WMO Nuclear Emergency Response Activities in the framework of the Joint Plan

Current status and lessons learned from Fukushima

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

World Meteorological Organization
Weather · Climate · Water

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

Presentation at IAEA's International Experts' Meeting, Vienna, Austria, 17-21 February 2015

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
- Summary and conclusions

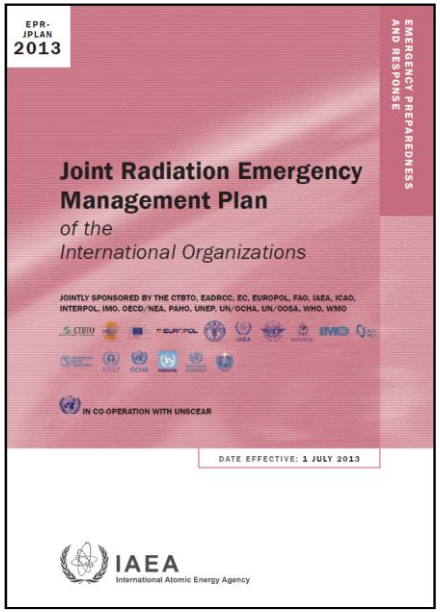
World Meteorological Organization
Weather · Climate · Water

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

Joint Plan

WMO has the following tasks under the Joint Plan:

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

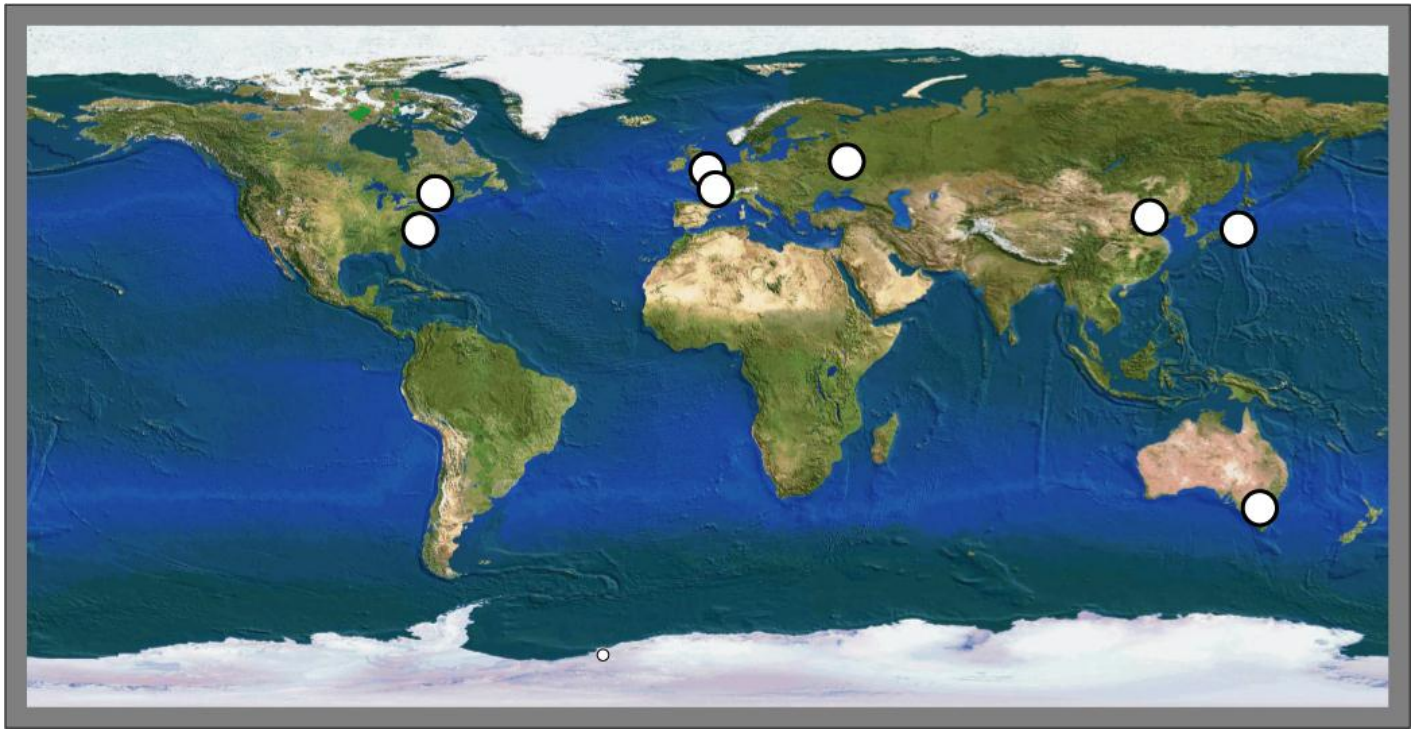


World Meteorological Organization
Weather · Climate · Water

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

Nuclear ERA: Structure and Responsibilities

• Atmospheric transport and dispersion predictions are performed by 8 Regional Specialized Meteorological Centers (RSMCs) with activity specialization in Atmospheric Transport Modelling designated by WMO (Montreal, Washington, Exeter, Toulouse, Obninsk, Beijing, Tokyo and Melbourne)



World Meteorological Organization
Weather · Climate · Water

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

Nuclear ERA: Structure and Responsibilities (2)

• Operational procedures are defined in the Manual on the Global Data Processing and Forecasting System (GDPFS)

• Operational procedures are revised and coordination is performed by the WMO/CBS Expert Team on Emergency Response Activities (ERA-ET)

• Standard products are delivered by the “lead RSMC” designated

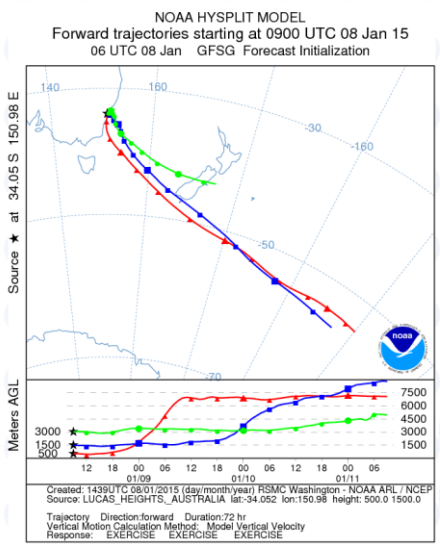
World Meteorological Organization
Weather • Climate • Water

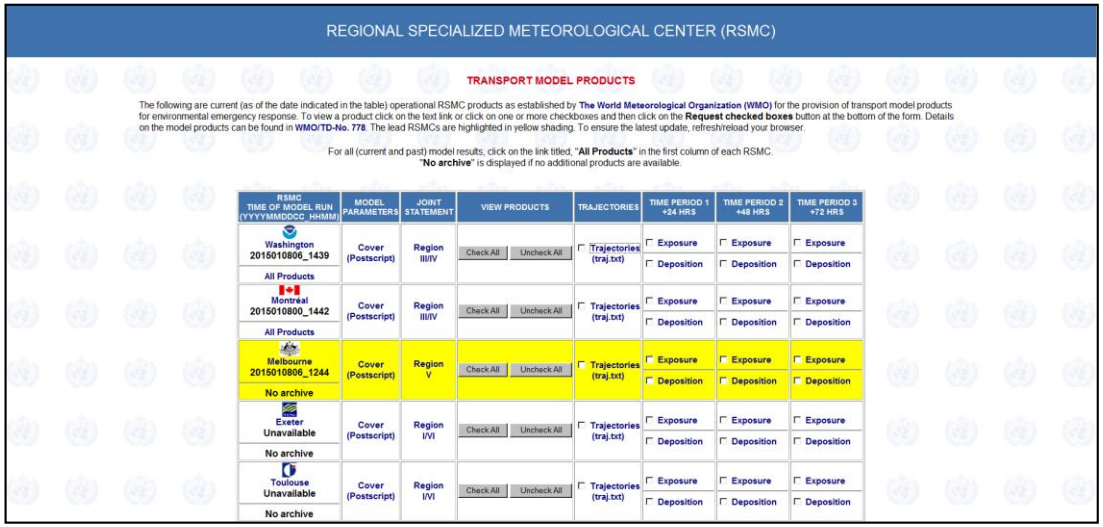
ZAMG
Zentralanstalt für Meteorologie und Geodynamik

RSMC Standard Products

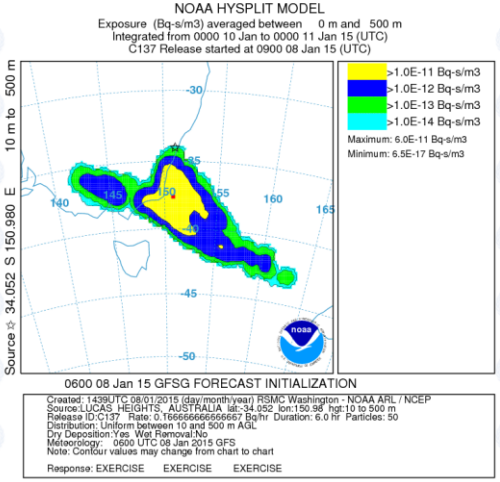
RSMC standard products include trajectories and exposure/deposition for 24/48/72 hours

Product from RSMC Washington

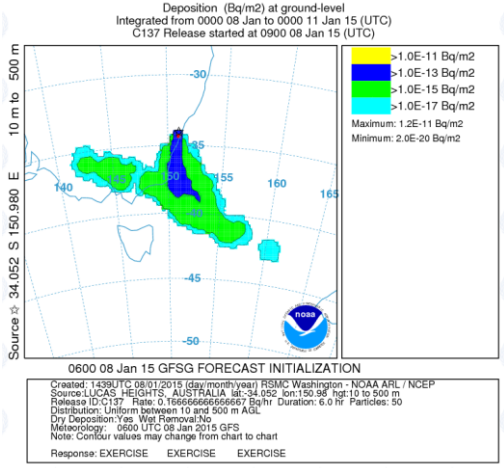




Product from RSMC Washington



Product from RSMC Washington



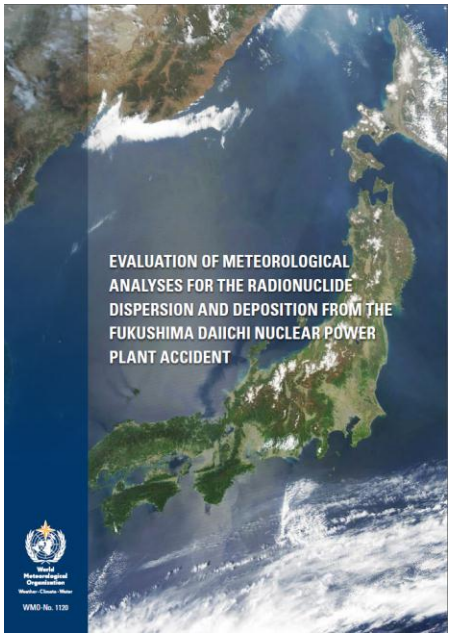
World Meteorological Organization
Weather · Climate · Water

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

Fukushima Lessons

- After Fukushima, the WMO SG set up a small Task Team (TT) to support UNSCEAR dose assessments

- Its mission was to examine how using met. analyses and introducing additional observational data might improve ATDM calculations



World Meteorological Organization
Weather · Climate · Water

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

Nuclear ERA products: Possibilities of improvement

- **High-resolution ATDM products**: better resolved terrain and precipitation features, improved deployment of sampling and monitoring devices

- **Ensemble ATDM products**: better account for ATDM uncertainty

- **Methods to deal with unspecified source terms**: possibility to deal with situations evolving with time

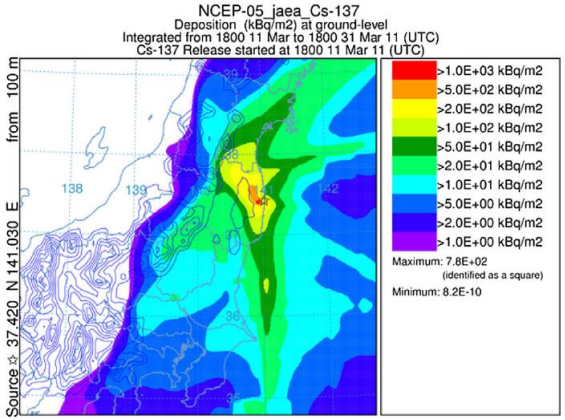
- Estimate/constrain **source terms of key radionuclides:** assure consistency between emission estimates and monitoring results

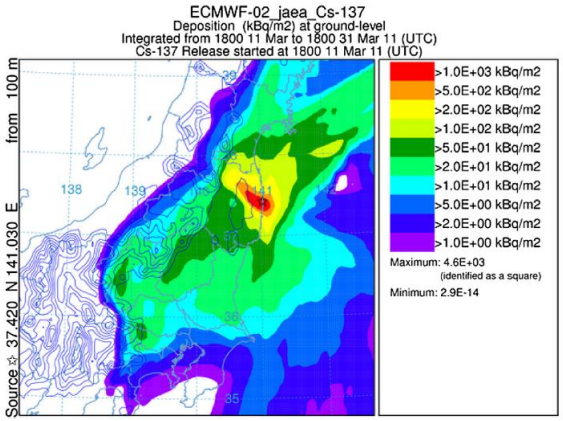
World Meteorological Organization
Weather · Climate · Water

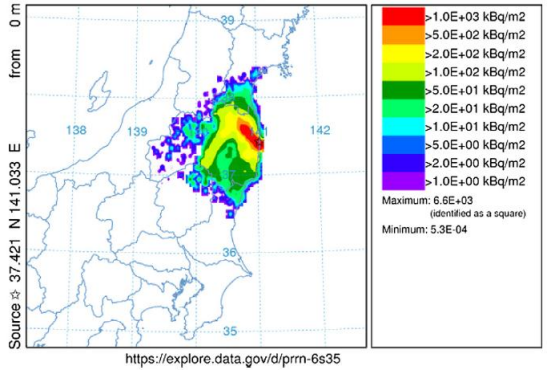
ZAMG
Zentralanstalt für Meteorologie und Geodynamik

High-resolution products

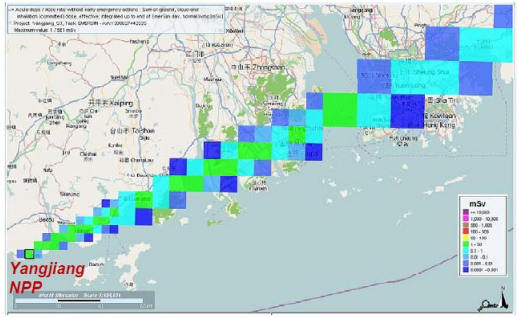
- **High-resolution ATDM products** are needed to better coordinate data sampling/measurement activities
- A **seamless transition between local and regional scale** ensures that predictions are consistent

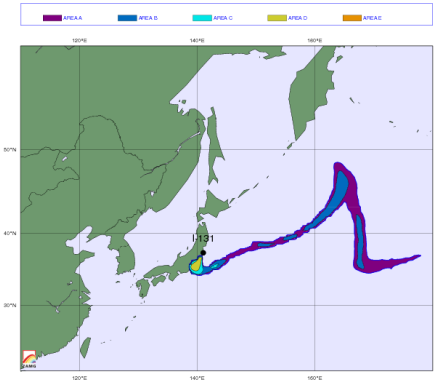






https://explore.data.gov/d/prrn-6s35



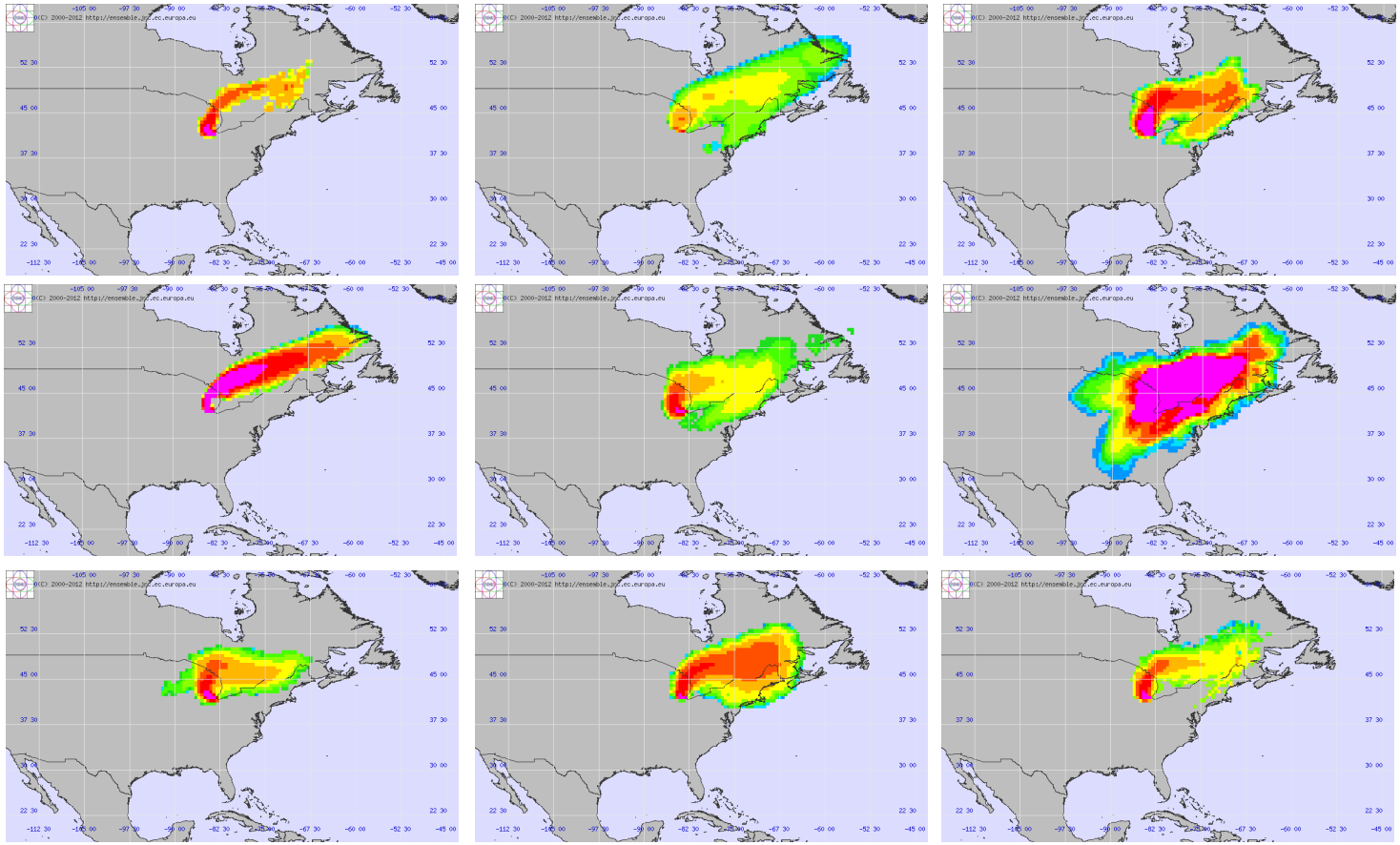


World Meteorological Organization
Weather · Climate · Water

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

Ensemble products

- **Ensemble products** show uncertainties of ATDM simulations



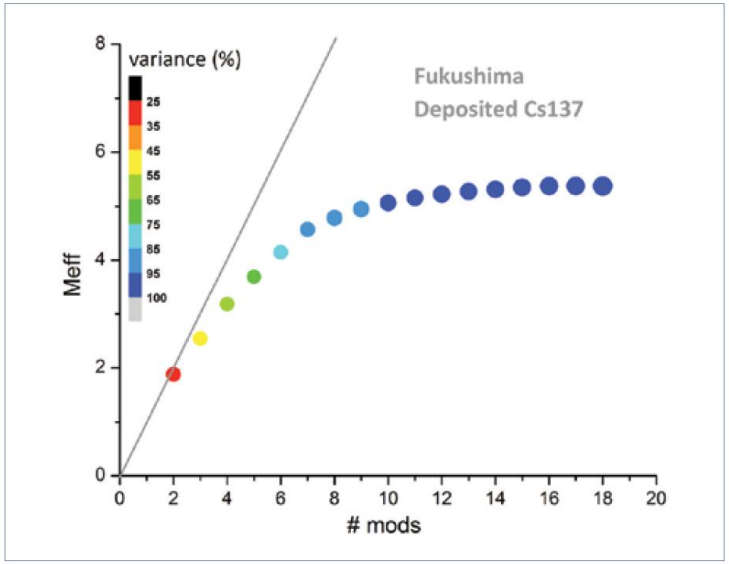
World Meteorological Organization
Weather · Climate · Water

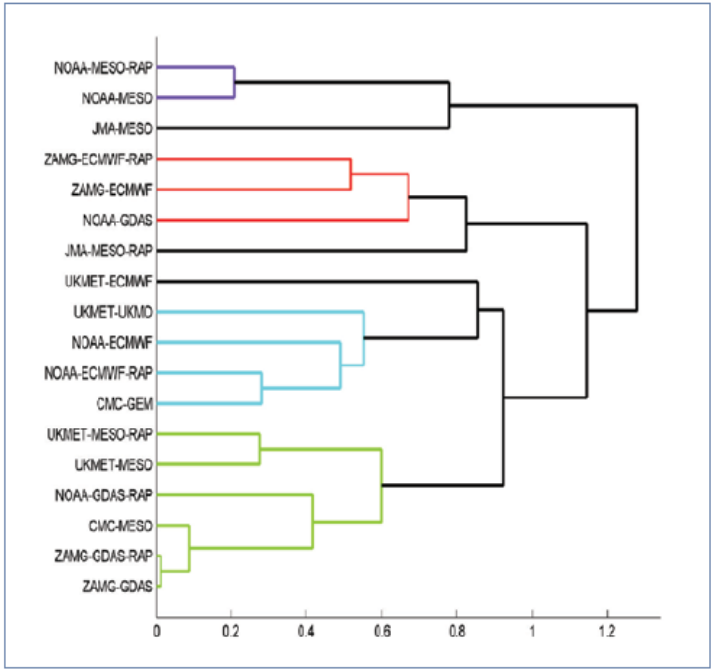
ZAMG
Zentralanstalt für Meteorologie und Geodynamik

Ensemble products (2)

- Ensemble modeling 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)





World Meteorological Organization
Weather · Climate · Water

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

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

World Meteorological Organization
Weather · Climate · Water

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

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)

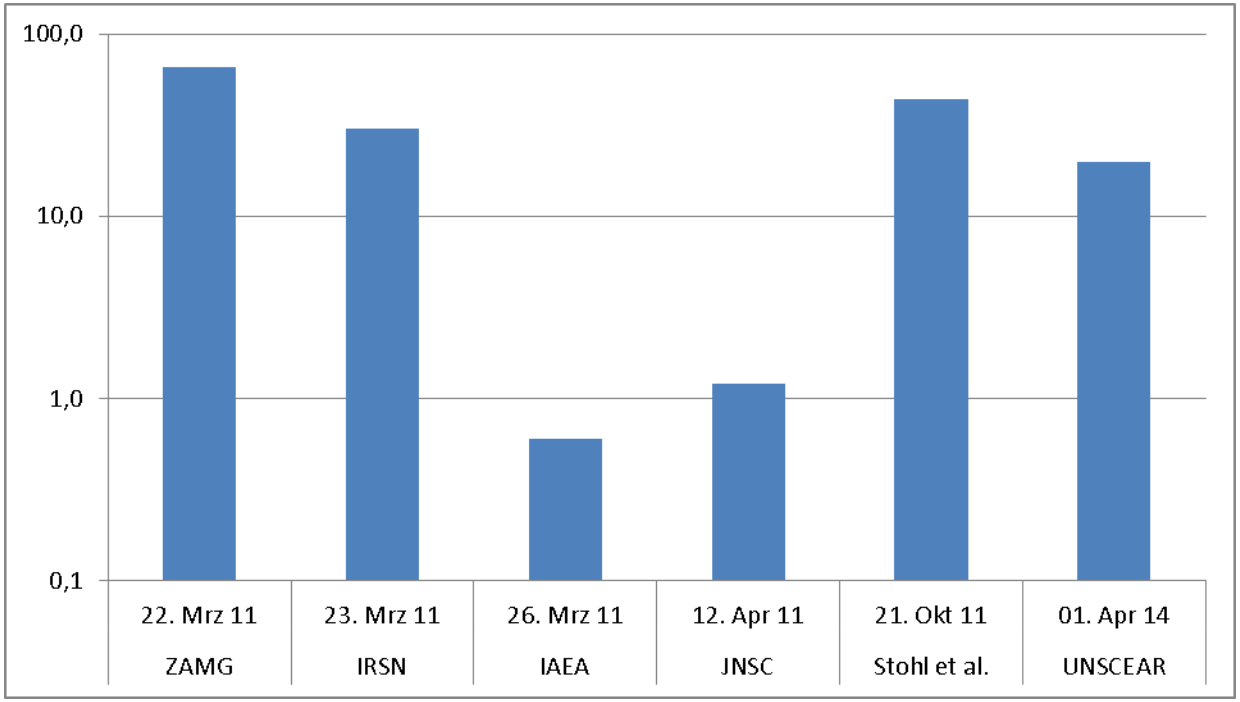
- TCM/SRM method also useful for planning of deployment of sampling/measurement devices

World Meteorological Organization
Weather · Climate · Water

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

Estimating emissions (2)

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



World Meteorological Organization
Weather · Climate · Water

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

Conclusions

- After Chernobyl, an **international system** was built up to provide meteorological/ATDM assistance to states affected by a nuclear accident and emergency

- During Fukushima, **designated RSMCs did exactly what they were supposed to do** in accordance with existing arrangements in the Manual on the GDPFS

- **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)

World Meteorological Organization
Weather · Climate · Water

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

Conclusions (2)

- There is a need for IAEA and WMO to **review existing arrangements** in light of the lessons learned and points discussed in this presentation

- Lessons learned can be incorporated, step by step, in the existing frameworks, assuring seamless reception by IAEA and states parties

- Technical concepts for improvements are ready

World Meteorological Organization
Weather · Climate · Water

ZAMG
Zentralanstalt für Meteorologie und Geodynamik