RSMC Washington report of activities for 2016

Executive Summary

RSMC Washington did not receive any requests for support for real events in 2016. Other RSMC-related activities for 2016 consisted of Regions III, IV, and V monthly tests, conducted for scenarios over Canada, the United States, and Australia, and four IAEA exercises during the year with RSMC Washington and Montreal as Lead RSMCs in August. A special exercise was conducted in September in conjunction with the National Meteorological Service of Argentina. Response procedures, software, and joint RSMC secure common web pages and numerical models were improved. The joint web pages are used for communicating transport model products to National Meteorological and Hydrological Services (NMHS) and between RSMCs and IAEA.

1. Introduction

The National Oceanic and Atmospheric Administration's (NOAA) Air Resources Laboratory (ARL) together with NOAA's National Weather Service's (NWS) National Centers for Environmental Prediction (NCEP) are designated by the WMO as the Washington Regional Specialized Meteorological Centre (RSMC) for the provision of atmospheric transport model products in case of an 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
NCEP Center for Weather and Climate Prediction
Suite 4600, W/NP
College Park, MD 20740
United States of America

Business contact: Mr Jeffery McQueen
Tel : 1 301 683 3736
Fax : 1 301 683 3703
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Operational contact (24 hours): Senior Duty Meteorologist
Tel : 1 301 683 1500
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Email : SDM@noaa.gov

3. Emergency operations

RSMC Washington did not respond to an emergency in 2016.

4. Routine operations

Monthly Tests:

RSMCs Montréal, Washington, and Melbourne generally hold a joint exercise on the second Thursday of every month and invite all other RSMCs to participate. In addition, RSMC Washington participated in four 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 2016.

Table 1: RSMC Washington monthly tests for 2016

Month	Source location
Jan 14	Gentilly, QB, CA
Feb 16	Koeberg-1, South Africa (IAEA request)
Mar 10	Lucas Heights, Australia
Apr 14	Calvert Cliffs, MD, USA
May 17	Shika, Japan (IAEA request)
Jun 9	Bruce, ON, CA
Jul 14	Lucas Heights, Australia
Aug 16	Laguna Verde, MX (IAEA request)
Sep 8	Clinton, IL, USA
Sep 14	Embalse, Argentina (special request)
Oct 13	Darlington, ON, CA
Nov 15	Lucas Heights, Australia (IAEA request)
Dec 8	Lucas Heights, Australia

Once the model products are posted to all 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.

RSMC Washington still awaits final recommendations for the new Time of Arrival Product being proposed for RSMCs before modifying the product already produced by RSMC Washington.

Common web pages:

RSMC Washington (ARL) continues to maintain and update, as needed, the common web page code on its web server. 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 2016, RSMC Washington was able to post its results to the common web sites at all other RSMCs. In addition, most RSMCs regularly post their results to the RSMC Washington common web page for IAEA and Region III/IV exercises. The goal is for all RSMCs to post their products on all common web pages whenever possible.

Currently ARL operates the RSMC Washington web site, but not on a 24x7 operational basis. Products are automatically sent and posted to this ARL site from the NCEP supercomputer which runs HYSPLIT and generates the graphics/product files. ARL manually runs scripts to send the products to the other RSMCs' web sites. Other RSMCs' products are automatically posted to this ARL site. The RSMC Washington joint web page is being ported to an operational NCEP web server, however, production backlogs have slowed the transition process for implementation in 2016. NCEP has developed the new web page, but testing the transfer of files from the NCEP supercomputer to other RSMC web pages and receipt/posting of other RSMC products on the NCEP site is scheduled to resume testing in 2017.

Provision of atmospheric backtracking Modelling for CTBTO Support:

The Department of State and NOAA entered into a Memorandum of Agreement for projects to make in-kind contributions to the CTBTO Preparatory Commission (PrepCom) on September 20, 2012 in accordance with the NOAA Backtracking Support to CTBTO Statement of Work of July 11, 2012. Therefore, NOAA, specifically, NCEP, agreed to become an operational center for CTBTO backtracking capabilities by utilizing the HYSPLIT dispersion model. The designation of RSMC Washington for the provision of atmospheric backtracking products was approved by CBS- Ext (2014) in Asunción, Paraguay, 8 to 12 September 2014 and the RSMC Washington CTBTO capability was successfully implemented into NWS operations (NCEP) on September 30, 2014.

HYSPLIT dispersion for atmospheric transport model backtracking response is primarily driven by the NWS/NCEP Global Forecast System (GFS) Global Data Assimilation System (GDAS). Outputs are at 1 degree horizontal resolution and 6 hour time intervals back 30 days from the present time. At least one month of GDAS model output at one-degree resolution is available for the CTBTO application.

RSMC Washington participated in several CTBTO initiated requests to provide backtracking information for radionuclide monitors in 2016. Table 2 shows the breakdown for the requests during 2016.

Table 2. List of CTBTO source-receptor matrix requests in 2016

Request Date/time (UTC)	Backward run ending time (UTC)	Latest measurement time (UTC)	Number of Receptors
20160315 1040	20160303 0000	20160314 0300	7
20161003 1130	20160920 0000	20161001 0600	7
20161121 1000	20161107 0000	20161118 0600	7

Note: Number of receptors. A single station can have multiple receptors as each 24-hr-average measurement counts as a separate receptor.

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

RSMC Washington continues to experience some intermittent problems during exercises due to the fact that the common web page is hosted by ARL on a non-operational web server. It is planned that the web site will be moved to NCEP operations in 2017 and work on transferring products from NCEP to other RSMCs and vice versa is currently being done.

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 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

HYSPLIT Model

RSMC Washington's operational atmospheric transport and dispersion model is the HYSPLIT (formerly called the HYbrid Single-Particle Lagrangian Integrated Trajectories) model (Draxler and Hess, 1998; Stein et al, 2015), developed at the ARL. HYSPLIT is driven by meteorological forecast data from the operational Global Forecast System (GFS) model (T1534, approximately 13 km, converted to 1 degree and half-degree latitude-longitude grids) and the North American Meso (NAM) Non-hydrostatic Multi-scale Model on a 12 km parent and 4 km CONUS, Alaska and Hawaii nested grids (NMMB). Note that a half- and quarter-degree GFS model output is also available and on the native hybrid-sigma levels compared to the 1 degree pressure levels. 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. A scavenging coefficient is used for both in- and below-cloud removal, which gave the best results when used for the Fukushima simulations. Radiological decay can also be included, when necessary.

8. Research and Development activities:

The HYSPLIT model is a complete system for computing simple air parcel trajectories as well as complex transport, dispersion, chemical transformation, and deposition simulations. As of 2016, HYSPLIT continues to be one of the most extensively used atmospheric transport and dispersion models in the atmospheric sciences community (e.g., more than 100 citations to Stein et al 2015, Web of Science; this hot paper was published in the past two years and received enough citations in September/October 2016 to place it in the top 0.1% of papers in the academic field of Geosciences. In addition, as of September/October 2016, this highly cited paper received enough citations to place it in the top 1% of the academic field of Geosciences based on a highly cited threshold for the field and publication year.).

In a recently published paper, Stein et al. (2015) present the model's historical evolution over the last 30 years from simple hand drawn back trajectories to very sophisticated computations of transport, mixing, chemical transformation, and deposition of pollutants and hazardous materials. They highlight recent applications of the HYSPLIT modelling system, including the simulation of atmospheric tracer release experiments, radionuclides, smoke originated from wild fires, volcanic ash, mercury, toxic chemicals and wind-blown dust. Among the model updates it is worth mentioning the inclusion of backward-in-time advection with dispersion to estimate footprints, time varying emissions, an embedded Global Eulerian Model (GEM), and the built-in capability to produce three different simulation ensembles.

In addition, HYSPLIT has very recently been coupled inline to the Weather Research and

Forecast model (WRF, Ngan et al, 2015) taking advantage of the higher temporal frequency available from the meteorological data. The model runs within the WRF architecture using the same spatial and temporal resolution and it has been tested against tracer experiments. This is a very promising approach for applications influenced by rapidly changing conditions and/or complex terrain. Further evaluation of this approach is underway. The capability to read/write GRIB2 files directly was implemented into operations in July, 2016 along improvements in wet deposition calculations.

Plans for 2017 and beyond:

There will be a HYSPLIT upgrade at NCEP, tentatively planned for December, 2017. The main features relevant to RSMC are (1) use the transfer coefficient matrix (TCM) approach with a 3-hourly emissions cycle, (2) transfer of the RSMC Washington web page from NOAA ARL to NCEP (see Section 4), and (3) posting of the HYSPLIT output in GRIB2 format to the "All Products" section of the NCEP RSMC Washington web page

- The schedule of routine monthly tests for all of 2017 has been set up in collaboration with RSMCs Montréal and Melbourne.
- Four exercises in 2017 will be initiated by IAEA with the February exercise being designated "Lead" for RSMCs Washington and Montréal.
- The joint web page will be installed on an operational server run by 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.
- RSMC/CTBTO applications continue using GFS/GDAS model output at half or one-degree though the GFS/GDAS modeling system will be upgraded (see NWP section below)
- Upgrade the HYSPLIT system at NCEP to a more recent version in December 2017.
- In 2017, allow HYSPLIT to be driven by NOAA's High Resolution Rapid Refresh (HRRR) 3 km model predictions in a development account in preparation for transfer to operations.

9. Summary and status of the operational Numerical Weather Prediction (NWP) models

The HYSPLIT dispersion for RSMC response is primarily driven by the NWS/NCEP Global Forecast System (GFS) or the North American Model (NAM). The NAM 12 km Non-hydrostatic Multiscale Meteorological Model on the B grid (NMMB; Janjic and Gall, 2012) has been NCEP's operational North American Mesoscale model since October 2011. Four fixed domain nests (3 km CONUS, Alaska, Hawaii and Puerto Rico) are embedded within the NAM 12 km parent mode beginning March 2017. .

In 2016, a CRAY based supercomputer was made operational increasing the total capacity of the Weather and Climate Operational Supercomputer system (WCOSS) IBM and CRAY systems to 2.8 PFlops, 3748 Nodes, 84,512 processors and 8.124 PB of storage. WCOSS provides the operational and developmental platform to run HYSPLIT, GFS 13 km, NAM as well as the 16 km Short Range Ensemble Forecast (SREF), T574 Global Ensemble Forecast, hourly 13 km Rapid Refresh (RAP), 3 km High Resolution Rapid Refresh (HRRR) models and 2.5 km Real-Time Mesoscale Analysis (RTMA) and other customized weather and ocean modeling systems. The HRRR hourly analysis and forecast system (18 forecast hours) over the Continental U.S is based on the Weather Research and Forecasting (WRF) Advanced Research WRF (ARW) model

with explicit microphysics, 2nd order closure boundary layer scheme and a multiple layer land surface model.

Plans for 2017:

Development of the TCM on the NCEP supercomputer will continue, with the intent to replace the current operational RSMC run with the TCM approach in 2017, however the current graphics will still be produced from the forecast portion of the TCM calculation.

- Update all NAM nests to 3 km horizontal resolution with forecasts to 60 hours four times per day.
- Implement a high resolution ensemble prediction system (~3 km) targeted for improving short-term severe storm prediction.
- In 2017, the Global Forecast System (GFS) system will be updated to the NOAA Environmental Modeling System architecture to improve coupling between various physical process components (eg: Ocean-atmosphere, aerosol-atmosphere).Transition the RSMC Washington web site to 24x7 operational NCEP web server.

References

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