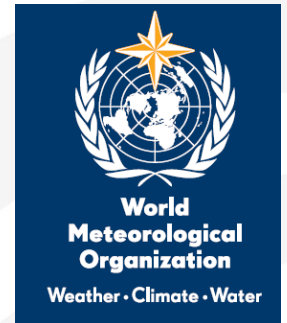


WMO Nuclear Emergency Response Activities

in cooperation with the IAEA

Dr. Gerhard Wotawa, Head of Division Data,
Methods and Modelling, ZAMG
WMO Representative (Member of ET-ERA)

Presentation at IAEA's International Experts' Meeting,
Vienna, Austria, 20 - 24 April 2015



ZAMG
Zentralanstalt für
Meteorologie und
Geodynamik

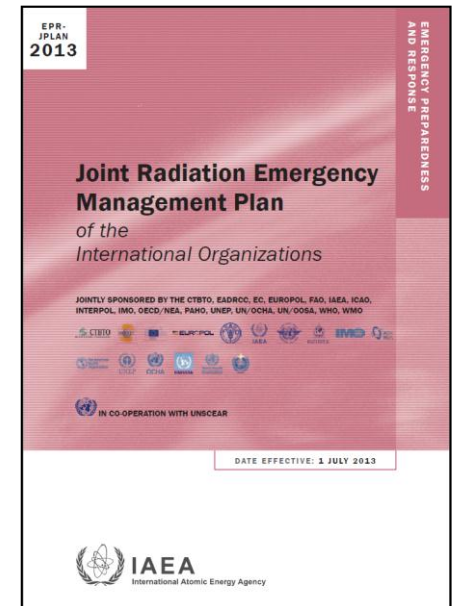
Outline

- WMO involvement in the Joint Plan
- Nuclear ERA: Structure and Responsibilities
- The Fukushima lessons
 - High-resolution modelling products
 - Ensemble products
 - Dealing with unspecified source terms
 - Enhanced assessment and data analysis capabilities
- Summary and conclusions

Joint Plan

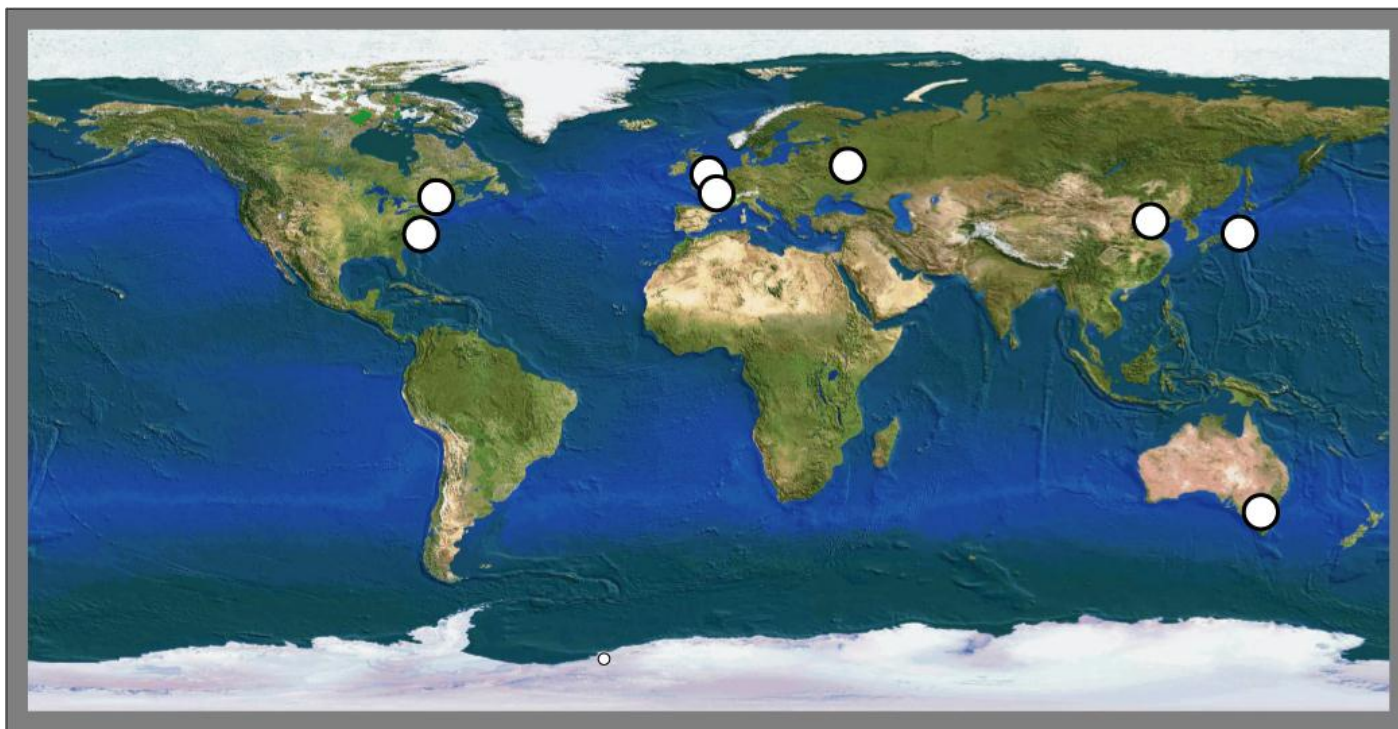
WMO has the following tasks under the Joint Plan:

- Provision of meteorological information, including wind and precipitation
- Atmospheric transport and dispersion (ATDM) predictions
- Retransmission of information to all NMHSs
 - Information distributed to authorities/government agencies in each state by NMHS according to national arrangements



Nuclear ERA: Structure and Responsibilities

ATDM predictions are performed by 8 **Regional Specialized Meteorological Centers (RSMCs)** with activity specialization in ATM designated by WMO (Montreal, Washington, Exeter, Toulouse, Obninsk, Beijing, Tokyo and Melbourne)

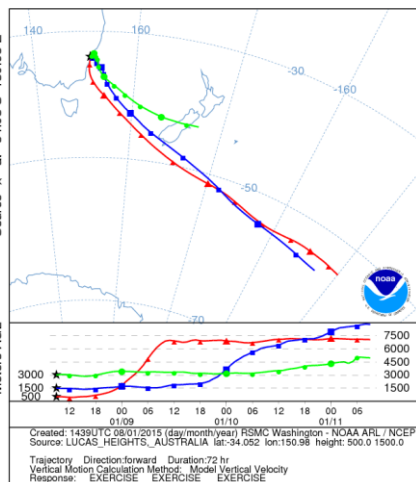


RSMC Standard Products

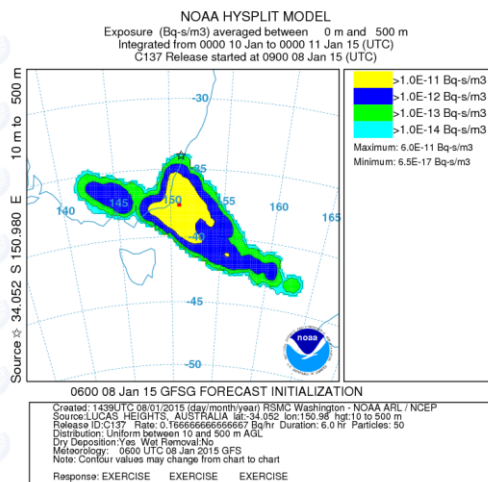
RSMC standard products include trajectories and exposure/deposition for 24/48/72 hours

Product from RSMC Washington

NOAA HYSPLIT MODEL
Forward trajectories starting at 0900 UTC 08 Jan 15
06 UTC 08 Jan GFSQ Forecast Initialization



Product from RSMC Washington



REGIONAL SPECIALIZED METEOROLOGICAL CENTER (RSMC)

TRANSPORT MODEL PRODUCTS

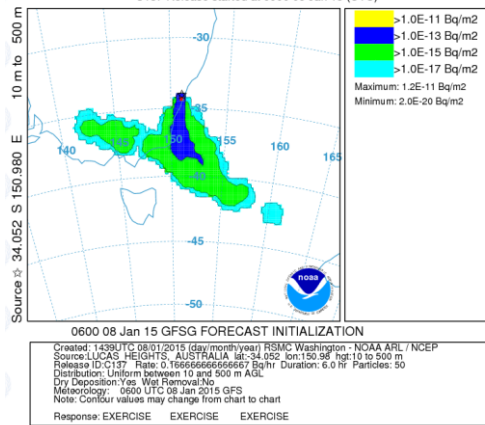
The following are current (as of the date indicated in the table) operational RSMC products as established by The World Meteorological Organization (WMO) for the provision of transport model products for environmental emergency response. To view a product click on the text link or click on one or more checkboxes and then click on the **Request checked boxes** button at the bottom of the form. Details on the model products can be found in **WMO/TD-No. 778**. The lead RSMCs are highlighted in yellow shading. To ensure the latest update, refresh/reload your browser.

For all (current and past) model results, click on the link titled, **"All Products"** in the first column of each RSMC.
"No archive" is displayed if no additional products are available.

RSMC TIME OF MODEL RUN (YYYYMMDD HHMM)	MODEL PARAMETERS	JOINT STATEMENT	VIEW PRODUCTS	TRAJECTORIES	TIME PERIOD 1 +24 HRS	TIME PERIOD 2 +48 HRS	TIME PERIOD 3 +72 HRS
Washington 2015010805_1439	Cover (Postscript)	Region BIV	<input checked="" type="checkbox"/> Check All <input type="checkbox"/> Uncheck All	<input type="checkbox"/> Trajectories (traj.txt)	<input type="checkbox"/> Exposure <input type="checkbox"/> Exposure <input type="checkbox"/> Exposure	<input type="checkbox"/> Deposition <input type="checkbox"/> Deposition <input type="checkbox"/> Deposition	<input type="checkbox"/> Deposition <input type="checkbox"/> Deposition <input type="checkbox"/> Deposition
All Products							
Montreal 2015010800_1442	Cover (Postscript)	Region BIV	<input checked="" type="checkbox"/> Check All <input type="checkbox"/> Uncheck All	<input type="checkbox"/> Trajectories (traj.txt)	<input type="checkbox"/> Exposure <input type="checkbox"/> Exposure <input type="checkbox"/> Exposure	<input type="checkbox"/> Deposition <input type="checkbox"/> Deposition <input type="checkbox"/> Deposition	<input type="checkbox"/> Deposition <input type="checkbox"/> Deposition <input type="checkbox"/> Deposition
All Products							
Melbourne 2015010806_1244	Cover (Postscript)	Region V	<input checked="" type="checkbox"/> Check All <input type="checkbox"/> Uncheck All	<input type="checkbox"/> Trajectories (traj.txt)	<input type="checkbox"/> Exposure <input type="checkbox"/> Exposure <input type="checkbox"/> Exposure	<input type="checkbox"/> Deposition <input type="checkbox"/> Deposition <input type="checkbox"/> Deposition	<input type="checkbox"/> Deposition <input type="checkbox"/> Deposition <input type="checkbox"/> Deposition
No archive							
Essex Unavailable	Cover (Postscript)	Region IVI	<input checked="" type="checkbox"/> Check All <input type="checkbox"/> Uncheck All	<input type="checkbox"/> Trajectories (traj.txt)	<input type="checkbox"/> Exposure <input type="checkbox"/> Exposure <input type="checkbox"/> Exposure	<input type="checkbox"/> Deposition <input type="checkbox"/> Deposition <input type="checkbox"/> Deposition	<input type="checkbox"/> Deposition <input type="checkbox"/> Deposition <input type="checkbox"/> Deposition
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Toulouse Unavailable	Cover (Postscript)	Region IVI	<input checked="" type="checkbox"/> Check All <input type="checkbox"/> Uncheck All	<input type="checkbox"/> Trajectories (traj.txt)	<input type="checkbox"/> Exposure <input type="checkbox"/> Exposure <input type="checkbox"/> Exposure	<input type="checkbox"/> Deposition <input type="checkbox"/> Deposition <input type="checkbox"/> Deposition	<input type="checkbox"/> Deposition <input type="checkbox"/> Deposition <input type="checkbox"/> Deposition
No archive							

Product from RSMC Washington

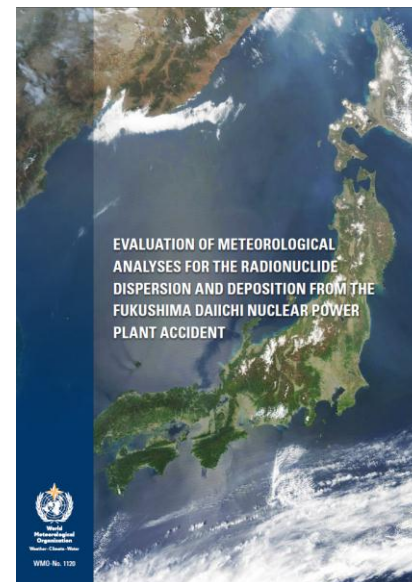
NOAA HYSPLIT MODEL
Deposition (Bq/m2) at ground-level
Integrated from 0000 08 Jan to 0000 11 Jan 15 (UTC)
C137 Release started at 0900 08 Jan 15 (UTC)



Fukushima Lessons

The WMO SG set up a small Task Team (TT) with the following mission:

- **Support UNSCEAR** dose assessments
- Examine how using met. analyses and introducing additional observational data might **improve ATDM calculations**
- Contribute to the **review and possible enhancement** of the WMO EER system



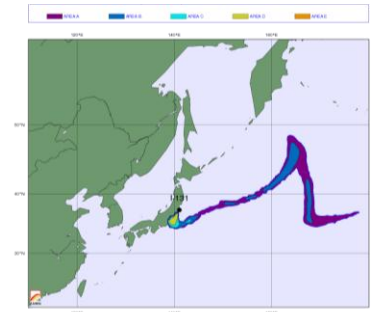
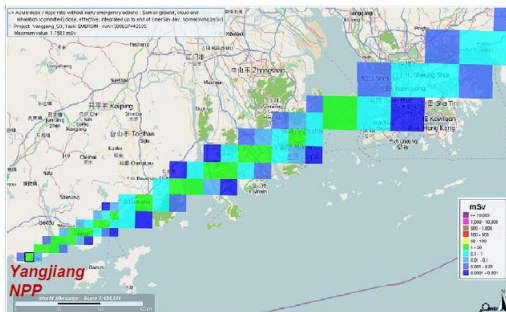
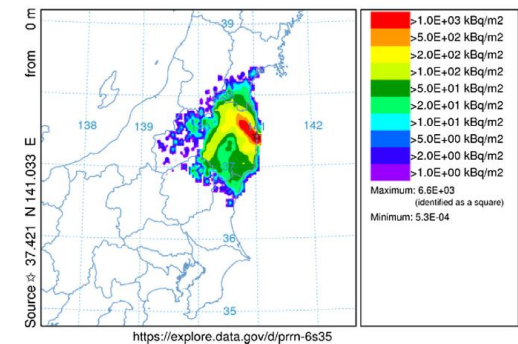
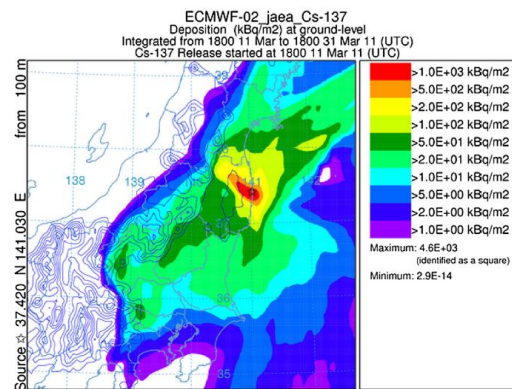
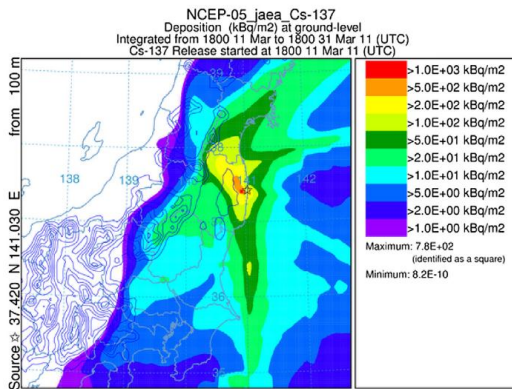
Main areas of improvement

The following main improvement areas are identified

- **Improve forecast information** during a nuclear accident (higher resolution, variable emissions, flexible post-processing,...)
- **Support IAEA and State Parties** in the **assessment** of an accident scenario (source estimates, ...)
- **Enhanced assessment and data analysis capabilities** (determination of source location based on detections, backtracking capabilities)

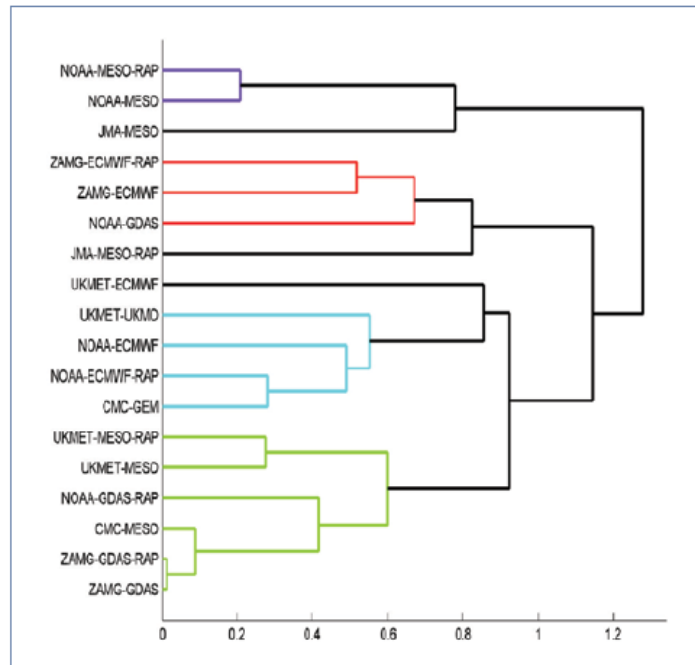
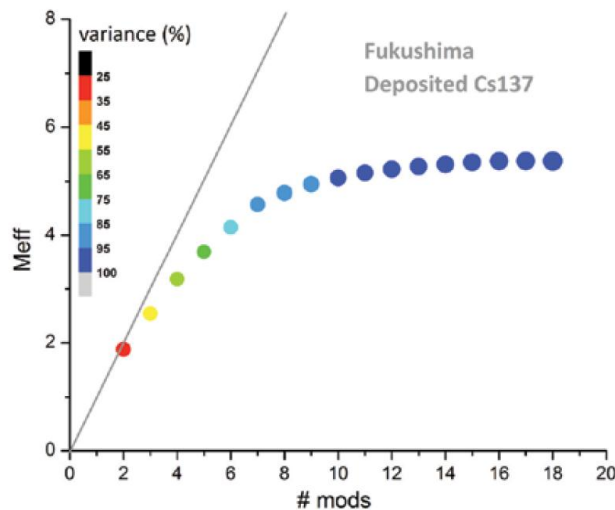
High-resolution products

- **High-resolution ATDM products** are needed to better coordinate data sampling/measurement activities
- A **seamless transition between local and regional scale** ensures that predictions are consistent; WMO will undertake development and implementation of a seamless Data Processing and Forecasting System



Ensemble products

- Different ATDM models can yield different results
- **Ensemble modeling** reflects uncertainty, but does not mean to run a large number of different models
- **State of the art ensemble analysis** helps to limit number of members, better assess contribution of individual models (case dependent)



Dealing with unspecified/variable emissions

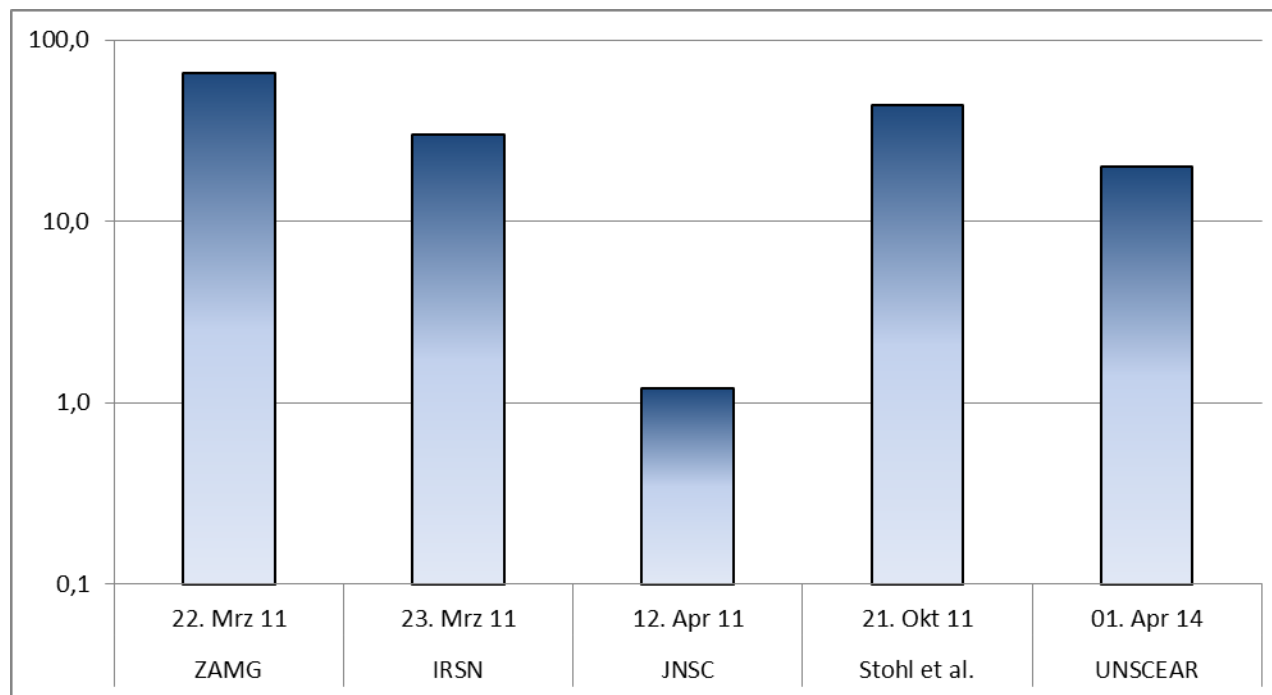
- **WMO/RSMC standard runs** – unit emissions for 24/48/72 hours – are not useful in case emissions are highly variable
- **WMO Fukushima TT used alternative approach** – perform consecutive unit emission runs – e.g. every 3 hours – throughout the accident period (called Transfer Coefficient Matrix – TCM; or Source Receptor Matrix - SRM)
- By **multiplying the unit emission runs with** – estimated or assumed – **emissions** for the – e.g. 3 hour – time period, or by keeping the unit emissions, either standard products or customized add-on products are possible depending on how scenario evolves

Accident assessment: Estimating emissions

- TCM/SRM method allows to **estimate emissions** of selected key nuclides based on measurements
- **Emission factors** for the unit runs **are varied** under certain constraints to **best describe measurement scenario**
- **Estimates** can be **done** by the center(s) calculating the TCM/SRM fields, but also **by any other entity that has access** to the TCM/SRM results (allows for de-centralization)
- TCM/SRM method also useful for planning of deployment of sampling/measurement devices

Estimating emissions (2)

- Order-of-magnitude emission estimates are possible also with very few measurements (example: ^{137}Cs source estimates after Fukushima)

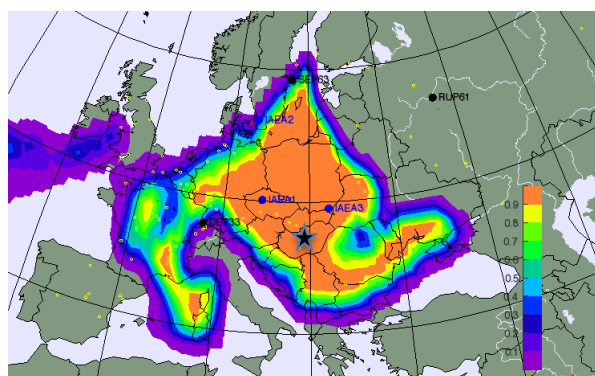


Data analysis capabilities: atmospheric backtracking

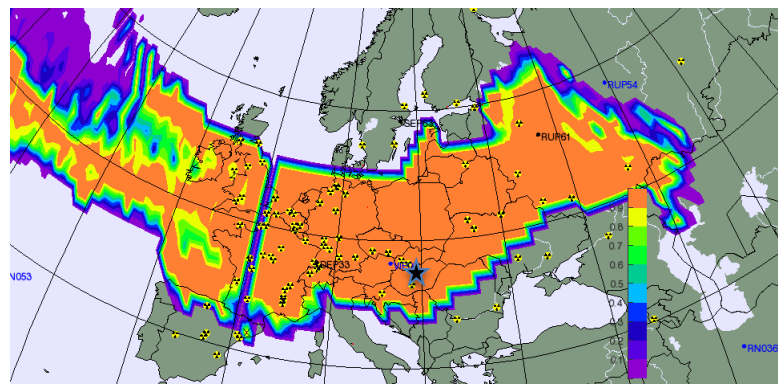
- WMO built up an atmospheric backtracking response system with CTBO to support the interpretation of treaty-relevant radionuclide detections
- Detections with unknown origin are also relevant in the IAEA framework
- Based on ATM backtracking, information on previously unidentified sources can be obtained (possible source area, source strengths)

Atmospheric backtracking: ^{131}I detections in Europe

- In September/October 2011, ^{131}I was detected at various stations in Europe
- Based on backtracking, the **source area could be confined** with the required accuracy to help identifying the institute causing the releases
- Technology developed in **CTBT framework** can also **support IAEA**



Backtracking from Stockholm



Backtracking from Dubna

Conclusions

- **International system** was built up to provide meteorological/ATDM assistance to states affected by a nuclear accident and emergency
- During Fukushima, **designated RSMCs did what they were supposed to do** in accordance with existing arrangements
- **WMO and its various Centers provided crucial input** to emergency response during the Fukushima case, and situation assessment in the aftermath (e.g. UNSCEAR report to UN GA)
- There is a need for key organizations in JPLAN to **review existing arrangements**, in order to seamlessly **incorporate lessons learned** and newly developed improvements

