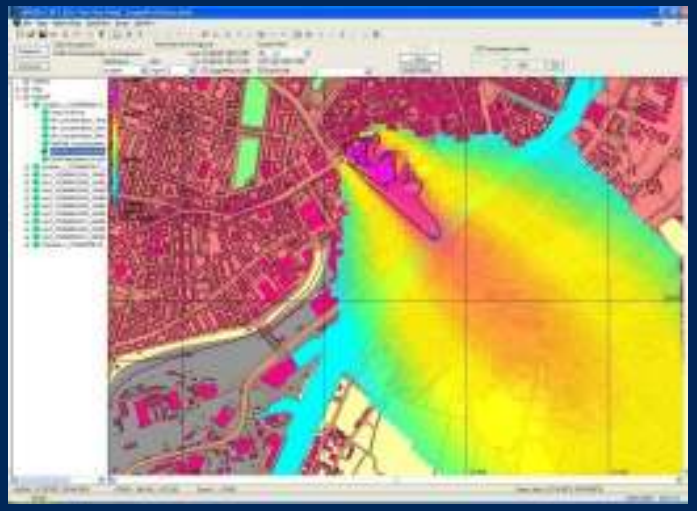
DEMA DANISH EMERGENCY MANAGEMENT AGENCY

Operational use of dispersion calculation with quantified uncertainties

NERIS April 2018, Ireland



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Institute (DMI)

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Uncertainty in dispersion calculation

- This presentation will only look into the uncertainty from the metrology and the dispersion model.
- DEMA is involved in the NKS-project AWESOME developing a operational concept for inclusion of source terms.
- The method developed for metrological uncertainties has been used for Inverse or Backward, Dispersion Modelling for Ru-106 – *if time permits*

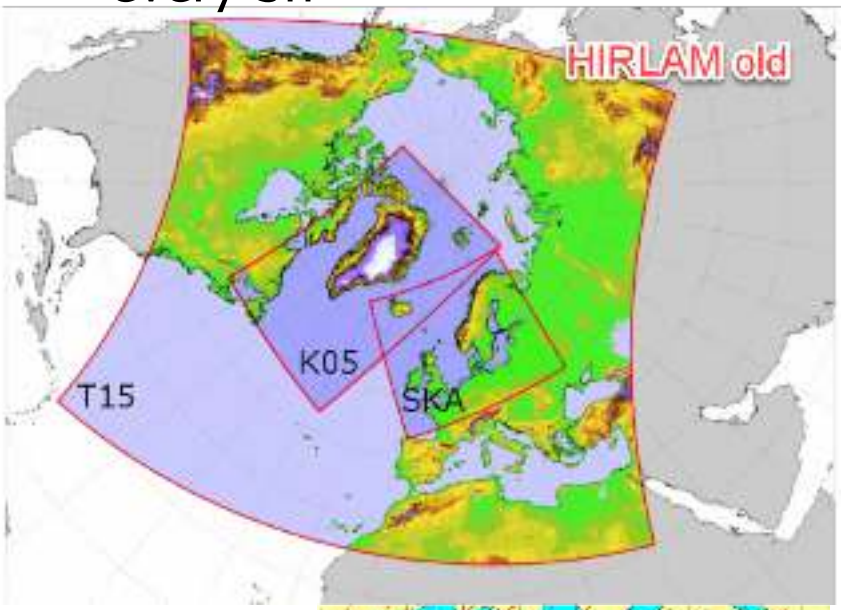
Uncertainty I

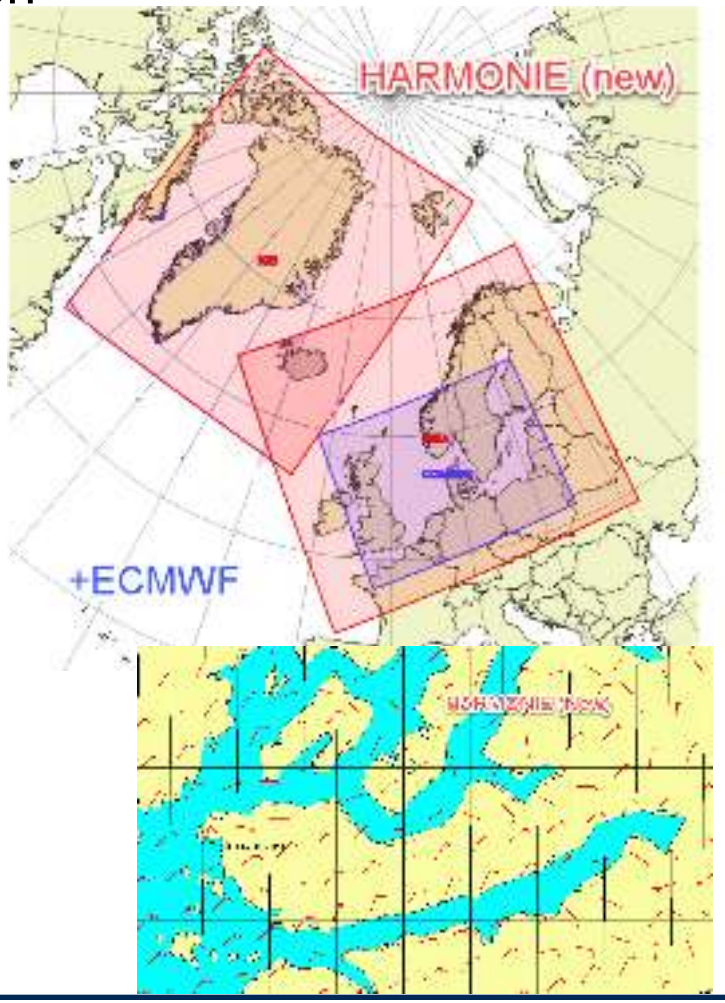
- Dispersion models
- Numerical Weather Prediction models

- Danish Operational setup in
  - Danish Metrological Institute - DMI
  - Danish Emergency Management- DEMA

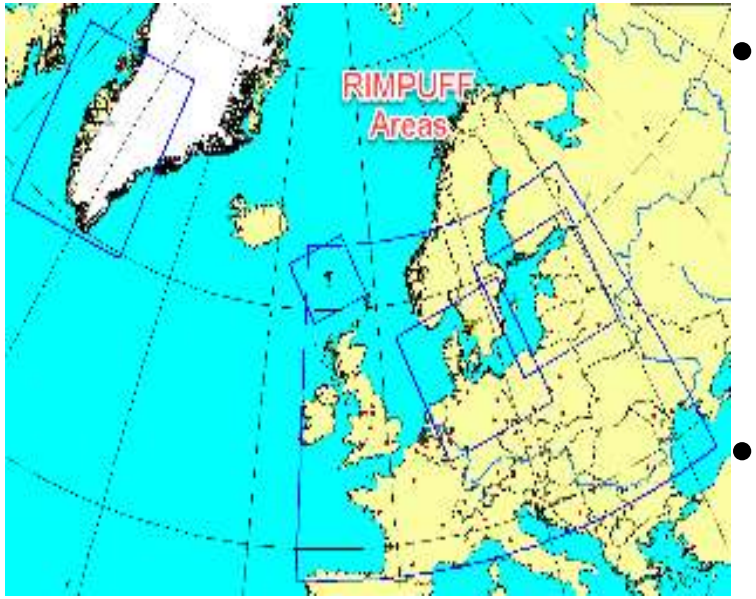
Metrological models, used in Denmark

- Horizontal resolution 2.5km – forecast length 60h – 1h resolution – every 3h





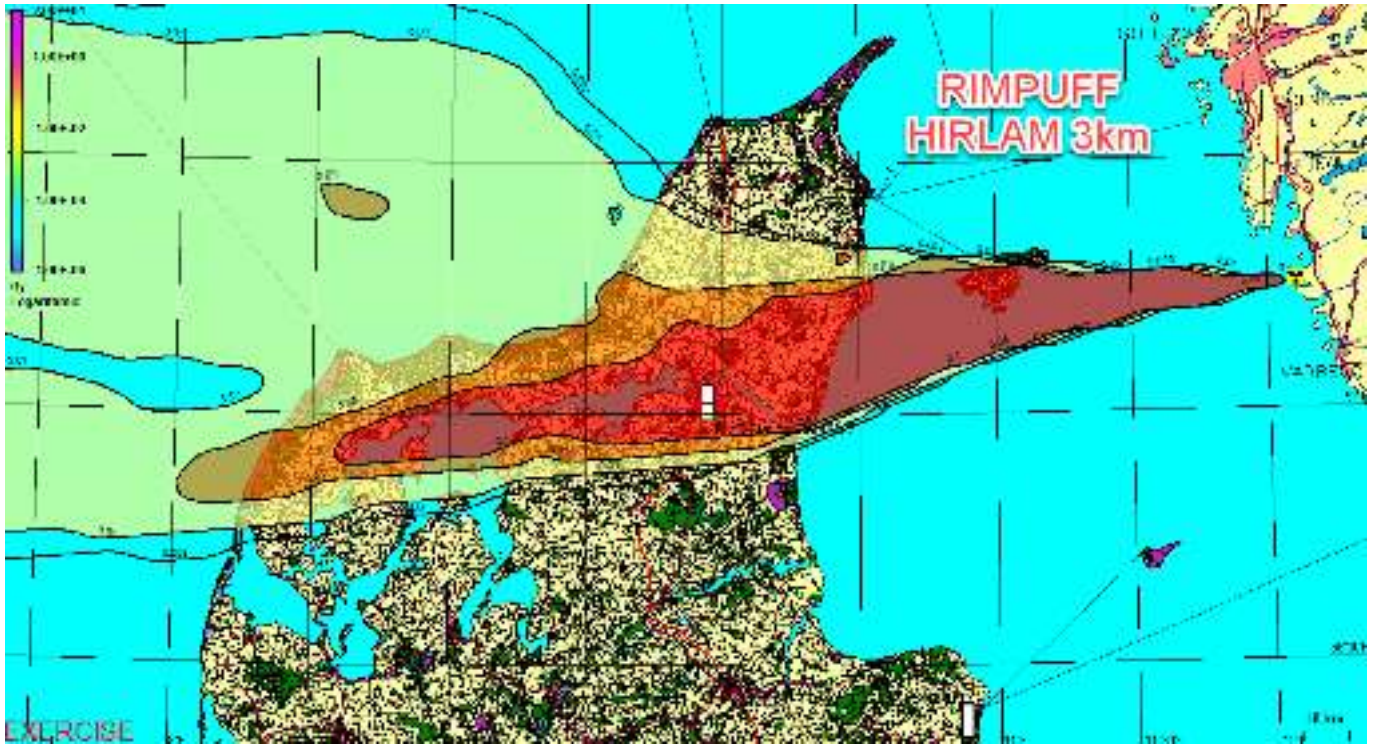
Dispersion models used in Denmark



- URD (Urban model up to 5 km distance) – *Automatic setup for Denmark with buildings*
- RIMPUFF (MESO scale model up to 100-500km distance) *Automatic setup for selected areas close to Southern Denmark, Greenland and Faro Island. Advanced users can use the model globally*
- DERMA (Long range model 50km – global) – *Automatic setup for Northern Globe*

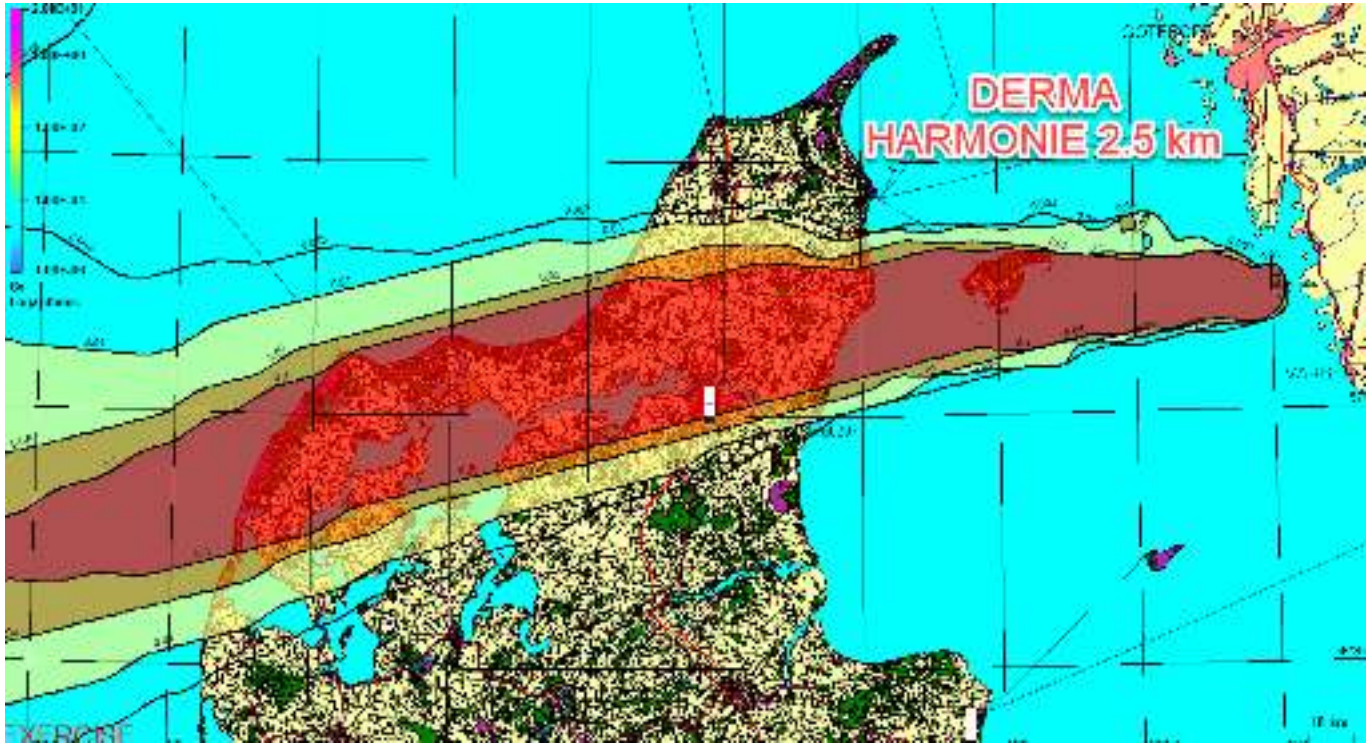
Thyroid dose (5y)
Large postulated release from Ringhals NPP

- RIMPUFF (based on HIRLAM data)



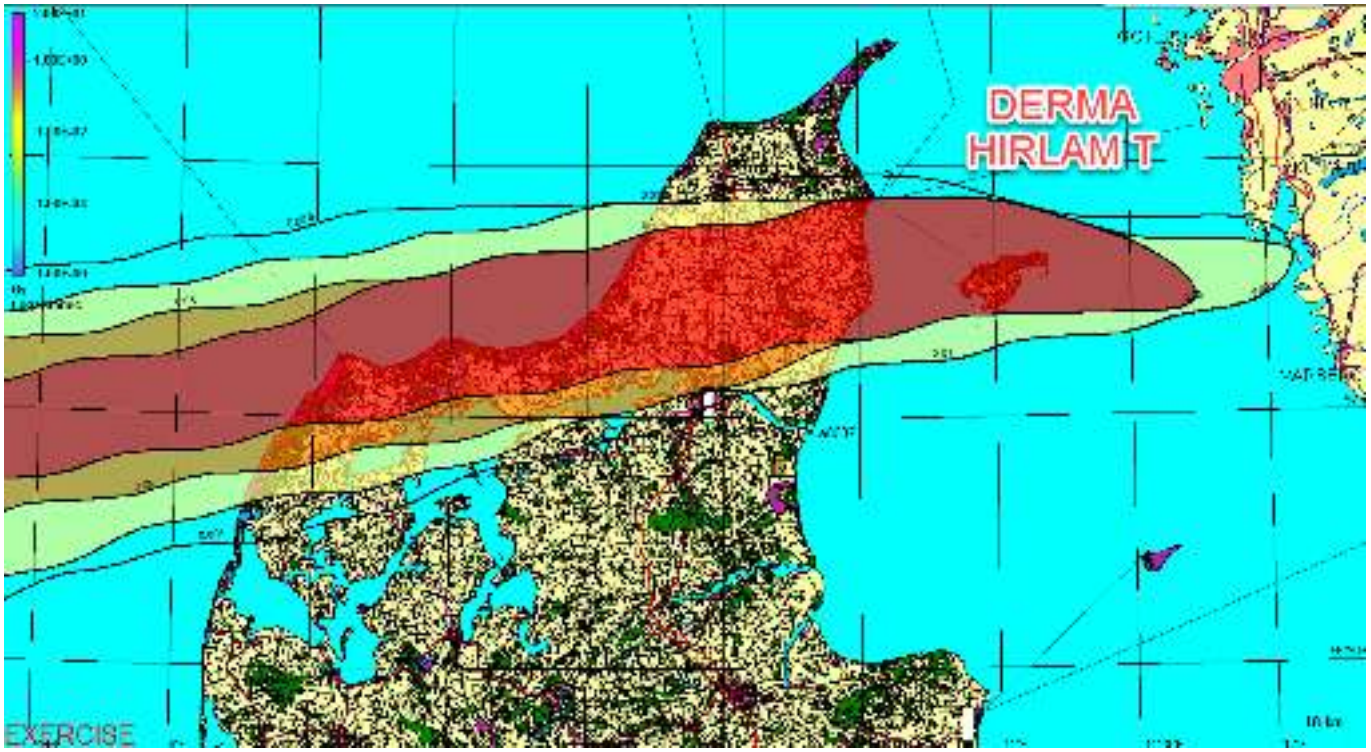
Thyroid dose (5y)

- DERMA (based on HARMONIE)



Thyroid dose (5y)

- DERMA (based on HIRLAM T)

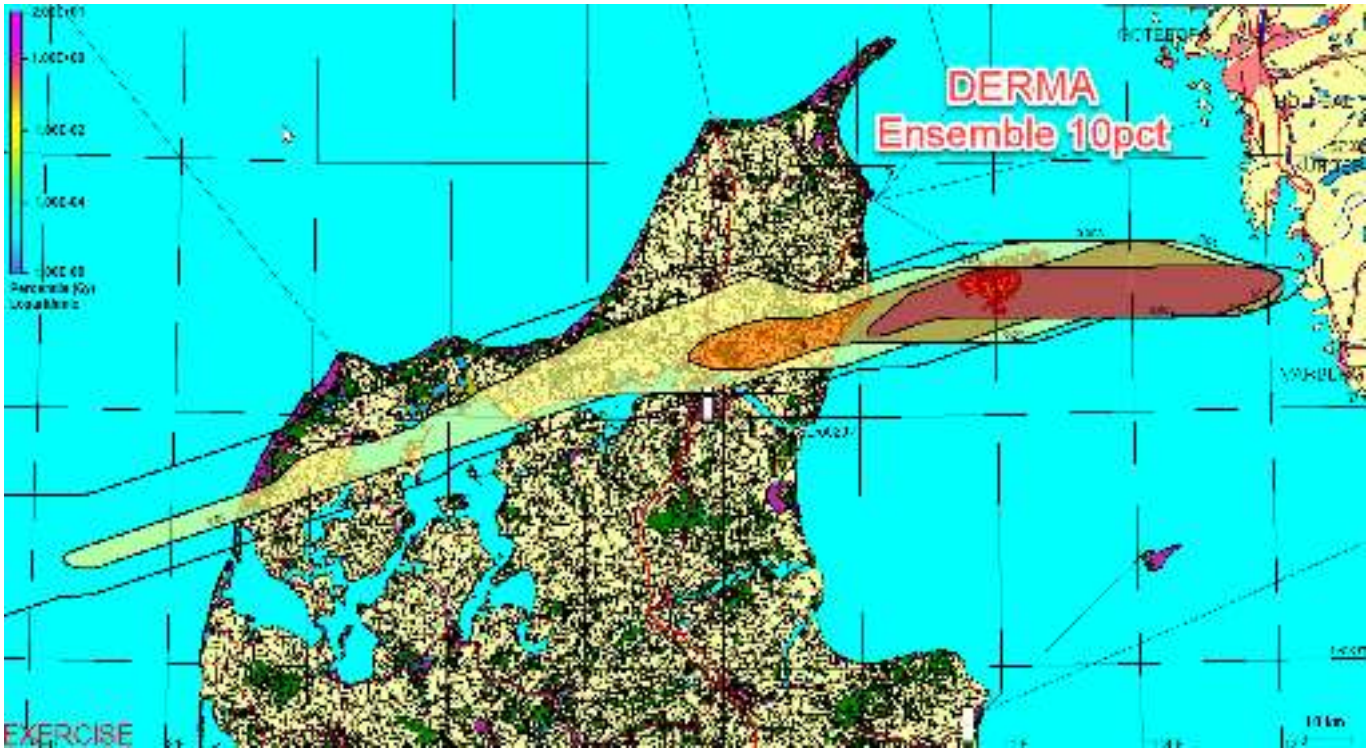


Uncertainty II

- Ensemble modelling at DMI with 25 versions of the same NWP model with different parameterization and 5 km horizontal resolution.

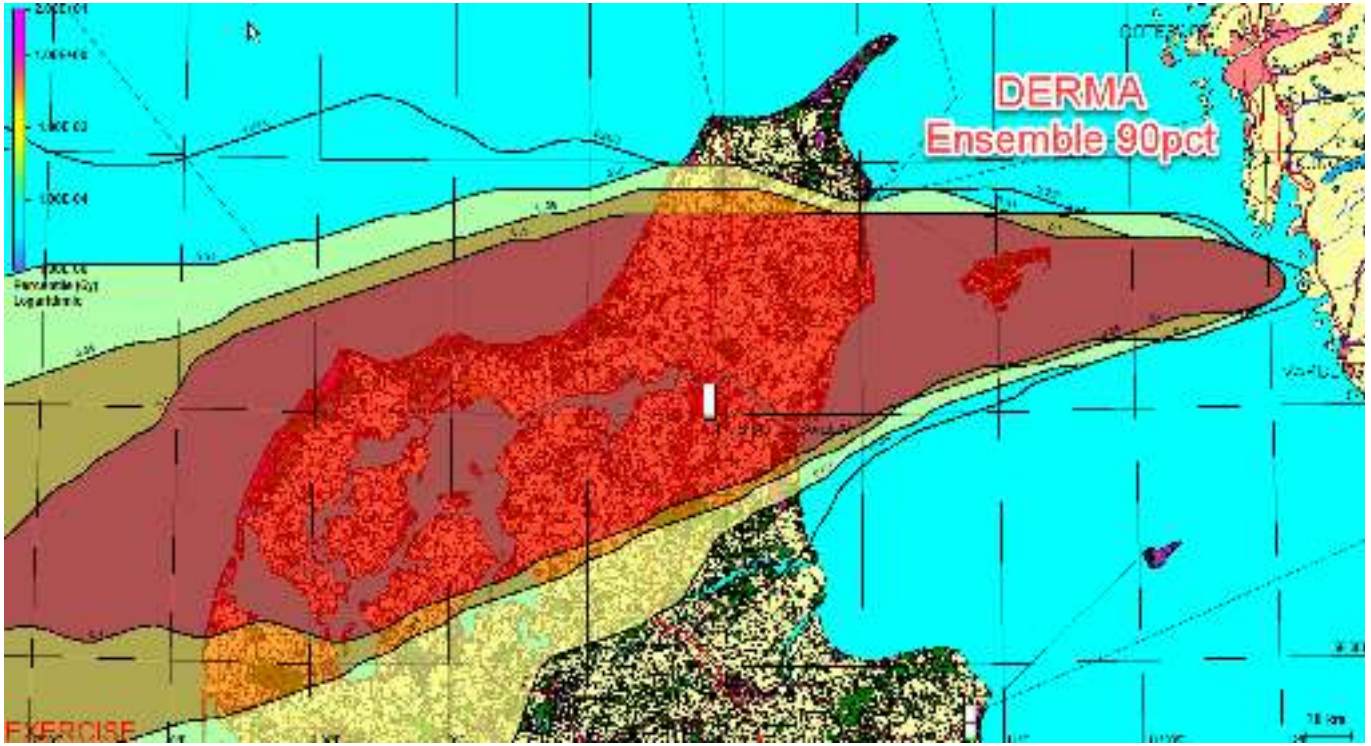
Thyroid “dose” (5y)

- DERMA ensemble result “where most models agrees”



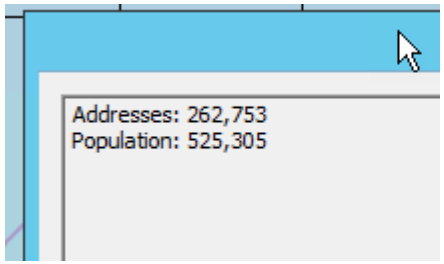
Thyroid “dose” (5y)

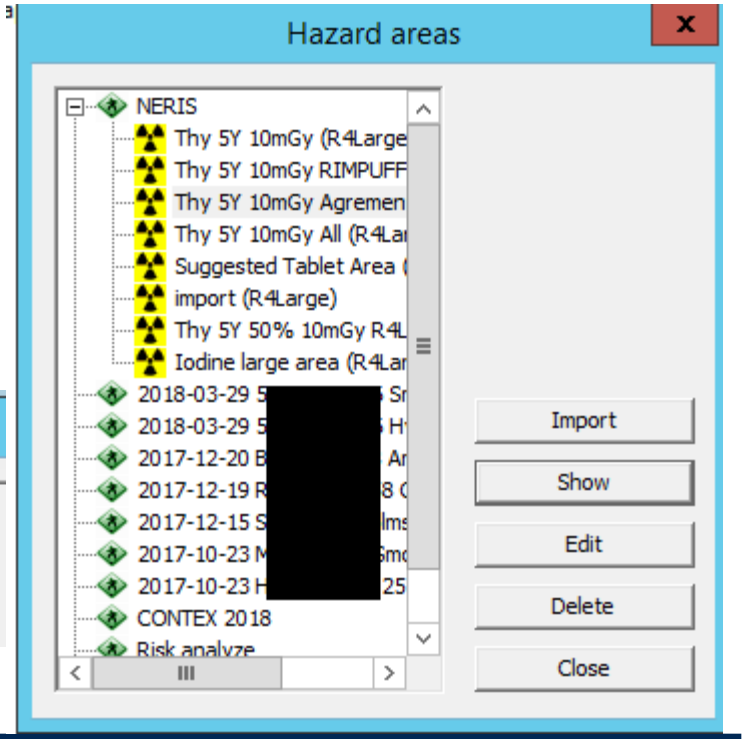
- DERMA ensemble result with areas for “potential high values”- not physical correct



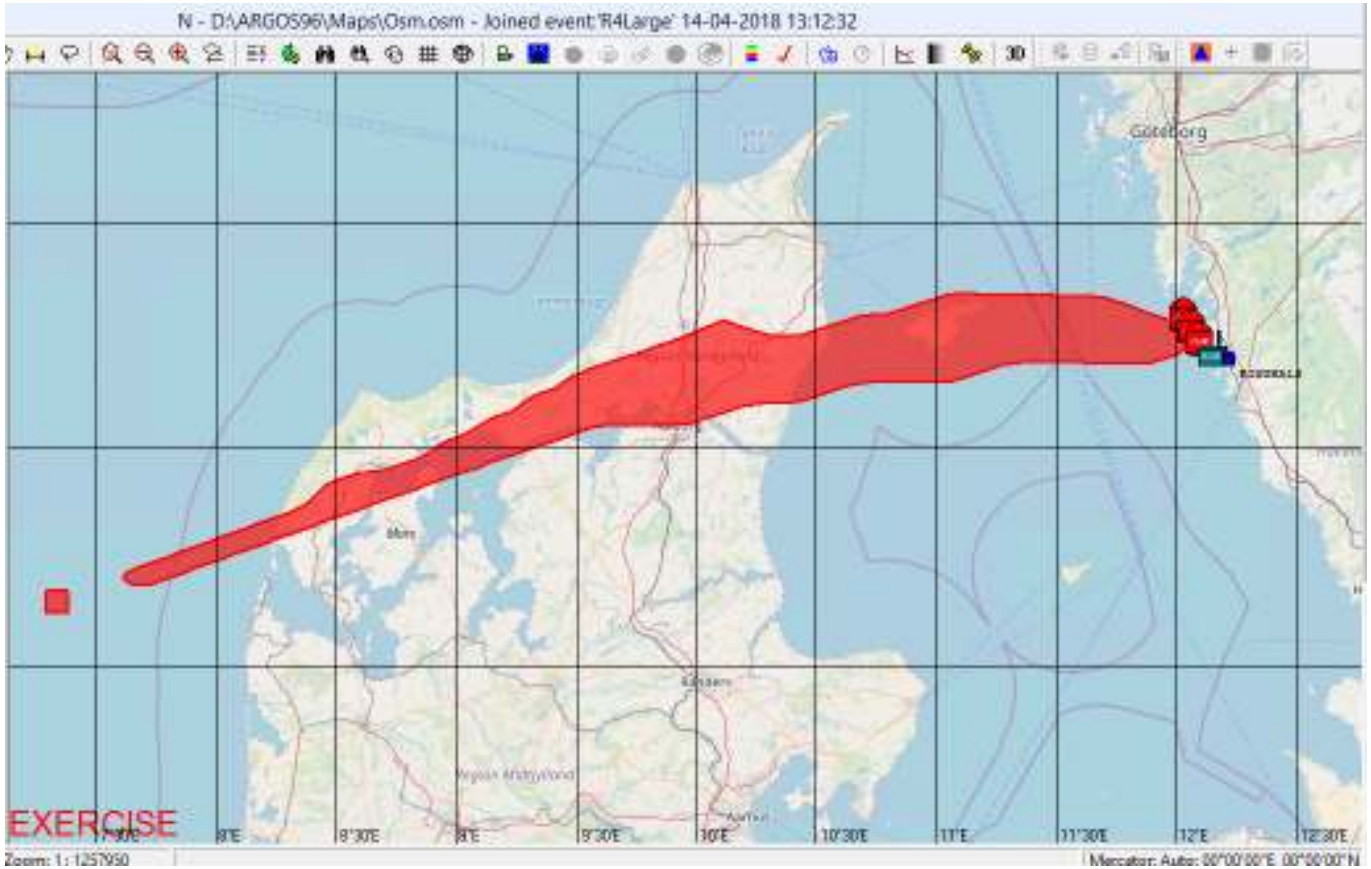
Coping with uncertainty

- Iso Curves are stored as Hazard areas in ARGOS
- Population data can be calculated for Hazard areas in DEMA's ARGOS-installation

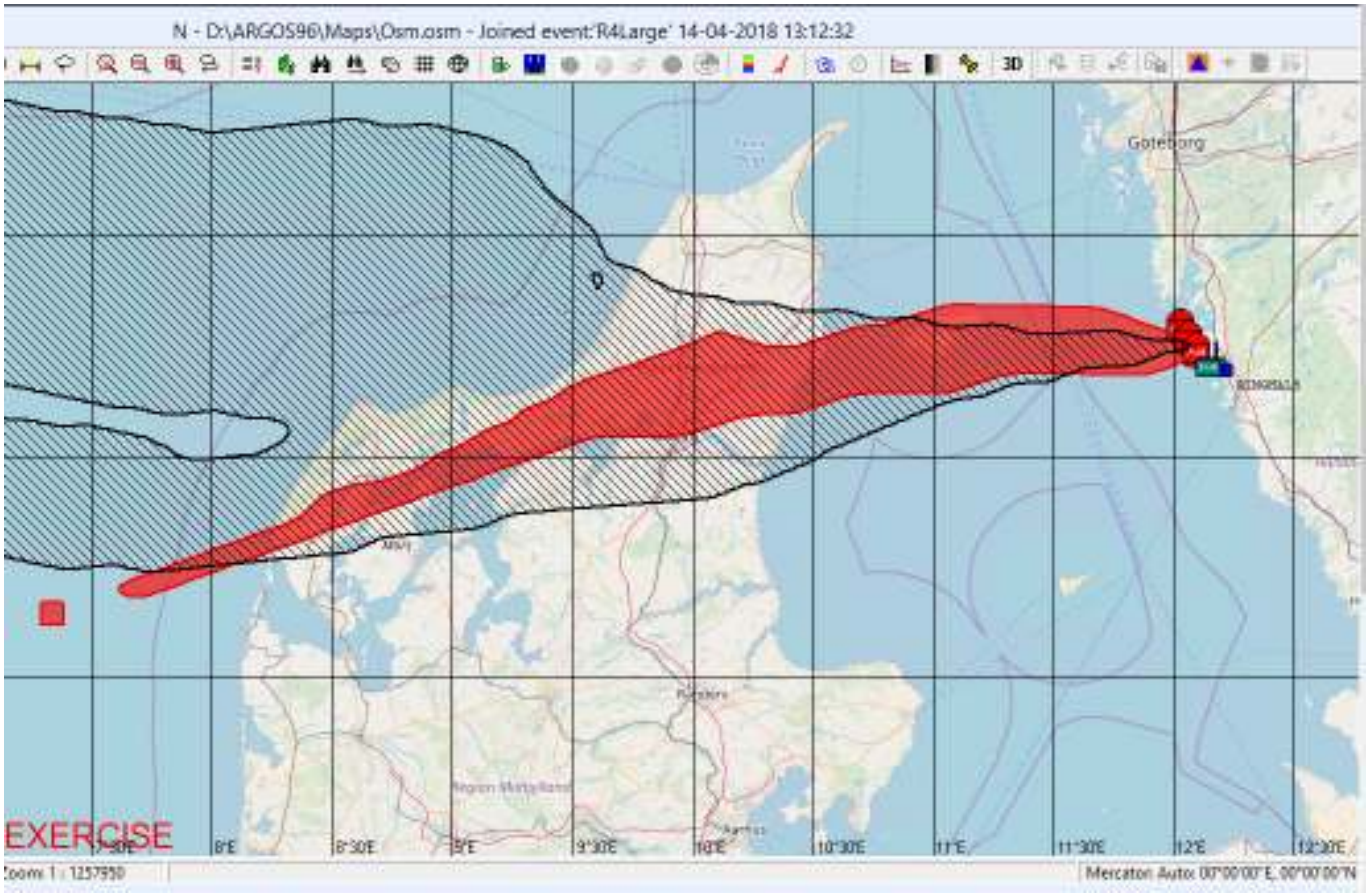




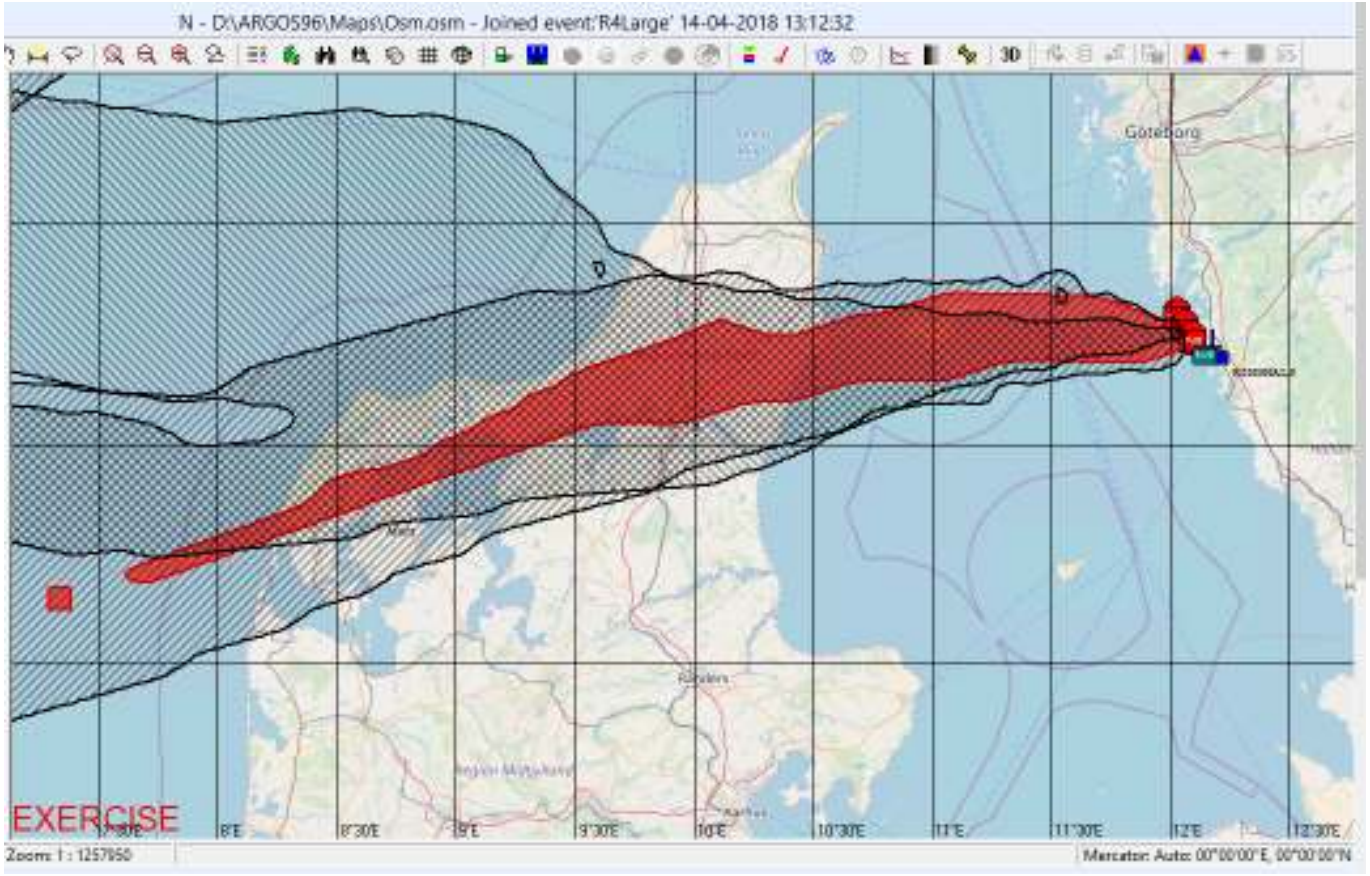
Ensemble 10th percentile



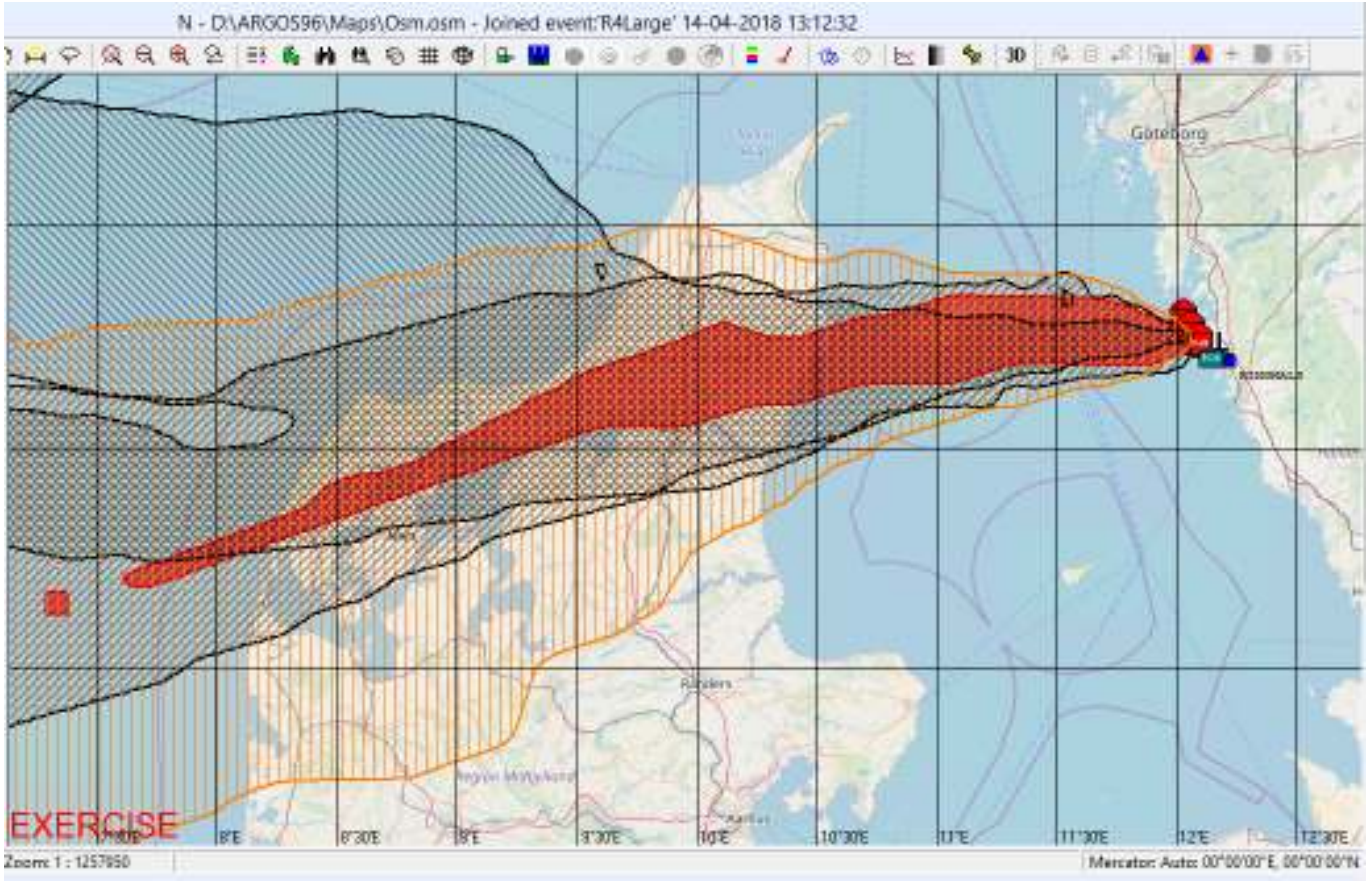
10th percentile+RIMPUFF



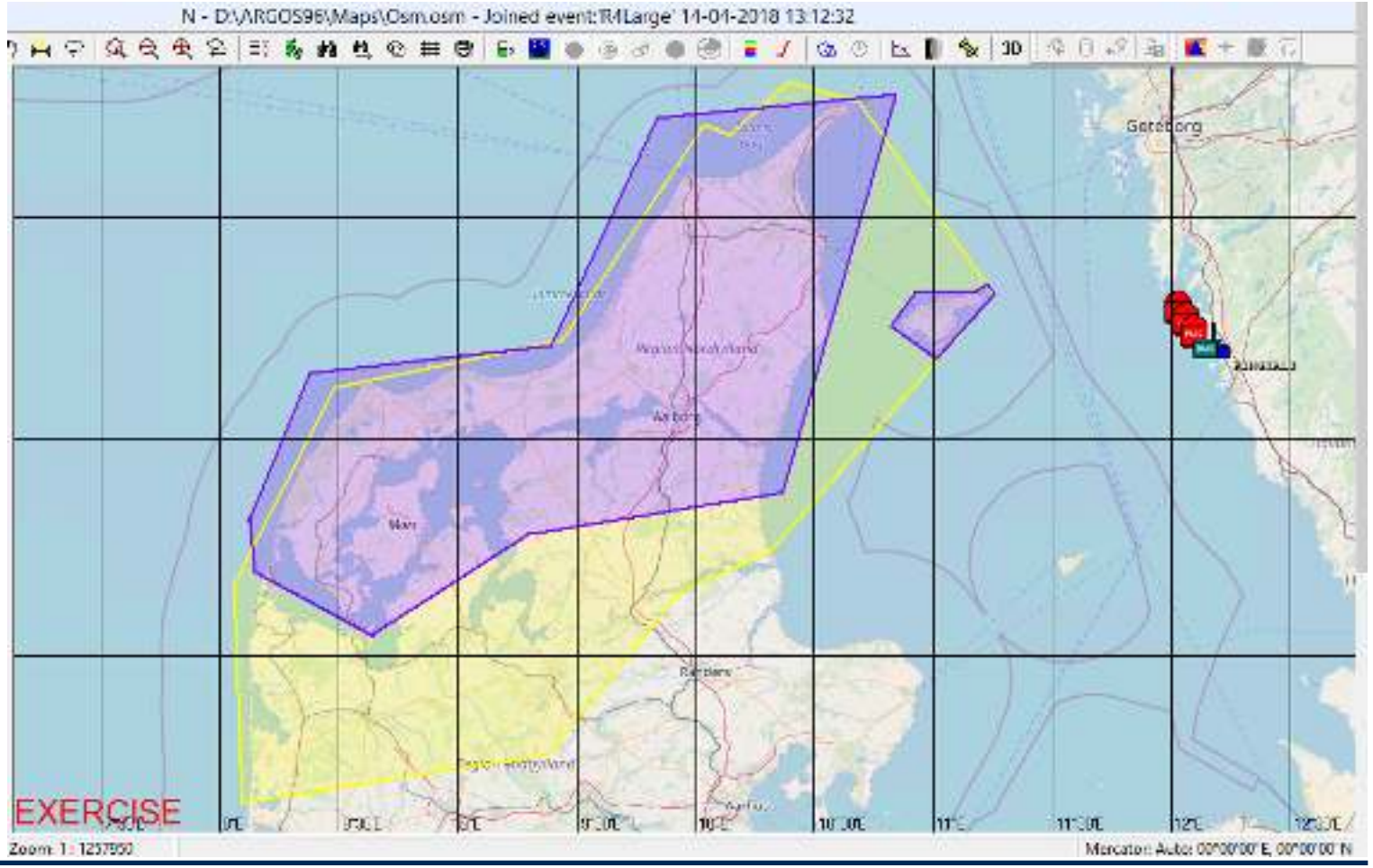
10th percentile+RIMPUFF+DERMA



10th percentile+RIMPUFF+DERMA+90th percentile



Solution: 2 areas for decision makers



Ru-106 case

- The "Engine" from the ensemble modelling was used on backward calculation.
- The suggested release points is only 2 out of many possible places!

Measurements of Ru-106

During 3–6 October 2017, low concentrations of Ru-106 detected in Europe. No other radionuclides (e.g. fission products such as Cs-137).

387 measurement data, some of which below detection limit.

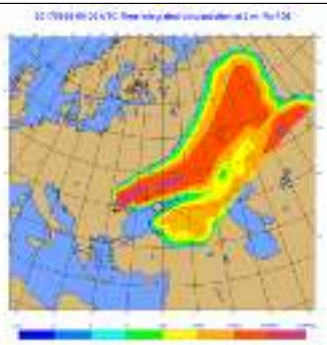
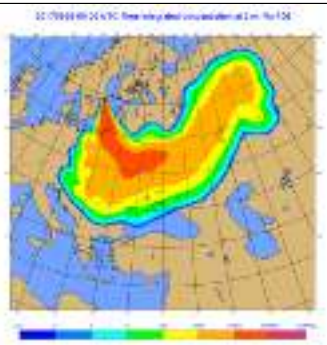
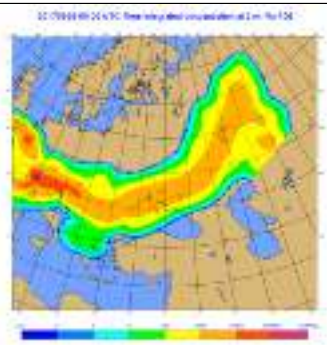
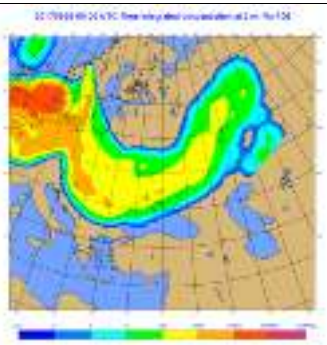
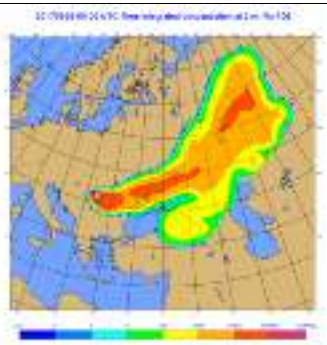
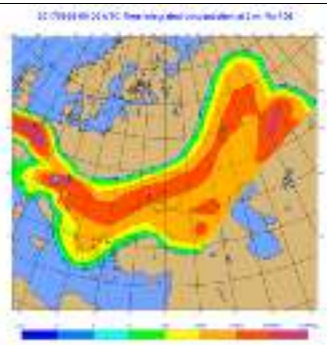
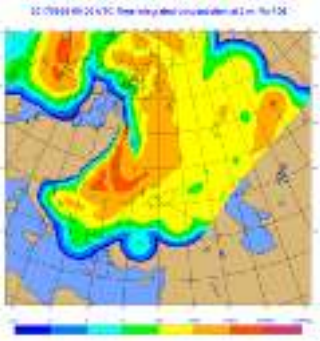
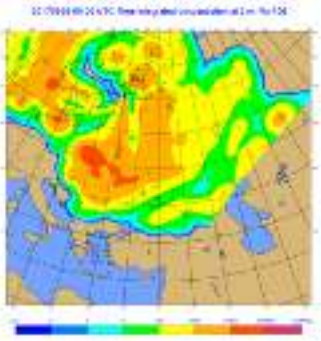
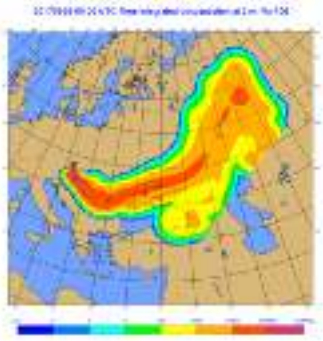
Ref.:

J. H. Sørensen.
Method for source localization proposed and applied to the October 2017 case of atmospheric dispersion of Ru-106.
Journ. Envir. Radioactivity **189C** (2018) 221–226

Inverse modelling

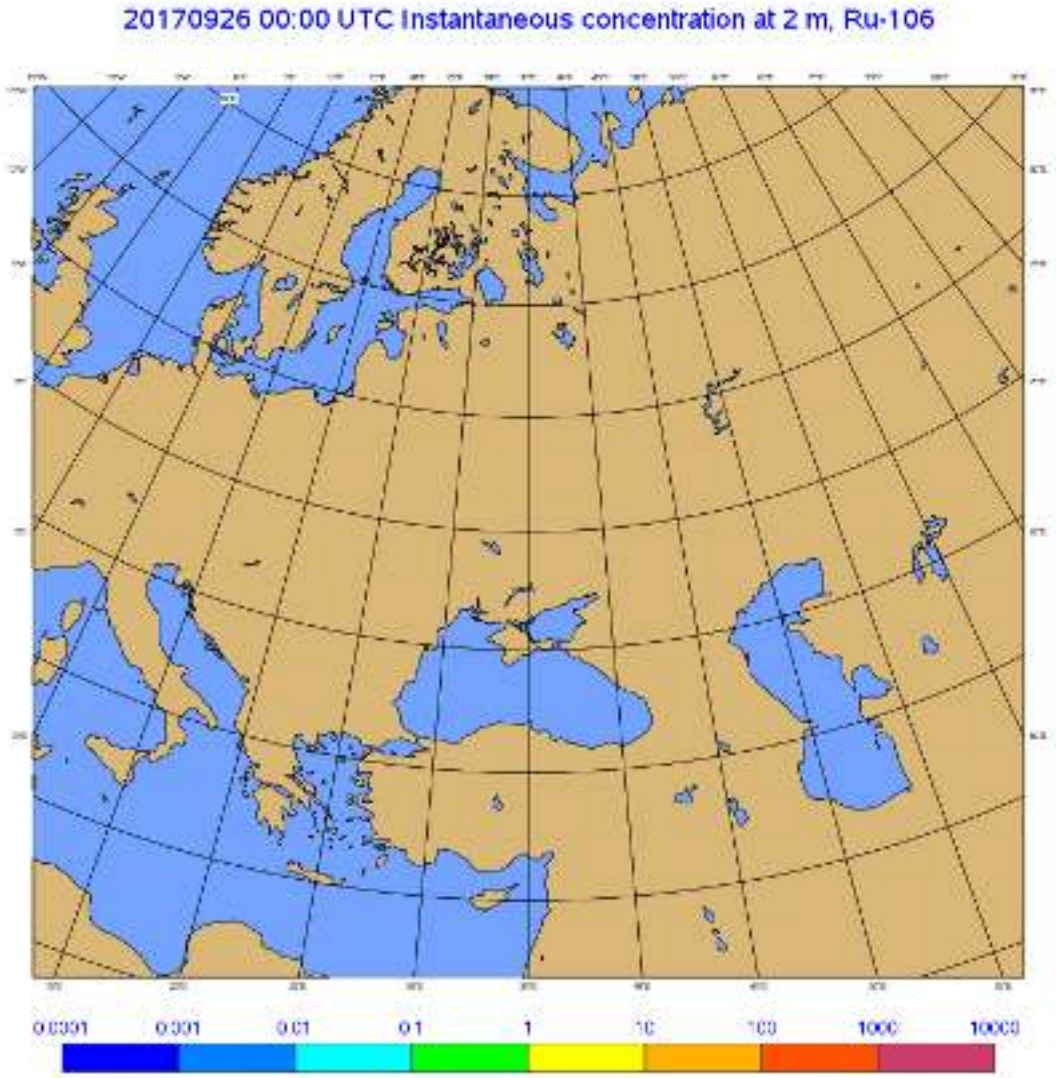
Influence functions (time-integrated concentration)

Release point to be found in the overlap, i.e. the intersection

Station Bucharest	Station Stockholm	Station Milano
		
Station Ørland	**Station Arad**	**Station Wien**
		
Station Braslaw	**Station Helsinki**	**Station Laa a/d Thaya**
		

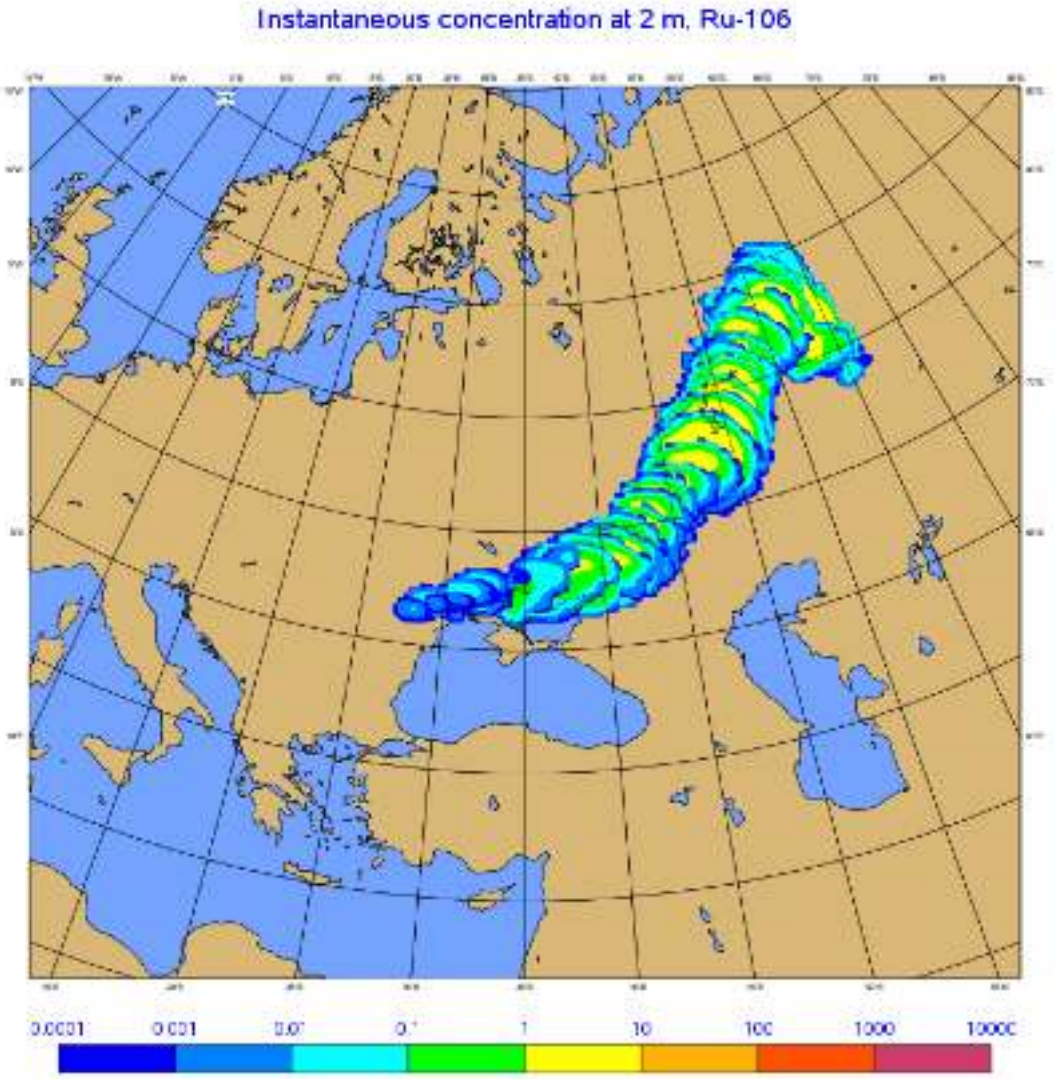
Time series of the 20th percentile of the set of inverse concentration values corresponding to station measurements.

Allows for disagreement between measurements and models.



Potential location of the release of Ru-106.

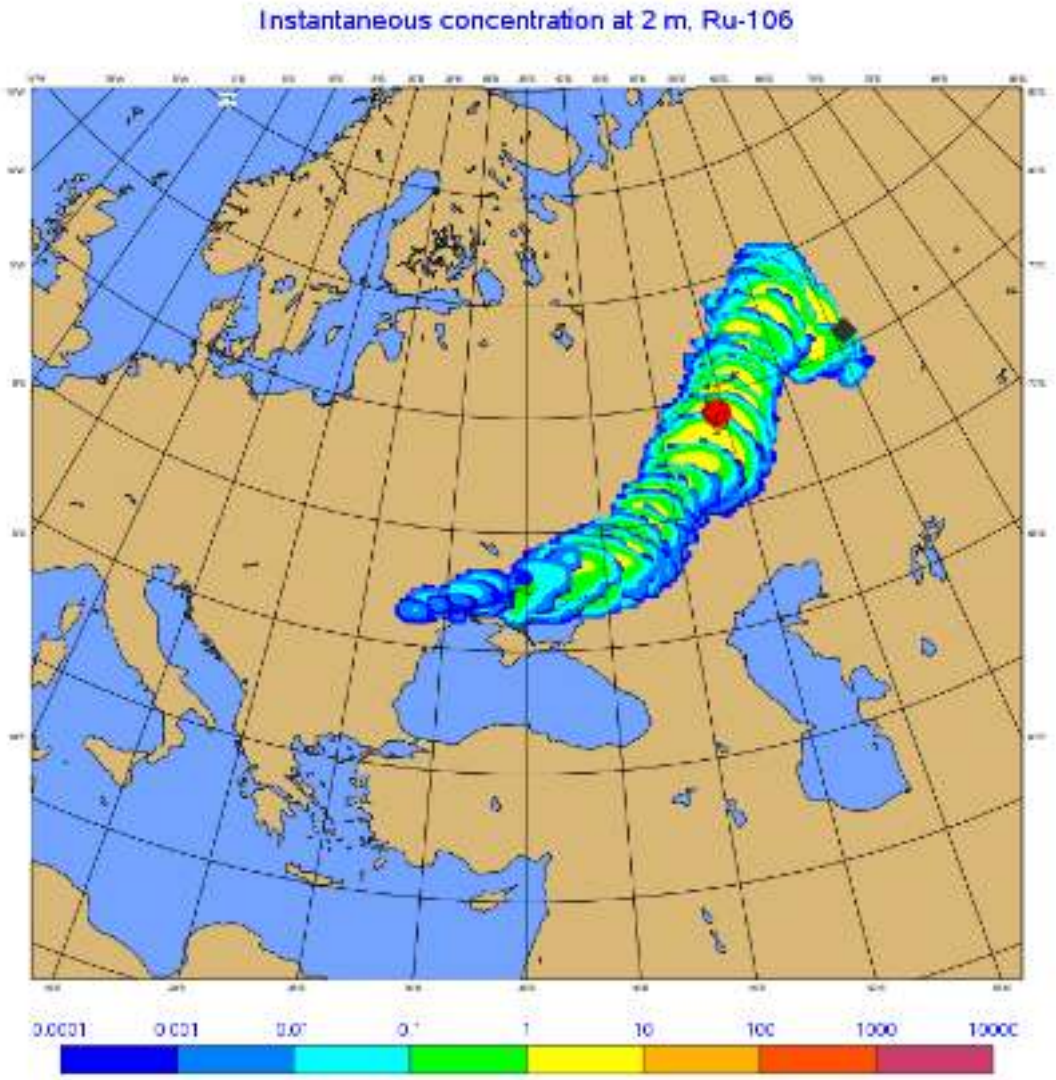
The figure consists of the overlapping time series of three-hourly 20th percentile inverse 2-m concentration maps from 2017-09-26 06 UTC to 2017-09-29 15 UTC.



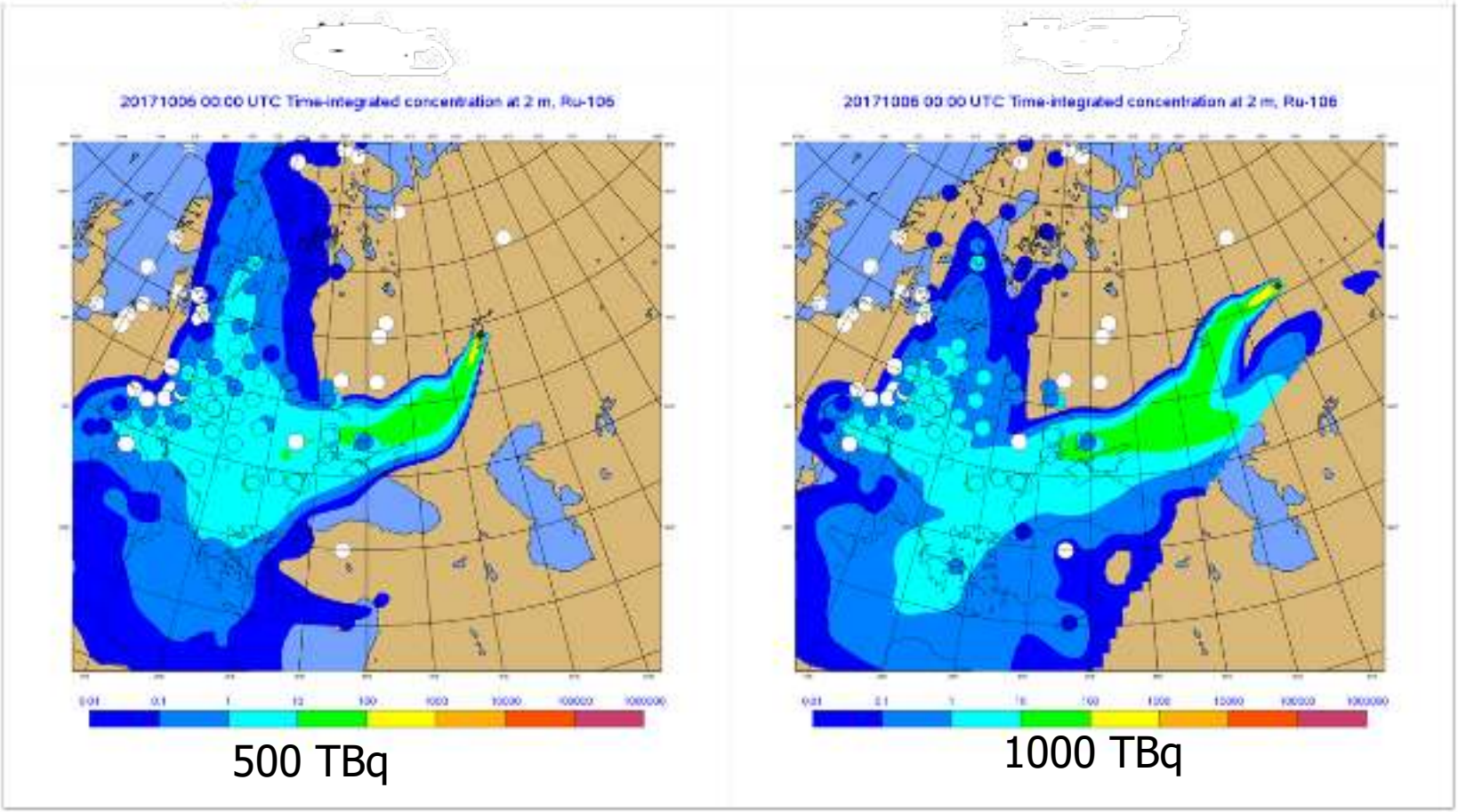
Potential location of the release of Ru-106.

The figure consists of the overlapping time series of three-hourly 20th percentile inverse 2-m concentration maps from 2017-09-26 06 UTC to 2017-09-29 15 UTC.

With a red dot and a black diamond, 2 nuclear facilities are indicated.



Forward modelling - source strength based on ***only one measurement***



500 TBq

1000 TBq

All measurements inserted. White indicates measurement below detection limit.

Thank you