The Decision Support System RODOS and its Features Concerning Atmospheric Dispersion and the Input from Measurements

International Workshop on Dispersion and Deposition Modeling for Nuclear Accident Releases
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Fukushima, Japan

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Transfer of Science from Academic to Operational Models

- Activities conducted during and after the Fukushima accident with DSS in Germany

Activities during the early phases of the Fukushima accident

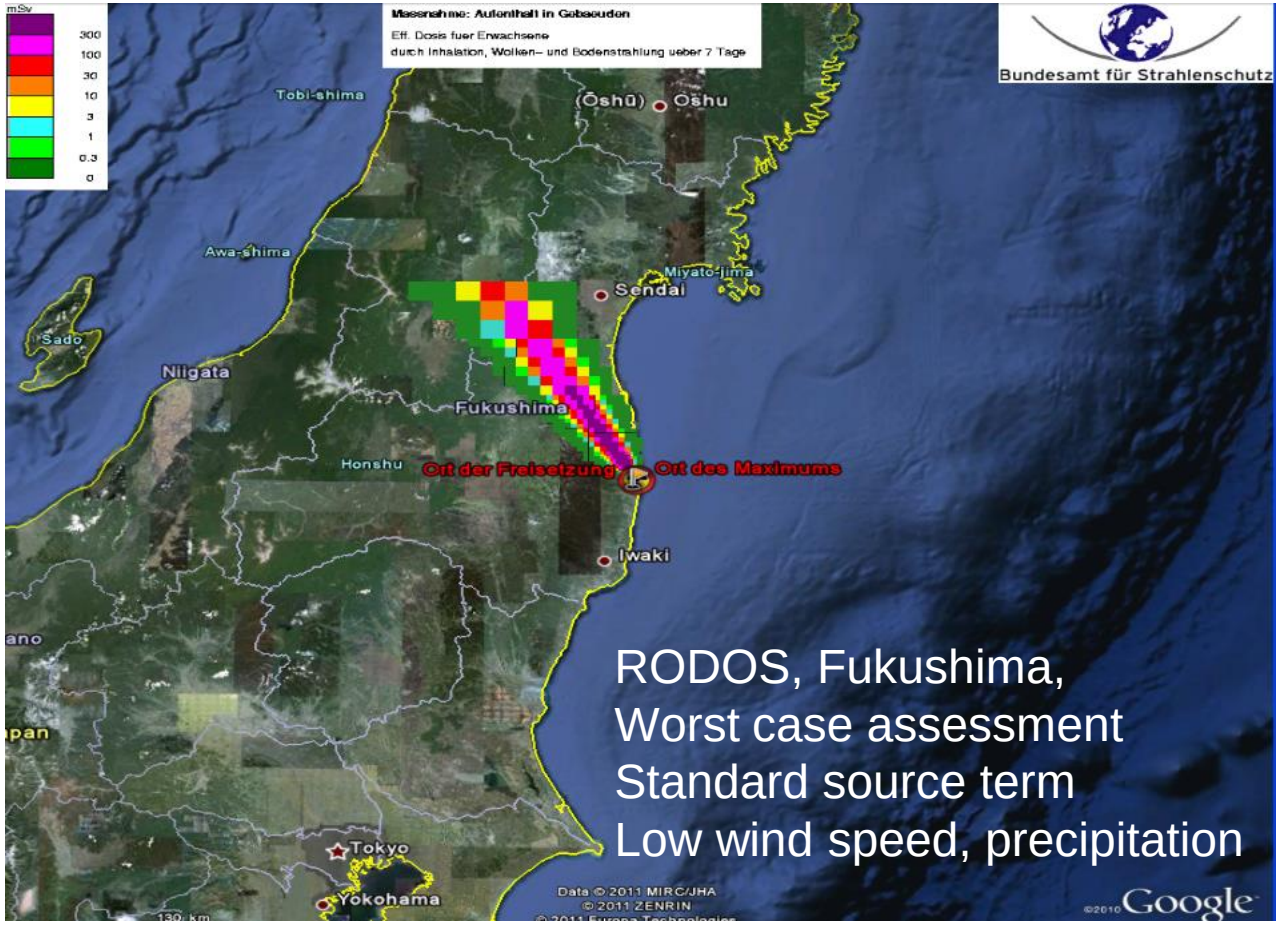
Source term estimation

- Poor information available
- Experts from German advisory groups (SSK, GRS)
- Dispersion computations with standard source term

  on the fly computations (adapted to Japan)

Activities during the early phases of the Fukushima accident

Dispersion modeling and dose assessment (worst case assessment)



Activities during the early phases of the Fukushima accident

Meteorological data

- Datasets available from German Weather Service (DWD)

  only coarse data

- Try to get data from NOAA, USA

Activities during the early phases of the Fukushima accident

Dispersion modeling and dose assessment

- **Close vicinity to the accident**
  RODOS dispersion models and dose assessment
  (ATSTEP, RIMPUFF, DIPCOT)

- **Far vicinity from the accident**
  Dispersion modelling by German Weather Service
  COSMO GME + LPDM
  RODOS dose assessment

Activities during the early phases of the Fukushima accident

Cooperation between DWD and BfS

German Weather Service

DWD

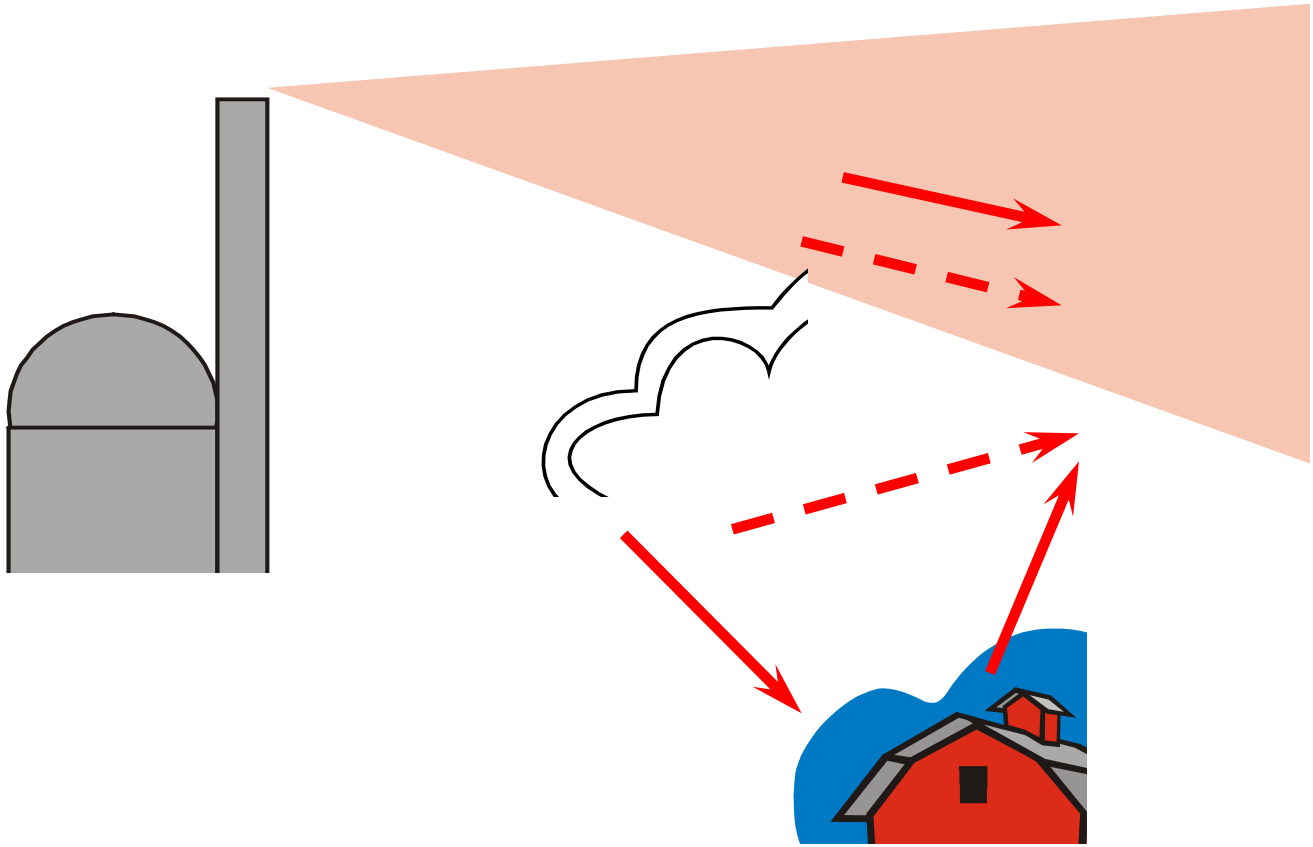
Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Federal Office for Radiation Protection

BfS

Bundesamt für Strahlenschutz

RODOS Radiological Prognosis for DSS



Moduls

- Atmospheric Dispersion
- Deposition
- Food Chain Module
- Dose Module

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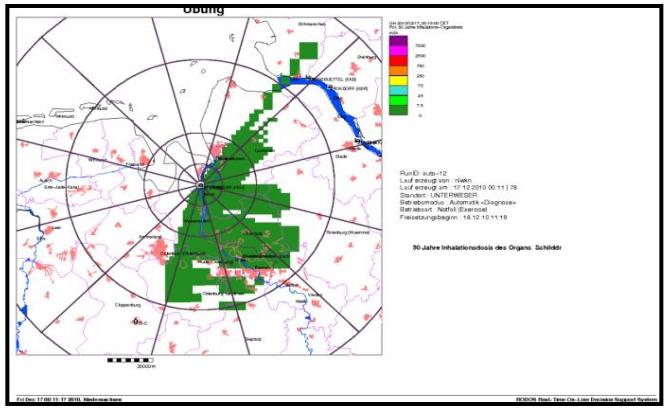
RODOS Calculations

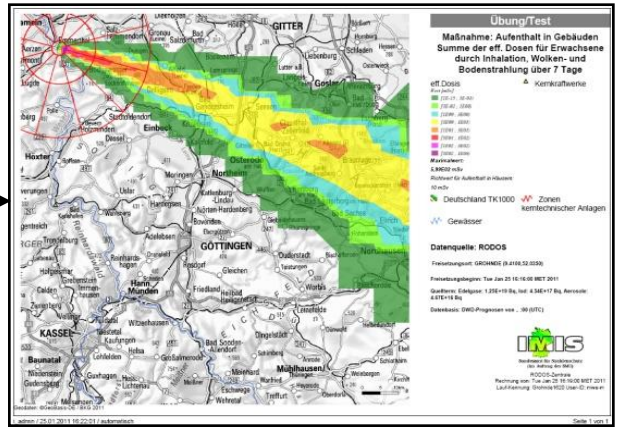
source term data,,gamma dose rates

meteorological data

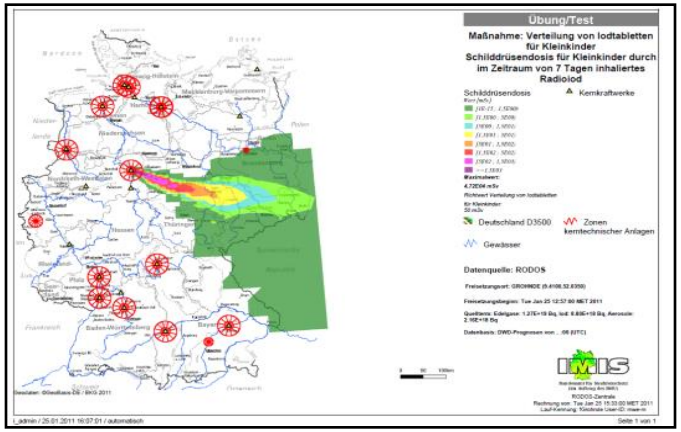
weather predictions



actual and prognostic exposition and contamination



Micro scale dispersion up to 100 km



Macro scale dispersion > 100 km

RODOS input data

RODOS results

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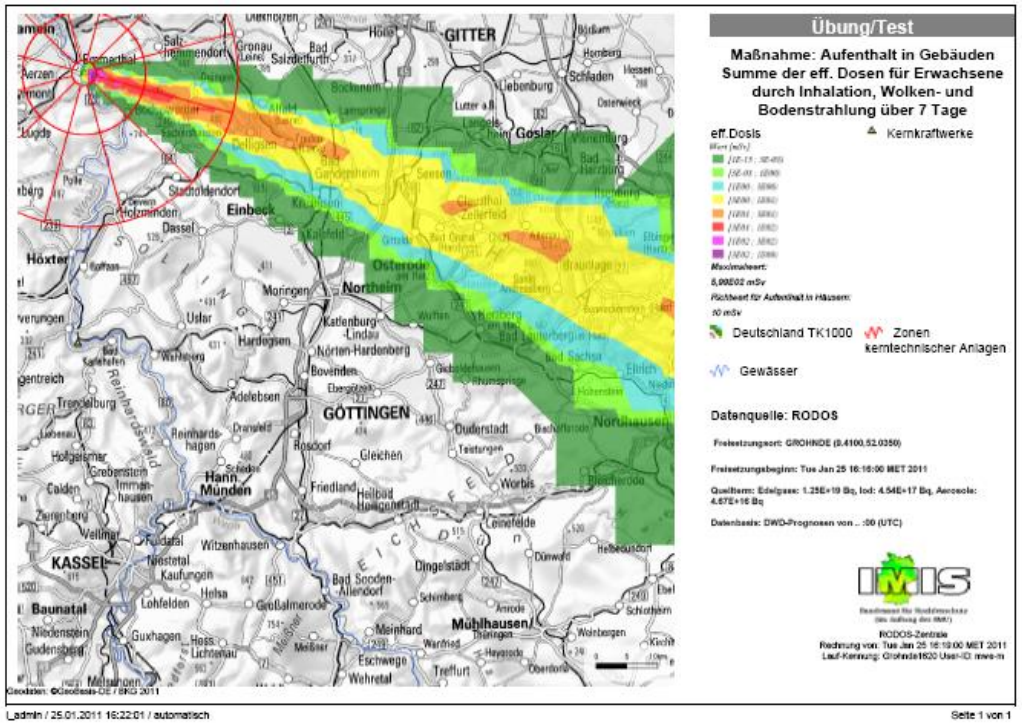
Standard results of RODOS



note colour of legend

Emergency Management

- All Doses (e.g. sheltering, evacuation, distribution of stable iodine, relocation)
- Activity concentrations
  ~ 20 nuclides
- Contamination
  deposition on the ground
  leafy vegetables
  cow‘s milk
- Further results
  gamma dose results (ADR)
  cloud arrival time

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Activities during the early phases of the Fukushima accident

Coordination with others

- **Coordination in Germany**
  with responsible authorities or institutes
  BMUB, SSK, GRS, KIT,
  Support German embassy in Japan (fon, email, assessments)
  on call service for population (24/7)

- **Coordination outside of Germany**
  IAEA, UN, WMO

- **Coordinate/publish in German + English**

Model improvements since Fukushima

Source term estimation (ongoing research programme)

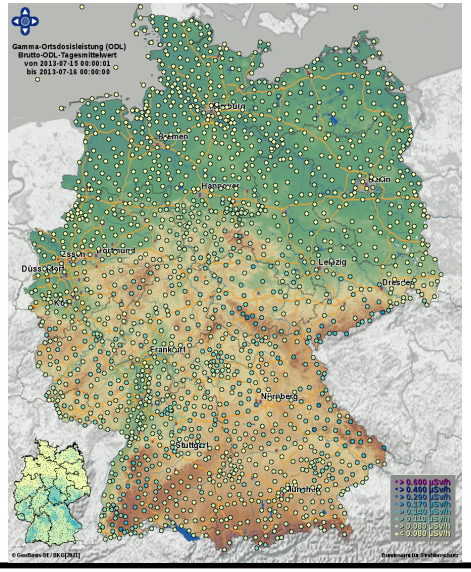
- **Estimation of a source term based on radiological measurement of dose rates or nuclide specific activity concentrations from a nuclear facility emitting radioactivity into the atmosphere during a nuclear incident**
- **gives a diagnosis of the plant state based primarily on this backward calculated source term**
- **offers a prognosis of the plant state evolution and source term evolution based on the diagnosis**

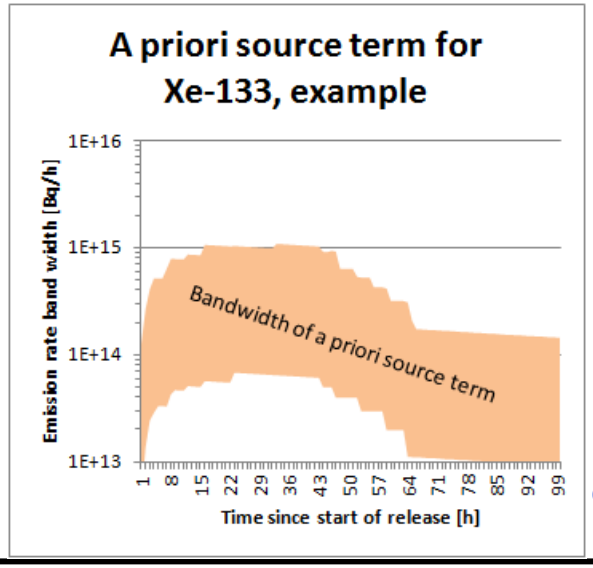
Courtesy: N. Zander + TÜV Süd

Model improvements since Fukushima

Source term estimation
Input data consist of the following three independent data sets:

- Time dependent measurements of dose rates or nuclide specific activity concentrations in the atmosphere or on ground in the environment
- A priori source term: Rough estimation of a source term with bandwidth, using information about the plant and the incident.
- Weather data in the environment (past for inverse calculation and future for prognosis)





Courtesy: N. Zander + TÜV Süd

Model improvements since Fukushima

Source term estimation

Using these data sets, following steps are carried out:

Atmospheric dispersion/transport calculation for a series of normalized pulse emissions (one for each time interval considered) using the weather data,
-> creation of dispersion data.

Calculation of a refined source term („A posteriori source term“) via a Bayes method. i. e. the a priori source term is modified and refined on the basis of radiological measurements and the dispersion data.

Comparison of the refined source term with source terms from a source term data base of incidents of the nuclear facility concerned (A posteriori source term analysis).

Best matches between the a posteriori source term and the source terms from the data base will be used for a plant state diagnosis.

Source terms from the database will be used for a prognosis of the radiological situation.

Courtesy: N. Zander + TÜV Süd

Model improvements since Fukushima

Meteorological data acquisition

- **Responsibility of German Weather Service (DWD)**

- **New model chain since January 2015**
  ICON ICOsa-hedral Non-hydrostatic flow model

Grid size
△ x 13 km worldwide
△ x 6,5 km Europe

Model improvements since Fukushima

Consequence assessment

- **Extension of planning zones around NPPs**

  extensive elaboration of BfS working group details

  see poster Walter, Gering

Model improvements since Fukushima

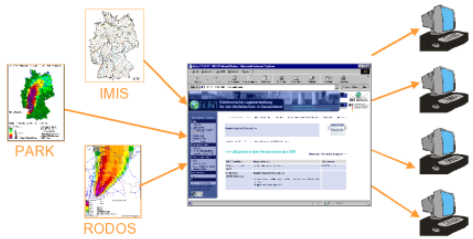
Model validation

- **No specific validation**

Model improvements since Fukushima

Communication

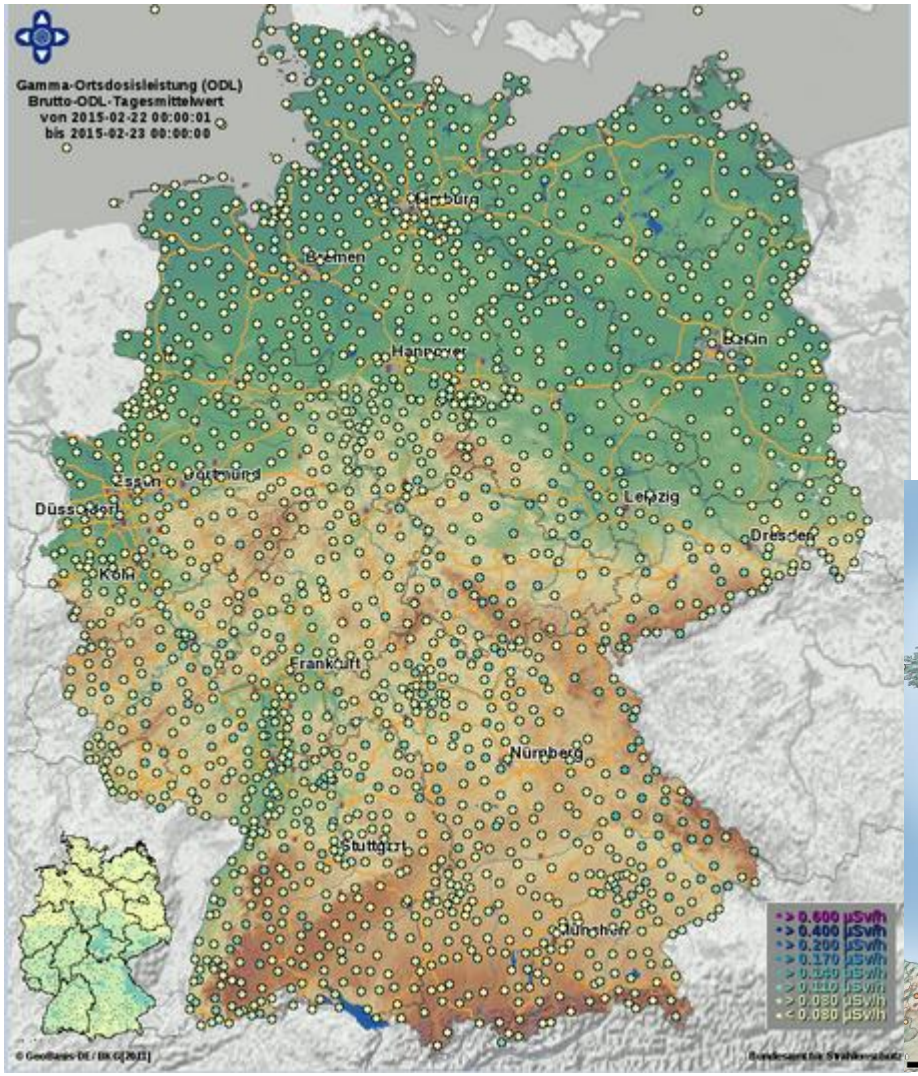
- Communication structures have been simplified
- Different assessment center (crisis room) should merge into one central center and a few assistant centers
  (responsibility of the Federal States + Federal Government of Germany
- ELAN
  Electronic Situation Display for Emergency Preparedness

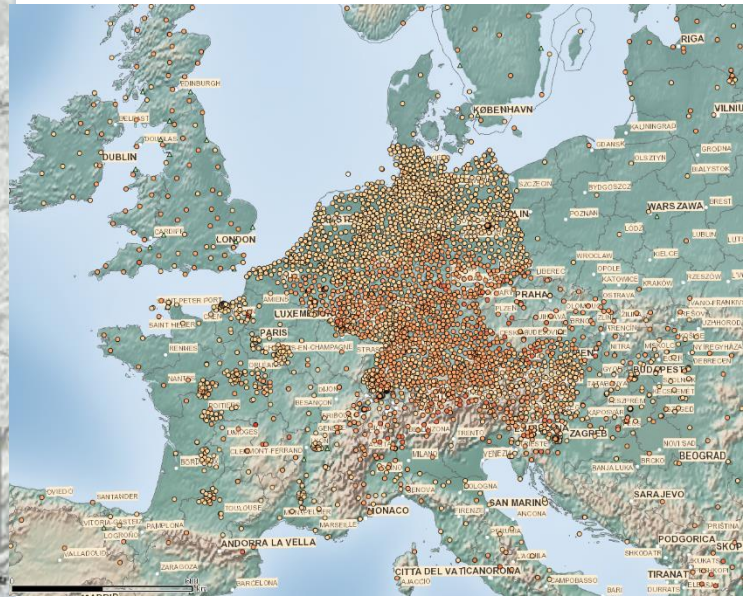


Measurements in Germany

Courtesy: M. Bleher

Measurements in Germany (ADR monitoring)





Courtesy: M. Bleher

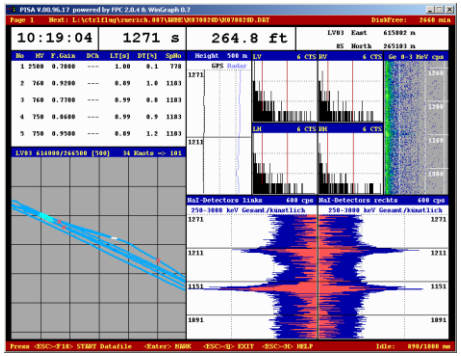
Measurements in Germany (ADR monitoring)

Stationary and quasi-stationary dose rate probes

- Autarkic dose rate probes (without external power supply and with mobile data communication techniques)
- Distribution before / after release (at predefined sites) in affected areas

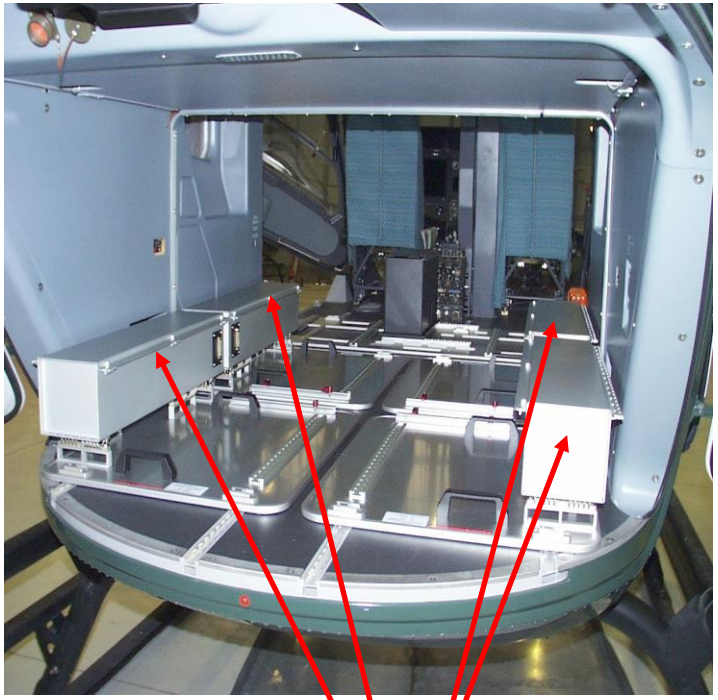
Courtesy: M. Bleher

Helicopter Measurement System



Courtesy: C. Strobl

Helicopter Measurement System



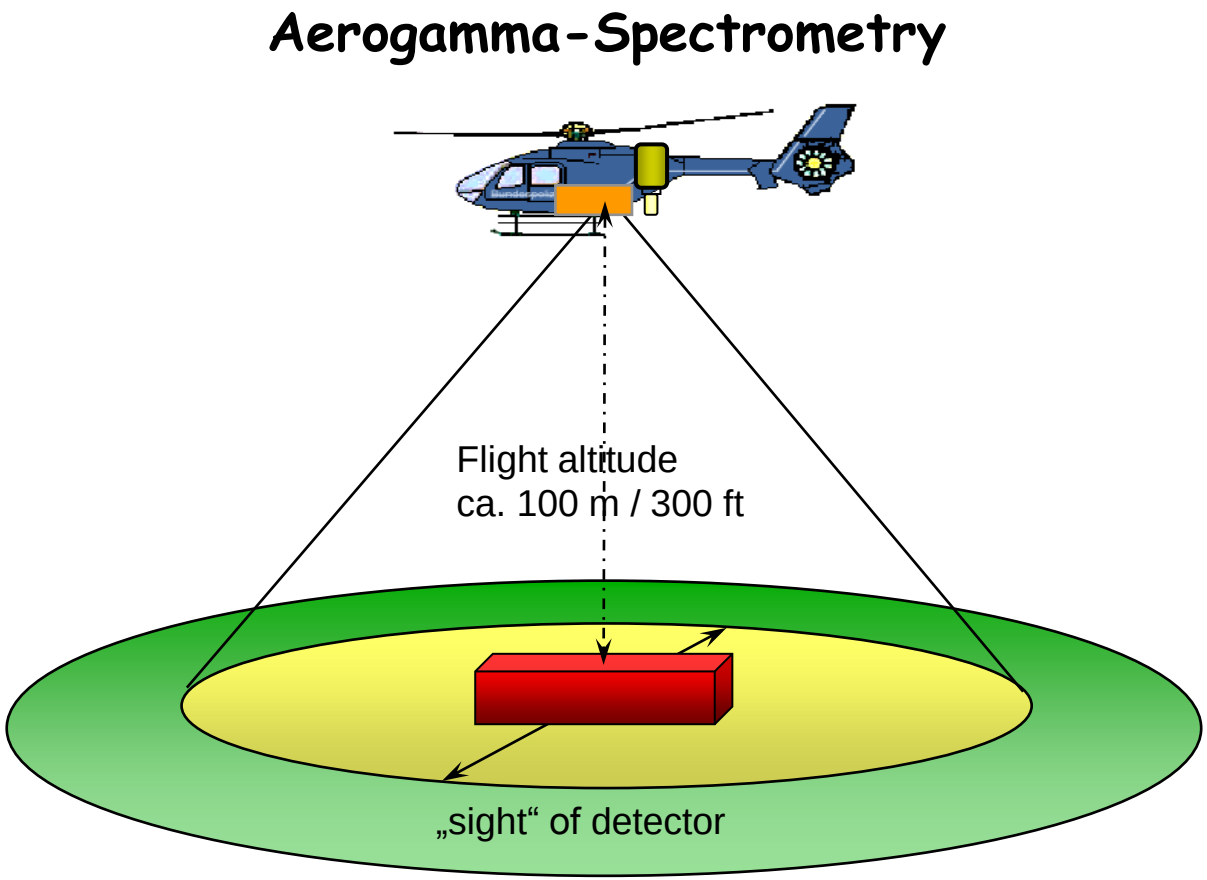
PC with specific software

4 * 4L NaI(Tl)-Detectors

HPGe-Detectors

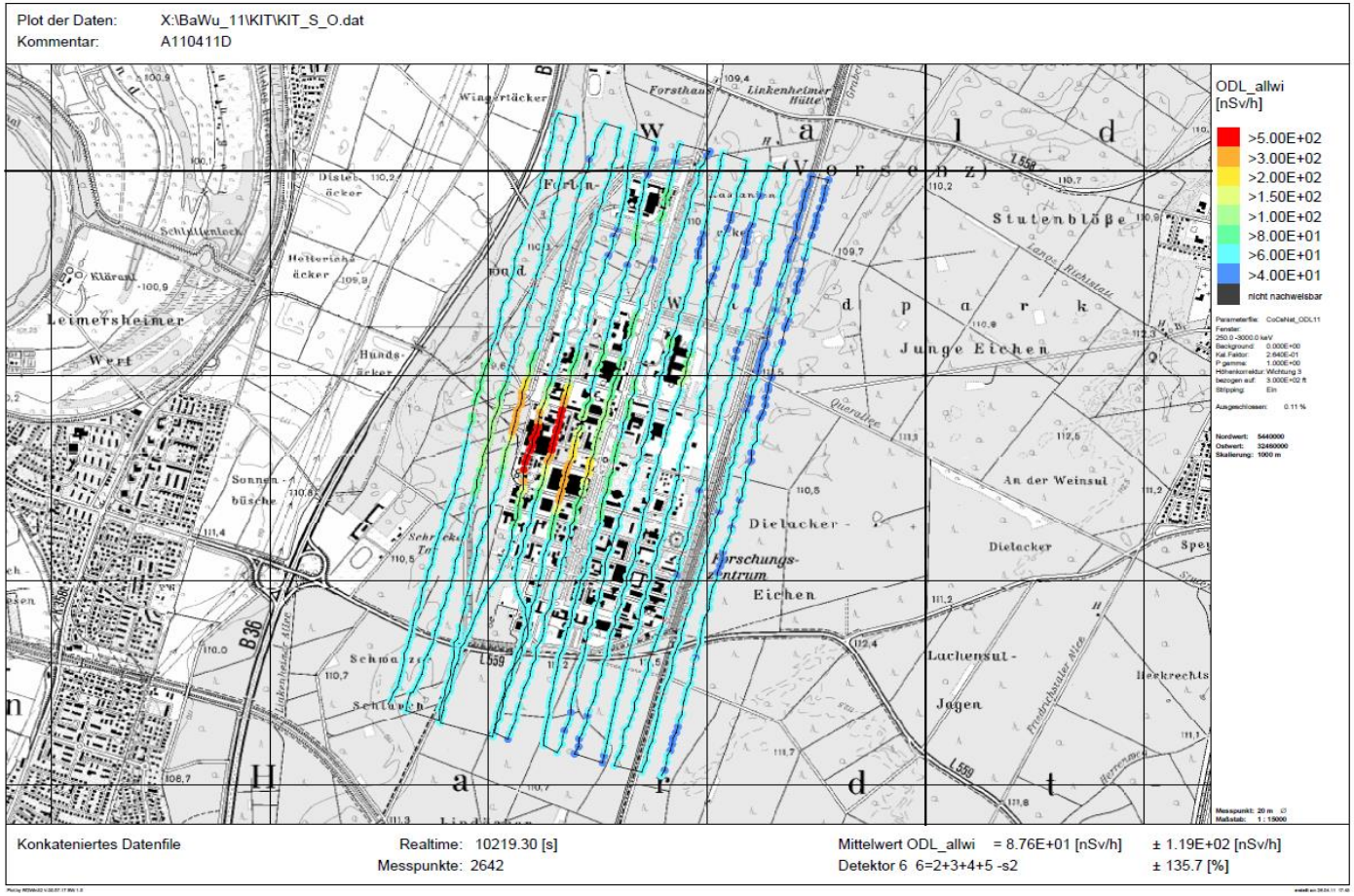
Courtesy: C. Strobl

Helicopter Measurement System



Courtesy: C. Strobl

Helicopter search pattern



Courtesy: C. Strobl

Drone Measurement System (future !)

Measurement vehicle

Measurement vehicle

Standard measuring device

NBR-Sonde FHZ 672 E „Franz“
Gamma – nuclides,
NBR = Natural Background Rejection

Courtesy: G. Heinrich

Standard measuring device

Alpha-Beta-Gamma – Contamination measurements
FHZ 382 „Erika“

Courtesy: G. Heinrich

Standard measuring device

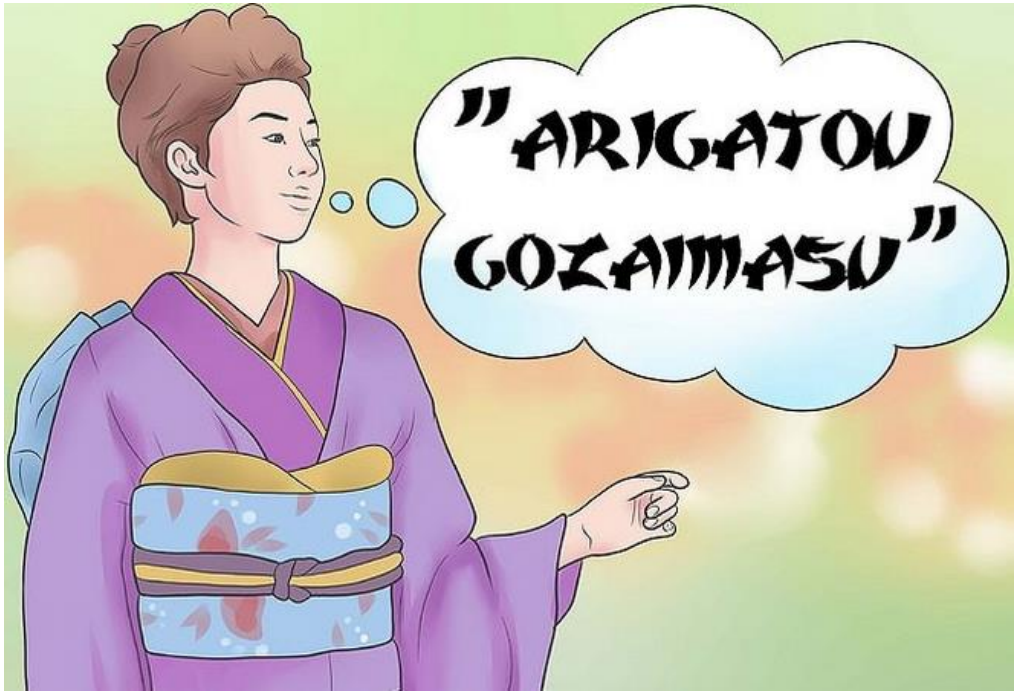
Biorem-Counter Thermo FHT 752 / 752 „Willi“
Neutron / Gamma measurements

Courtesy: G. Heinrich

Thanks to supporting Colleagues

- **Bleher, Martin**
- **Gering, Florian**
- **Heinrich, Gerhard**
- **Strobl, Christopher**
- **Werner, Maria**
- **Zander, Natalie**

Thank you



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