RSMC Montréal Report of Activities for 2017

Executive Summary

Regional Specialized Meteorological Centre (RSMC) monthly tests comprised the primary activity during 2017, involving hypothetical scenarios run over Canada, the United States, Australia, Brazil, Hungary, and Malaysia. Other activities included incremental updates and improvements to the response procedures, software, and to the joint RSMC secure web pages. The latter are the primary means of communicating transport model products to National Meteorological and Hydrological Services (NMHS), and between RSMCs. RSMC Montréal also responded to requests for modelling support from the Provisional Technical Secretariat (PTS) of the Comprehensive Test Ban Treaty Organization (CTBTO).

1. Introduction

The Canadian Meteorological Centre (Meteorological Service of Canada, Environment and Climate Change Canada) is designated by the World Meteorological Organisation (WMO) as RSMC Montréal for the provision of atmospheric transport modelling (ATM) in support of 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. In addition to emergency response support, RSMC Montréal provides backtracking modelling support to the CTBTO verification system.

2. Operational Contact Information

Canadian Meteorological Centre (CMC)
Environment and Climate Change Canada
2121 Trans-Canada Highway
DORVAL, Québec
Canada H9P 1J3

Business contact: Mr. Nils Ek
Tel : 1 514 421 7207
Fax : 1 514 421 4679
Email : Nils.Ek@canada.ca

Operational contact (24 hours): Shift supervisor
Tel : 1 514 421 4635
Fax : 1 514 412 4639

3. Responses and information on dissemination of products

i. Production of CTBTO meteorological bulletins

Work continues toward transferring the production of bulletins containing meteorological data from CTBTO atmospheric monitoring stations from the Canadian Meteorological

Centre (CMC) to Zentralanstalt für Meteorologie und Geodynamik (ZAMG) in Austria. These bulletins have been issued by CMC under header SNCN19 CWAO.

In order for these stations to be officially recognized internationally, the WMO requested each member-state that has CTBTO stations on its territory to assign synoptic codes to identify the stations. The transfer of production of bulletins thus requires each CTBTO station to first be assigned a WMO synoptic identifier. Observations from those stations which have a WMO synoptic identifier are now transmitted by ZAMG under header ISAX30 LOWM in BUFR format.

ii. Dissemination of products

Transport model graphical products and joint statements are posted to secure joint web pages. When requested by the International Atomic Energy Agency (IAEA) these products are also faxed to relevant RSMCs and National Meteorological and Hydrological Services (NMHS). For examples of the graphical products, see Annex 4 of **WMO, 2011**. Throughout 2017, monitoring of RSMC mirror web pages continued, to ensure that they remained congruent.

It is the practice at RSMC Montréal to transmit blank charts to all RSMC mirror websites at the start of each response, before transmitting the actual product charts once the response has begun. The charts of RSMC Montreal's own modelling products that are transmitted to the mirror websites during exercises are removed and archived 3 days after the end of each exercise.

In addition to the other RSMCs, the following NMHSs are in our email and/or fax lists: Antigua and Barbuda, Argentina, Bahamas, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Guatemala, Guyana, Mexico, Netherlands Antilles and Aruba, Panama, Peru, Suriname, Trinidad and Tobago, Uruguay and Venezuela.

iii. Response to requests from CTBTO-PTS

There were 3 responses to requests from the PTS of the CTBTO in 2017: on 20 February, 4 October and 23 October.

iv. Other responses

RSMC Montreal participated in a special nuclear exercise with NMHS Argentina on 2 November 2017.

4. Routine operations

Monthly Test:
RSMCs Montréal, Washington and Melbourne hold a joint test on the third Tuesday of every month. The request to start the exercise is emailed to all RSMCs. In addition, RSMC Montréal participated in quarterly tests initiated by the IAEA. The following table lists

scheduled monthly and quarterly tests in 2017.

Month	Source location	Initiated by	RSMC providing joint statement (Lead)
January	Angra NPP, Brazil	Washington	Montréal
February	Enrico Fermi NPP, MI, USA	IAEA	Lead RSMCs in WMO RA III and IV (Washington)
March	Point Lepreau NPP, NB, Canada	Montréal	Washington
April	Lucas Heights, Australia	Melbourne	Melbourne
May	Grand Gulf NPP, MS, USA	Washington	Montréal
June	Paks NPP, Hungary	IAEA	ConvEx-3 Exercise: the usual quarterly test in May was moved to June as a result. Exeter and Toulouse as lead RSMCs.
July	Darlington NPP, ON, Canada	Montréal	Washington
August	PUSPATI nuclear research reactor, Malaysia	IAEA	Lead RSMCs in WMO RA V (Melbourne)
September	Lucas Heights, Australia	Melbourne	Melbourne
October	Enrico Fermi NPP, MI, USA	Washington	Montréal
November	N/A: this quarterly test was cancelled	IAEA	Lead RSMC in WMO RA II
December	Point Lepreau NPP, New Brunswick, Canada	Montréal	Washington

5. Lessons learned and significant operational or technical changes:

In addition to the normal maintenance and software upgrades to the operational atmospheric transport and dispersion modelling system, a major migration of the hosting informatics system at CMC was completed in 2017. However this has resulted in minimal disruptions.

6. Operational issues and challenges:

Faxing of products to NMHSs is not done for monthly tests, since transmission of faxes is time-consuming and has shown a high failure rate. Email has become the preferred method of communications, and faxes will only to be sent to RA III and IV NMHS upon request from the IAEA.

7. Other activities:

The follow-up to Action 18 of the CBS E-ERA meeting of October 2013 continued, with an extensive joint test of Time of Arrival (TOA) products, on 21 June 2017. This test was coordinated by RSMC Tokyo with eight participating RMSCs. RSMC Montreal prepared and submitted TOA products for the 5 emission scenarios which were supplied by the IAEA during its Convex-3 exercise.

8. Summary and status of the operational atmospheric transport and dispersion models:

Current global weather conditions and forecasts are available at CMC at all times, to provide, in real time, the necessary input to the atmospheric transport model, and to assist in evaluation and interpretation of the transport model outputs.

For forecasts and analyses, CMC uses the Canadian Global Environmental Multiscale (GEM) numerical weather prediction (NWP) model. Three configurations of GEM are available: global, regional, and high resolution. The global GEM is the backbone of the data assimilation cycle, providing global analyses and medium term forecast guidance at a uniform horizontal resolution (25 km). The grid spacing of the regional configuration is approximately 10 km covering North America. High resolution configurations of the GEM model operate at a resolution of 2.5 km and cover all but the northernmost areas of Canada.

i. The Modèle Lagrangien de Dispersion de Particules (MLDP)

This is a Lagrangian particle dispersion model designed for dispersion problems occurring at regional and global scales and is described in detail in D'Amours et al. 2015 and D'Amours and Malo 2004.

MLDP is executed off-line and requires pre-calculated meteorological fields (3D wind, moisture, temperature and geopotential heights) from a NWP system. At RSMC Montréal these fields are obtained from the GEM model forecast and analysis system, at global, regional, or high resolution. MLDP can be run using forecasts and/or analyses of the meteorological fields, which enable it to be run over any period in the past or future for which the fields are available.

The source term is input through an emission scenario module that enables the user to specify different release rates for one or more periods of emission. In addition to radionuclides from a long list of isotopes, MLDP can model the emission, transport and dispersion of volcanic ash (D'Amours et al, 2010), and inert tracers.

For volcanic eruptions, total released mass can be estimated from an empirical formula derived by Sparks *et al.*, 1997, which is a function of particle density, plume height and effective

emission duration (Malo, 2007). A particle size distribution can be selected for modelling longer-range gravitational settling effects in the trajectory calculations.

MLDP can be run on a global grid, or, for smaller areas, on a polar stereographic horizontal grid in either hemisphere. The modeller may define the grid size and resolution needed for a particular simulation. There are also a set of pre-defined grids, from which the user can select the appropriate configuration for rapid operational use.

MLDP can be executed in reverse-time mode. This configuration is the one used for responding to modelling requests from the CTBTO-PTS.

ii. Trajectory model

This model uses winds directly from the GEM model's analyses and/or forecasts. The wind fields are available every hour. Initial positions of one or more air parcels in a column are specified, and the parcels are then advected or displaced incrementally, using time and spatial discretizations of the three-dimensional wind field. It is assumed that air parcels preserve their identity as they are transported in the wind.

The model has been validated using back-trajectories from stations that measured concentrations of tracers from a single source (D'Amours 1998). The back-trajectories converge remarkably well towards the tracer source location. On the other hand, the lack of a boundary layer treatment and the assumption air parcel identity preservation are reflected in the results, which result in vertical motions that are not in line with the observations.

9. Plans for 2018-2019:

The schedule of routine monthly tests for all of 2018 has been set up in collaboration with RSMCs Washington and Melbourne. Each RSMC will select the simulated accident location and write the joint statement, on a rotating basis. The tests include the quarterly tests scheduled by the IAEA. Tests are set for the third Tuesday of each month.

References

D'Amours, R.., 1998: Modelling the ETEX plume dispersion with the Canadian Emergency Response Model, *Atmospheric Environment*, **32**, 4335-4331

D'Amours, R., and Malo, A., 2004, "*A Zeroth Order Lagrangian Particle Dispersion Model: MLDP0*", Internal report, Canadian Meteorological Centre, Environmental Emergency Response Section, Dorval, Québec, Canada, 18 pp.

D'Amours, R., A. Malo, R. Servranckx, D. Bensimon, S. Trudel, and J.P. Gauthier-Bilodeau (2010), Application of the atmospheric Lagrangian particle dispersion model MLDP0 to the 2008 eruptions of Okmok and Kasatochi volcanoes, J. Geophys. Res., 115, D00L11, doi:10.1029/2009JD013602.

D'Amours, R., Malo, A., Flesch, T., Wilson, J., Gauthier J.-P., Servranckx, R. (2015). The Canadian Meteorological Centre's Atmospheric Transport and Dispersion Modelling Suite, *Atmosphere-Ocean*, **53** (2), 176–199, doi:10.1080/07055900.2014.1000260

Malo, A., 16 November 2007, "*Total Released Mass Calculation for Volcanic Eruption in CMC's Long-Range Transport and Dispersion Model MLDP0*", Internal Publication, Canadian Meteorological Centre, Environmental Emergency Response Section, Dorval, Québec, Canada, 2 pp.

WMO, 2011: Documentation on RSMC Support for Environmental Emergency Response. *WMO-TD/No.778*, http://www.wmo.int/pages/prog/www/DPFSERA/td778.html