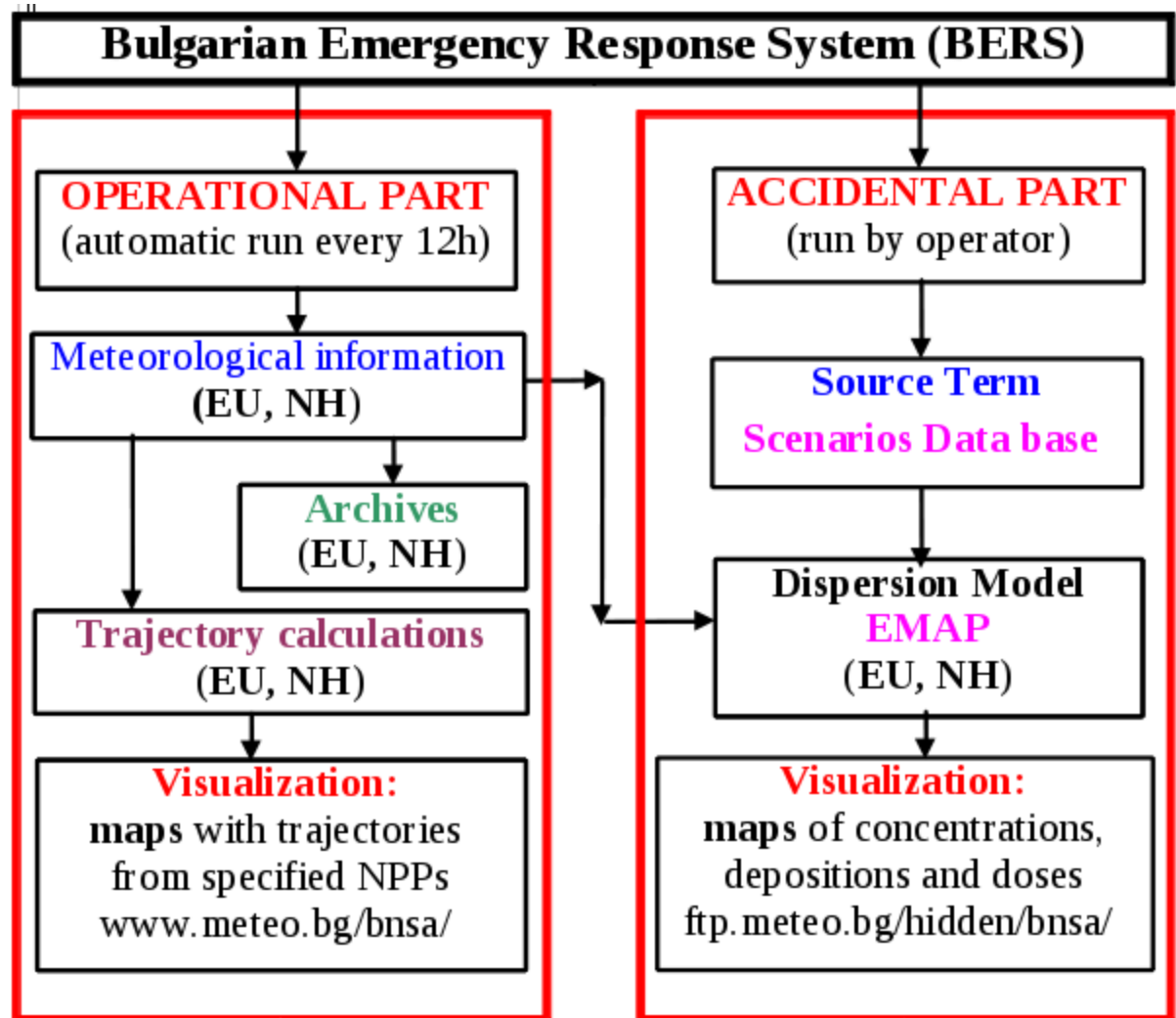
Meteorological input:

- DWD Global model
- Resolution 1.5°, 12 h
- U₈₅₀, V₈₅₀, T₈₅₀, T_{gl}, Prec
- Internal met-file
- Used in both parts

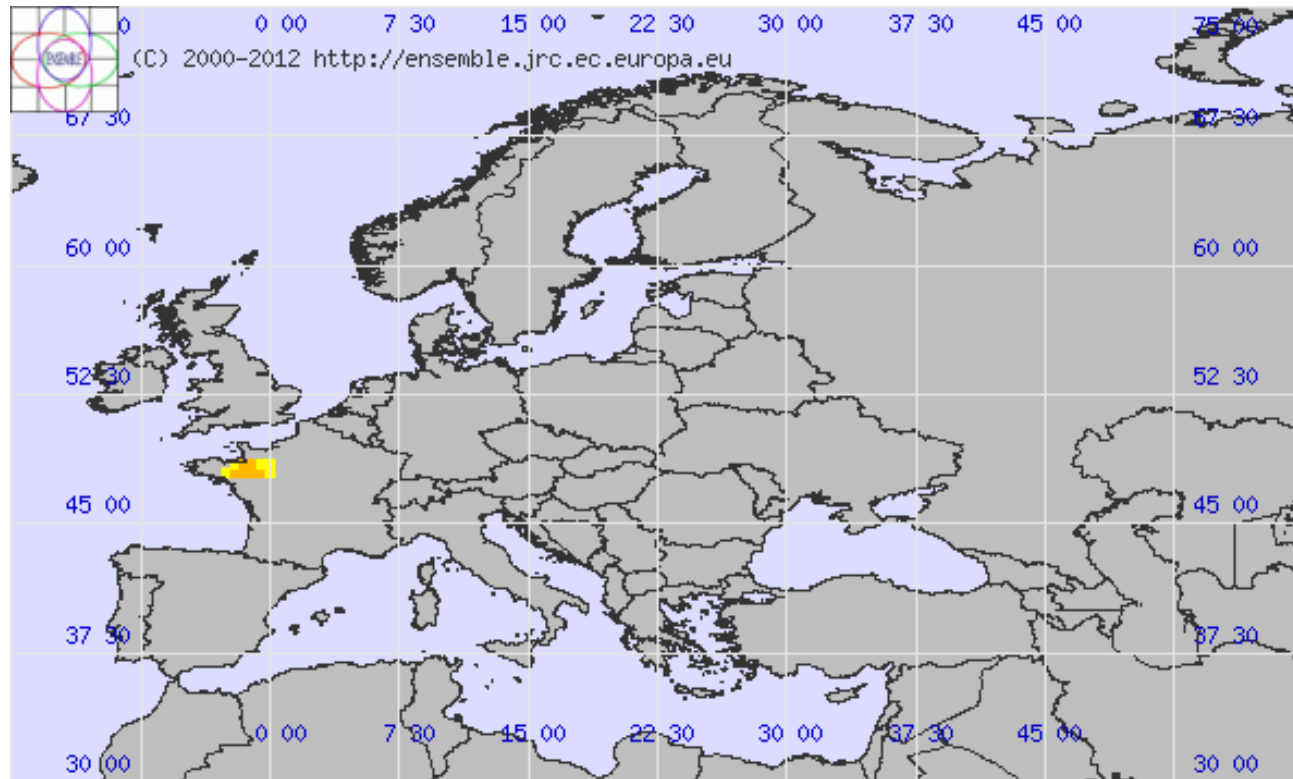
Trajectory calculations

Dispersion – EMAP model

- 3-dimensional
- Eulerian type
- Irregular Z-coordinate
- Processes accounted for:
 - Advection
 - Diffusion
 - Dry&Wet deposition
 - Transformations



EMAP calibration and validation (ETEX exercise) 1/2

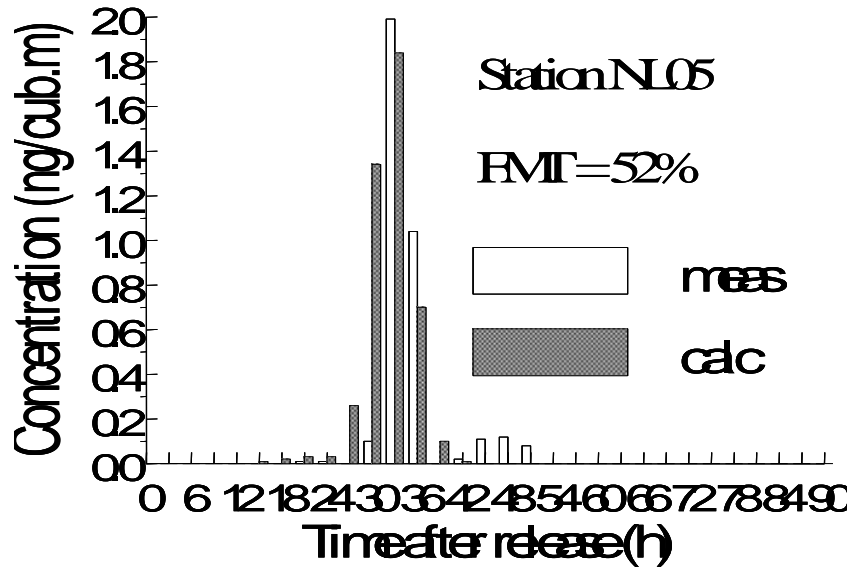


A (none): ■ A
ETEX1m16 [+0h] ■ B
B (none): ■ Overlap
BG1 [+68h]

Case 0901-001 - Space overlap - PMCH Concentration (0 m agl)
Date and time: 1994-10-23 18:00 UTC (+2h0m after release start)
Threshold: 1.00E-12
Overlap: 55.0%
Created by user dsyrakov on 2012-01-05 12:00:33 UTC

Release from: Rennes (FR)
Coordinates: -2 48.05
Start: 1994-10-23 16:00 UTC

Figure of Merit in Space



Netherlands

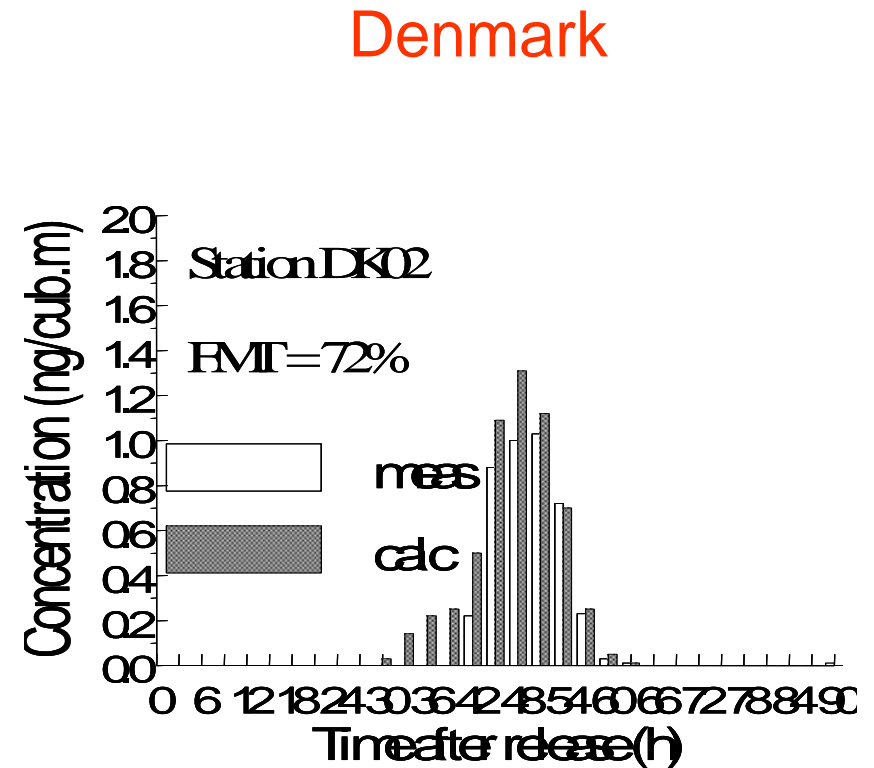


Figure of Merit in Time

New version (BERS2) - data flow chart

Improvements:

GFS met-data

Resolution: 0.25°, 6 h

Met-models:

WRF, MCIP

Internal met-file

36 European NPP

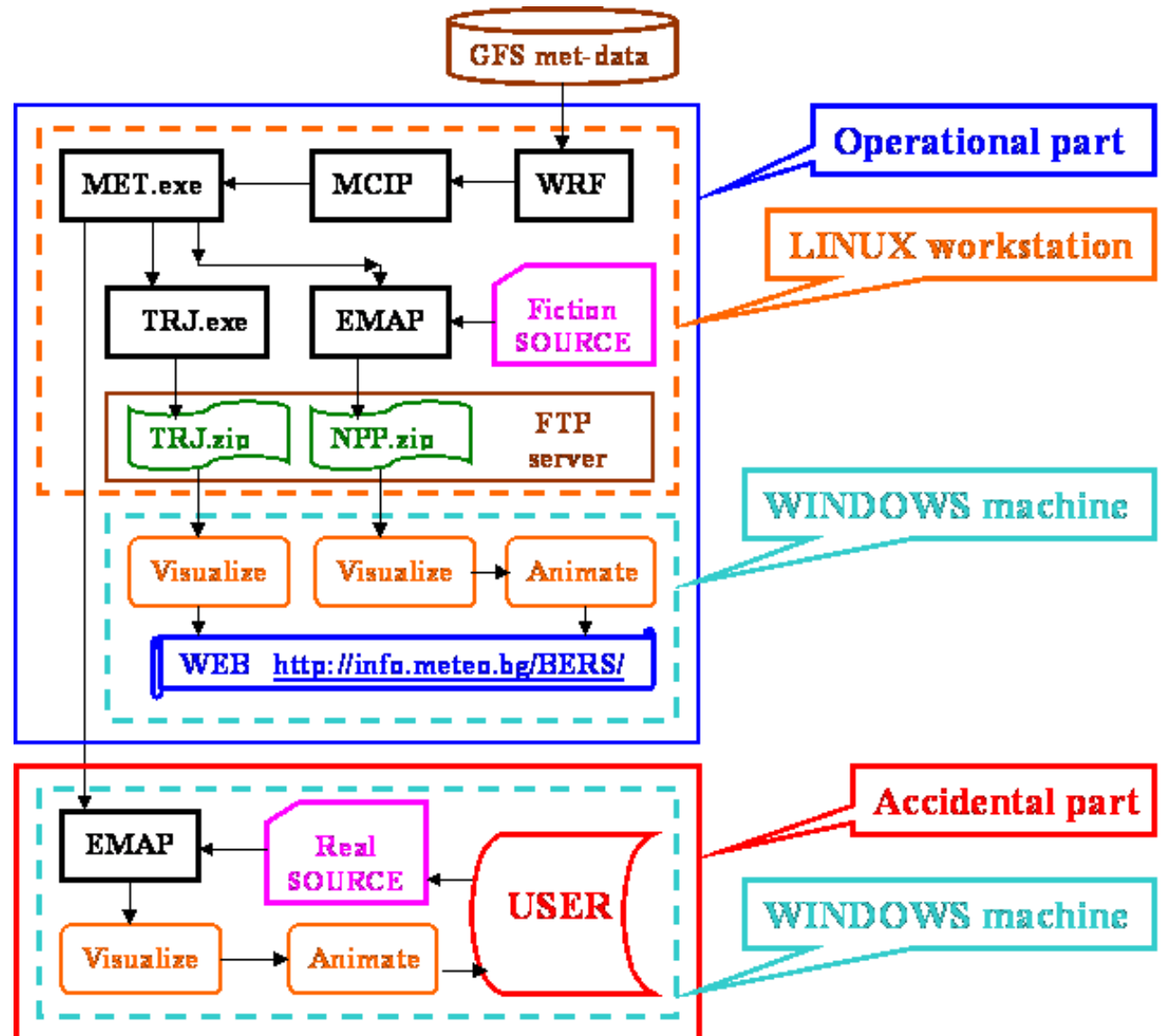
Trajectories

Conc&Dep

Visualization

Animations

New WEB site



BERS2 WEB-site - Trajectories



Bulgarian Academy of Science: National Institute of Meteorology and Hydrology

EARLY WARNING SYSTEM FOR POSSIBLE LONG-RANGE TRANSPORT OF RADIOACTIVE POLLUTION
IN CASE OF NUCLEAR ACCIDENT OVER EUROPE



The results of operational runs of Bulgarian Early Warning System in case of nuclear accident are presented on this site.

TRAJECTORIES (upper menu)

Visualization of 3-day forecast trajectories of particles, released from selected Nuclear Power Plants' sites over Europe can be invoked by clicking on the links above the image. The NPPs are grouped by 6 for better visibility. The names of every NPP can be found in the list to the right, enumerated in consistency with the trajectory image.

The depicted trajectories originating from each site, correspond to 3 release heights:

1000 m — green;		1000 m
300 m — pink;		300 m
100 m — red;		100 m

The starting time of each trajectory is 00:00 on the current day. The points over each trajectory determine the particle position after 12, 24, 36,..., 72 hours. The NPPs positions are shown by asterisks.

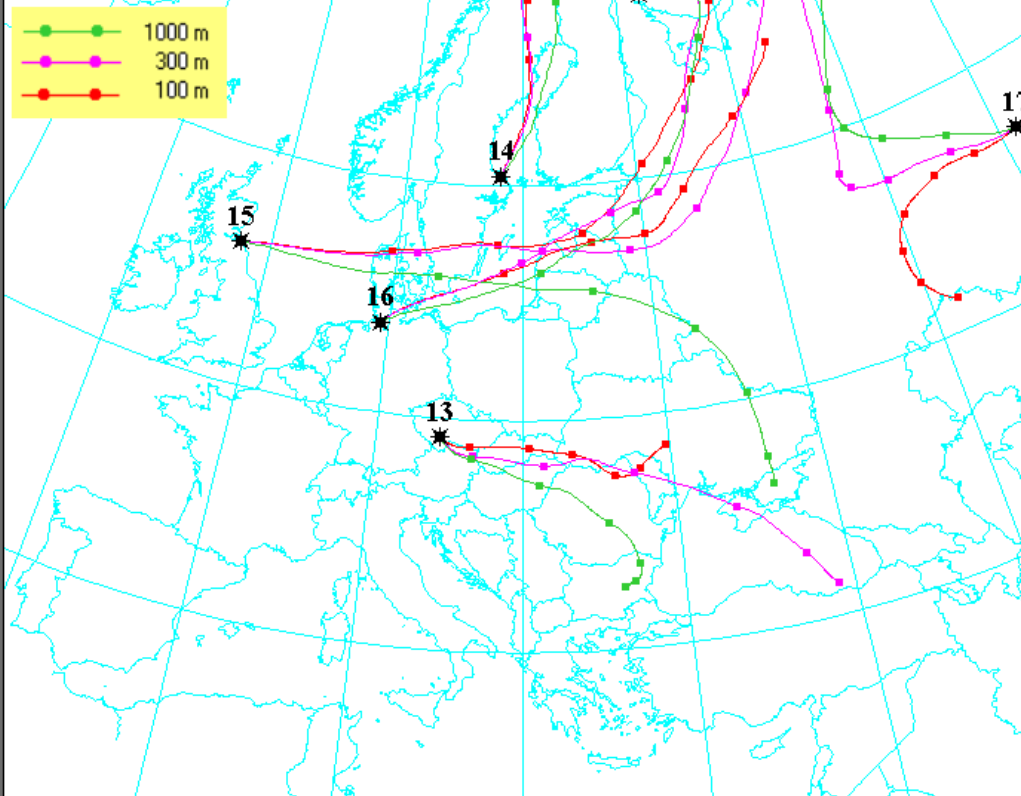
CONCENTRATIONS AND DEPOSITIONS (right menu)

Pointing over a NPP name in the list to the right invokes a drop-down menu with 2 items: *concentration* and *deposition* which are links to animations of a simulated nuclear accident. The accident parameters are fixed (shown in animations) and simulate a powerful release of radioactive material.

TRAJECTORIES: [NPP# 1-6](#); [NPP# 7-12](#); [NPP# 13-18](#); [NPP# 19-24](#); [NPP# 25-30](#); [NPP# 31-36](#);

3-day forecast

Start of release: 28.09.2016 00Z



1. Kozloduy, BG
2. José Cabrera, ES
3. Kursk, RU
4. Krisko, SL
5. Paluel, FR
6. Leibstadt, CH
7. Ringhals, SE
8. Doel, BE
9. Heysham, UK
10. Chernavoda, RO
11. Smolensk, RU
12. Blayais, FR
13. Temelin, CZ
14. Forsmark, SE
15. Torness, UK
16. Brokdorf, DE
17. Beloyarsky, RU
18. Kola, RU
19. Bohunice, SQ
20. Zaporozhe, UA
21. Dampierre, FR
22. Sizewell, UK
23. Isar, DE
24. Balakovo, RU
25. Leningrad, RU
26. South Ukraine, UA
27. Paks, HU
28. Tricastin, FR
29. Hinkley Point, UK
30. Philippsburg, DE
31. Askó, ES
32. Rovno, UA
33. Loviisa, FI
34. Dukovany, CZ
35. Armenia, AR
36. Kalinin, RU

BERS2 WEB-site – Animated Con&Dep



Bulgarian Academy of Science: National Institute of Meteorology and Hydrology

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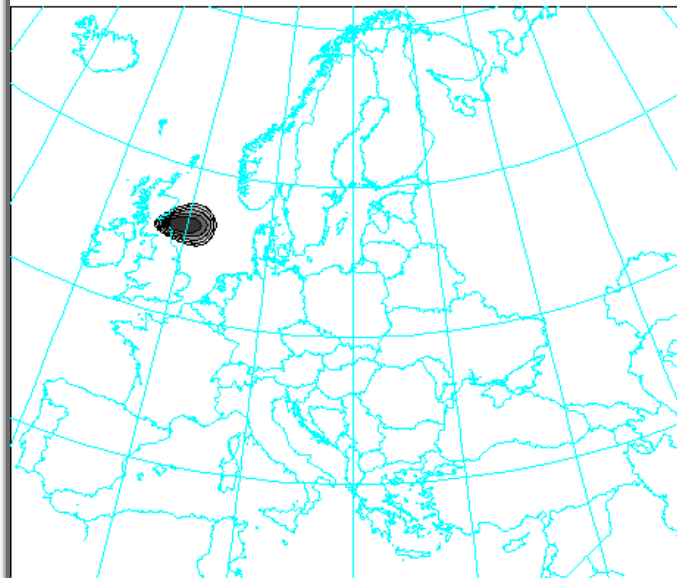
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NATIONAL INSTITUTE OF METEOROLOGY AND HYDROLOGY

Numerical Simulation of Radioactive Pollution Distribution



SIMULATION DESCRIPTION:

Nuclear Power Plant Name:

Torness, UK

Source Location (°)
2.40W 55.97N

Release Rate:
0.100E+16 Bq/s

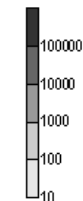
Release Height:
100.00 m

Release Duration:
3.00 h

Start of Release:
28/09/16 00:00 UTC

Forecast for:
28/09/16 03:00 UTC

Maximum Value:
0.356E+07



Ground-Level Concentration in Air (Bq/cub.m)



1. Kozloduy, BG
2. José Cabrera, ES
3. Kursk, RU
4. Krisko, SL
5. Paluel, FR
6. Leibstadt, CH
7. Ringhals, SE
8. Doel, BE
9. Heysham, UK
10. Chernobyl, UA
11. Smolensk, RU
12. Blayais, FR
13. Temelin, CZ
14. Forsmark, SE
15. Torness, UK
- concentration
- deposition
19. Bohunice, SK
20. Zaporozhje, UA
21. Dampierre, FR
22. Sizewell, UK
23. Isar, DE
24. Balakovo, RU
25. Leningrad, RU
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33. Loviisa, FI
34. Dukovany, CZ
35. Armenia, AR
36. Kalinin, RU

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COST Actions ES0602, ES1004 and TD1505.

5thFP project BULAIR (Contract Nr. EVK2-CT-2002-80024).

6thFP Network of Excellence ACCENT (Contr. Nr. GOCE-CT-2002-500337).

6thFP Integrated Project QUANTIFY (Contract Nr. GOGЕ-003893).

7thFP project SEE-GRID-SCI (Contract Nr. FP7 –RI-211338).

7th FP project EGI-InSPIRE (Contract Nr. 261323).

7th FP project PASODOBLE (Contract Nr. 241557).

US EPA, NSEP, EMEP, TNO for providing free-of-charge models and data

Special thanks to ENSEMBLE team at EC-JRC

THANK YOU !