

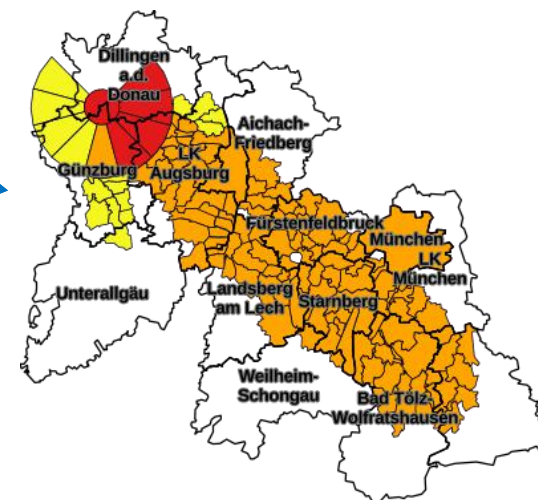
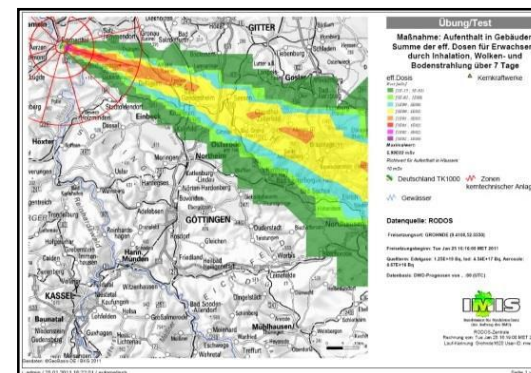
Individual dose reconstruction after nuclear accidents based on environmental monitoring data

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Tasks of BfS in case of nuclear emergencies

- Evaluation of the radiological situation
- Prognosis/Forecast (dispersion modelling)
- Dose estimation
- Consequence assessment
- **Dose reconstruction** (= Estimation of individual doses based on environmental monitoring data)



RODOS dose calculation

Standard procedure

Meteorological data,
source term data



Atmospheric
Dispersion Module



New option

Measurement data
(GDR, air
concentration, ground
contamination)



preprocessor
dose reconstruction

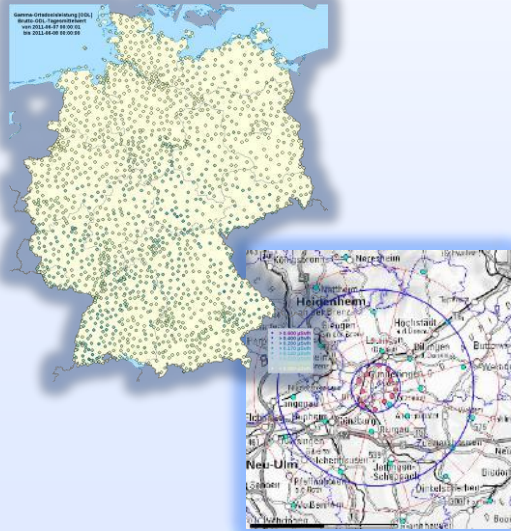


Dose calculation in FDMT
(RODOS Food Chain Dose Module)

Radiological measurement data used for the dose reconstruction in Germany

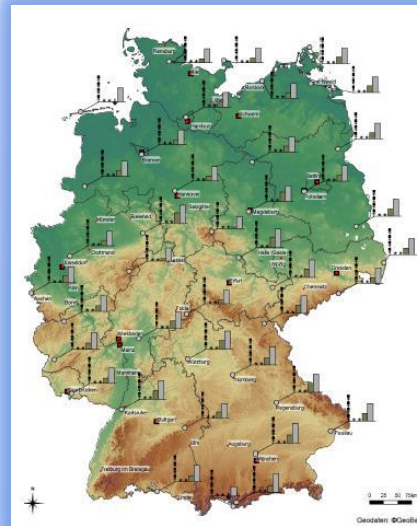
Gamma dose rate measurements (GDR)

- Nationwide: ~1800 automatic stations plus ~300 probes (remote monitoring of NPPs)
- (~200 *spectrometric probes*)



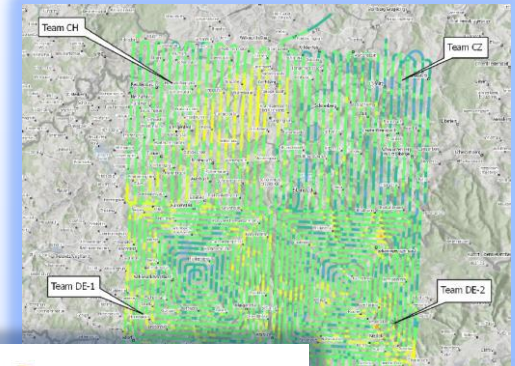
Nuclide measurements (continuous)

- ~40 stations with nuclide information of ground contamination and activity concentration in air (DWD)
 - (*precipitation*)



Nuclide measurements (mobile)

- Aerogamma (up to 4 helicopters)
- Car-borne (in situ, GDR; BfS: 12 cars + ...)



Overview of the dose reconstruction approach

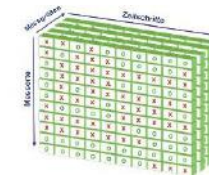
Input

- **measurement data** (location, time, measured variable and value)
- **some parameters** (deposition velocity, estimated source term, etc.)



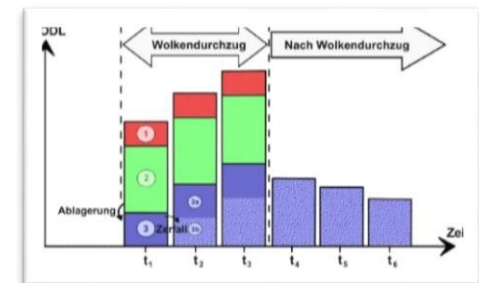
data processing

- Generation of a spatio-temporal **computational grid**
- Definition of the **cloud passage** based on measurement data



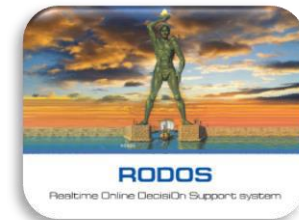
modelling

- Modelling of missing time steps and missing variables **in the cloud transition phase** and **after the cloud passage**
- Calculation of time-dependent, nuclide-specific **air concentration** and **ground contamination** at all measurement sites



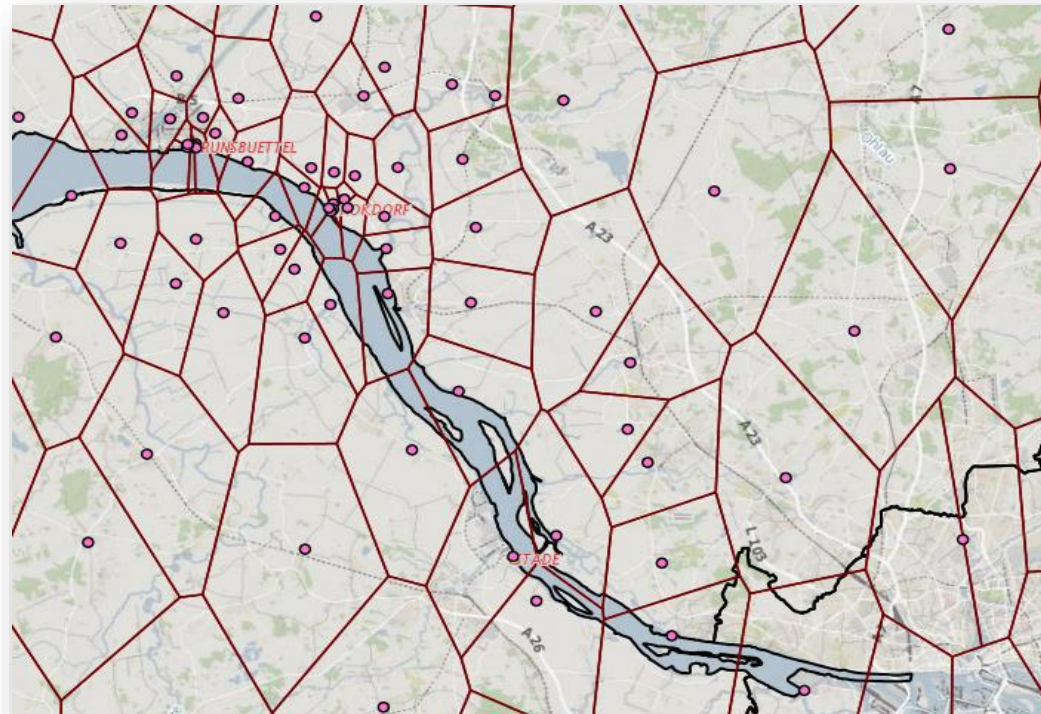
dose calculation

- Calculation of **dose values** at all measurement sites
- **dose reconstruction for individuals** based on individual tracks and residences in a contaminated area



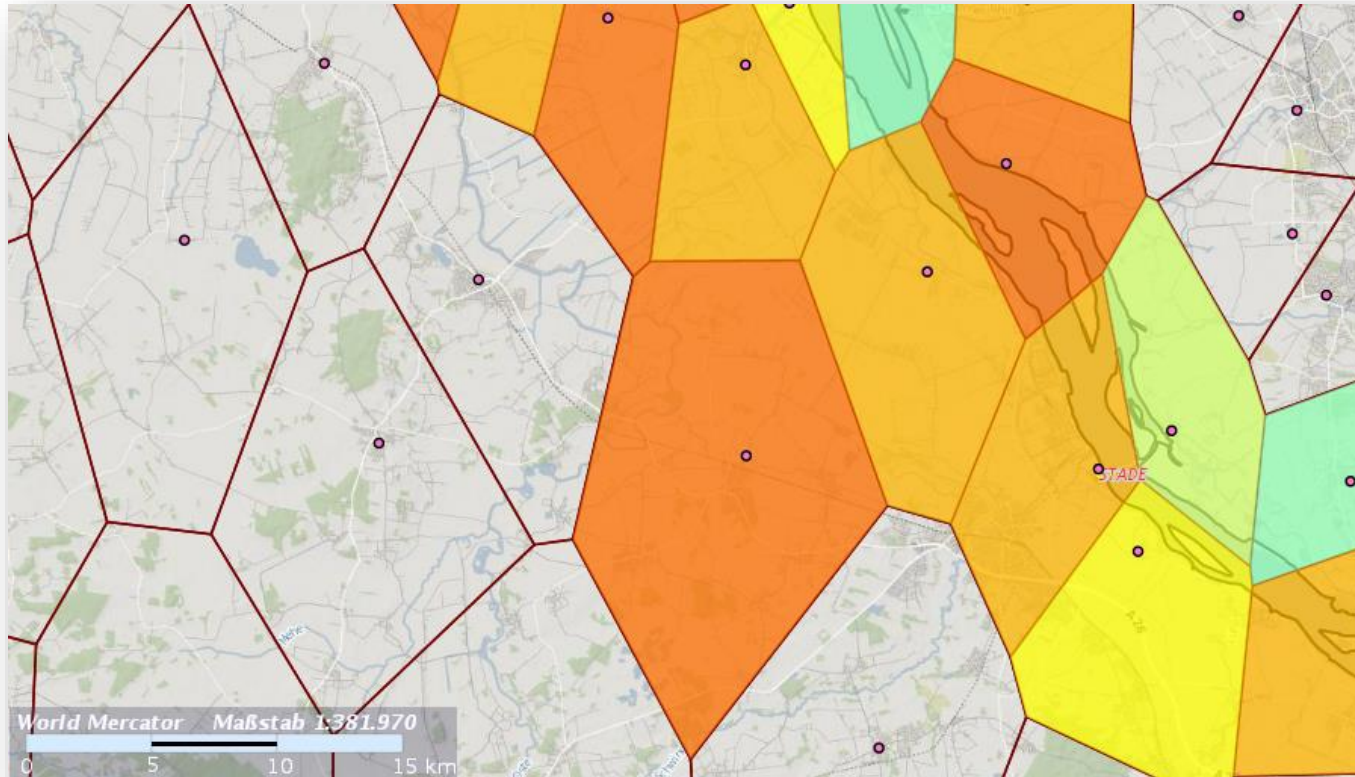
Areas around the measurement stations: Voronoi-diagram

Voronoi diagram: Subdivision of a contaminated area based on the location of measurement sites in polygons („each point of the map obtains the measurement data of the nearest measurement site“, simple and robust interpolation technique)



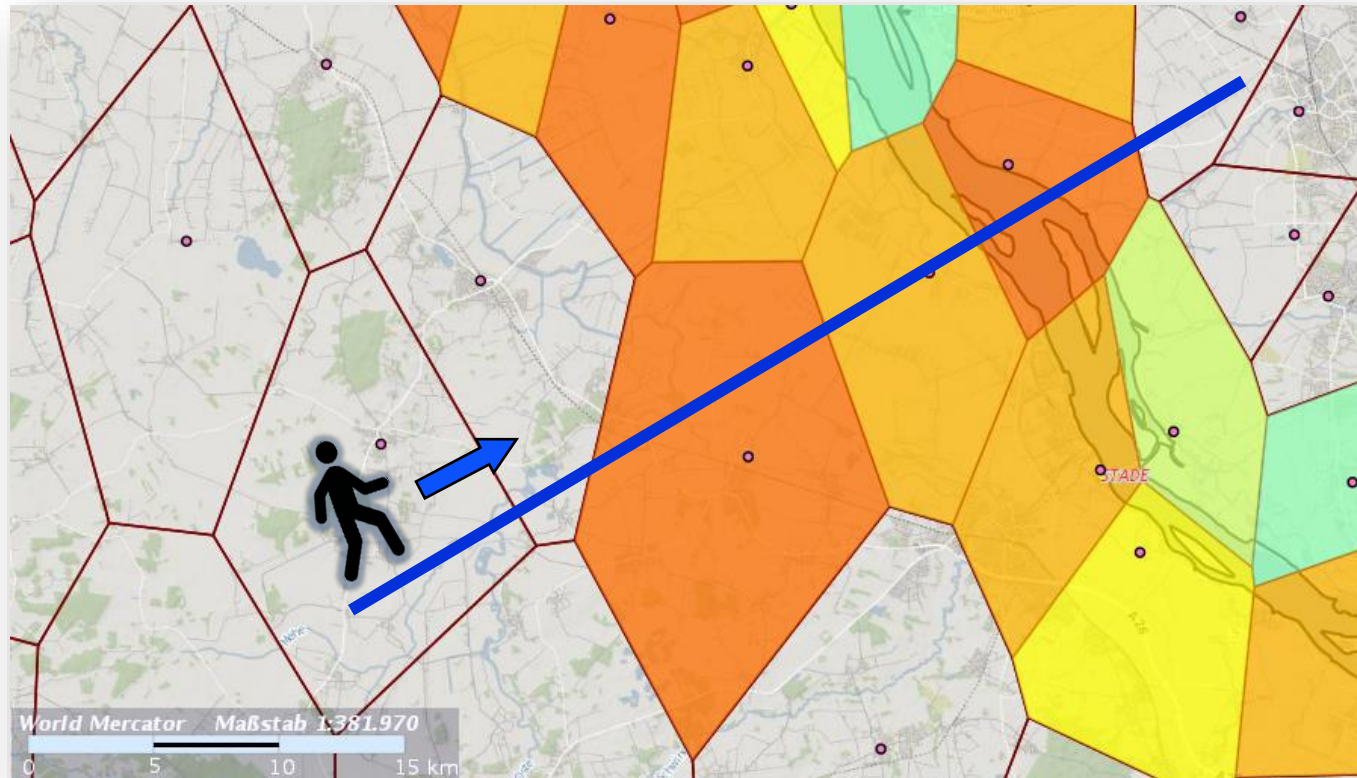
Individual dose reconstruction

For persons in contaminated areas:
Estimation of doses based on individual tracks and residences



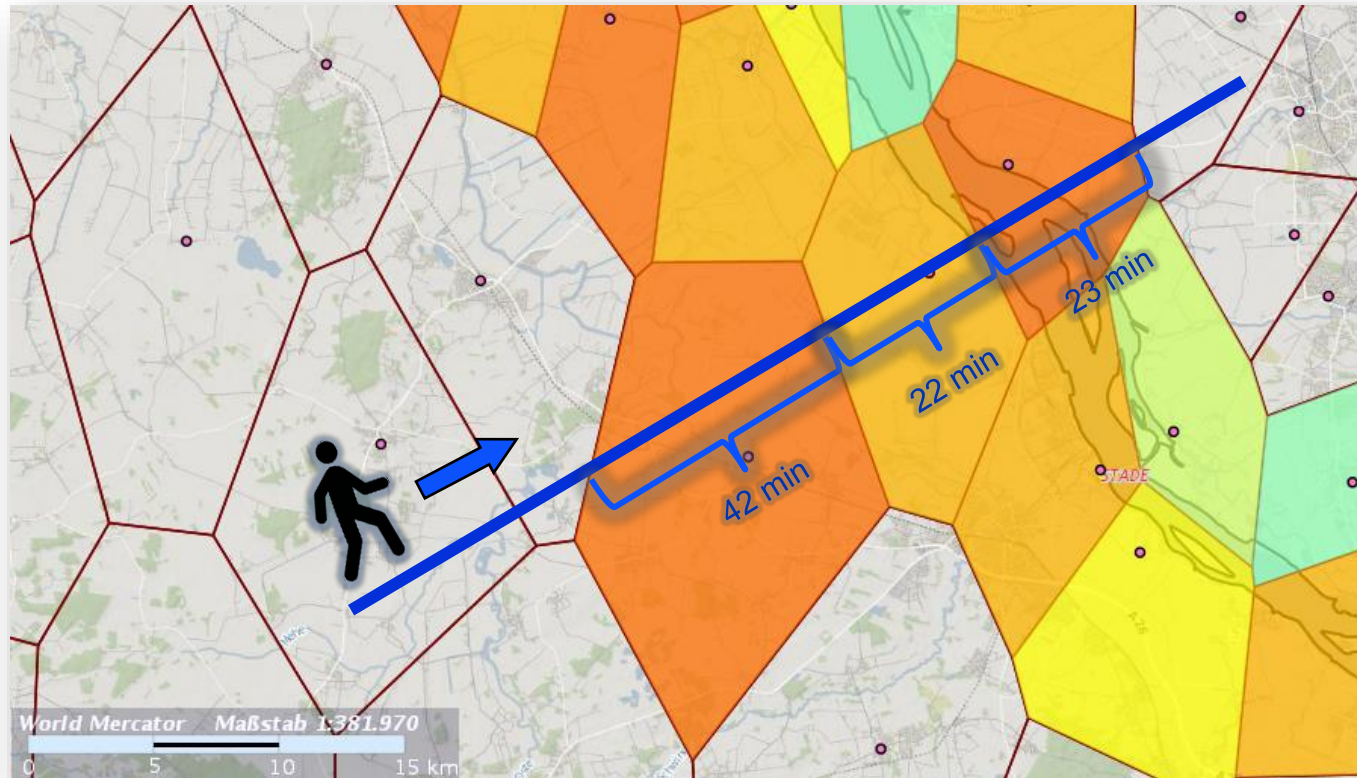
Individual dose reconstruction

For persons in contaminated areas:
Estimation of doses based on individual tracks and residences



Individual dose reconstruction

For persons in contaminated areas:
Estimation of doses based on individual tracks and residences



Graphical User Interface (e.g. for emergency care stations)

Open Street Map:
Click to create
individual tracks
of the potentially
exposed person

Personal
information: ID
code, age, gender

Dosisrekonstruktion

Persönliche Daten

Identifikation:

Altersklasse:

Geschlecht:

Ergebnis Dosisberechnung:

Organ	Wert in [mSv]
Effektive Dosis	bnis
Schilddrüse	bnis
rotes Knochenmark	Rechnung liefert Ergebnis

lösche	Wegbezeichnung	Anfangspunkt	Endpunkt	Beginn	Ende	Aufenthaltsort	Schutzmaßnahmen
×	drive to work	8.4379,49.3165	8.5492,49.321	02.06.2015 08:00	02.06.2015 08:30	im Freien/Auto	keine
×	at work	8.5492,49.321	8.5492,49.321	02.06.2015 08:30	02.06.2015 12:00	Haus	keine
×	drive to kindergarten	8.5492,49.321	8.5629,49.2937	02.06.2015 12:00	02.06.2015 12:15	im Freien/Auto	Schutzmaske
×	drive to emergency care station	8.5629,49.2937	8.7071,49.2206	02.06.2015 12:15	02.06.2015 13:00	im Freien/Auto	Schutzmaske,Jodtablette

Formular zurücksetzen Dosisberechnung starten

Listing of all track sequences including information about their duration
and protective measures (e.g. sheltering; iodine tablets, protective masks)

Results of the dose
calculation:
effective dose,
thyroid dose and
red bone marrow
dose



Individual dose reconstruction: first successful test

Large emergency response exercise (including an emergency care center) in Berlin in Oct 2017

- **Goal:** Testing the concepts of the emergency management plan for the research reactor BER II of the Helmholtz Center Berlin
- **Scenario:** plane crash, one-hour release of radioactive material, predefined weather conditions
- **Dose reconstruction:** Three BfS employees on site: Supervision of the “dose reconstruction” sub-station: Reconstructed doses for individuals on the basis of radiological measurement data, plausibility check of the skin contamination and thyroid measurement data

