NKS-B NORCON: Results Of The NKS-Activity "Nordic Nuclear Accident Consequence Analysis"

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- Contracts: AFT/B(14)1 and AFT/B(15)2.
- Period: 2014 – 2015
- Overall Objective:

«To follow the scheme of a consequence analysis from a common starting point for the purpose of identifing areas of potential divergence or disparity in the production of the information upon which handling of a serious nuclear accident is based»

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Stages:

1. Development/adoption of robust, practicable, source terms for two nuclear faciilties – one in and one near to the Nordic region.

2. Agreement on comparators and how they will be employed within the project.

3. Conducting and comparison of dispersion/transport prognoses.

4. Conducting and comparison of later phase assessment – environmental transfer/impacts etc.

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Source terms:

Brokdorf PWR, Germany (53˚51′03″N 9˚20′41″E), 1440 $MW_{(e)}$. Source term from "*Aktualisierung der Quelltermbibliothek des Entscheidungshilfesystems RODOS für Ereignisse im Leistungsbetrieb", Löffler, H., Mildenberger, O., Sogalla, M., Stahl, T., Gesellschaft für Anlagenund Reaktorsicherheit (GRS) GmbH, 2010*.

Ringhals PWR, Level 2 Probabilistic Safety Assessment (PSA) for the 2011 uprated Ringhals 4 PWR (3300 $MW_{(th)}$) reactor (57˚15′35″N 12˚6′39″E).

26 isotopes for each source term, release heights, releases with time etc etc.

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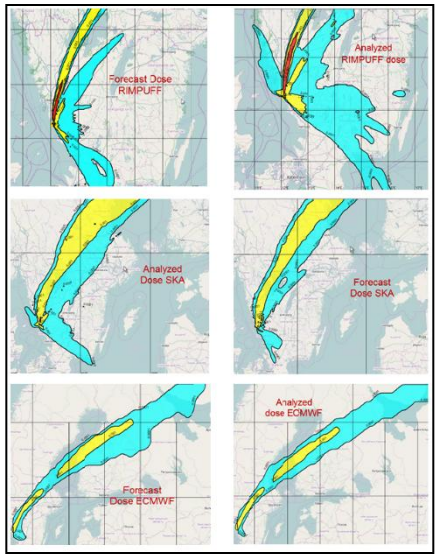
Dispersion/Transport

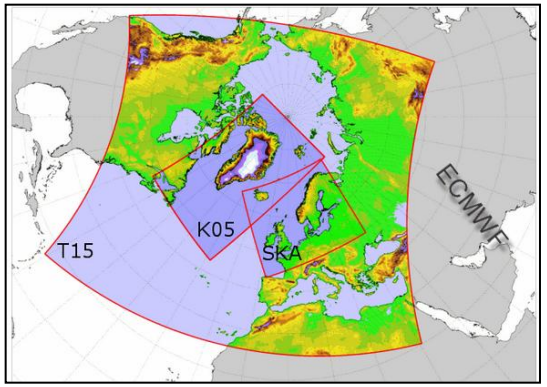
Each country performed dispersion/transport assessment according to the systems employed in each country and which would be employed in an accident.

Calculations were performed for actual weather conditions on two specific dates chosen within 2014 and 2015.

Countries were asked to report information relating to specific output parameters relevant to emergency preparedness.

<u>NOT</u> a comparison of models against any «true» situation - a comparison of the use of models by operators and the information produced.





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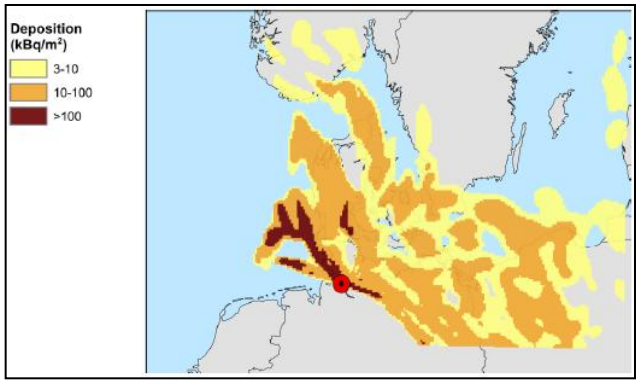
16 results (eight for each of the reactors) covering eight different NWP models and four dispersion models were generated for each release date.

Various data filtering routines applied to make the outputs more comparable.

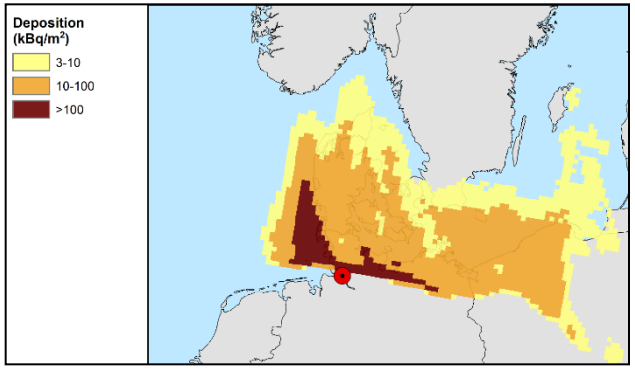
Outputs compared using a GIS system.

RIMPUFF outputs compared with outputs from long range models individually and combined.

^{137}Cs ground deposition, Brokdorf case



RIMPUFF with NOMADS-model.



SNAP with Norwegian HIRLAM-model.

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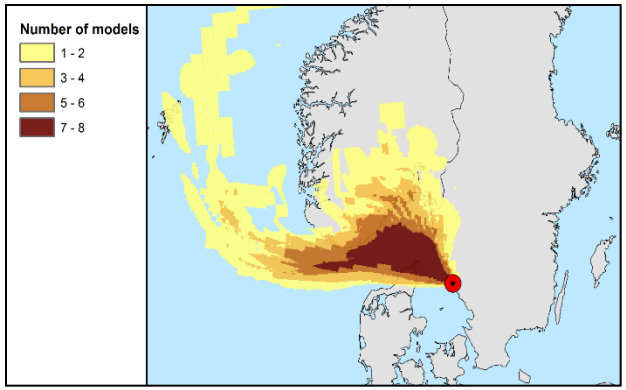
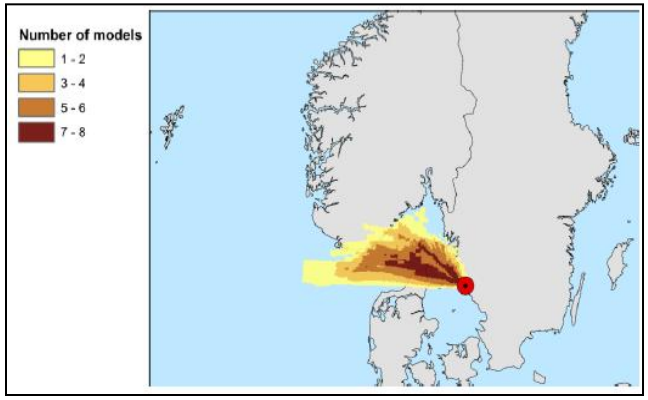
^{137}Cs ground deposition: Ringhals case comparison



A comparison of how all results agree to which areas are contaminated with 10 kBq/m^2 or more.



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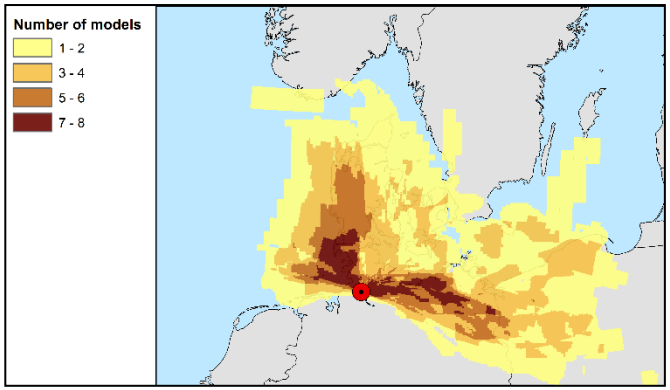

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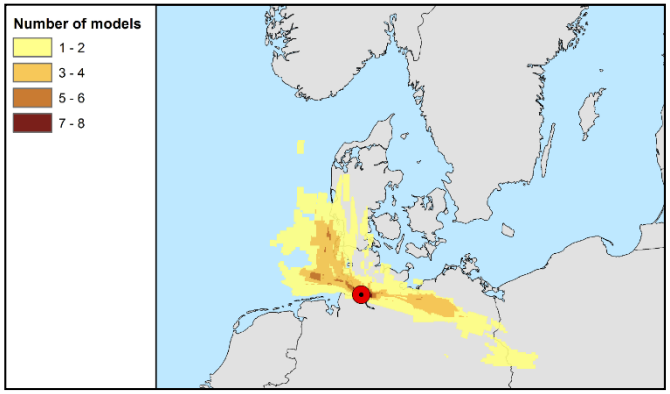

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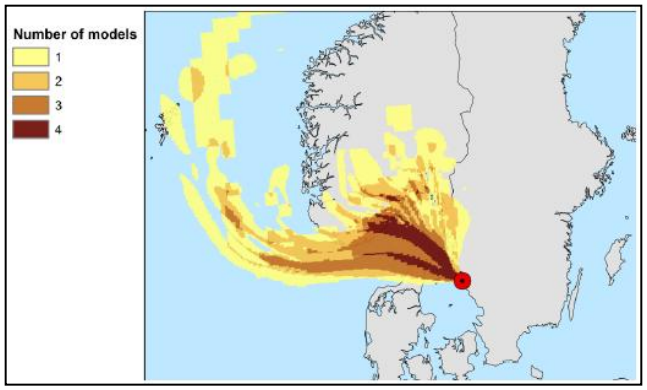
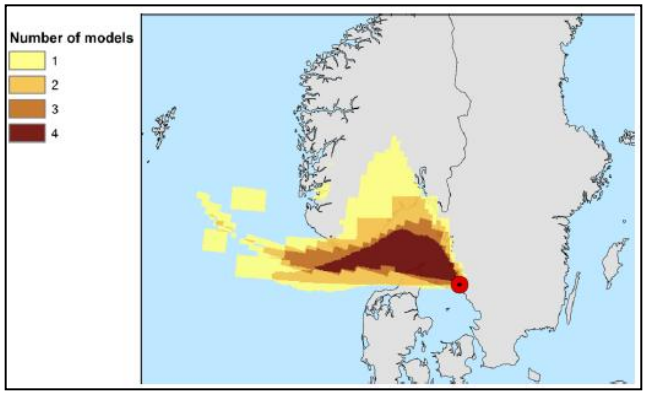
^{137}Cs ground deposition: Ringhals case comparison

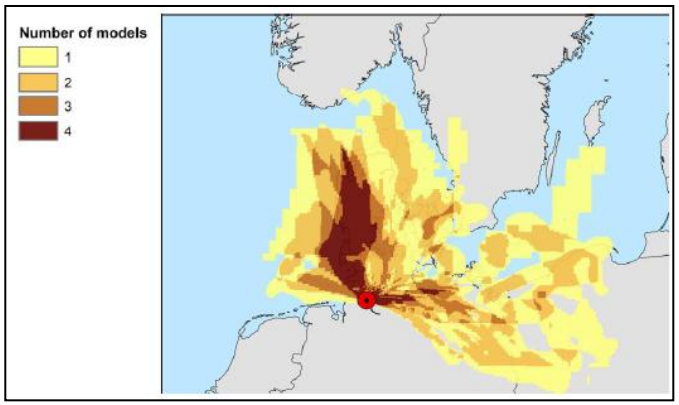


A comparison of how results from RIMPUFF agree to which areas are contaminated with 10 kBq/m^2 or more.



A comparison of how results from long range agree to which areas are contaminated with 10 kBq/m^2 or more.

^{137}Cs ground deposition: Brokdorf case comparison



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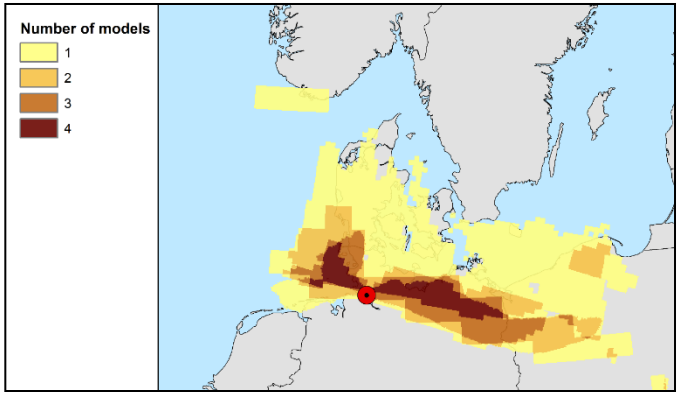

A comparison of how results from long range agree to which areas are contaminated with 10 kBq/m^2 or more.

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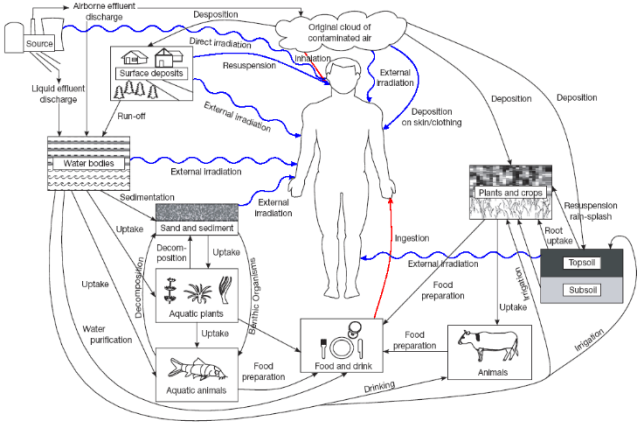
Environmental fate/transport

Each country, using common outputs from the first phase of NORCON and to the extent such procedures would be implemented in real life, estimated the transfer of specific radionuclides within terrestrial food chains and environmental systems.



Following «end points» were used:

- Soil values in Bq/kg over the top 10 cm.
- Grass Bq/kg
- Cow – meat and milk, Bq/kg and Bq/l
- Blueberry Bq/kg
- Mushroom Bq/kg
- Leafy Vegetables Bq/kg
- Root vegetable Bq/kg

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«Consequences» were estimated for data derived from dispersion prognoses conducted for October 17th 2015.

Estimates were based on deposition levels of 10000 and 100000 Bq/m^2 ^{137}Cs plus related levels of other isotopes.

Estimates produced for two «seasons» – 1st of March and 17th of October.

Estimates produced for four time periods:

- 7 days after release
- 3 months after release
- 1 year after release
- 2 years after release

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	Sweden/Norway			
Beef	7 days	90 days	1 yr	2 yrs
^{134}Cs	***0.008***	***0.0009***	0.16	0.09
^{137}Cs	***0.005***	***0.0006***	0.14	0.08
Berries				
^{134}Cs			***0.0004***	***0.0003***
^{137}Cs			***0.0004***	***0.0003***
Milk				
^{134}Cs	1.7	***0.04***	3.3	1.03
^{137}Cs	1.1	***0.03***	2.9	0.91
Leafy Veg.				
^{134}Cs	0.40	3.23	0.24	0.18
^{137}Cs	0.25	2.02	0.21	0.16
Root veg.				
^{134}Cs	0.24	***17.9***	0.2	0.15
^{137}Cs	0.17	***11.6***	0.18	0.14
Grass, int.				
^{134}Cs	1.1	***11.0***	0.2	0.15
^{137}Cs	0.74	7.0	0.18	0.13

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Possible explanations:

Source data – where it has come from, the quality of it.

The approach – generic transfer factors applied to specific categories etc.

The models – what exactly is occurring within the models, how inputs are dealt with, transfer coefficients versus transfer ratios etc.

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Observations:

There is little reason to conclude that different approaches to dispersion/transport modelling could result in radically different appreciations of potential consequences.

Within systems of estimating longer term consequences there is potential for arriving at different estimates based upon common inputs.

Even the simpler approaches to making such estimates can result in significant divergence depending on sources of input data.

Within more complex models or methods, the reason for divergence is less simple to establish.

Ways forward:

More focus on how or if long term consequences are estimated by individual countries.

Acknowledgements

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