

RSMC Washington report of activities for 2011

Executive Summary

RSMC Washington responded to an initial request for support for the Fukushima-Daiichi event in Japan from the International Atomic Energy Agency (IAEA) on 14 March 2011 and then responded to an additional 21 requests from the IAEA between 11 March and 15 April 2011. Other RSMC-related activities for 2011 consisted of Region 3, 4, and 5 monthly tests, conducted for scenarios over Canada, the United States, and Australia, two IAEA exercises with RSMC Washington and Montreal as Lead RSMCs for one exercise in November, incremental updates and improvements to the response procedures, software, and to the joint RSMC secure common web pages, which are used for communicating transport model products between RSMCs, and numerical modeling improvements.

1. Introduction

The National Oceanic and Atmospheric Administration's (NOAA) Air Resources Laboratory (ARL) together with NOAA's National Centers for Environmental Prediction (NCEP) are designated by the WMO as the Washington Regional Specialized Meteorological Centre (RSMC) with the specialization to provide atmospheric transport model products for environmental emergency response. The primary regions of responsibility are WMO Regional Associations (RA) III & IV, which encompass Canada, United-States, Mexico, Central and South America.

2. Operational Contact Information

RSMC Washington
National Oceanic and Atmospheric Administration (NOAA)
National Weather Service
1325 East West Highway
Silver Spring, Maryland 20910-3283
United States of America

Business contact: Mr Jeffery McQueen
Tel : 1 301 763 8000, Extension 7226
Fax : 1 301 713 8545
Email : jeff.mcqueen@noaa.gov

Operational contact (24 hours): Senior Duty Meteorologist
Tel : 1 301 763 8298
Fax : 1 301 763 8592
Email : SDM@noaa.gov

3. Emergency operations

RSMC Washington responded to 22 requests for support from the IAEA between 11 March and 15 April 2011 related to the Fukushima-Daiichi nuclear reactor accident. Although RSMC Washington was not the Lead RSMC for this event, the IAEA requested model product support from all RSMCs. Further details on RSMC Washington's support can be found in the attached document presented by RSMC Washington at the WMO CBS Coordination Group for Nuclear Emergency Response Activities meeting held in Vienna, Austria 31 October – 4 November 2011, entitled "*Fukushima Daiichi NPP Accident: NOAA/National Weather Service RSMC Washington Response, Challenges and Lessons Learned.*"

4. Routine operations

Monthly Test:

RSMCs Montréal, Washington, and Melbourne generally hold a joint exercise on the second Thursday of every month. In addition, RSMC Washington participated in two IAEA-initiated exercises during the year, one of which RSMC Montréal and RSMC Washington were designated as Lead RSMCs. Table 1 shows the breakdown of the details for the exercises in 2011.

Month	Source location
Jan 13	Gentilly, QC, Canada
Feb 17	Rockingham, WA Australia (IAEA request)
Mar 10	Manyberries, AL, Canada
Jun 9	Lucas Heights, Australia
Jul 14	Bruce, ON, Canada
Sep 8	Pickering, ON, Canada
Oct 13	Lucas Heights, Australia
Nov 10	Atucha, Argentina (IAEA request)
Dec 8	Clinton, IL, USA

Table 1: RSMC Washington monthly tests for 2011

Once the model products are posted to the common web pages, an email is sent in both Spanish and English to those NMHS contact points with valid email addresses in WMO RA III and IV, the IAEA and WMO. The email contains login information to retrieve the RSMC products from the common web pages.

Common web pages:

RSMC Washington (ARL) continues to maintain and update, as needed, the common web page code. RSMC Washington is responsible for maintaining and distributing the web page code to all RSMCs and to make changes to the code based on lessons learned and RSMC technical meeting suggestions from other RSMCs. In 2011, RSMC Washington was able to post its results to the common web sites at all other RSMCs except Exeter, greatly enhancing the redundant capability of access to RSMC model products. In addition, most RSMCs regularly post their results to the RSMC Washington common web page for IAEA exercises. The objective is for all RSMCs to post their products on all common web pages whenever possible.

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

- See the attached Fukushima-Daiichi document for challenges and lessons learned during that event.

- In early November a new RSMC file dissemination system was implemented at NOAA NCEP that provides the Senior Duty Meteorologist with the option to send updated run graphics or "unavailable" notification files to the NOAA ARL RSMC web server for exercises and after older forecasts become out dated (~after 24 hours). In addition, Google map (kmz) plume files will now be available on the NOAA ARL RSMC Web server.

6. Additional operational issues and challenges:

RSMC Washington continues to have difficulty with invalid email addresses for NMS contacts who receive email notices of updated model products. Guidance from WMO on how the proper procedure to remove bad email addresses from our system would be helpful.

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

i. The HYbrid Single-Particle Lagrangian Integrated Trajectory Model (HYSPLIT)

RSMC Washington's operational atmospheric transport and dispersion model is HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectories) model, developed at the NOAA Air Resources Laboratory. HYSPLIT is driven by meteorological forecast data from the operational Global Forecast System (GFS) model (T574, 22 km) and the North American Meso (NAM) Non-hydrostatic Multi-scale Model on a 12 km grid (NMM). The system is available for running on demand and can produce forecast trajectories, concentrations (or exposures) and depositions for nuclear accidents, volcanic eruptions, smoke episodes and other related atmospheric pollutant releases.

HYSPLIT can be used for modeling atmospheric transport and dispersion of pollutants over a broad range of distances; from local to global scales. The equations used in the calculation of pollutant transport and dispersion are a hybrid between Eulerian and Lagrangian approaches. Advection and diffusion calculations are made in a Lagrangian framework using the gridded meteorological analysis and forecast fields. Air concentrations are calculated on a fixed three dimensional grid by integrating all particle masses over a pre-set averaging period. Routine calculations may consist of simple trajectories from a single source to complex emissions from several sources. Dry deposition is treated with a deposition velocity. Wet deposition is divided into two processes: a scavenging ratio for pollutants located within a cloud layer and a scavenging coefficient for pollutant removal in rain below a cloud layer. Radiological decay is also included when necessary.

8. Plans for 2012:

- The schedule of routine monthly tests for all of 2012 has been set up in collaboration with RSMCs Montréal and Melbourne.
- Four exercises in 2012 will be initiated by IAEA with the August exercise being designated "Lead" for RSMCs Washington and Montréal.
- Create and test a RSMC Washington web server at NOAA NCEP.
- Continue to make small modifications to the common web page code as needed based on problems encountered during exercises/events and provide the changes to all RSMCs.

- Upgrade the operational NCEP HYSPLIT (dispersion, trajectory and all associated programs) to the current version 4.9 in early 2012 along with required changes according to the revision of the GDPFS manual (WMO No.485). Dispersion code wet deposition changes per Fukushima lessons learned.
- Implement HYSPLIT driven by the National Environmental Modeling System (NEMS) NMMB model on a 12 km North American grid as an option to the older more coarse (vertical and temporal) 12 km grid, and the global model (GFS)
- Add option for driving HYSPLIT with hourly NAM meteorology.
- Implement a 'testing' job to test the operational run scripts for a variety of test cases.
- Implement Plume Time of Arrival Product

References

WMO, 2010: Documentation on RSMC Support for Environmental Emergency Response. *WMO-TD/No.778*. Available online at <http://www.wmo.int/pages/prog/www/DPS/WMOTDNO778/Annex4.html>

WORLD METEOROLOGICAL ORGANIZATION

CBS/CG-NERA/Doc. 5(12)

**COMMISSION FOR BASIC SYSTEMS
OPAG on DPFS**

(25.10.2011)

**COORDINATION GROUP FOR
NUCLEAR EMERGENCY RESPONSE ACTIVITIES**

Agenda item: 5

Vienna, Austria, 31 October - 4 November 2011

Original: ENGLISH

**FUKUSHIMA DAIICHI NPP ACCIDENT:
NOAA/ NATIONAL WEATHER SERVICE RSMC
WASHINGTON
RESPONSE, CHALLENGES AND LESSONS LEARNED**

(Submitted by RSMC Washington)

Summary and purpose of document

This document 1) describes the response of the NOAA/NWS National Centers for Environmental Prediction response to the Fukushima Daiichi NPP accident as part of its role as a WMO Regional Specialized Meteorological Center. This document does not discuss additional customized support (e.g. high resolution dispersion model simulations) for other U.S. Government requests

Action Proposed

The Meeting is invited to discuss the paper and decide on recommendations to improve the response / products in the future.

1. Introduction

The NWS National Centers for Environmental Prediction (NCEP) hosts a WMO Regional Specialized Meteorology Centre (RSMC Washington) for the provision of atmospheric transport modeling following the release of radioactive material into the atmosphere. We present here a summary of the national and international support provided by RSMC Washington following the Fukushima Daiichi NPP accident.

In what follows, "RSMC Washington" is used to refer to the international mandate, as defined in the WMO Manual on the GDPFS. This document summarizes response as NCEP's role as an operational RSMC. Additional support requested by other U.S. or international agencies is not discussed.

2. Response of the National Centers for Environmental Prediction

Government requests: RSMC Washington for response was activated on 14 March 2011. RSMC Washington was not the lead for nuclear emergencies as covered in the Federal Nuclear Emergency portion of the Plan. Rather the U.S. Interagency Modeling and Atmospheric Advisory Center (IMAAC) currently hosted at DOE Lawrence Livermore Labs led the response to U.S. agencies. However, the RSMC Washington did provide meteorological and atmospheric transport modeling guidance as well as weather forecasts and other meteorological information. The RSMC-Washington responded to several requests for atmospheric transport modelling for Fukushima between 11 March and 22 March 2011. See Annex 1 and 2.

This information was included in the daily report to NWS and NOAA leadership along with estimates of source terms, dose calculations, possible worse case scenarios, etc. Various U.S. Government Departments and Agencies (e.g: DOD Defense Threats Reduction Agency, U.S. Army) used the reports that were eventually coordinated with the lead U.S. agency, the Department of Energy. The information was used to provide advice to the U.S. embassy staff in Tokyo as well as American in Japan and abroad. See Annex 2.

International Atomic Energy Agency

Standard requests: A total of 32 requests for atmospheric transport modelling related to Fukushima were received from IAEA between 11 March and 15 April 2011. Ten of these were for a response by the lead RSMCs only and RSMC Washington responded to 22 requests.

Special / private requests: These were made by the IAEA to some of the members of the WMO CG-nERA but outside of the formal IAEA – WMO RSMCs arrangements. The response was done on a voluntary basis. The requests involved additional modelling using diagnostic and sometimes prognostic meteorological data for scenarios where the release varied as a function of time and involved multiple isotopes (typically I-131 and Cs-137). The objective was to support various agencies trying to quantify the impact of the radioactivity released from Fukushima Daiichi NPP accident and for media briefings by the IAEA. These special products are not covered in this document but some were produced by NOAA-Research Air Resources Laboratory in Silver Spring, MD.

A total of 13 such requests were made by IAEA between 11 March and 15 April 2011 and RSMC Washington responded to some of these. At the request of the IAEA, the modelling results were provided in GIS compatible format (shapefile) in addition to the standard RSMC product formats defined in the WMO Manual on the GDPFS. See Annex 1.

Additional products / services: Access to the SDM runs password protected web site (Annex 1) was given to the IAEA and well as other international organizations. Additional capabilities (eg: for a continuous release) were developed and are outlined in Annex 2.

Comprehensive Test Ban Treaty Organization

The RSMC Washington does not participate in the CTBTO program.

3. Challenges and lessons learned

1. Products

- This event helped to identify the need for new products at RSMC Washington / National Centers for Environmental Prediction and lead to their development / posting on web pages in a matter of a few days.
- The need for data in GIS compatible format is clear, in addition to the product formats already defined in the Manual of the GDPFS. RSMC Washington did find a bug in their Google Earth GIS formatted product that was corrected by NOAA/ARL within a few days.
- Addition
- Existing IAEA – WMO arrangements and products are well suited for the response to short lived events and for the initial phases of a long lived event. Fukushima has showed us that additional arrangements may be needed to deal with long lived events. As was shown by the IAEA special / private requests, modelling runs using diagnostic meteorological fields and more detailed / better source term information (isotopes, time varying release, etc.) become increasingly important as we move away from an initial response to the accident into defining a better picture of what actually happened. These

runs are obviously very important for international organizations, but have an impact on workload.

- RSMC Washington did receive requests from the Japan Meteorological Agency and the WMO for additional modeling runs using diagnostic wind fields or higher resolution grids. If / how / when such requests should be answered needs to be discussed.
- The NWS/NCEP Aviation Weather Center (AWC) did request products to support aircraft guidance for avoiding the radiological plume. RSMC Washington is working with the AWC and NWS to define and possibly produce such products.
- Importance of getting feedback from the users regarding products, especially new ones, so as to know whether or not to continue them.
- Importance of defining clearly the needs for existing and new products including format of data for GIS.

2. Workload

- Answering requests in diagnostic mode and for more detailed source terms takes time / manpower, resulting in workload problems as was experienced by RSMC Washington.

3. Other

- Some confusion in the U.S. as to which agency was the lead. NOAA Air Resources Laboratory and NWS coordinated with the Department of Energy who was eventually declared the lead to provide a unified response to U.S. government agencies.
- NCEP did provide DOE/IMAAC with its ½ degree GFS gridded NWP fields to drive high resolution (5 km) Weather Research and Forecast (WRF) model predictions centered over the accident.
- Considerable work was done by the RSMCs (mainly under the development of NOAA Air Resources Lab) during Fukushima to set up the posting of products on the common web pages.
- It was found that the NWS Global Forecasting System was not ingesting the Japan Profiler Network data. NCEP subsequently began to evaluate these profilers for possible ingest into the Global Data Assimilation System.
- The event helped to review, adjust, clarify and update information on the WMO ERA web pages.

4. Conclusion

This paper has identified a number of challenges and lessons learned by RSMC Washington / NCEP during the response to the Fukushima Daiichi NPP accident. The Meeting is invited to discuss the points raised in this paper and decide on recommendations to improve the response / products in the future.

ANNEX 1: modelling runs produced by the RSMC-Washington

A) INFORMATION PROVIDED TO USERS ON THE WEB PAGE:

WARNING: THESE IMAGES ARE PROVIDED FOR GUIDANCE AND PLANNING PURPOSES ONLY. THEY REQUIRE EXPERT INTERPRETATION IN METEOROLOGY, ATMOSPHERIC TRANSPORT MODELLING AS WELL AS POTENTIAL IMPACT ON HEALTH.

RSMC Washington HYSPLIT Outputs:

The HYSPLIT outputs are produced by the NWS/NCEP Senior Duty Meteorologist (SDM) using hypothetical radioactive releases and using the NWS Global Forecast System numerical Weather Prediction (T574 spectral, ~35 km native resolution) on a ½ degree horizontal and vertical pressure grid

Short-range modelling:

- Domain covering north Pacific at ½ degree grid mesh
- Forecast duration: 72 h
- Release duration: 24 h
- Release quantity: 1 Bq of Cs-137
- Starting release hours:
 - 06, 12 ,18 and 00 UTC using forecast meteorology of the GFS GLOBAL model run
- Maximum initial plume height: 500 m
- Vertical distribution: uniform

TRAJECTORIES:

The trajectories are produced automatically from the NCEP SDM using theoretical radioactive releases. The following parameters are used in these simulations:

- Forecast duration: 72 h
- Starting release hours:
 - 00,06,12 and 18 UTC using meteorological fields of the latest GFS model prediction.

B) EXAMPLE OF PRODUCTS:

Not shown here as they are the same as those found in

http://www.wmo.int/pages/prog/www/DPS/WMOTDNO778/documents/WMO_TD778_Washington_July2010.pdf

ANNEX 2.

Timeline for RSMC Washington response to the Fukushima – Daiichi, Japan Nuclear Power Plant Incident. March 11, 2011 → April 15, 2011

Date	Request	Model/Products requested	Response
March 11- March 15, 2011	IAEA: Began running HYSPLIT for RSMC in exercise mode.	GFS-HYSPLIT RSMC Default configuration: <ul style="list-style-type: none"> • Unit release (CS-131) • 6 hr release duration • 72 hour forecast • 1° GFS 3 hrly Pres. Grids 	<u>NCO-SDM</u> <ul style="list-style-type: none"> • Default RSMCs runs started and • Updated every 6 hours. • Distribution to IAEA & ARL.
March 12, 2011	IAEA: Run for real event	GFS-HYSPLIT RSMC Default configuration	<u>NCO-SDM</u> <ul style="list-style-type: none"> • Continue RSMC run and distribute to Region IV National Met. Services , AWC and FAA.
March 12, 2011	AWC/FAA: Aviation guidance for radiological plume forecasts	GFS-HYSPLIT RSMC Default configuration	<u>NCO-SDM</u> <ul style="list-style-type: none"> • Provided interpretation of RSMC forecasts. • RSMC products only for surface guidance.
March 12, 2011	DOD/Army Institute for Public Health: HYSPLIT model predictions	GFS-HYSPLIT RSMC Default configuration	<u>NCO-SDM</u> <ul style="list-style-type: none"> • Provided latest RSMC forecasts.
March 12-13, 2011	RSMC Canada, NWS/HQ	RSMC Mirror web page, product dissemination	<u>EMC/ARL/NCO-SDM</u> <ul style="list-style-type: none"> • Corrections to RSMC web site made (contour lines, updated background info). • Coordination on capabilities.
March 15- <u>April 15</u> , 2011	IAEA, RSMC	Modify RSMC run for a continuous 72 hour release.	<u>NCO/SDM – ARL</u> <ul style="list-style-type: none"> • SDM found an error when trying to run. Worked with ARL to modify HYSPLIT configuration. • Running every 6 hours to 72 hours.
March 17-18, 2011	JMA: 2 km Met and RSMC dispersion model forecasts	No Change to RSMC model configuration.	<u>EMC</u> <ul style="list-style-type: none"> • Compute or personnel resources not available. • Lead agency, DOE, to respond.

March 18, 2011	NCO/SDM : Error found in creation of RSMC Google-Earth files.	HYSPLIT Post.	<u>ARL/EMC/NCO</u> <ul style="list-style-type: none"> • ARL provided EMC with fix to test. RFC submitted and implemented on March 21.
March 18, 2011	DOE/NARAC	Global Ensemble Forecasts to drive NARAC LODI Dispersion model.	<u>EMC</u> <ul style="list-style-type: none"> • ftp site location provided. NARAC to evaluate the use of GEFS.
March 18, 21 2011	NWS/IA DOD/DTRA NCO/SDM	Japanese Profiler data.	<u>EMC/NCO</u> <ul style="list-style-type: none"> • NCO receiving data but not yet ingested into GDAS. • NCO providing text files of profiler data nearest to the site.
