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Comparison of atmospheric dispersion model outputs and radioactivity measurements made in Ireland following the Fukushima nuclear emergency

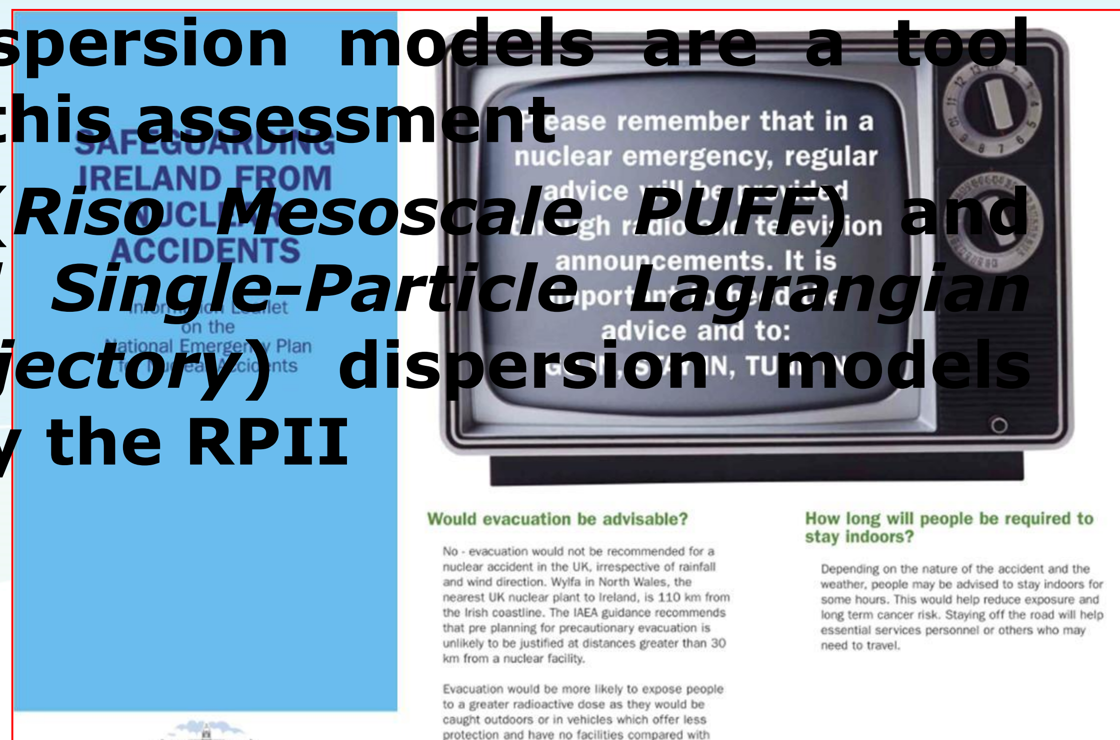
K. Smith, C. Organo, S. Somerville, O. Hanley and C. McMahon

Outline

- Background
- Atmospheric Dispersion Modelling Approach
- Results
- Conclusions

Background

- **The Radiological Protection Institute of Ireland (RPII) is responsible for assessing the potential contamination of the Irish environment and food, and doses to the population following an unplanned release of radionuclides to the atmosphere.**
- **Atmospheric dispersion models are a tool used as part of this assessment**
- **The RIMPUFF (*Riso Mesoscale PUFF*) and HySplit (*Hybrid Single-Particle Lagrangian Integrated Trajectory*) dispersion models are both used by the RPII**



Background

- The RPII increased the frequency of sampling and analysis of air, rainwater, and ... of the arrival of the ... Ireland.
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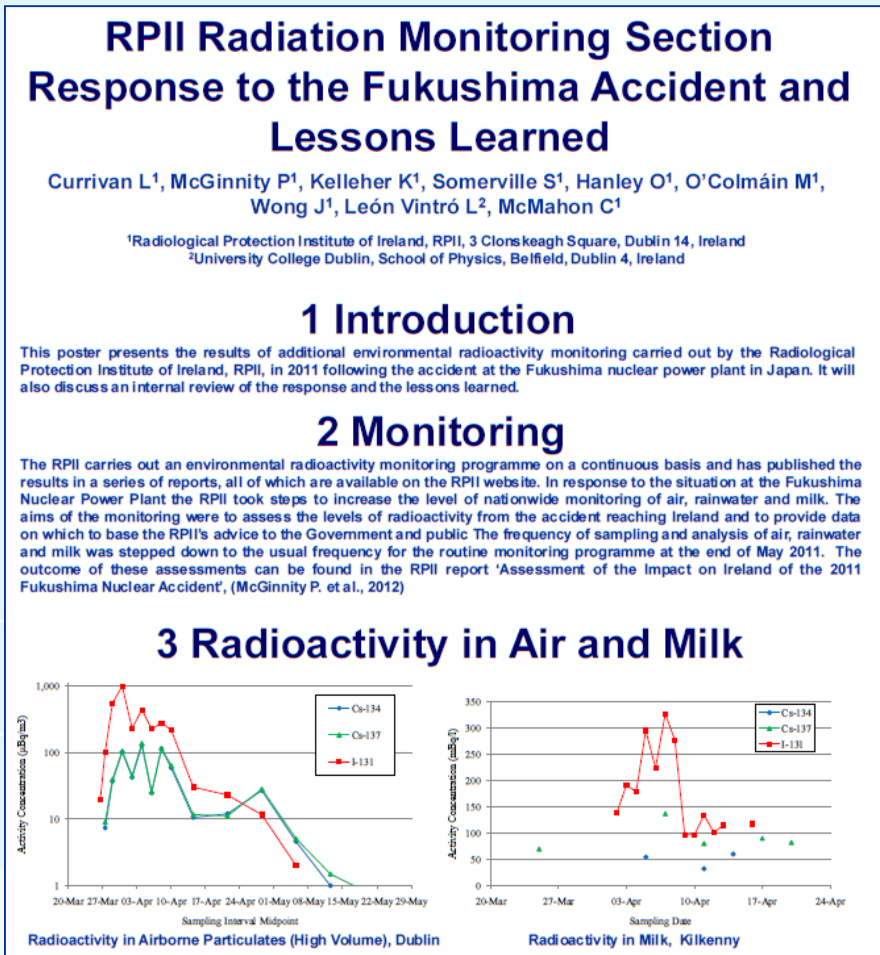


RPII Radiation Monitoring Section Response to the Fukushima Accident and Lessons Learned

Currivan L[1], McGinnity P[1], Kelleher K[1], Somerville S[1], Hanley O[1], O'Colmáin M[1], Wong J[1], León Vintró L[2], McMahon C[1]

[1]Radiological Protection Institute of Ireland, RPII, 3 Clonskeagh Square, Dublin 14, Ireland
[2]University College Dublin, School of Physics, Belfield, Dublin 4, Ireland

1 Introduction

This poster presents the results of additional environmental radioactivity monitoring carried out by the Radiological Protection Institute of Ireland, RPII, in 2011 following the accident at the Fukushima nuclear power plant in Japan. It will also discuss an internal review of the response and the lessons learned.

2 Monitoring

The RPII carries out an environmental radioactivity monitoring programme on a continuous basis and has published the results in a series of reports, all of which are available on the RPII website. In response to the situation at the Fukushima Nuclear Power Plant the RPII took steps to increase the level of nationwide monitoring of air, rainwater and milk. The aims of the monitoring were to assess the levels of radioactivity from the accident reaching Ireland and to provide data on which to base the RPII's advice to the Government and public The frequency of sampling and analysis of air, rainwater and milk was stepped down to the usual frequency for the routine monitoring programme at the end of May 2011. The outcome of these assessments can be found in the RPII report 'Assessment of the Impact on Ireland of the 2011 Fukushima Nuclear Accident', (McGinnity P. et al., 2012)

3 Radioactivity in Air and Milk

Radioactivity in Airborne Particulates (High Volume), Dublin

Radioactivity in Milk, Kilkenny

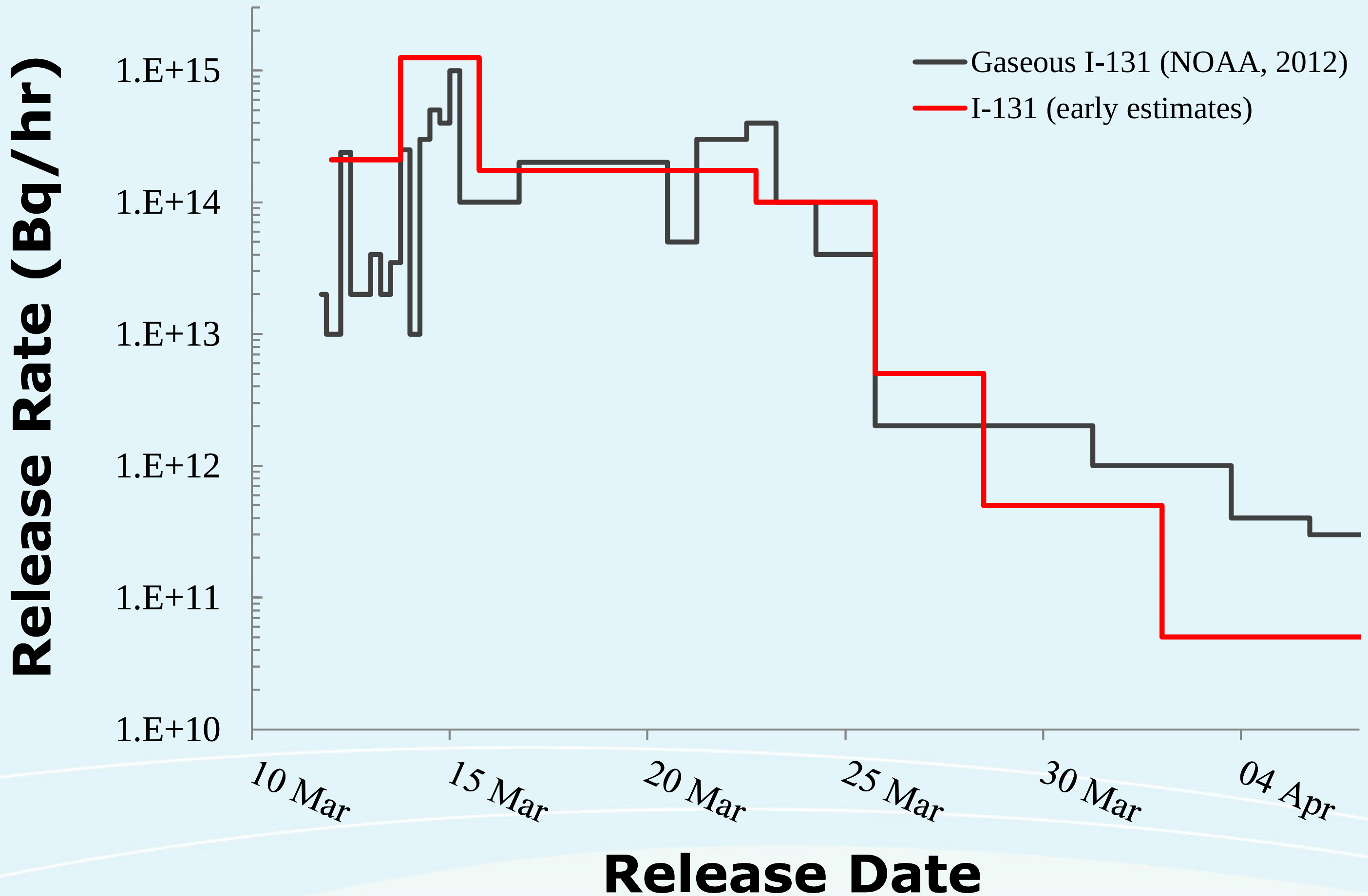
Dispersion Modelling

- **The dispersion modelling approach used by the RPII developed in three phases over the course our response to the accident**
- **In the first few days of the event little information was available on the quantity and timings of radioactive releases from the NPP.**
- **During this first phase, HySplit was run assuming a unit (1 GBq/hr) release rate of I-131 and Cs-137 dispersion**
- **This provided an indication of the arrival time of the radioactive plume in Ireland.**

Dispersion Modelling

- In the second phase of the modelling (late March to end of April), estimates of the quantities and timings of the releases became available.
- Model outputs provided an estimate of the radionuclide air concentrations expected in Dublin.
- In the final (post accident analysis) phase, we used estimates of the temporal emissions provided by NOAA ARL and modifications to the model input parameters

Atmospheric Releases (I-131)



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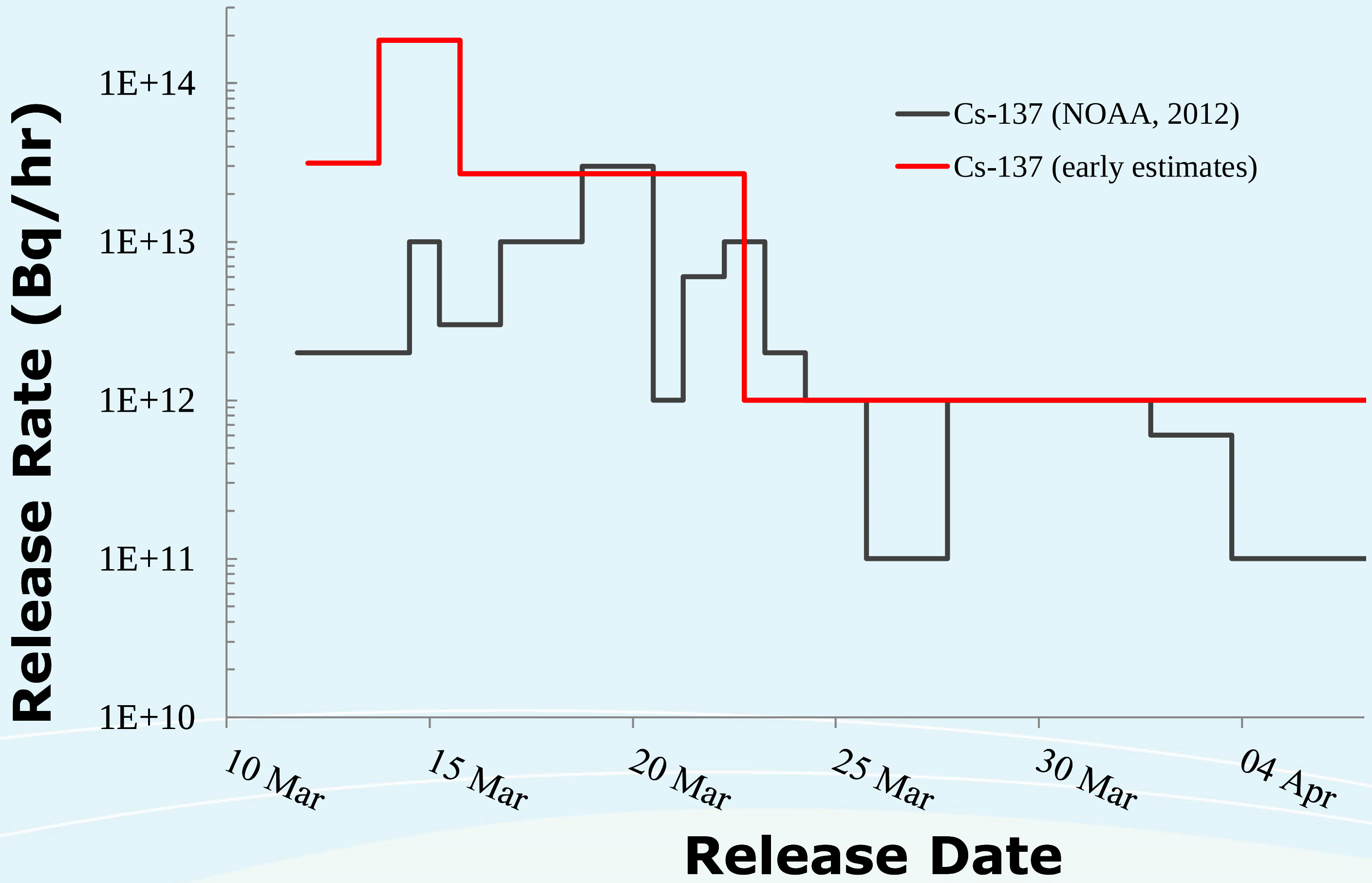
Atmospheric Releases (Cs-137)



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Dispersion Modelling

- **In the first and second phases, the model was run using a combination of archive (Global Data Assimilation System, GDAS) and forecast (Global Forecasting System, GFS) meteorological data.**
- **These data sets have a 1-degree horizontal resolution with meteorological fields available every three hours.**
- **In the post accident analysis phase, the model was run using a 0.5-degree horizontal resolution archive meteorological data set from NOAA's Global Forecast System (GFS).**

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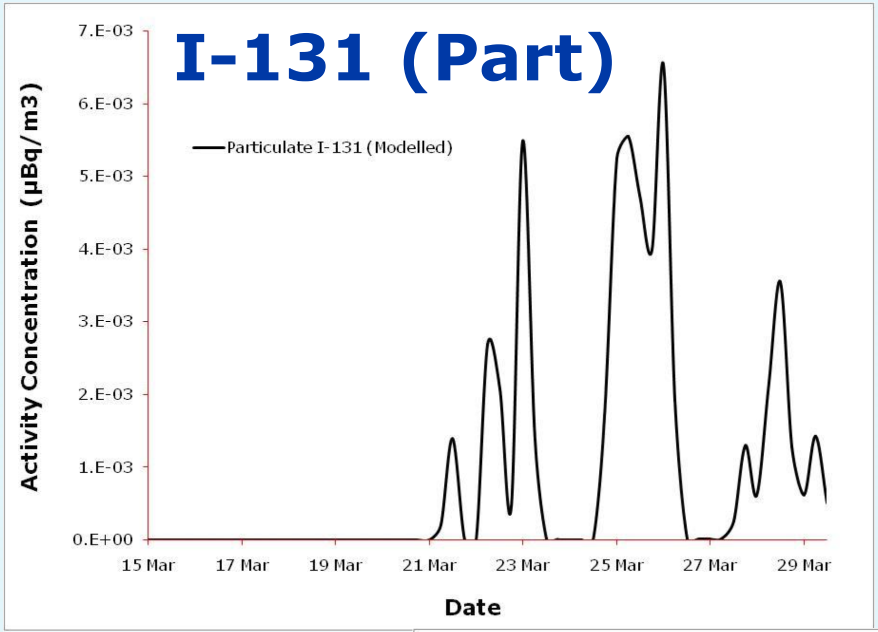
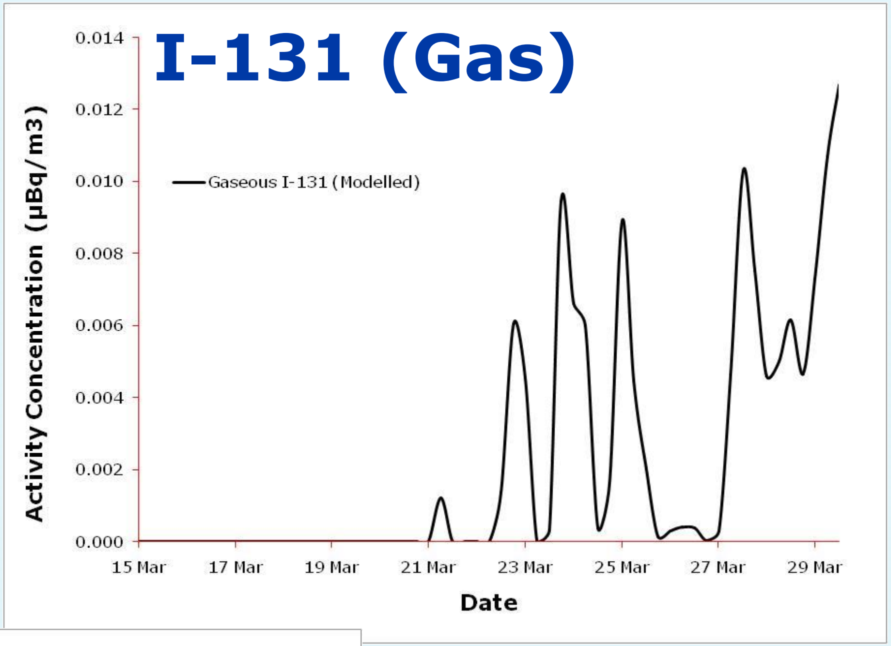
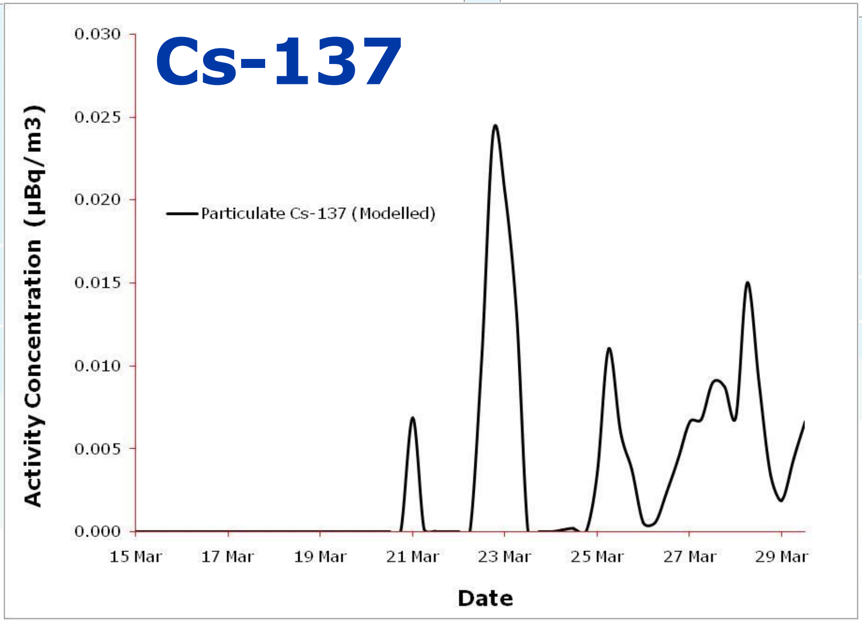
- Thes... the RPII...

Results: *First Modelling Phase*







1 GBq/hr)
release rate

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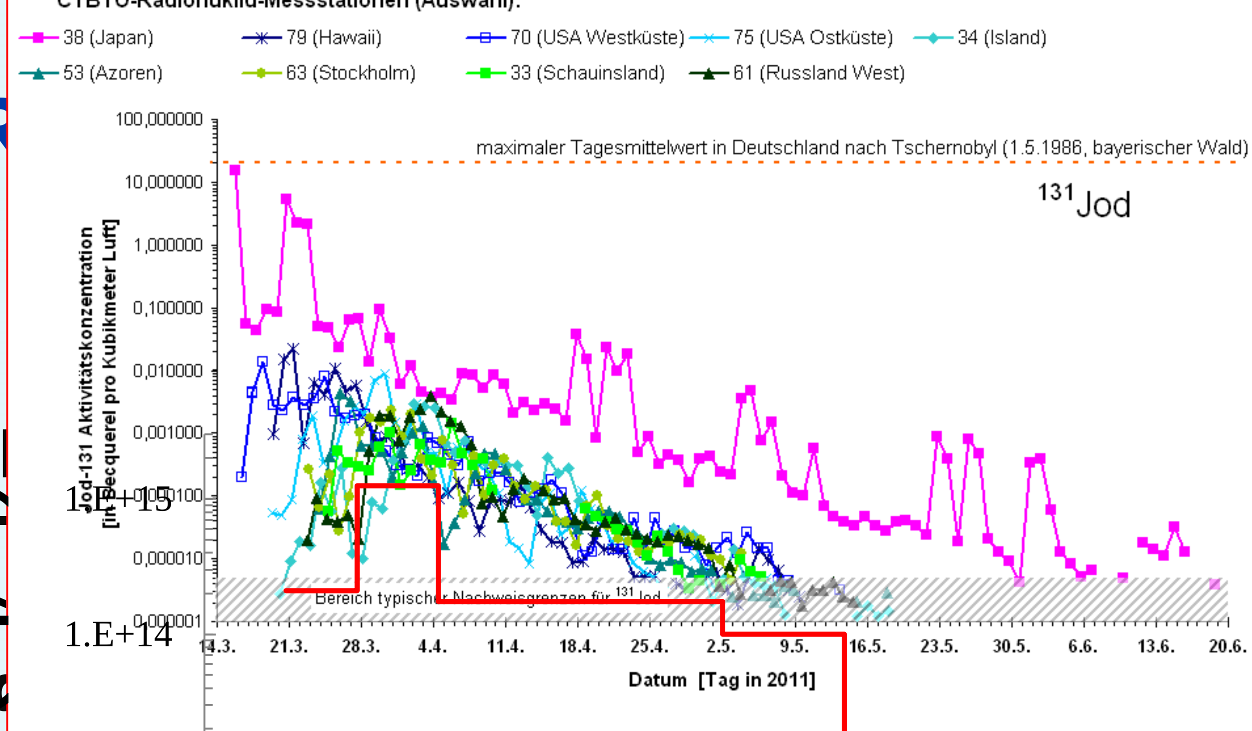
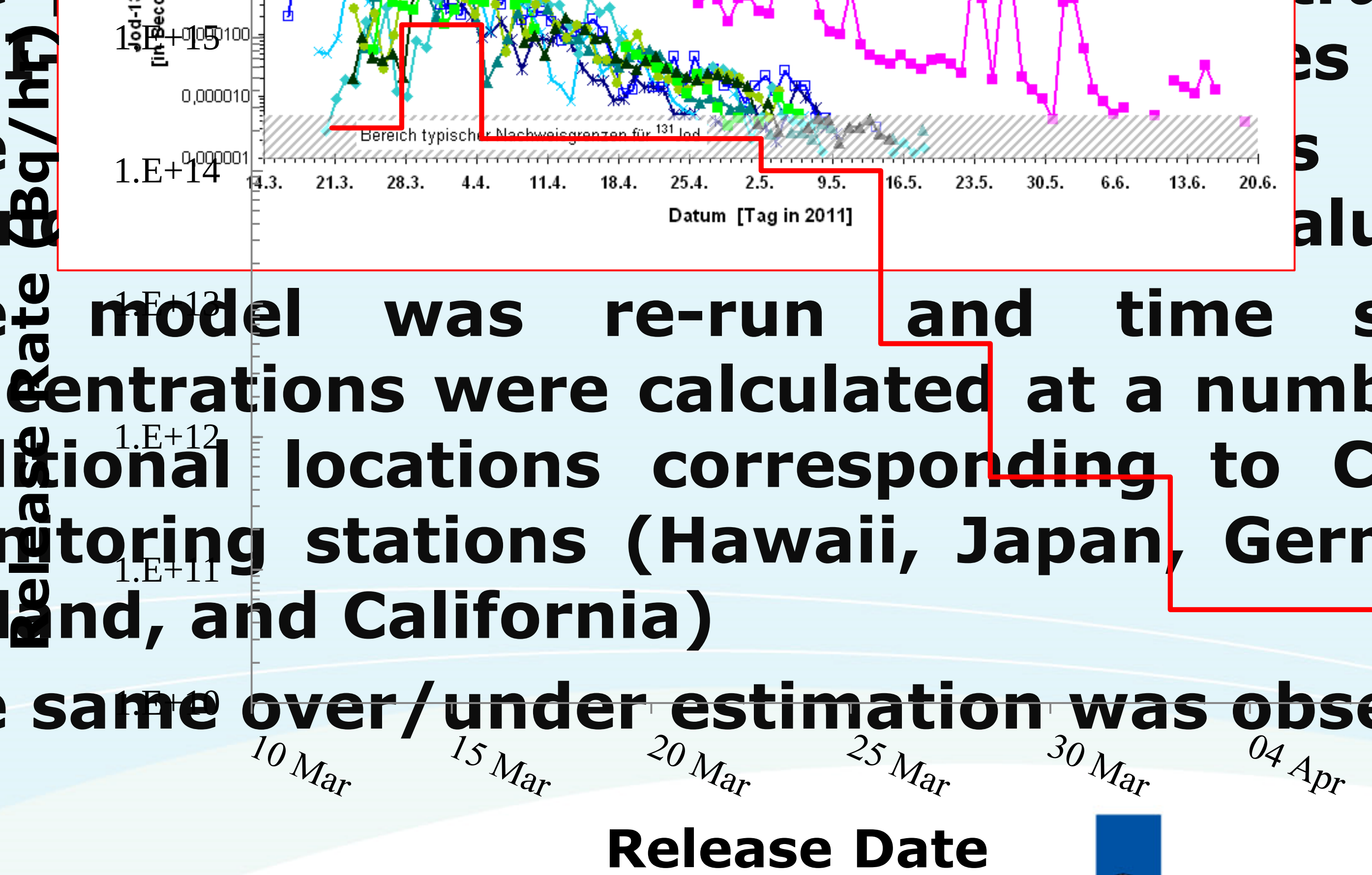
R… ase

- Used …
- The … trations for 1… es
- The … s were found … alues
- The model was re-run and time series concentrations were calculated at a number of additional locations corresponding to CTBTO monitoring stations (Hawaii, Japan, Germany, Iceland, and California)
- The same over/under estimation was observed





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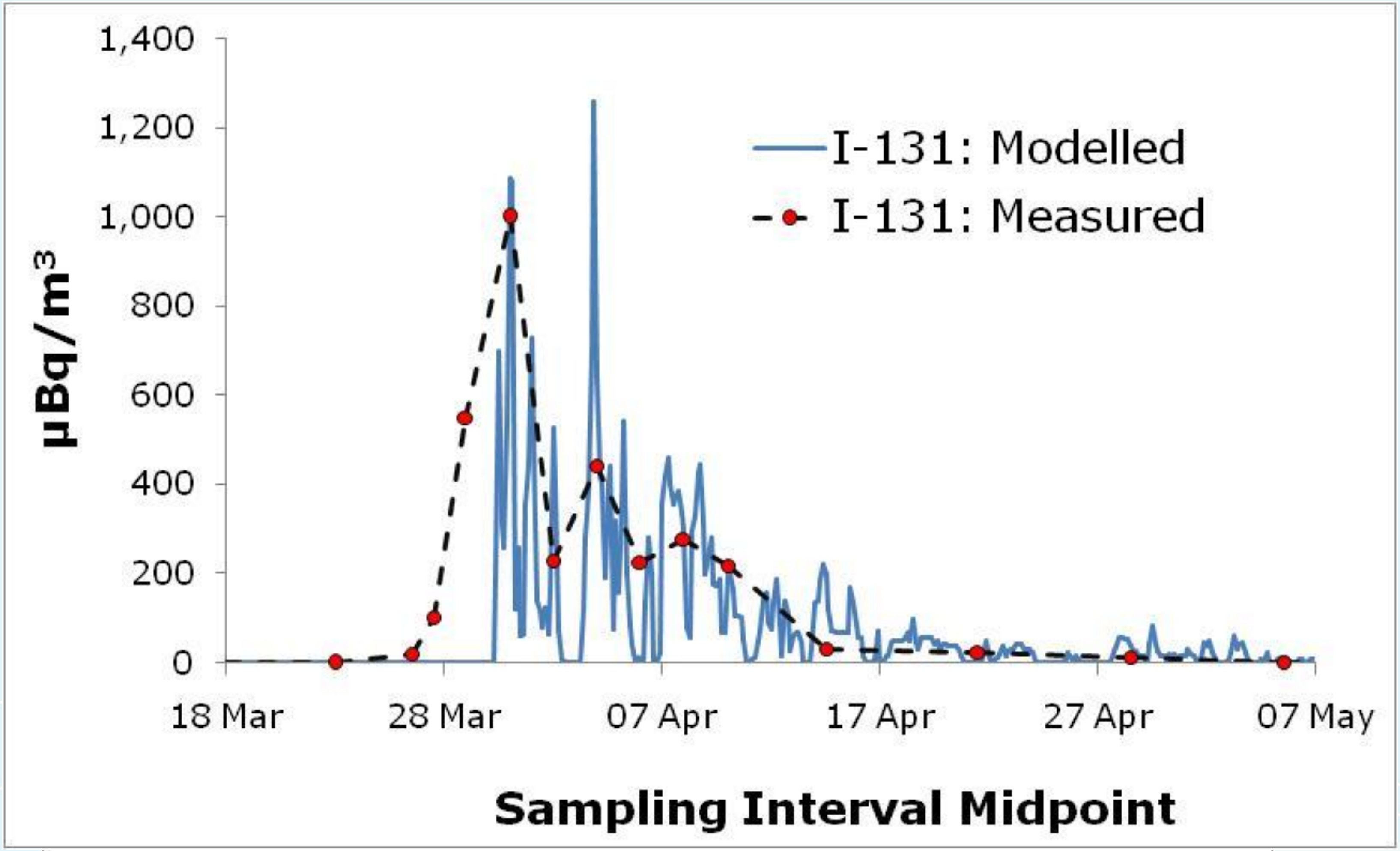
Results: *Second Modelling Phase*

- **It was assumed that this was a result of a combination of large uncertainties in the model inputs, including a lack of definitive data on the quantities and timings of the radioactive release.**
- **It was also assumed that the wet and dry deposition parameters required some modification.**
- **The meteorological data used during this phase of the modelling had a one degree resolution and may not have adequately modelled precipitation along the path of the plume.**

Results: *Second Modelling Phase*



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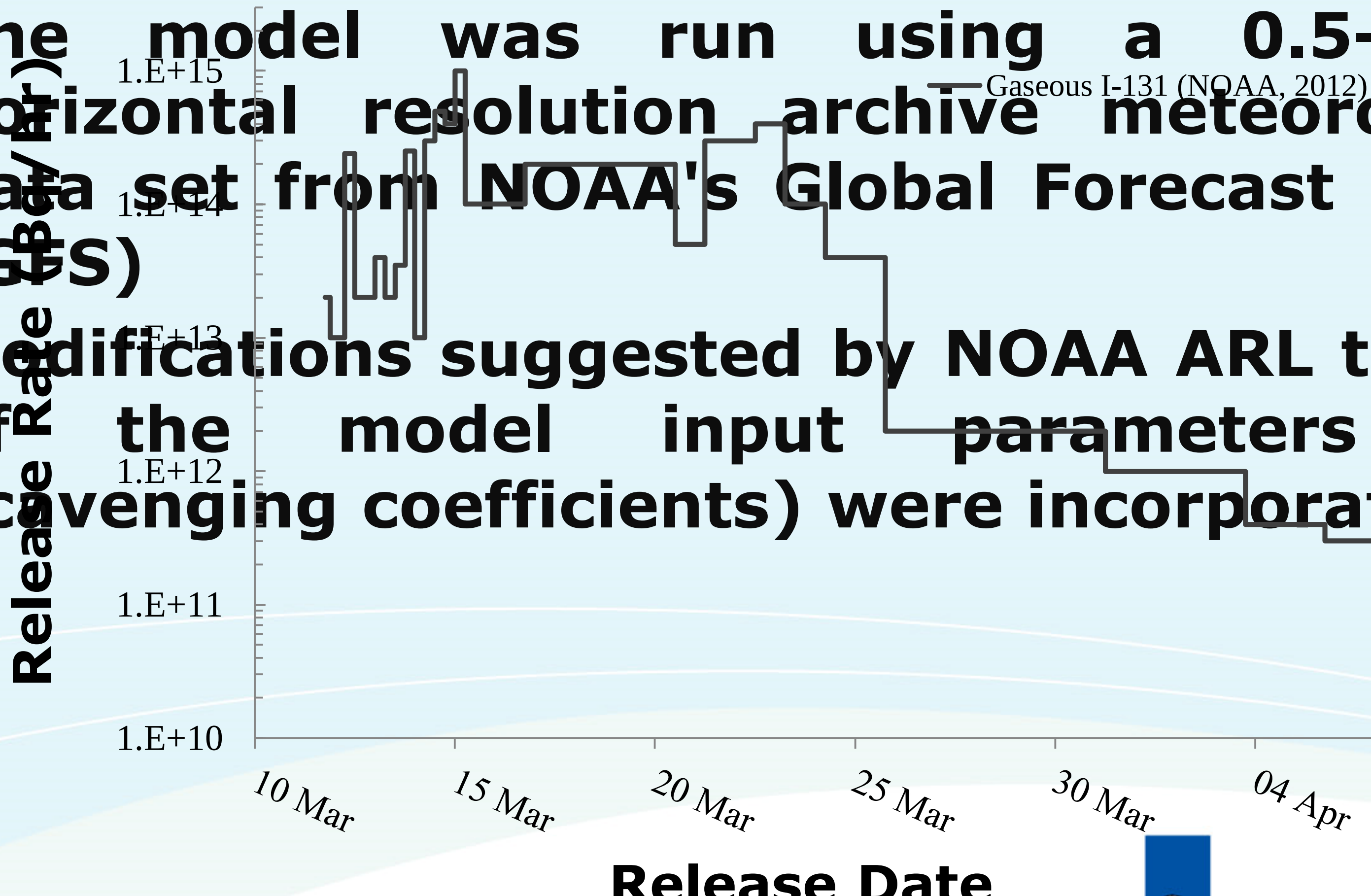
Results: *Final Modelling Phase*

- **Used the latest release estimates**
- **The model was run using a 0.5-degree horizontal resolution archive meteorological data set from NOAA's Global Forecast System (GFS)**
- **Modifications suggested by NOAA ARL to some of the model input parameters (e.g. scavenging coefficients) were incorporated.**



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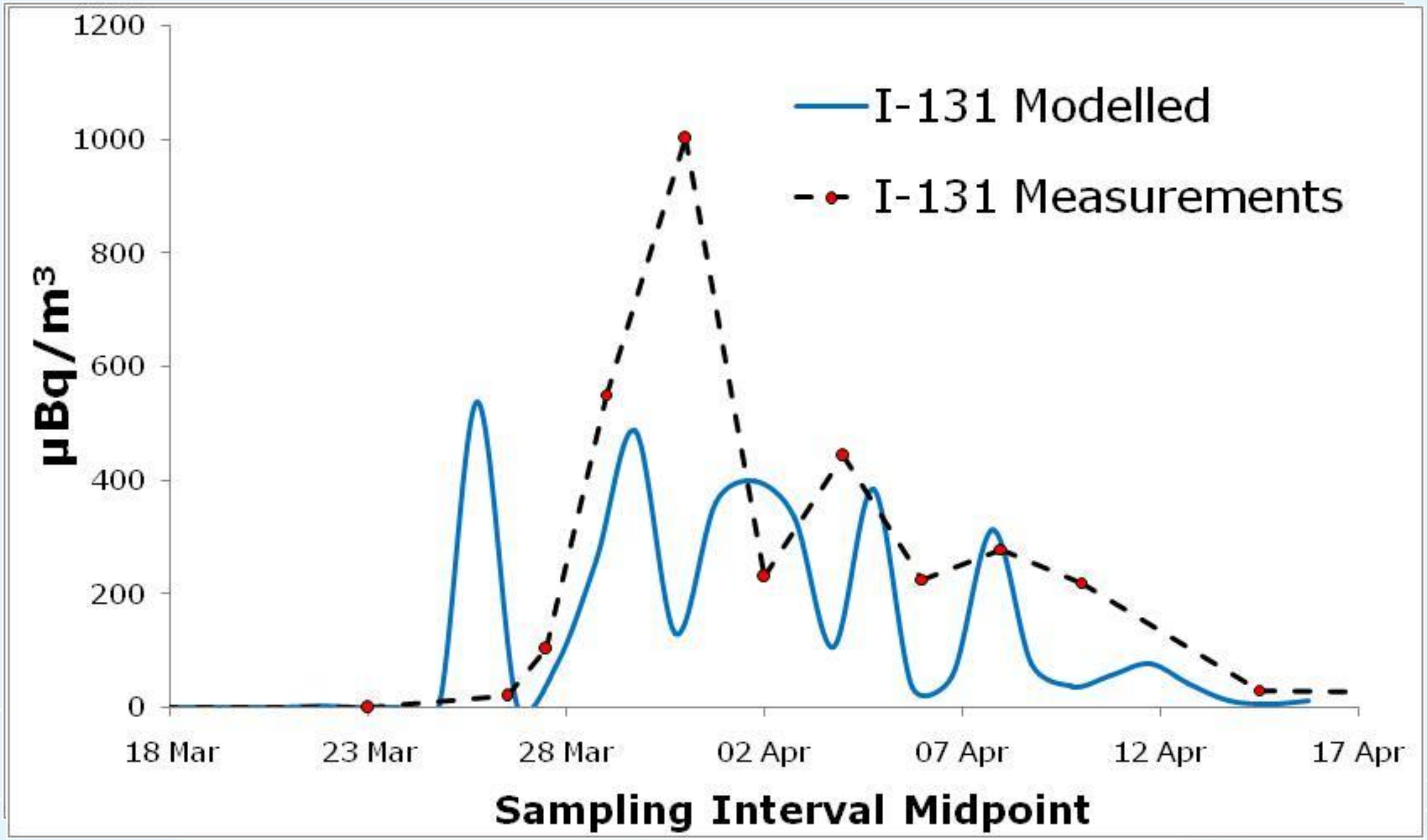
Results: *Final Modelling Phase*



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Conclusions

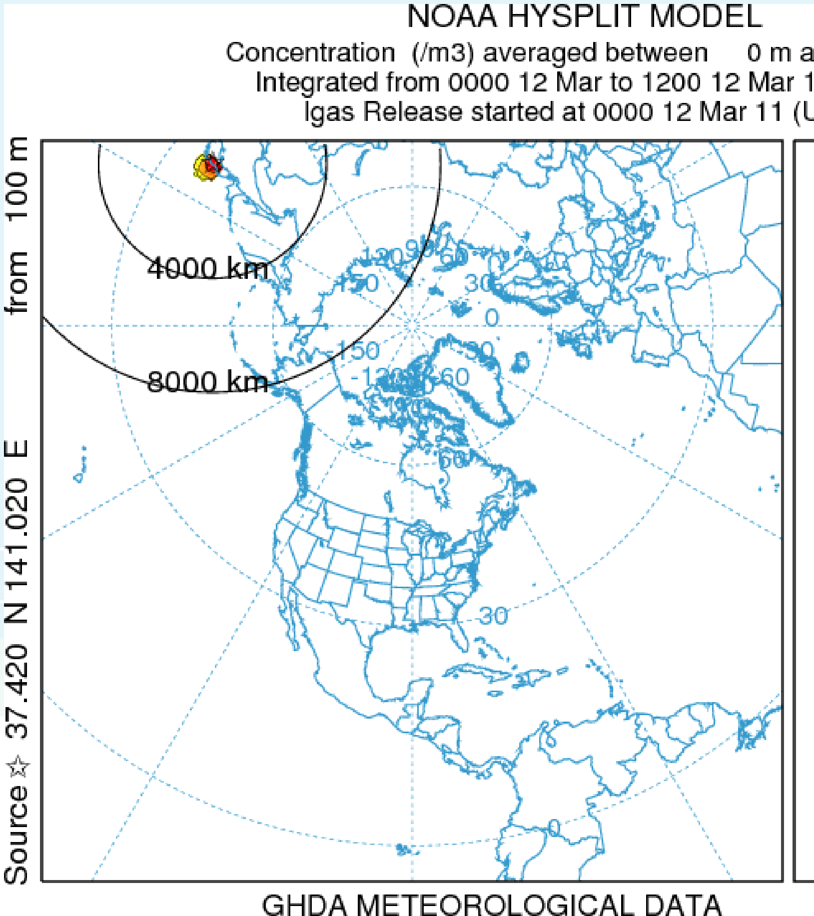
- The HySplit atmospheric dispersion model played an important role in the assessment of the Fukushima accident.
- In general, HySplit made reasonable estimates of the timing and duration of the radioactive plume over Dublin.
- The post accident analysis phase is ongoing
- This study shows that atmospheric are a useful supplementary tool to measurements

Go raibh maith agaibh!

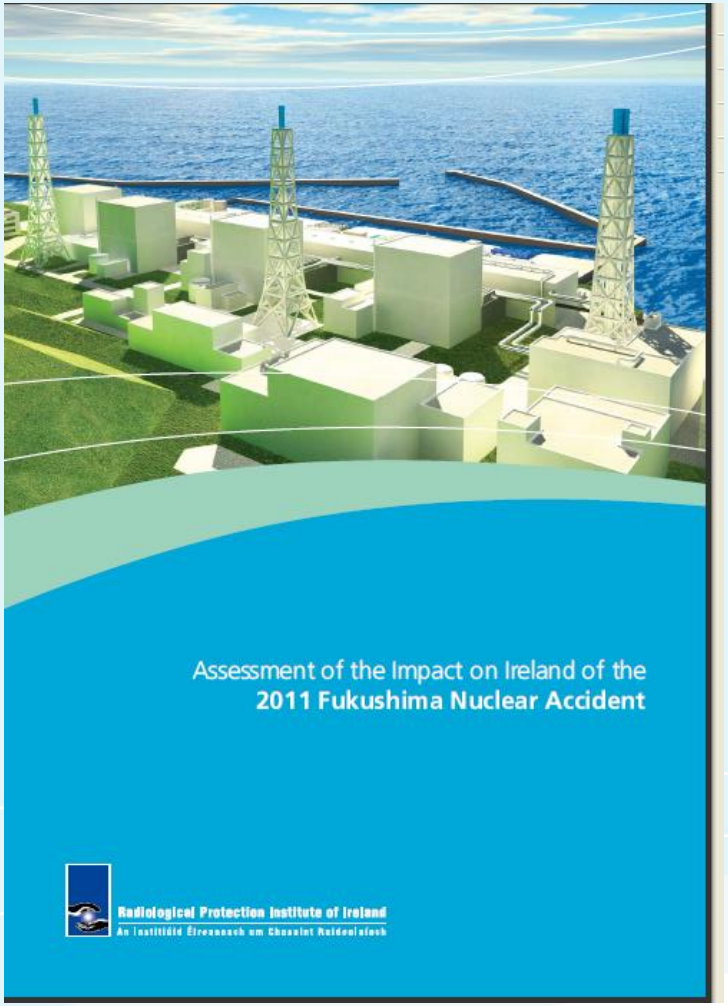
Thank you!

Acknowledgements

- **NOAA Air Resources Laboratory for provision of the HySplit transport and dispersion model used in this work.**
- **R. Draxler for his assistance with HySplit.**
- **Masamichi Chino (Japan Atomic Energy Agency)**



Further Information



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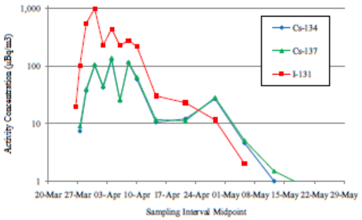
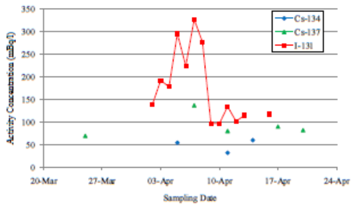


Radioactivity in Airborne Particulates (High Volume), Dublin



Radioactivity in Milk, Kilkenny

4 Results

The highest recorded I-131 activity on airborne particulates was 1,000 µBq/m³ in the sampling period 30 March to 1 April. Cs-134 and Cs-137 levels in air peaked during the sampling period 3 to 5 April at 128 µBq/m³ and 138 µBq/m³ respectively. No regional differences in Ireland were expected or observed. Gaseous I-131 was also detected in activated charcoal filters from low volume air samplers, mainly during the last week of March and the first two weeks of April 2011.

Iodine-131 was detected in some rainwater samples during the same period.

The highest level measured of I-131 in milk was 327 mBq/l. Elevated levels of Cs-134 and Cs-137 were also found in some samples. By 23 April, levels in milk had decreased to below the level at which they can be detected.

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