

Modelling uncertainties and the use of “uncertain” model results in nuclear emergency preparedness

Nordic Nuclear and Radiation Risk Estimates -
Advances and Uncertainties - Joint NKS-R and
NKS-B Seminar, Finlandshuset,
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Introductory remarks, Topics

Uncertainties from

- Meteorological models
- Atmospheric Models
- Source Terms Models

How to mix and use model result with uncertainties in
Nuclear Emergency Management

Introductory remarks, acknowledgements

Material and help to this presentation from:

- Dr Jens Havskov Sørensen , Danish Meteorological Institute (DMI),
- Jan Pehrsson, PDC-ARGOS, Denmark
- SSM
- Elisabeth Tengborn, Anders Riber Marklund Lloyd's Register, Sweden
- IRSN website

Projects and software:

- NKS (AVESOME), EU-FASTNET, ARGOS- and RASTEP- software

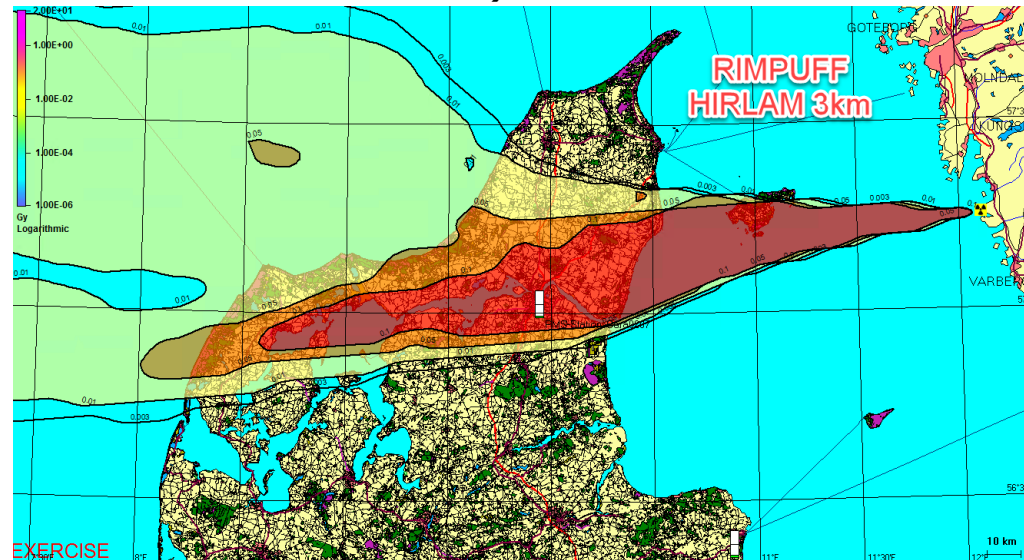
Uncertainty – dispersion models

- Selection of dispersion models (ex DERMA, MATCH, SNAP, RIMPUFF and URD)
- Numerical Weather Prediction models (HARMONIE, HIRLAM, ECMWF,...)
- Danish Operational setup in
 - Danish Meteorological Institute - DMI
 - Danish Emergency Management- DEMA

Thyroid dose (5y)

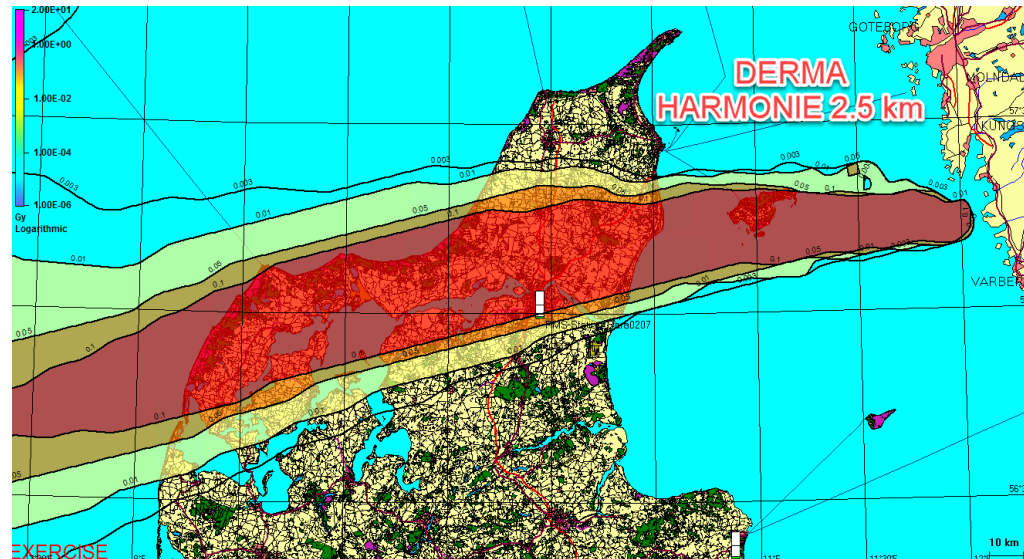
Large postulated release from Ringhals NPP

- RIMPUFF (based on HIRLAM data)



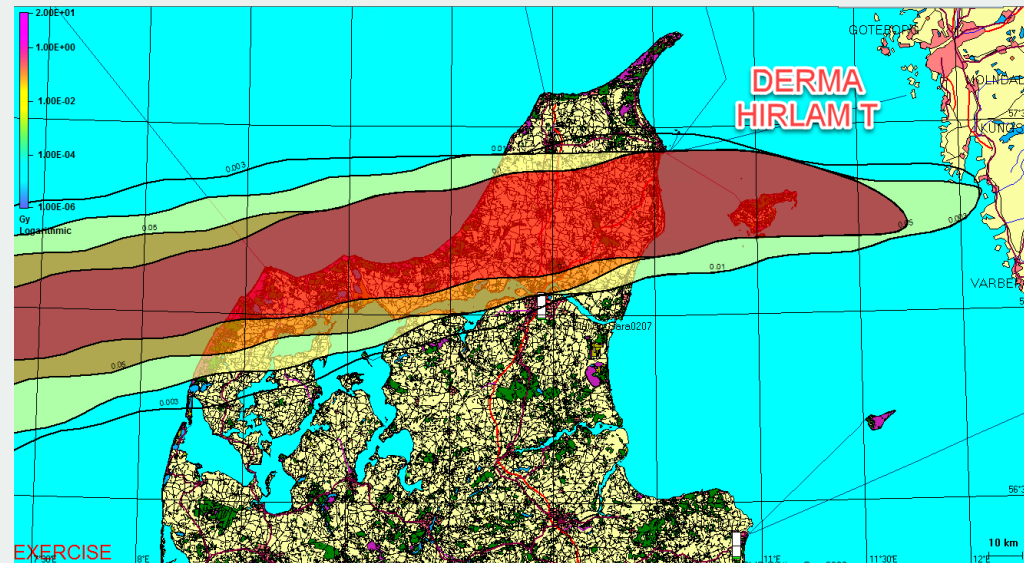
Thyroid dose (5y)

- DERMA (based on HARMONIE)



Thyroid dose (5y)

- DERMA (based on HIRLAM T)

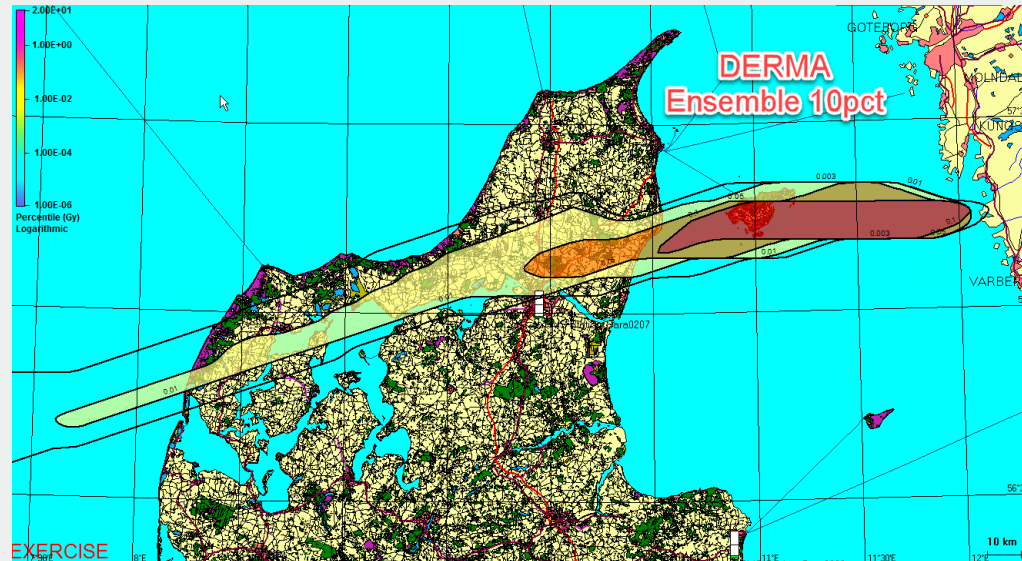


Uncertainty – Meteorological (Harmonie Model)

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

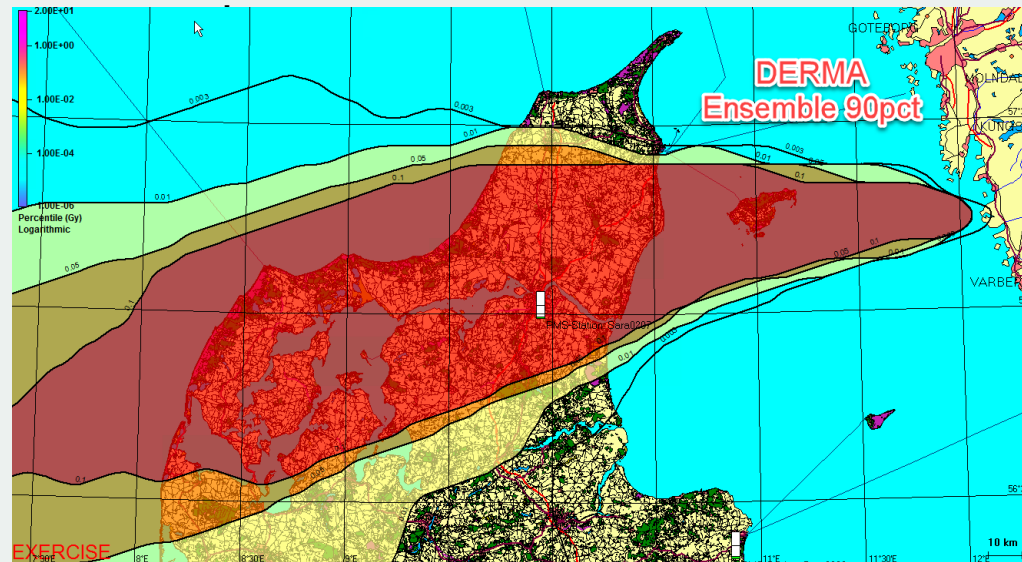
Thyroid “dose” (5y)

- DERMA ensemble result “where most models agrees”



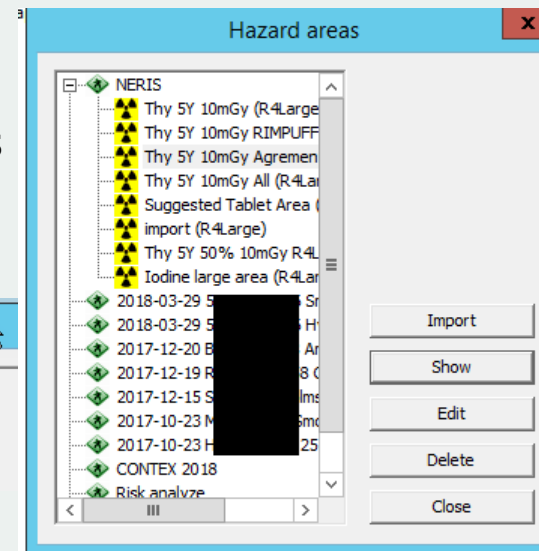
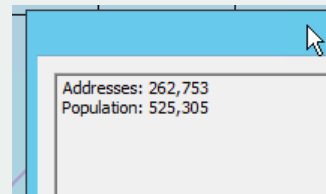
Thyroid “dose” (5y)

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

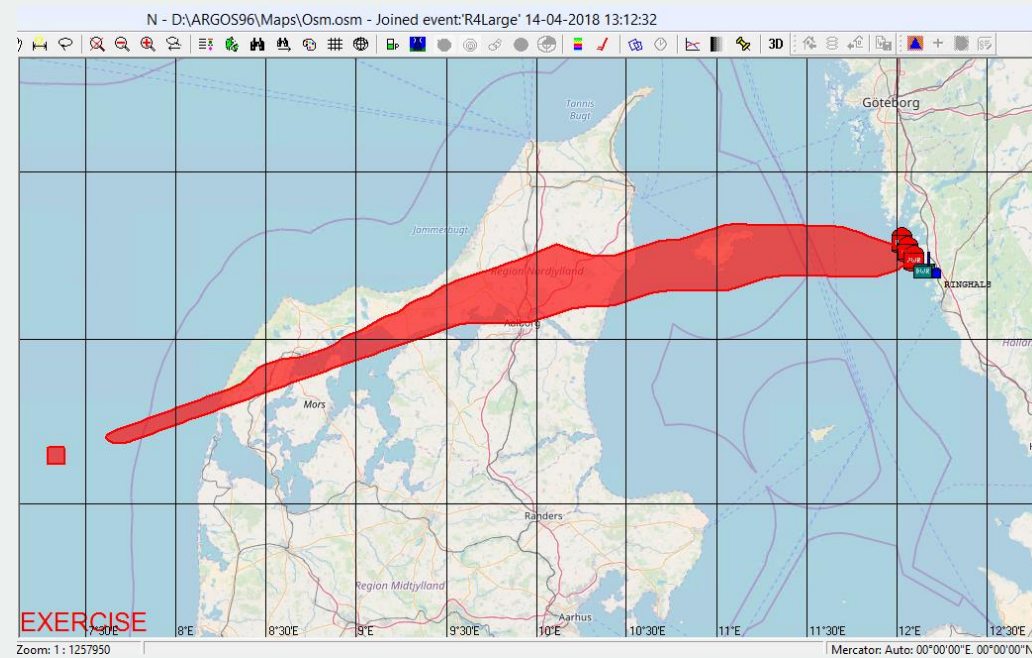


Coping with uncertainty in ARGOS

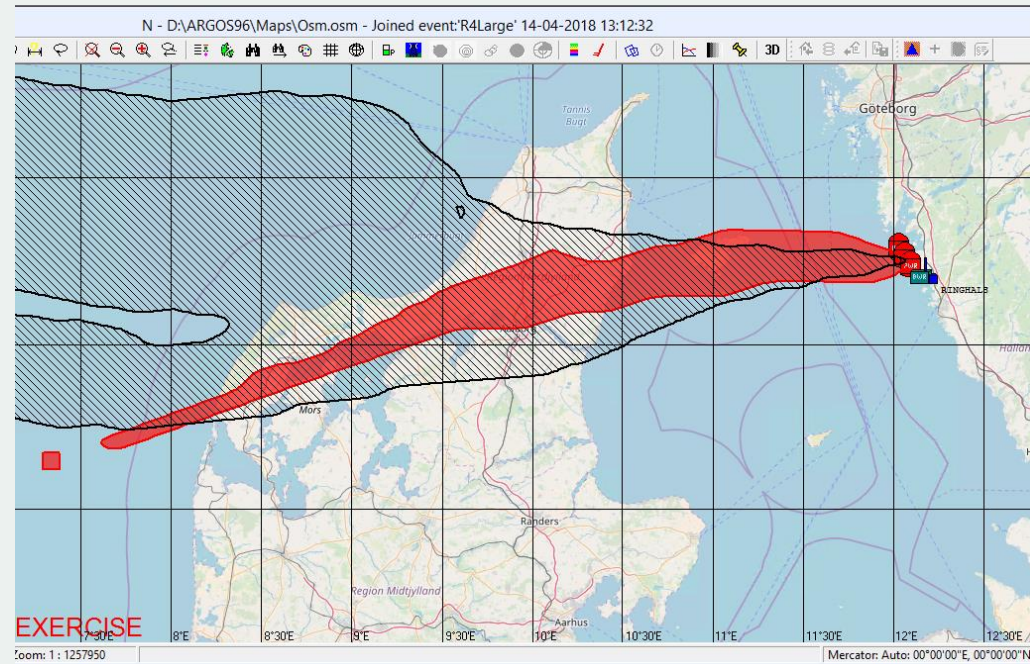
- Iso Curves are stored as Hazard areas in ARGOS
- Population data can be calculated for Hazard areas in DEMA's ARGOS-installation



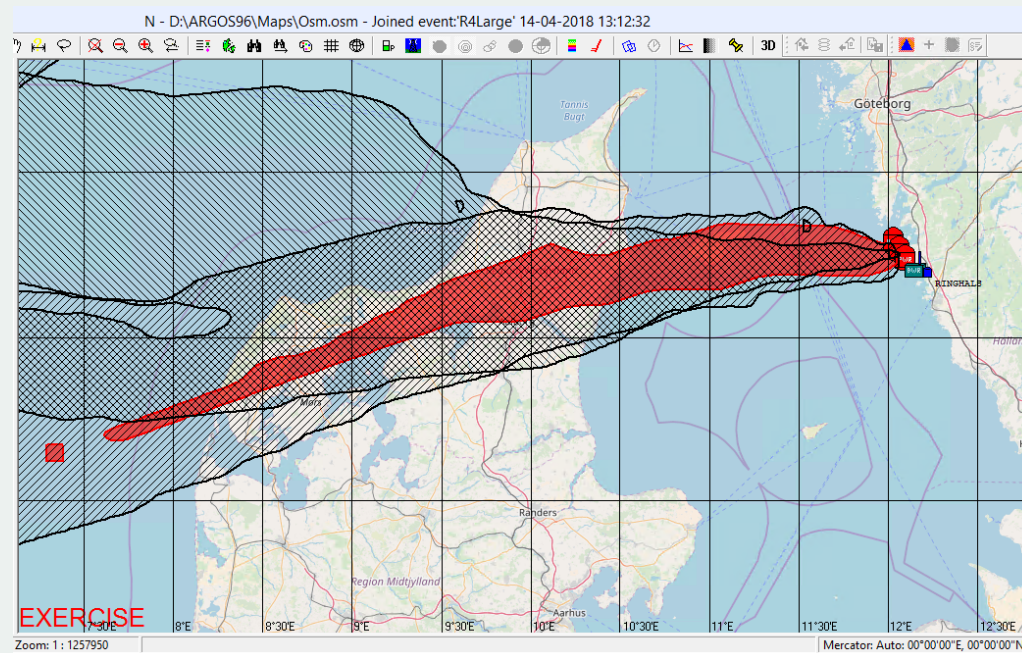
Ensemble 10th percentile



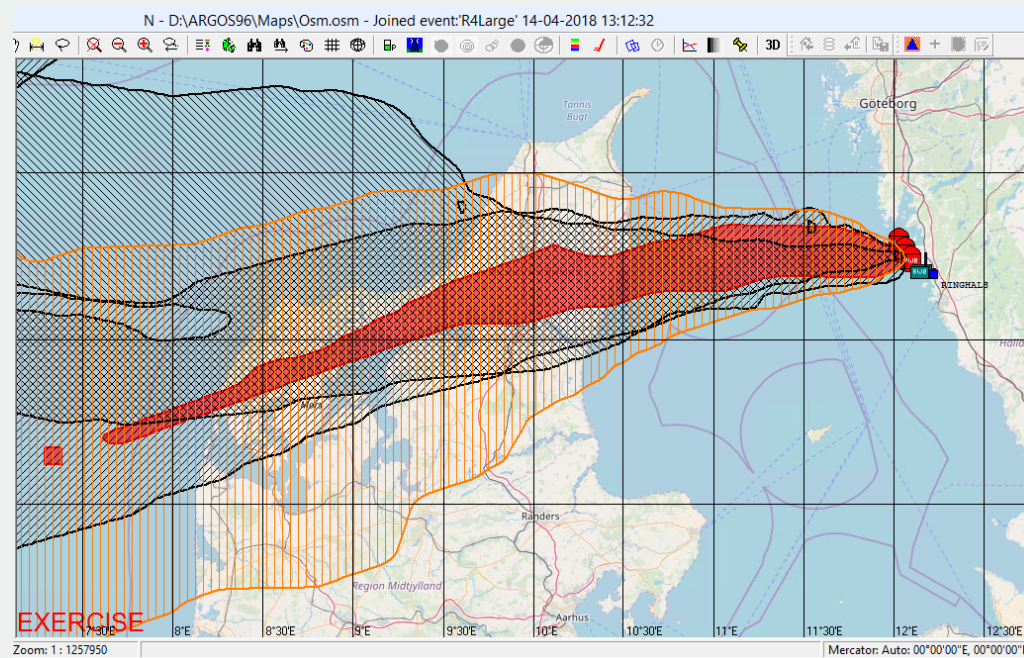
10th percentile+RIMPUFF



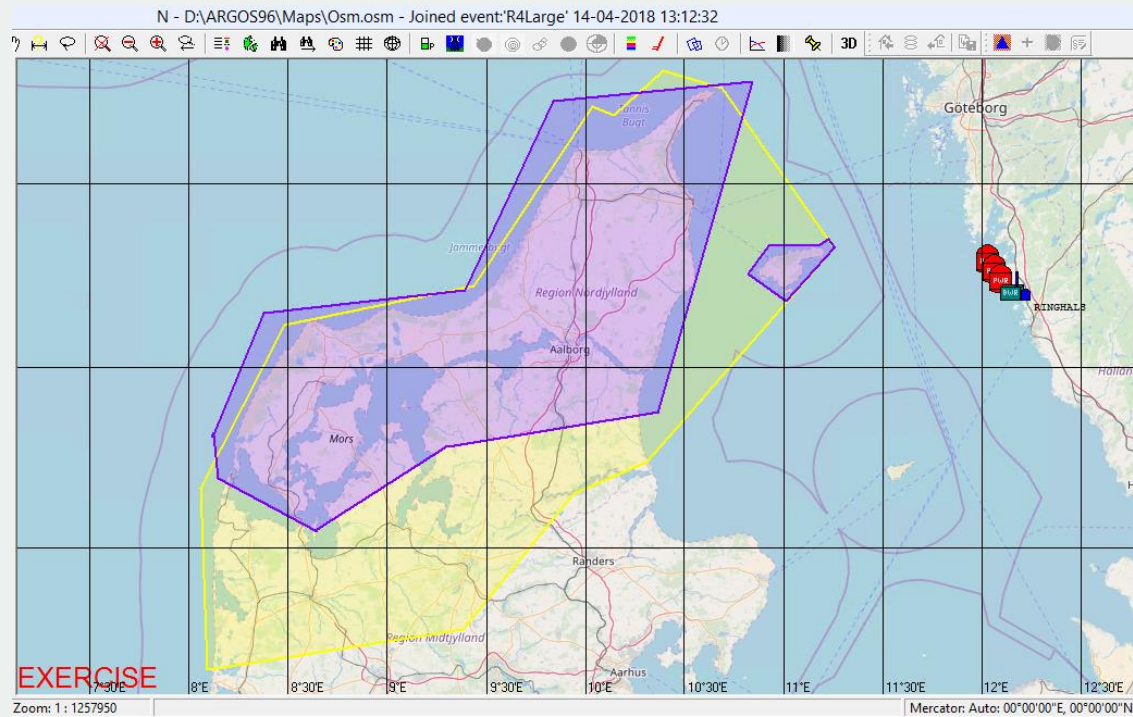
10th percentile+RIMPUFF+DERMA



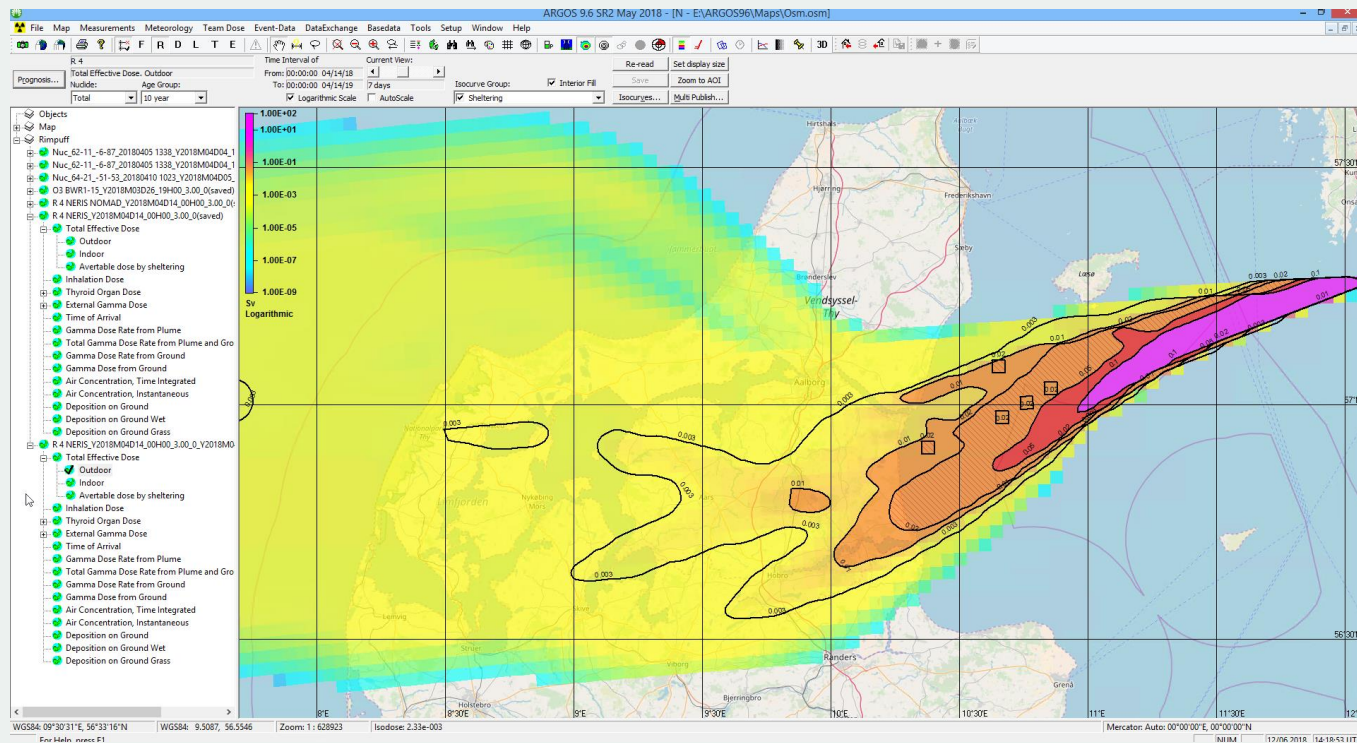
10th percentile+RIMPUFF+DERMA+90th percentile



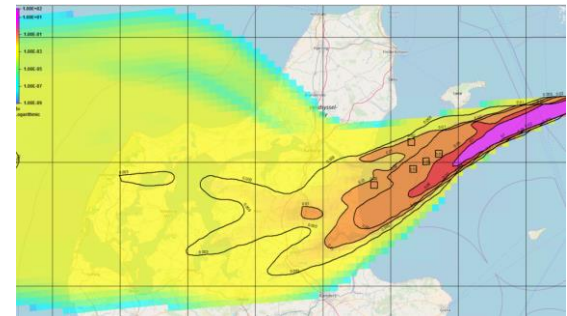
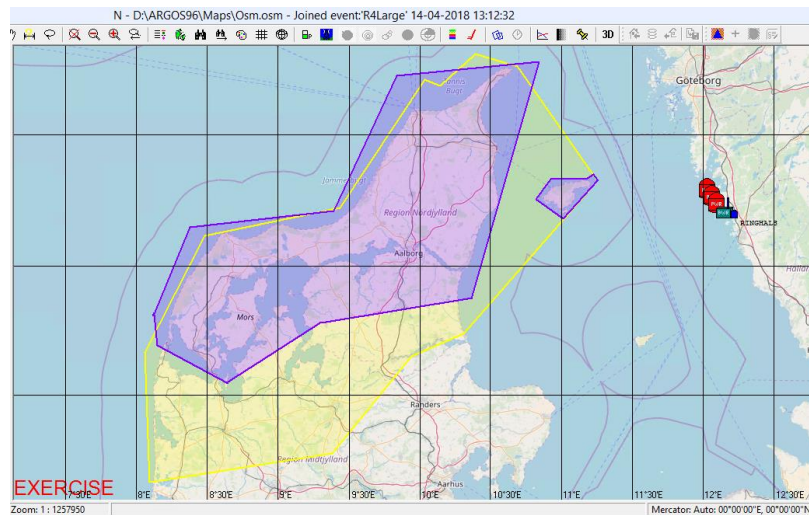
Solution: 2 areas for decision makers



Total early Dose – recalculated

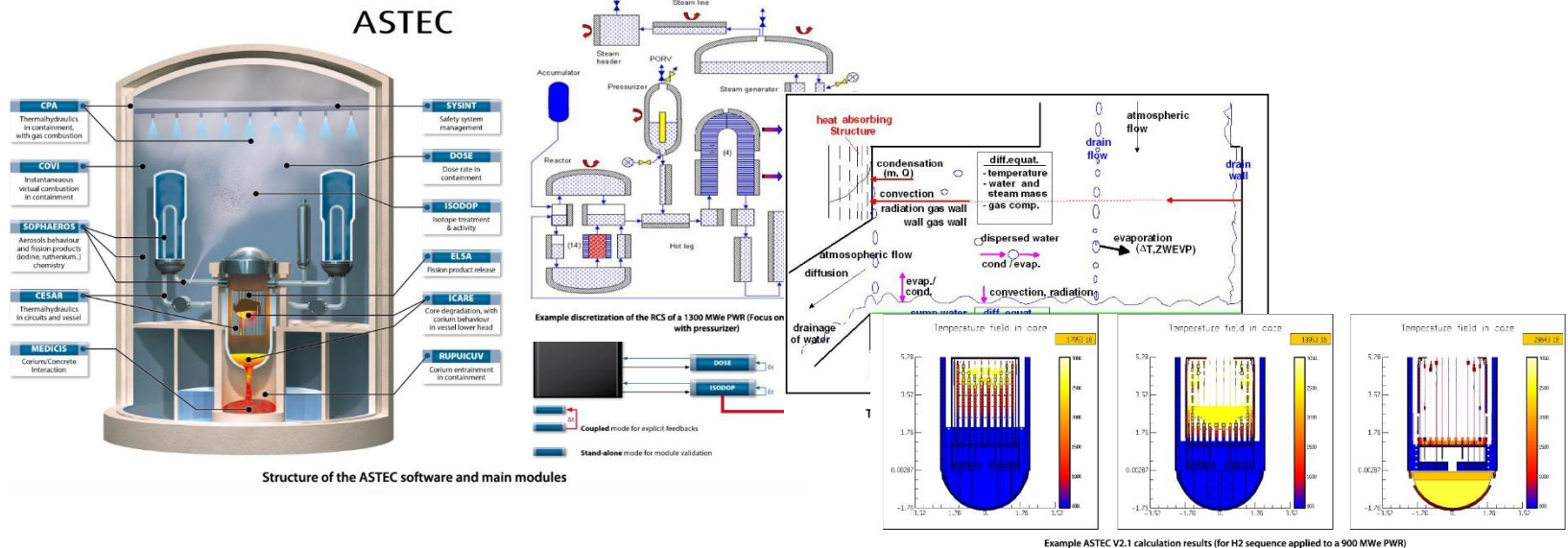


DID you remember?



Source Terms?

- Advanced Source Term models and severe accidents codes
- MELCOR, MAAP and ASTEC - not very usefully in the emergency phase



<https://www.irs.fr/EN/Research/Scientific-tools/Computer-codes/Pages/The-ASTEC-Software-Package-2949.aspx>

The EU FASTNET project

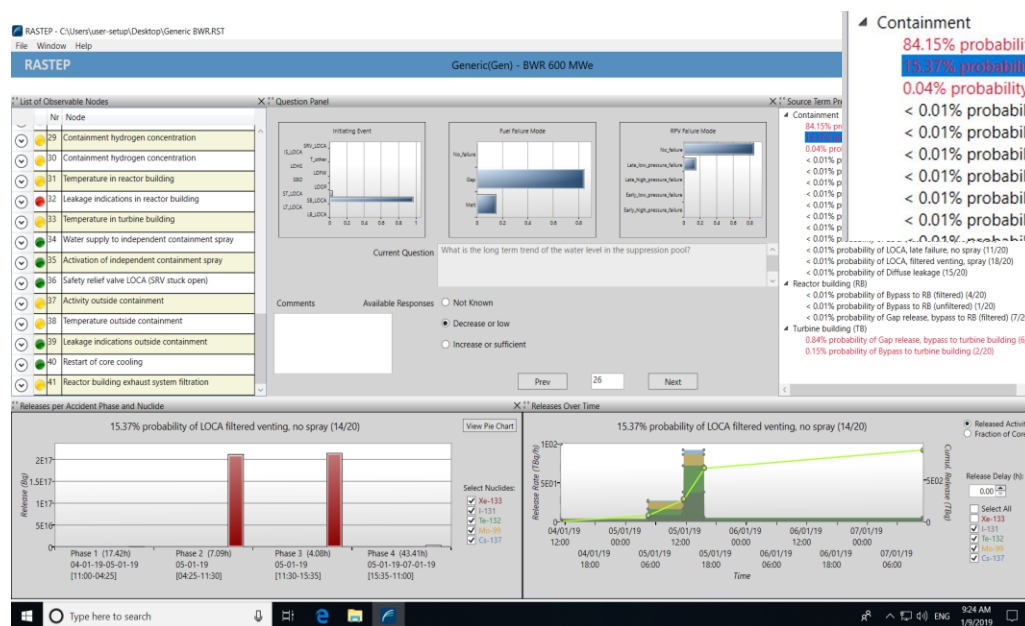
“Tool for the fast and reliable prediction of severe accident progression and anticipation of the source term of a nuclear accident”

- WP1: Developing a severe accident scenario database with generic source terms
- WP2 and WP3: Developing generic models for existing NPPs in Europe both using a deterministic approach (3D/3P and PERSAN) and a probabilistic method (RASTEP)
- WP4: Exercises using the source term tools developed in WP2 and WP3 together with decision support systems

RASTEP

(Developed by Lloyds Register Consulting for SSM)

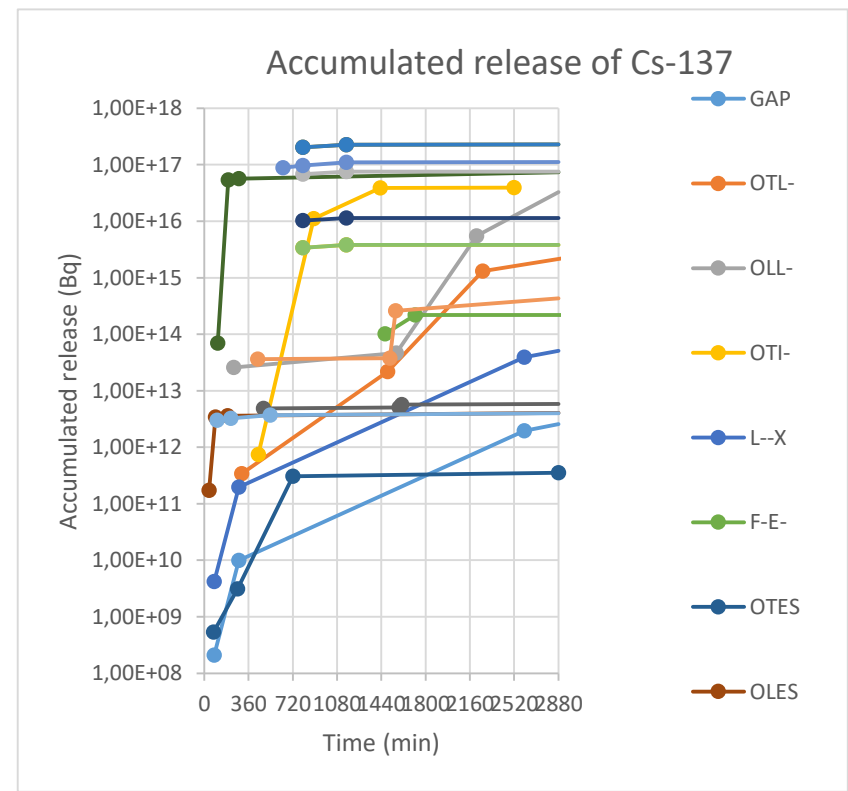
- By answering questions about e.g. system availability and containment pressure etc. RASTEP gives the probability for different source terms. The source terms in RASTEP are pre-calculated using a severe accident code.



How to mix uncertainties from a model chain in Nuclear Emergency Management

NKS AVESOME project lessons from a Emergency management View:

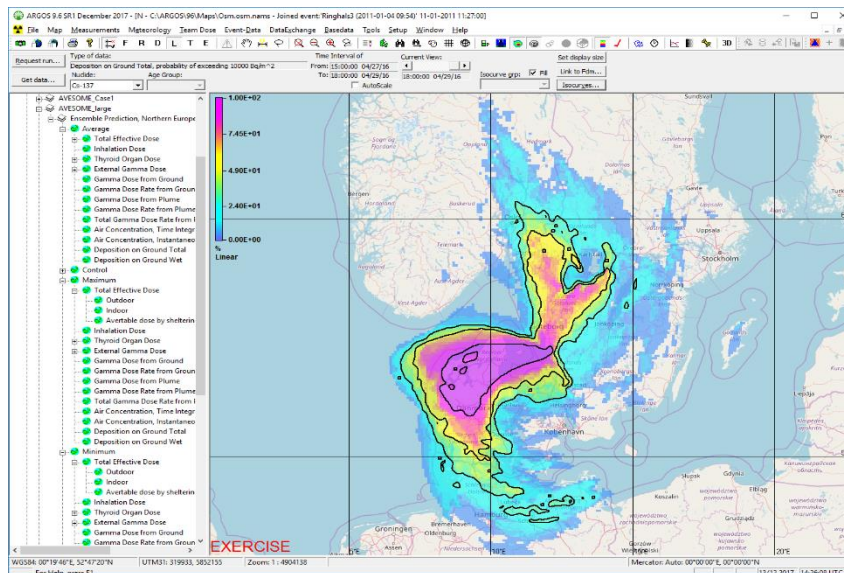
- Start with only a few source terms
- Only compare source term of similar size.
- *One forecast, one source term are still relevant!*



Implementation in ARGOS

Operational only for Meteorological
Ensemble modelling in Denmark

Technical operational before spring
2019.



Source Term Ensemble Definition

Sample Ensemble

Source Terms:

Source term	Probability [%]
BWR LOCA early failure with no spray	50
BWR Transient with filtered venting and no spray	33
BWR Transient with early failure and no spray	12
BWR Transient with late failure and no spray	5

Add source term Delete source term Save As...

☐ Basic

OK Cancel

Conclusions and hopes

Meteorological Ensemble Modelling is operational and provides dispersion outputs (In Denmark) **but with limited forecast time**, but we need more research in handling the uncertainty of source terms and monitoring data.

The Emergency management system can have **problem** with digesting the amount of data/prognosis coming from the models.

We need more technical cooperation between neighbouring countries and a more open approach for exchanging potential source term.

If we shall maintain a trustworthy Nuclear Emergency handling, we need technical expertise on all levels in the Emergency Organisations.

Thank you



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