ARGOS

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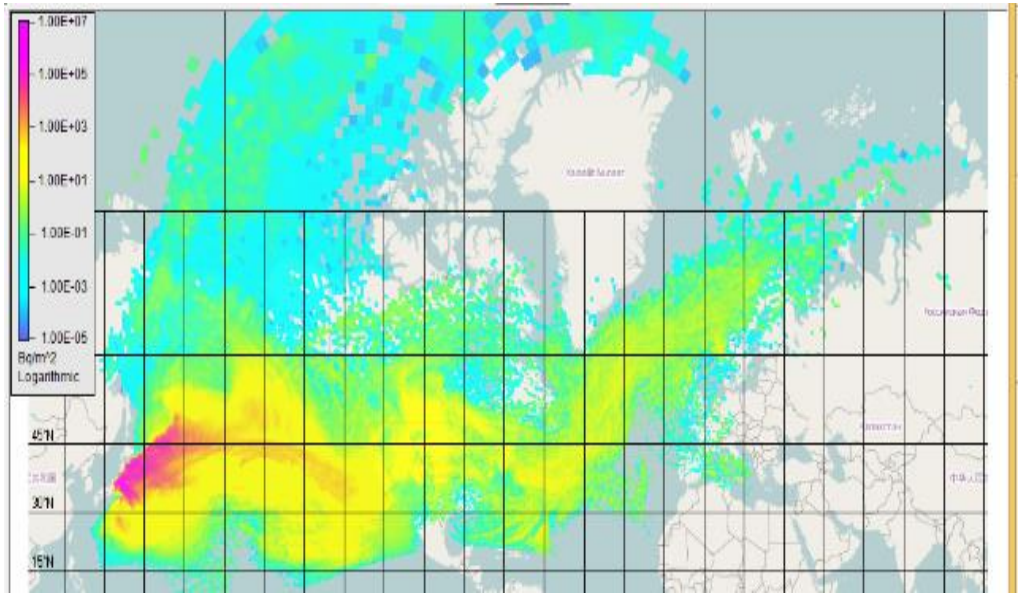
What is ARGOS

- Decision Support System (DSS) for Nuclear Health and Safety – off-site
- Dispersion prognoses, measurement data and dose calculation (short and long term)
- For exercises, dimensioning – and accidents



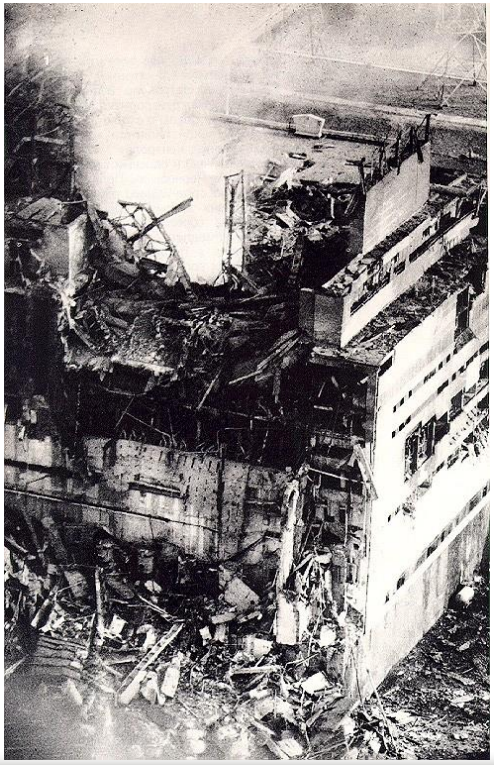
Model calculation of ^{131}I deposition performed by NRPA in ARGOS DSS during the Fukushima accident

Where does ARGOS come from?

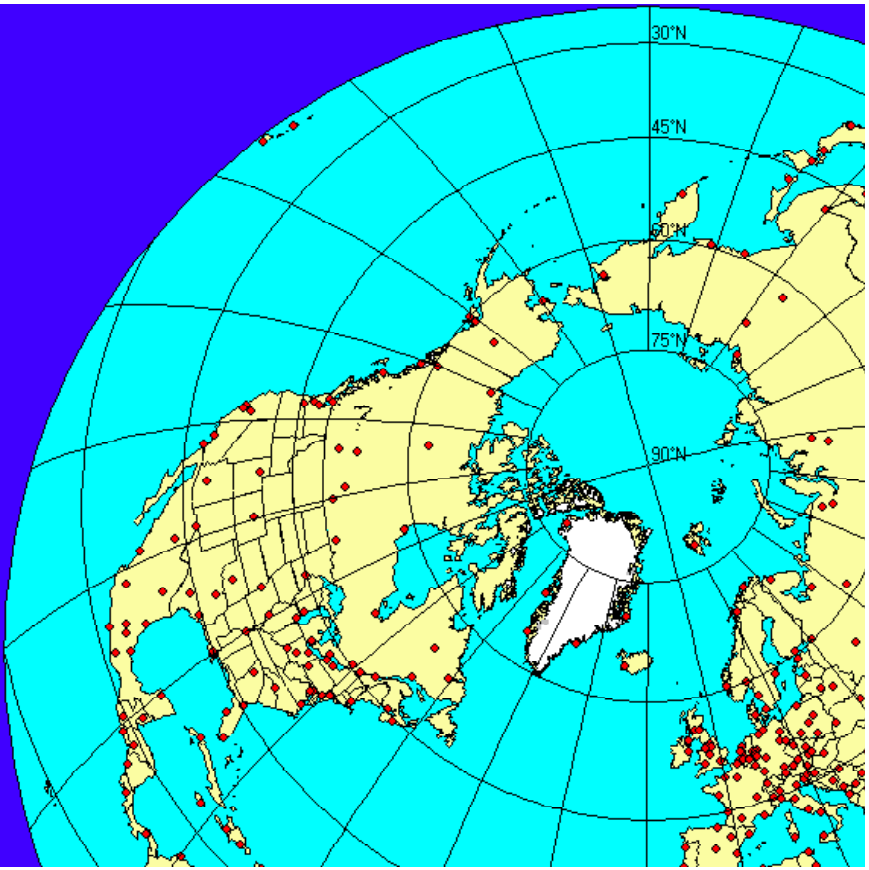
Accident
Reporting
Guidance and
Operational
Support

Analysis for operational use

- Monitoring
- Measurements
- Modeling
  - Urban/Meso/Long Dispersion calculation
  - External Dose
  - Food Dose



ARGOS history



1. The first primitive version of ARGOS was presented in 1986 (Chernobyl)
2. A complete rewriting into Windows NT (ß) was done in 1993 (Nuclear)
3. In 2001 DEMA and Prolog Development Centre established a consortium of users now covering:
   Australia, Brazil, Bosnia-Herzegovina, Canada, Denmark, Estonia, Ireland, Lithuania, FYR Macedonia, Montenegro, Norway, Poland, Serbia, Sweden
4. ARGOS users include:
   VDD, Latvia. DSO, Singapore. Tokyo University. North West university, ZA
5. In 2005 Chemical scenarios were included
6. In 2009 full CBRN functionality implemented

ARGOS Goals

- Get an overview of the incident.
- Create a prognosis of how the incident will evolve.
- Calculate consequences of the incident.
- Handle information to decision makers.
- Support decision on appropriate countermeasures.
- Handle information/decisions to the public.

ARGOS collects data in order to provide

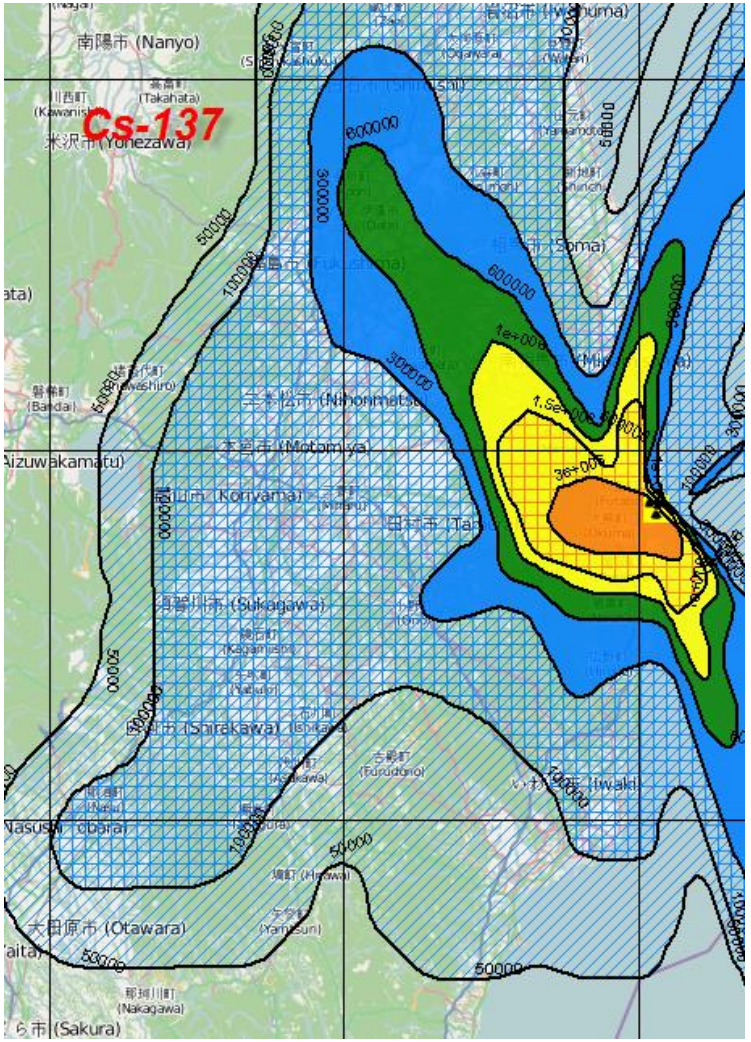
INFORMATION

Cooperation during Fukushima incident

- DTU provided high resolution land-use and orography within 36 hours
- ARPANSA provided worldwide NWP within 24 hours
- RPB, NRPA, SSM and DEMA all provided long range dispersion calculations within 36 hours
- Through out the accident ARGOS users continued to share data, information and results
- Developers provided improved interface to NOMADS NWP within 48 hours

RIMPUFF – Dispersion calculation

- Developed by RISØ-DTU
- Range: 0 to “some hundred km’s”
- Puff-based model
- Driven by
  - NWP
  - Met-Towers
  - Manual Met input
  - Combinations of the above
- Handles Wet deposition
  - NWP, Radar, Manual input

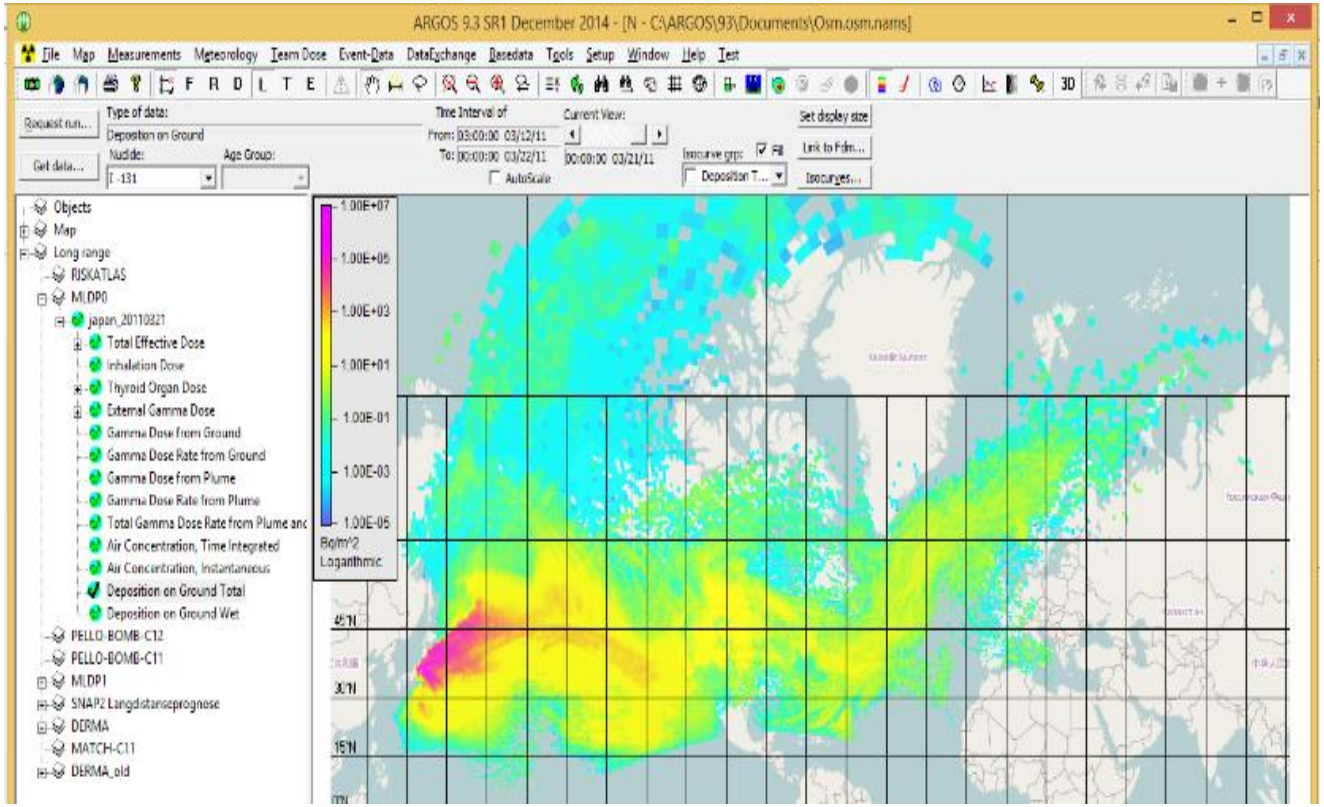


Operational model description

Items	ARGOS
Code name	ARGOS (RIMPUFF for meso scale dispersion calculation)
Development organization	PDC-ARGOS ApS – Danish Technical University
Operational organizations	DEMA-DK 1992, ERPC-EE 1995, EPA-LT 1995, PAA-PL 1997, EPA-IE 2001, NRPA-NO 2001, RPB-CA 2002, SSM-SE 2003, ARPANSA-AU 2007, CNEN-BR 2007, MUP-ME 2008, MST-BA 2010, MSB-MK 2011, MUP-RS 2012
Air flow model	Given by NWP-model
Gas dispersion model	Lagrangian puff
Dry deposition model Wet deposition model	Resistance analog model - FDM Parameterizations washout rate
Precipitation data	Observed data (radar) and/or calculated data from NWP
Calculation spatial domain	Rectangle (Min 1x1 km. Max 2560x2560 km) Gridsize: Min. 50 m. Max 5 km.
Calculation time step	Min. 1 min. Max. 10 h
Output data	Total Effective Dose, Inhalation Dose, Thyroid Organ Dose, External Gamma Dose from Plume and/or Ground, Time of Arrival, Total Gamma Dose Rate from Plume and Ground, Air Concentration Time integrated, Air Concentration Instantaneous, Deposition on Ground
Terrain effect	Imported terrain grid and landuse
Source term estimation	Import from external model or look-up-table

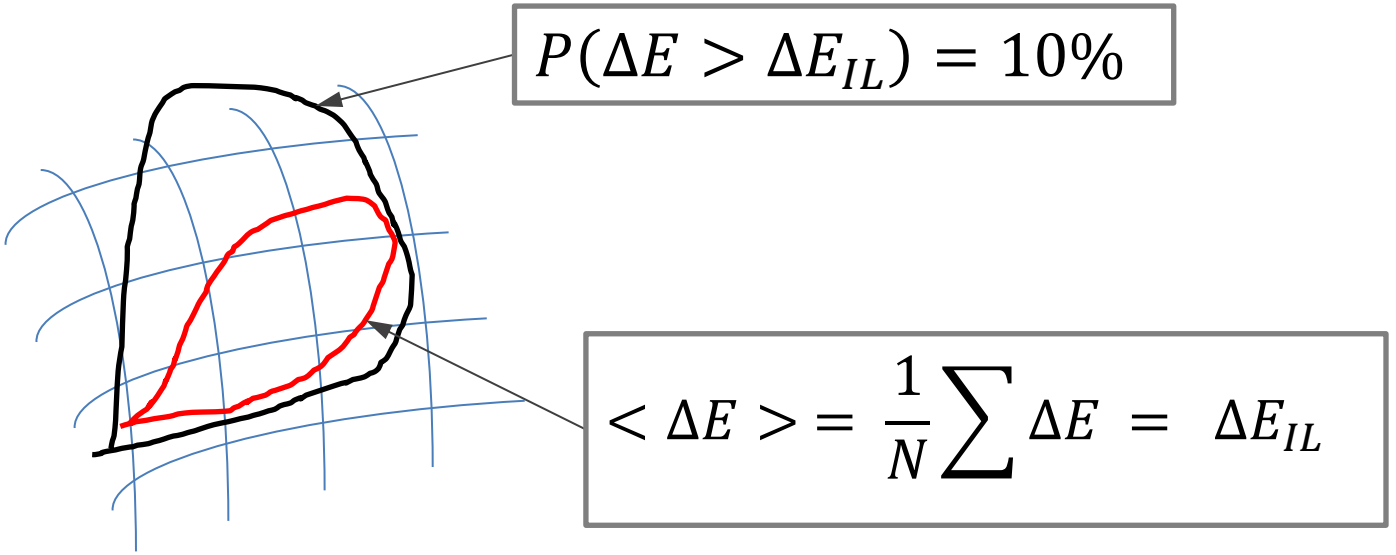
Long Range dispersion

- Interface to external models
- ARGOS calculates dose assessments



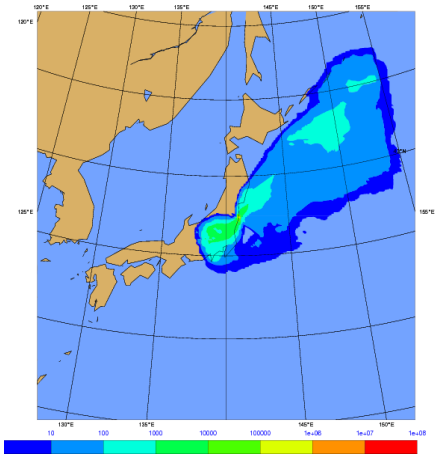
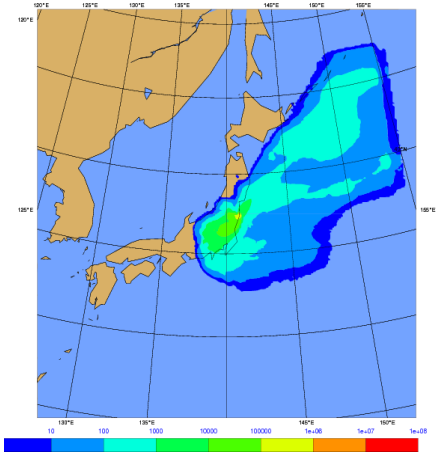
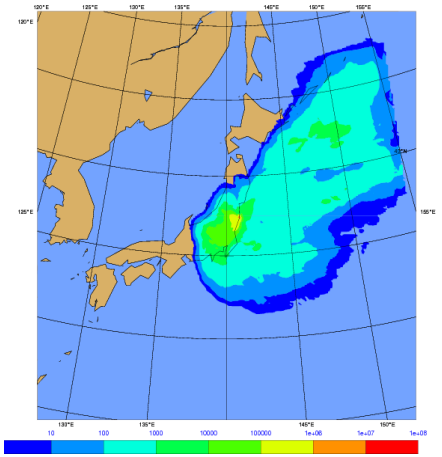
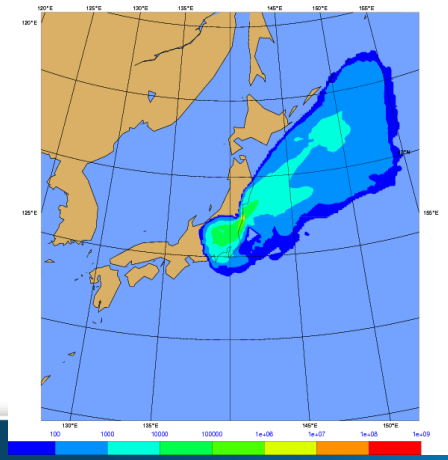
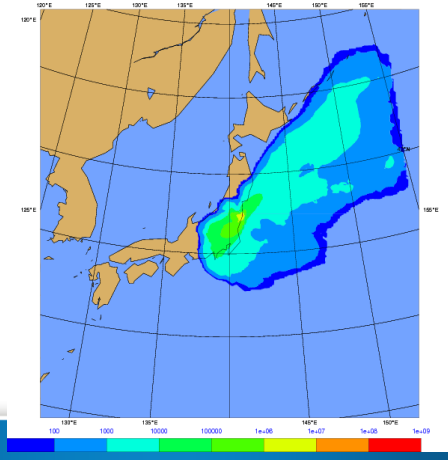
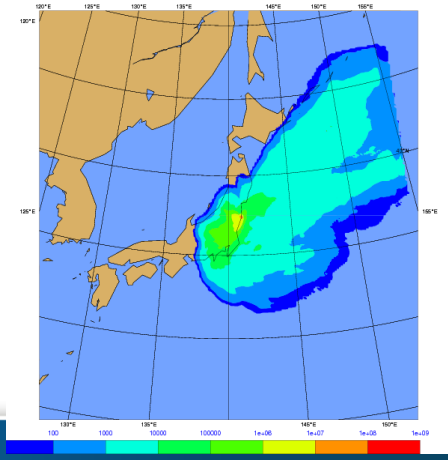
Atmospheric dispersion modelling: uncertainty and how to show it

- **Reference Level, e.g.: ΔE_{IL} = 100 mSv**



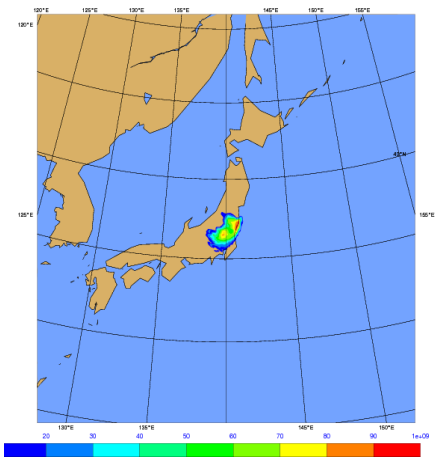
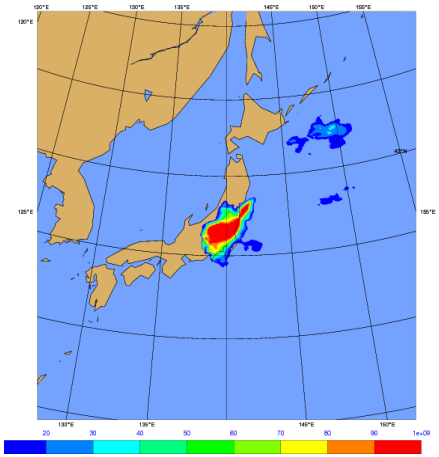
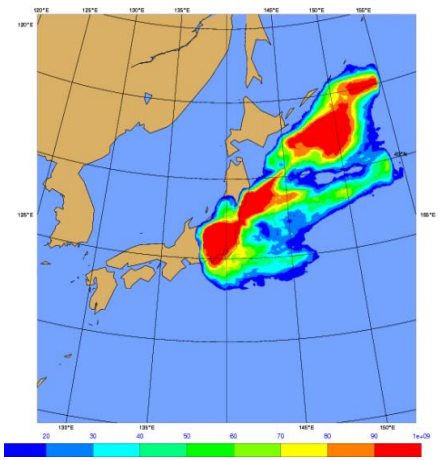
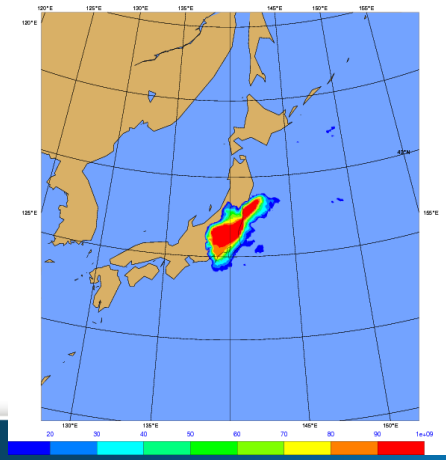
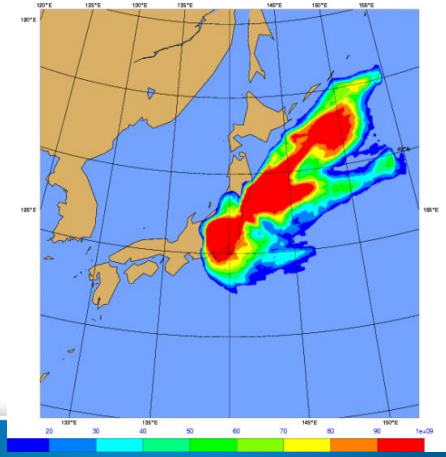
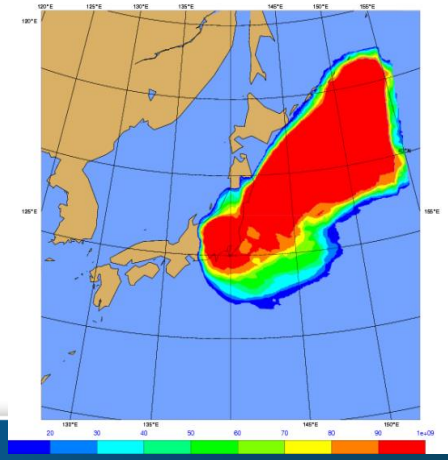
Scenario 1: 2011-03-14 0 UTC NWP

Total deposition

	10th percentile	50th percentile	90th percentile
Cs-134			
I-131			

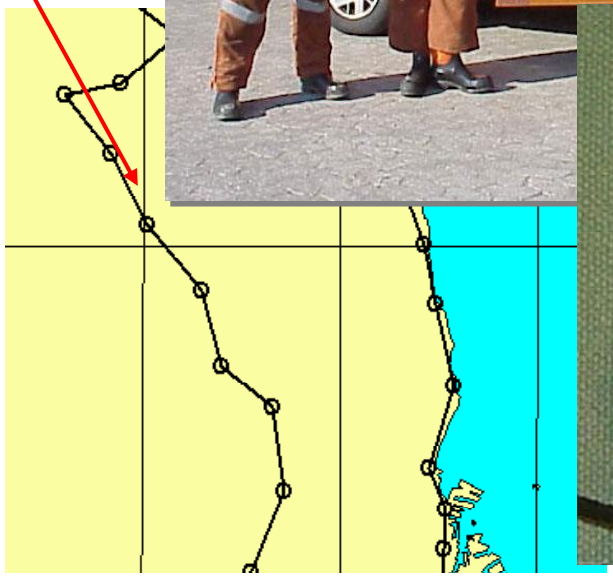
Scenario 1: 2011-03-14 0 UTC NWP

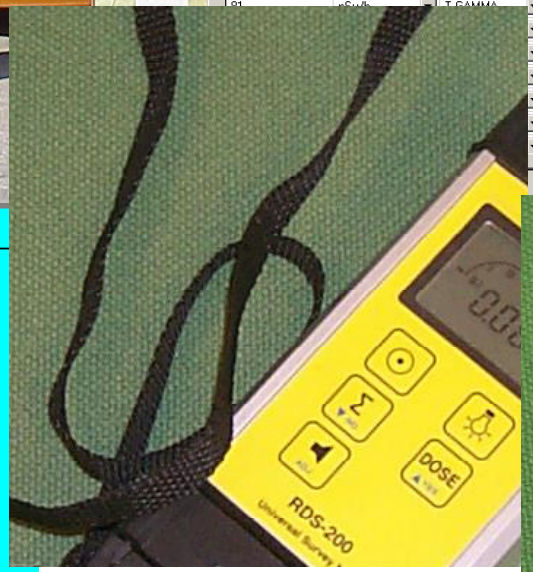
Total deposition

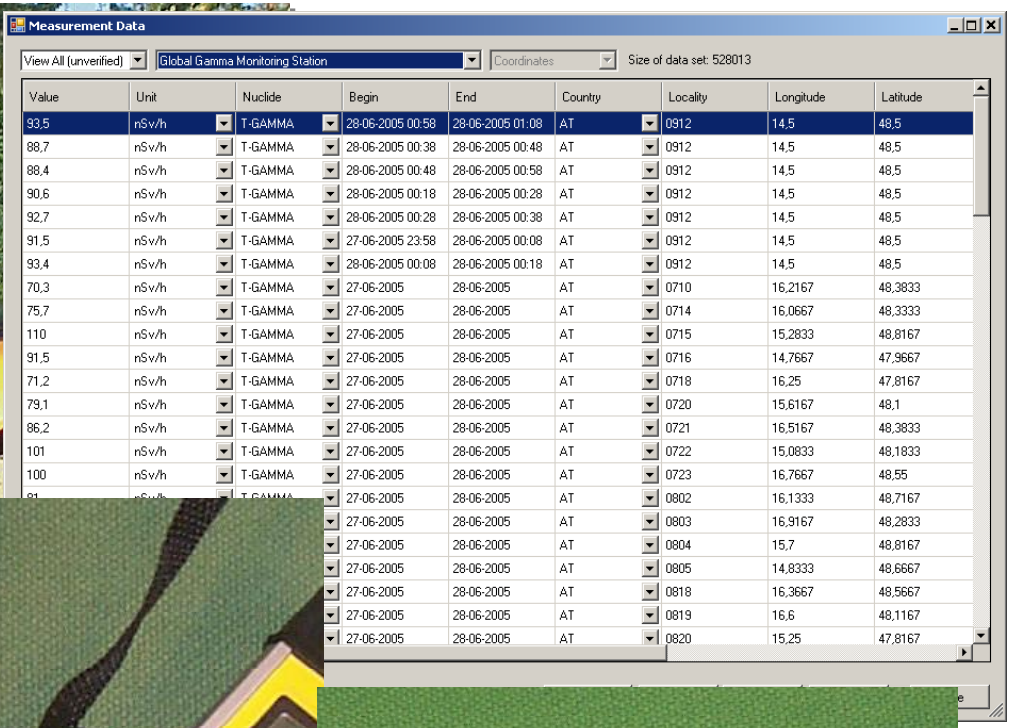
	$P(c > 10^4\ \mathrm{Bq/m^2})$	$P(c > 10^3\ \mathrm{Bq/m^2})$	$P(c > 10^2\ \mathrm{Bq/m^2})$
Cs-134			
I-131			

Interface for manual Measurements

Monitoring points

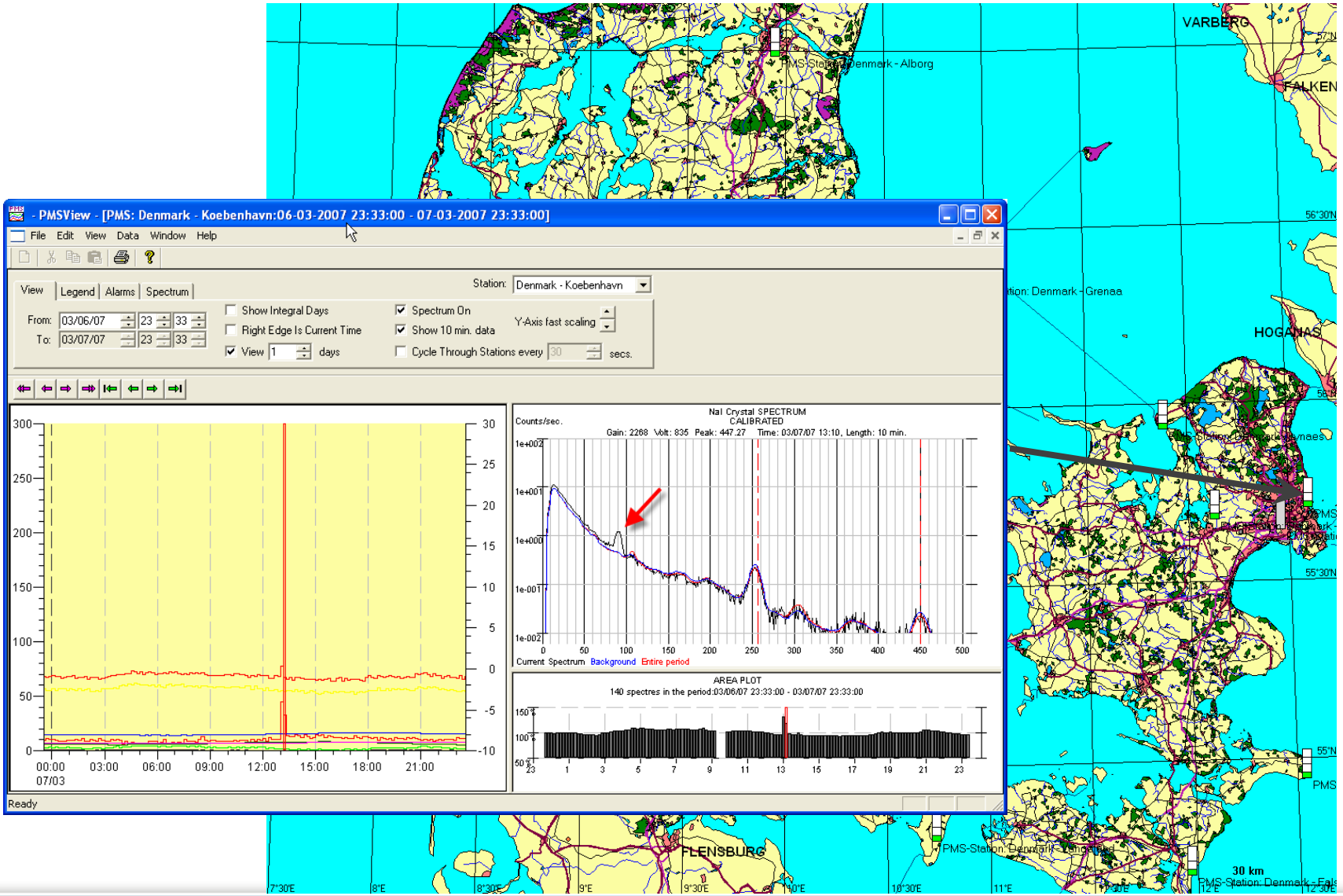






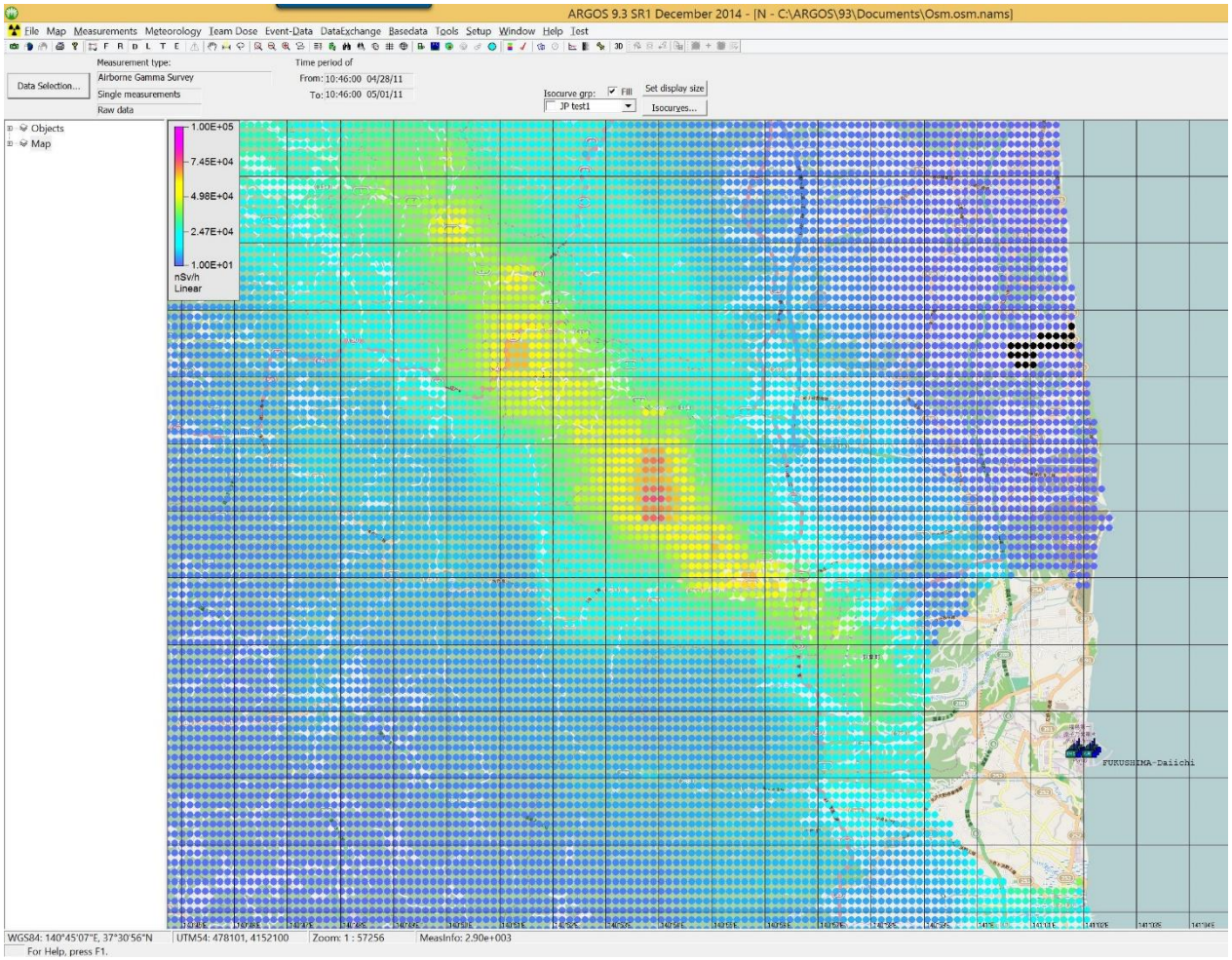
Value	Unit	Nuclide	Begin	End	Country	Locality	Longitude	Latitude
93,5	nSv/h	T-GAMMA	28-06-2005 00:58	28-06-2005 01:08	AT	0912	14,5	48,5
88,7	nSv/h	T-GAMMA	28-06-2005 00:38	28-06-2005 00:48	AT	0912	14,5	48,5
88,4	nSv/h	T-GAMMA	28-06-2005 00:48	28-06-2005 00:58	AT	0912	14,5	48,5
90,6	nSv/h	T-GAMMA	28-06-2005 00:18	28-06-2005 00:28	AT	0912	14,5	48,5
92,7	nSv/h	T-GAMMA	28-06-2005 00:28	28-06-2005 00:38	AT	0912	14,5	48,5
91,5	nSv/h	T-GAMMA	27-06-2005 23:58	28-06-2005 00:08	AT	0912	14,5	48,5
93,4	nSv/h	T-GAMMA	28-06-2005 00:08	28-06-2005 00:18	AT	0912	14,5	48,5
70,3	nSv/h	T-GAMMA	27-06-2005	28-06-2005	AT	0710	16,2167	48,3833
75,7	nSv/h	T-GAMMA	27-06-2005	28-06-2005	AT	0714	16,0667	48,3333
110	nSv/h	T-GAMMA	27-06-2005	28-06-2005	AT	0715	15,2833	48,8167
91,5	nSv/h	T-GAMMA	27-06-2005	28-06-2005	AT	0716	14,7667	47,9667
71,2	nSv/h	T-GAMMA	27-06-2005	28-06-2005	AT	0718	16,25	47,8167
79,1	nSv/h	T-GAMMA	27-06-2005	28-06-2005	AT	0720	15,6167	48,1
86,2	nSv/h	T-GAMMA	27-06-2005	28-06-2005	AT	0721	16,5167	48,3833
101	nSv/h	T-GAMMA	27-06-2005	28-06-2005	AT	0722	15,0833	48,1833
100	nSv/h	T-GAMMA	27-06-2005	28-06-2005	AT	0723	16,7667	48,55
			27-06-2005	28-06-2005	AT	0802	16,1333	48,7167
			27-06-2005	28-06-2005	AT	0803	16,9167	48,2833
			27-06-2005	28-06-2005	AT	0804	15,7	48,8167
			27-06-2005	28-06-2005	AT	0805	14,8333	48,6667
			27-06-2005	28-06-2005	AT	0818	16,3667	48,5667
			27-06-2005	28-06-2005	AT	0819	16,6	48,1167
			27-06-2005	28-06-2005	AT	0820	15,25	47,8167

Interface for Monitoring Stations



Import/Export of monitoring data

Here AGS from NNSA showing ɣ-dose rate measured April 28th 2011 as an example



Long term Dose Assessment

- **Agricultural areas**
  - AGRICP-model
  - Countermeasures – food act. / ingestion dose
- **Inhabited areas**
  - ERMIN-model
  - Initial dose on to surfaces – countermeasures
- **Both models include Countermeasures**
  - AGRICP: reducing ingestion dose
  - ERMIN: reducing external β and γ exposure from deposited material and internal dose from resuspended material
- **Both models can run using**
  - Dispersion calculation results
  - Measurements