RSMC Exeter report of activities for 2011

Executive Summary

At RSMC Exeter, activities for 2011 were dominated by the Fukushima NPP accident which began on Friday 11th March. In itself this heralded a busy time for RSMC Exeter (even in a non-lead RSMC role) but also precipitated other work which enhanced the capability of the RSMC. In addition, there were ad-hoc requests from the International Atomic Energy Authority (IAEA) and incremental updates and improvements to our response procedures and software. The Provisional Technical Secretariat (PTS) of the Comprehensive Test Ban Treaty Organization (CTBTO) made both operational and planned requests for inverse modelling support by RSMC Exeter throughout 2011.

1. Introduction

The UK Met Office is designated by the WMO as the Regional Specialized Meteorological Centre (RSMC) for the provision of atmospheric transport modelling in case of an environmental Emergency Response. The primary region of responsibility is WMO Regional Association (RA) VI, which encompasses Europe, the Ukraine and the Russian Federation. In the case of an event, RSMC Exeter would respond jointly with RSMC Toulouse.

2. Operational Contact Information

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3. Responses and information on dissemination of products

i. Participation in international inverse dispersion modeling events and exercises with CTBTO

RSMC Exeter has, throughout 2011, received a large number of requests for both real and exercise scenarios from the Provisional Technical Secretariat of the Comprehensive Test Ban Treaty Organisation (CBTBO). In the vast majority of cases the products were supplied to CTBTO within a few hours of receipt of the request. During the Fukushima

response (March and April 2011) the size of the files, and the lengths of the runs that were requested, meant that some responses were taking longer, in some cases many tens of hours.

4. i) Routine operations

RSMC Exeter did not undertake the planned exercise as lead RSMC (in conjunction with RSMC Toulouse) in May 2011 because this was cancelled as a result of the extreme workload experienced by the IAEA following the Fukushima incident.

RSMC Exeter has been responding to the monthly tests (initiated by RSMCs Melbourne, Montreal and Washington) by running dispersion models and sending output onto the mirrored RSMC web pages.

ii) Response to the Fukushima NPP event from 11th March 2011

In the hours following a major earthquake, and resulting tsunami, off the northeastern coast of Japan on Friday 11th March, RSMC Exeter became aware that there was a need to consider the impact of a release of radioactive material from the Nuclear Power Plants (NPP) at Fukushima in Japan. Early television news reports indicated that, potentially, the Fukushima I Nuclear Power Plant was most at risk, and may have suffered some damage.

The first communication from the IAEA was received at 09:49 UTC on Friday 11th March. This was a request for the designated lead RSMCs (Beijing, Tokyo and Obninsk) to provide a prediction to the IAEA based on a default release (1E12 Bq).

At this time, RSMC Exeter did run their dispersion model (NAME) based on the parameters provided by the IAEA and liaised with RSMC Toulouse in order to produce a Joint Statement, although this was for internal purposes and was not disseminated to any other recipients.

A second communication was received from the IAEA at 16:14 UTC on Friday 11th March, again with a request for the designated lead RSMCs (Beijing, Tokyo and Obninsk) to provide a prediction to the IAEA, this time based on a unit (1Bq) release. RSMC Exeter ran their dispersion model, using the supplied parameters, and posted the results onto the RSMC Exeter secure webpage.

The first communication from the IAEA where non-lead RSMCs were specifically requested to run their dispersion models, and to make the results available to the NMSs in their areas of responsibility, was received at 16:15 UTC on Saturday 12th March. RSMC subsequently ran their NAME model and issued to both their secure website, as well as to the NMSs in their area of responsibility.

Over the following four weeks, further requests were received from the IAEA. The majority of these were requesting a response only from the lead RSMCs (Beijing, Tokyo and Obninsk) but there were requests for non-lead RSMCs to produce and issue predictions. On average, the requests for non-lead RSMC participation were received approximately every two or three days.

The last request received from the IAEA, requiring a response from all RSMCs, was at 01:17 UTC on 15th April 2011. RSMC Exeter produced and issued output consistent with this request.

A message from IAEA, formally ending the response of any of the RSMCs for the Fukushima event, was received on 23rd May 2011.

iii) Response from RSMC Exeter concerning "special" IAEA requests

Private requests were received from IAEA for additional modelling results to support various UN agencies to quantify the impact of the accident at Fukushima (including the IAEA, the World Health Organization, ICAO and other organizations that are part of the IAEA Joint Radiation Emergency Management Plan). The Met Office became involved in this activity as a member of the WMO Nuclear Emergency Response Activities Coordination Group. Centres were requested to supply modelling results for comparison purposes and to get an idea of the variability amongst those results. The requests were on a voluntary basis and not part of the formal WMO RSMC - IAEA arrangements. The Met Office participated in conjunction with the Canadian Meteorological Centre / RSMC Montreal.

Three NAME runs were performed for this activity. These included releases from Fukushima that occurred on and after 22 UTC on 14 March (i.e. not considering the controlled venting / releases on 12 -13 March and hydrogen explosion early on 14 March). Given the extended nature of the model runs with multiple nuclide releases (rather than the normal 72-hour simulation for RSMC), our standard modelling/plotting routines needed to be modified, and as such there were some minor differences from the standard RSMC graphics that would ordinarily be produced by the Met Office. NAME results were sent via email to IAEA IEAC and WMO Secretariats and also to CMC.

Source term estimates were provided by IAEA for the early period (14 – 16 March) and ongoing releases thereafter from 17 March:

Run 1: For the period March 17 to March 26
Three radio nuclides were modelled Cs-137, I-131 and Te-132. Outputs from the first model run were a sequence of 24-hr time-integrated air concentrations (over the 0 - 500 m layer) output every 12 hours and also total deposition fields calculated over the entire simulation period. These were plotted over the Japan/W Pacific area for each of the three radio nuclides.

Run 2: For the period March 14 to April 12
Run 3: For the period March 14 to April 13 (updated evaluation of source)
Two radio nuclides were modelled Cs-137 and I-131. Output fields were produced for the entire N Hemisphere with a zoom over Japan/Pacific area. Here 24-hour time-integrated air concentrations (averaged over 0 - 500 m layer) were produced for each day, along with cumulative deposition (with and without considering the effect of radiological decay of deposited material) and total deposition over entire run (again with and without decay). Decay of deposited material is important only for I-131 due to its short half-life (the predictions of total deposition differ by almost an order of magnitude by the end of the period so it is important to consider decay when the intention is to compare against

monitoring data). But note that other factors which might influence deposited material (e.g. surface runoff, ground percolation, re-suspension) are not considered by NAME.

5. Lessons learned from recent experiences and significant operational and technical changes:

i. All requests for RSMC support during 2011 were carried out in a timely fashion.

ii. Various incremental changes continue to be made to NAME III to improve the capability of this model.

iii. During their response to the Fukushima event, RSMC Exeter were made aware that the labeling on some of RSMC Exeter's products were incorrect, referring to "dosage" where the term "24-hr time integrated air concentrations" was more appropriate. RSMC Exeter was able to make the required changes to their output within 36 hours.

iv. Additionally, the Fukushima event provided a catalyst for RSMC Exeter to provide their output to the common (mirrored) RSMC web pages, hosted by many of the other RSMCs. The work to enable this was completed just after the final products were issued by RSMC Exeter in April 2011. Since that time we have confirmed that the process is working successfully and RSMC Exeter is now able to provide its output to these mirrored web pages on a "business as usual" basis.

6. Operational issues and challenges:

i. As highlighted in previous reports, there is a need to ensure that all operational staff are regularly exercised and tested in their execution of all aspects of Emergency Response. The initiation of the dispersion model (NAME) runs is not a problem, since the process is well-documented and performed frequently by the team. However, the writing of the Joint Statement is somewhat more involved and it is this aspect that is being focussed on. The Fukushima event led to the whole team undertaking an intense period of writing these Joint Statements, to the benefit of all involved. Since then, specific "training" days have been implemented to allow the EMARC (RSMC) forecasters dedicated time away from operational duties in which to continually practice these (and other) Emergency Response activities.

7. Summary and status of the operational atmospheric transport and dispersion models

The Met Office's Numerical Atmospheric-dispersion Modelling Environment, NAME III, is a Lagrangian particle-trajectory model designed to predict the atmospheric dispersion and deposition of gases and particulates. A large number of particles are used to represent releases from pollution sources. Each model particle can have its own characteristics, represent different compounds or chemicals and represent real particulate sizes. These particles are advected by the temporally varying, three-dimensional model winds and dispersed using random walk techniques that take into account the atmospheric turbulent velocity structures.

Several deposition processes remove particles from the atmosphere; i) impaction with the surface, ii) washout where particles are `swept out' by falling precipitation, iii) rainout where particles are absorbed directly into cloud droplets as they form and, iv) fall out due to gravity.

A modular code design offers the user flexibility in configuring model runs and provides an infrastructure onto which extra modules could be added. NAME is capable of utilising meteorological data from a variety of sources: fields from a numerical weather prediction model, radar rainfall estimates, and single-site observations, with the available data used in a nested sense.

Other effects, such as plume-rise (for buoyant or momentum-driven releases), radioactive decay of radio nuclides, and chemical transformations, can also be included. At short ranges, NAME functionality includes modelling of short-period concentration fluctuations and the effects of small-scale terrain or isolated buildings on dispersion.

8. Plans for 2012:

- A continuation of the process to upgrade the EMARC computer facilities, helping to improve response time for an event.
- NAME III will continue to be developed, with an emphasis on enhancing deposition processes, as well as parallelisation of the code to enhance response.
- Ongoing dedicated training for the forecasting team to ensure that they are able to respond to any ATM requests in a timely and professional manner.
- RSMC Exeter will continue to respond to requests, including the quarterly test in February 2012 (RSMC Exeter and RSMC Toulouse acting as lead on this date) as well as ad-hoc requests from IAEA.
- RSMC Exeter will begin the process to host their own "mirrored" web site, enabling ATM modelling from all other RSMCs to be viewed.