Atmospheric dispersion modelling to locate the source of airborne radioactivity – do we use all the know-how we have?

Raimo Mustonen, Aleksi Mattila,
STUK, P.O. Box 14, FI-00881 Helsinki, Finland
raimo.mustonen@stuk.fi, aleksi.mattila@stuk.fi
Pilvi Siljamo, FMI, P.O. Box 503, FI-00101, Helsinki, Finland
pilvi.siljamo@fmi.fi

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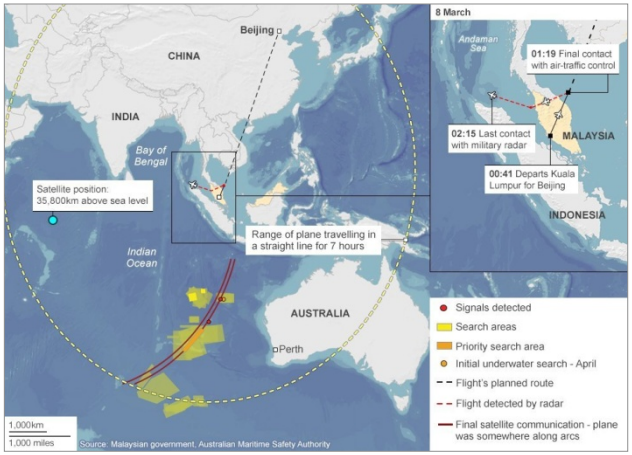
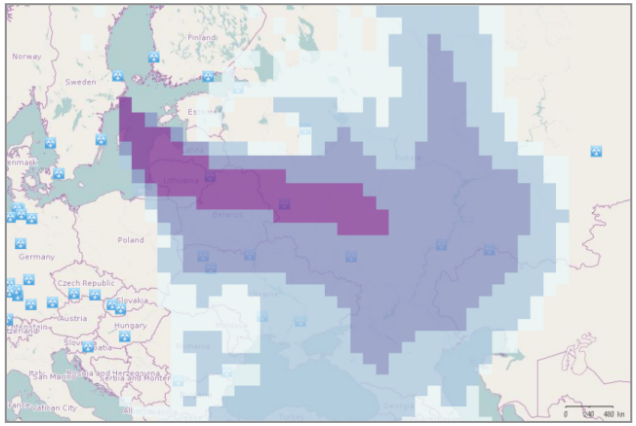
Motivation to this presentation (RM personal)

- Deep sympathy to the NERIS Platform
- Ending the career at STUK
- Need to improve operational co-operation in Europe
- Need to develop compatible working tools and methods in European countries
- Need for nearly real-time data exchange in nuclear emergencies
- Need to enhance transparency of authorities and research organizations
- Identification of events/detections in the atmosphere
- Future accidents in and releases from nuclear/radiation facilities

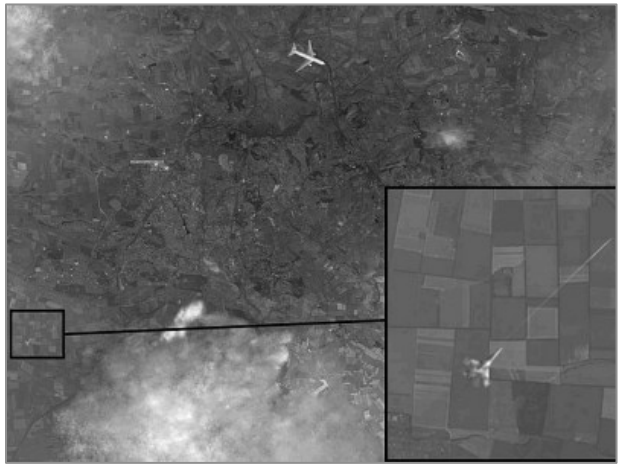
Identification of events/detections in the atmosphere

- Disappeared passenger plane in March 2014 (MH370)
- Destroyed passenger plane in July 2014 (MH17)
- Sources of airborne radioactivity





http://www.bbc.com/news/world-asia-26503141



http://thecount.com/2014/11/15/photo-mh17-shot-down-missile/

This presentation

Potential sources of radioactive releases

- In January 2015:
  - 185 nuclear power reactors in operation in Europe
  - 17 nuclear power reactors under construction in Europe
  - 137 research reactors in Europe
  - thousands of industrial, medical or educational nuclear/radiological facilities in Europe
- Malfunctions and accidents will happen
- Risk for malicious use of radioactive materials and radiation is significant

Modeling of dispersion in the atmosphere

- A great number of atmospheric dispersion models in operational use in Europe
- Simulation of the atmospheric transport and dispersion of radioactive substances from a source to downwind
- Abnormal radioactivity is detected in the environment several times in a year
- Running the dispersion models backwards in trying to determine the source characteristics if abnormal radioactivity is monitored

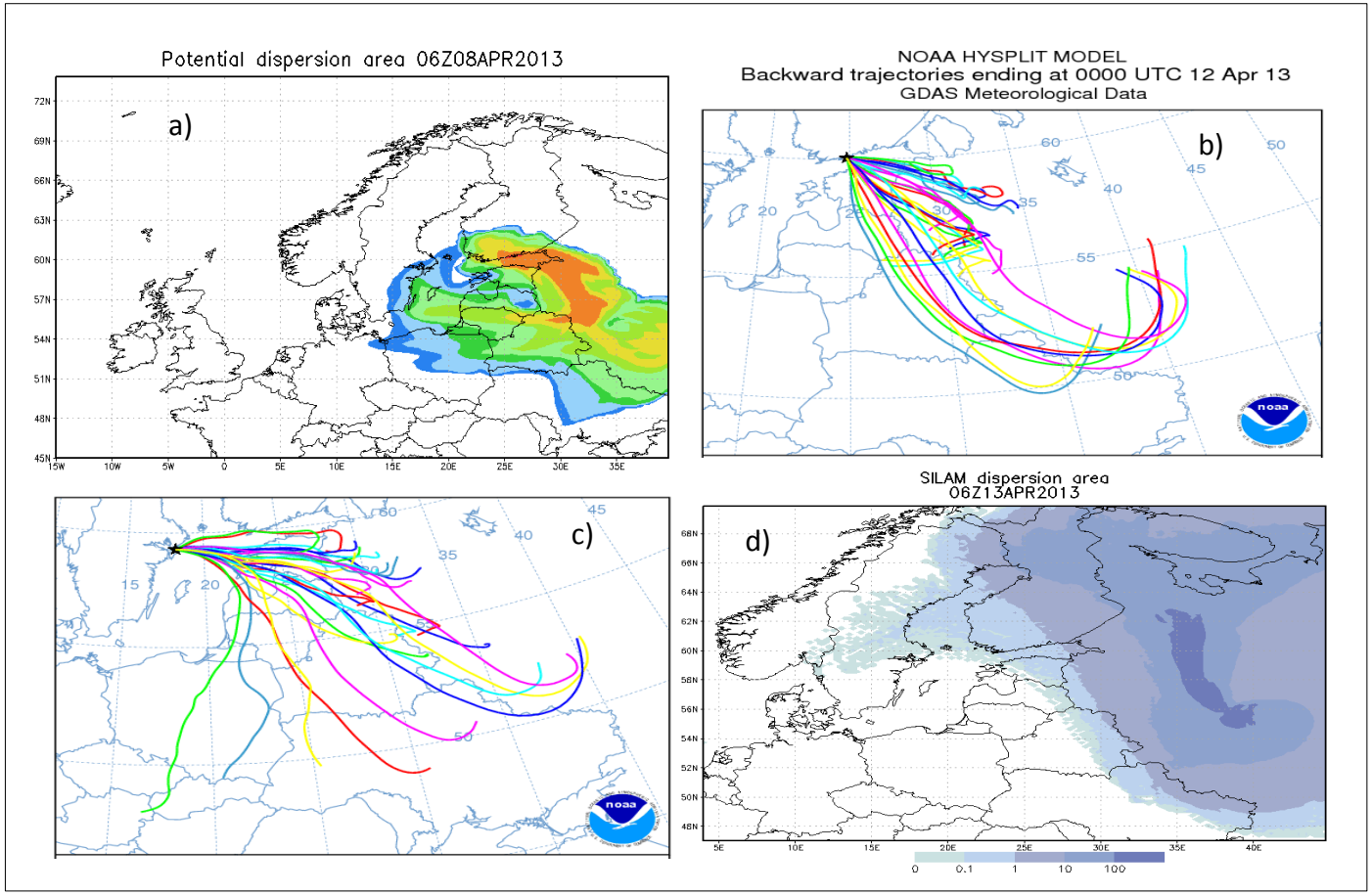
Challenges in backward dispersion calculations

- Only one detection result available and the source is unknown
- Weak source close to the detection site
- Strong source more remote from the detection site
- If the source location can be identified, the source strength may remain open
- Several detections in the same time
- Detection results available at several monitoring sites and in different times
- Several sources or geographically extended source
- Long sampling times in sampling of airborne radioactivity
- Great uncertainties in the source identification

Examples on source identification

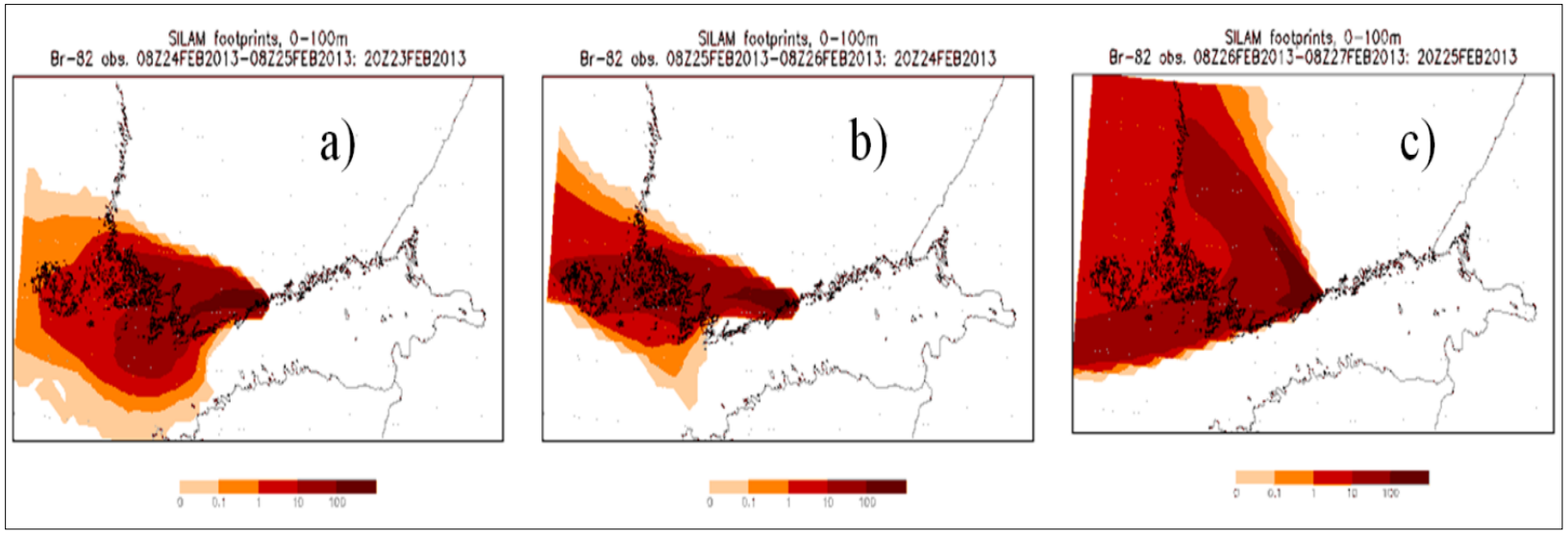
- Detection in Canada of Xe-133 escaped from the underground nuclear bomb test in North Korea in 2006
- Detection in Melbourne of Xe-133 escaped from a nuclear facility in Sydney in 2008
- Detections in Europe of I-131 released from the Hungarian institute producing radioisotopes in 2011
- Detections of abnormal levels of Cs-137 in the Nordic Countries in 2013
- Detection of Br-82 in Helsinki in 2013
- Detections of I-131 in Europe in March 2015

Cs-137 in the Nordic Countries in April 2013



The evident source was a smeltery 60 km east from Moscow, 2.2 TBq Cs-137 source was smelted on 12 April 2013.

Br-82 in Helsinki in February 2013



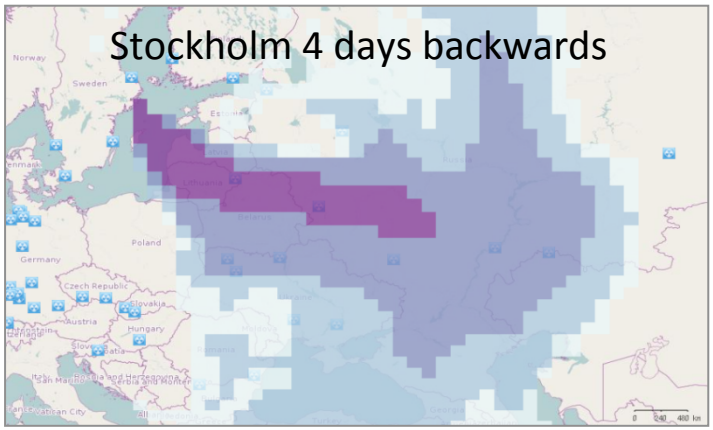
The source was confirmed to be a company making tracer tests in an industrial facility 60 km west from Helsinki

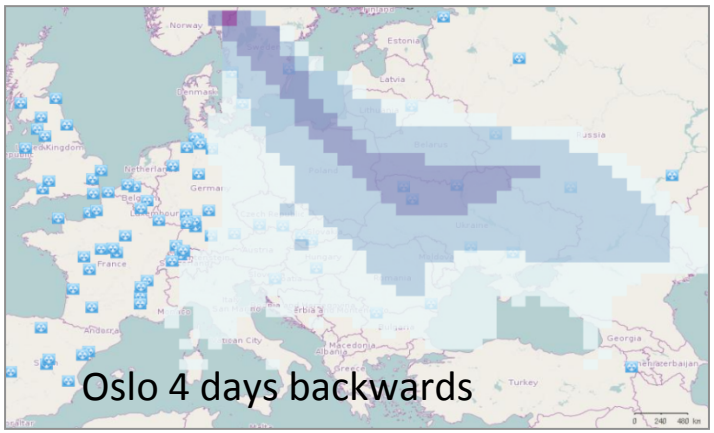
I-131 in Europe in March 2015

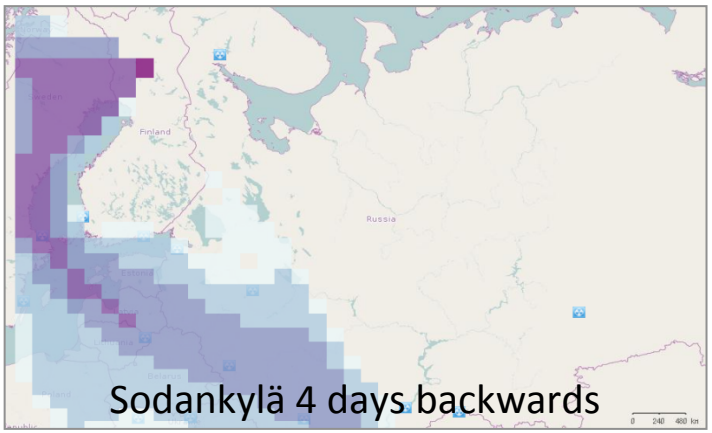
- Helsinki 18-19 March, 6.2 µBq/m^3
- Stockholm 16-17 March, 1-15 µBq/m^3
- Visby 9-20 March, 1.7-3.0 µBq/m^3
- Oslo 16-19 March, 1.2 µBq/m^3
- Sodankylä 16-19 March, 5.1 µBq/m^3
- Imatra 16-19 March, 2.0 µBq/m^3
- Kuopio 16-19 March, 2.8 µBq/m^3
- Ivalo 16-19 March, 1.6 µBq/m^3
- Rovaniemi 16-23 March, 1.6 µBq/m^3
- Kajaani 16-23 March, 1.0 µBq/m^3
- Kotka 17-23 March, 0.4 µBq/m^3

- Lithuania 13-19 March, 9.5-15 µBq/m^3
- Poland 16-23 March, 0.7-1.4 µBq/m^3
- France 9-18 March, 0.1-0.83 µBq/m^3
- Spain 2-8 March, 1.5 µBq/m^3 ?

I-131 in Europe in March 2015
(Global 1 degree ECMWF, SILAM dispersion model)







The source(s) is still unidentified

Do we use all the know-how we have?

- We have know-how enough to perform successful backward tracking
- We have to speed-up exchange of monitoring data and dispersion results
- The official data exchange systems shall be updated to function in almost real-time (EC, CBSS, IAEA?)
- Combination of several dispersion and numerical weather prediction (NWP) models would provide more reliable source estimations ?
- European competent authorities and their support organizations shall work together more efficiently
- NERIS could take an initiative to push the EC to more efficient co-operation of the Member Countries
- The development work should be included in the HORIZON 2020 Programme (Euratom Programme)

Thank you very much for the fruitful and pleasant co-operation

Keep NERIS in motion !