RSMC MELBOURNE
USERS' INTERPRETATION GUIDELINES
ATMOSPHERIC TRANSPORT MODEL OUTPUTS

February 2018

1.   INTRODUCTION

Australia's national weather service, the Bureau of Meteorology, maintains a centralised operational centre delivering guidance products to the seven Regional Forecasting Centres within Australia while providing a 24/7 nationwide weather watch. The Bureau's National Operations Centre (NOC) has been a Regional Specialised Meteorological Centre (RSMC) for Environmental Emergency Response (EER) since the 1st July 1995.

RSMC Melbourne has responsibility for the Regional Association V area, which includes the countries: Brunei Darussalam, Fiji, Indonesia, Malaysia, New Zealand, Papua New Guinea, Philippines and Singapore. The activity specialisation of the RSMC refers specifically to Atmospheric Transport Modelling. As part of its responsibility, RSMC Melbourne is required to provide advice, in the form of a basic set of products, on the atmospheric transport of pollutants resulting from nuclear disasters, volcanic eruptions, forest fires, chemical and biological incidents, and, perhaps, other causes.

In addition to its responsibility as an RSMC for Environmental Emergency Response, the NOC also performs international functions as a World Meteorological Centre, a Regional Specialised Meteorological Centre with geographical specialization, and a Regional Telecommunications Hub on the GTS. In addition, the NOC has aviation and marine responsibilities.

2.   OPERATIONAL SYSTEM

2.1 Overview

The EER system, in RSMC Melbourne, is currently based around HYSPLIT, a hybrid Lagrangian-Eulerian particle/puff Atmospheric Transport Model (ATM), developed by Roland Draxler at NOAA's Air Resources Laboratory. The meteorological input for HYSPLIT is derived from the output of the operational Numerical Weather Prediction (NWP) systems run in RSMC Melbourne. On request, nuclear products can be generated and disseminated to the IAEA and CTBTO, as well as to the other WMO RSMCs and the NMHSs (within RAV), and also to other various national agencies. The system is maintained in a state of readiness so that the ad-hoc requests for products can be satisfied quickly. Figure 1 summarises the operational approach taken in RSMC Melbourne.

The current status of the operational implementation of the EER system in RSMC Melbourne, in terms of the features of the NWP systems, the ATM, the mode of running, product generation and dissemination, is now described in more detail.

2.2   NWP Input
NOC runs a suite of NWP systems. The geographical domains of these systems, that currently provide input into the EER system, are shown in Figure 2. An overview of these NWP systems is provided in Table 1. The horizontal resolution of the systems ranges from a grid spacing of ~25 km, for the global scale ACCESS-G model down to ~1.5km for the ACCESS-C model, which is run over certain city-based domains. For most initial responses to requests
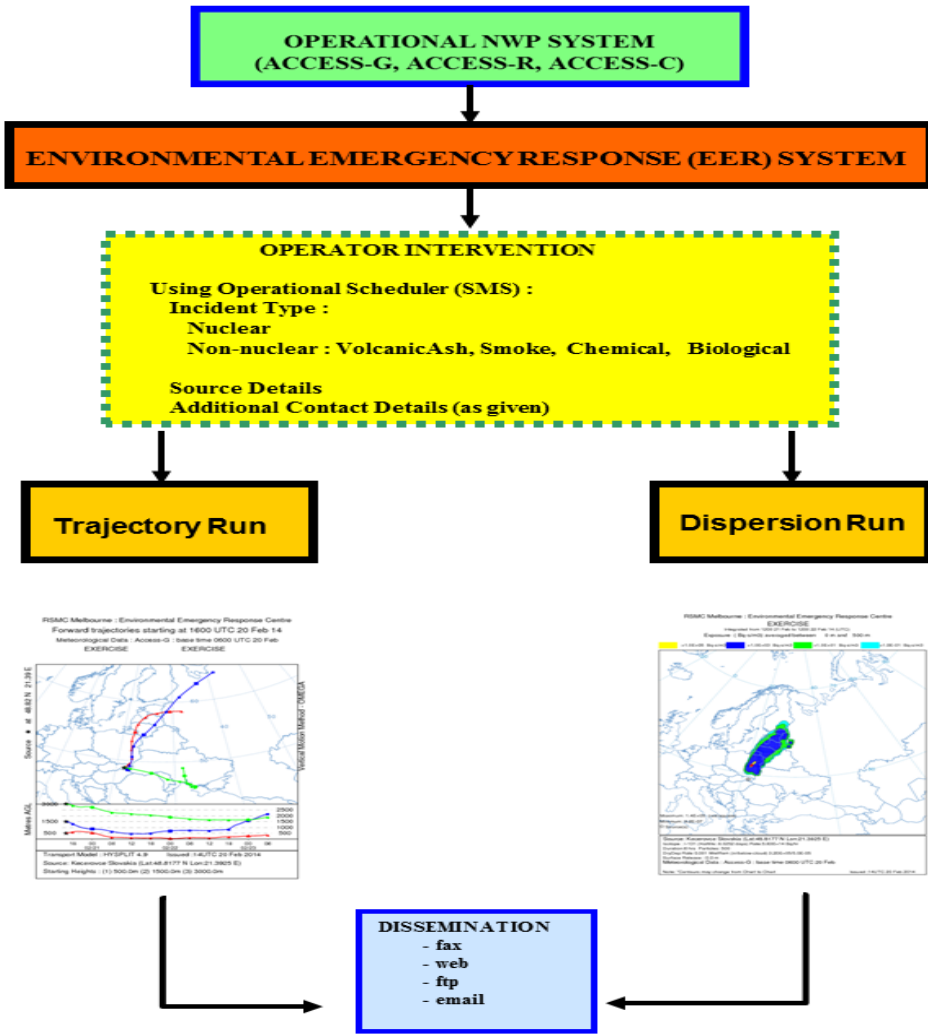
Figure 1: Schematic diagram of the Operational EER System in RSMC Melbourne

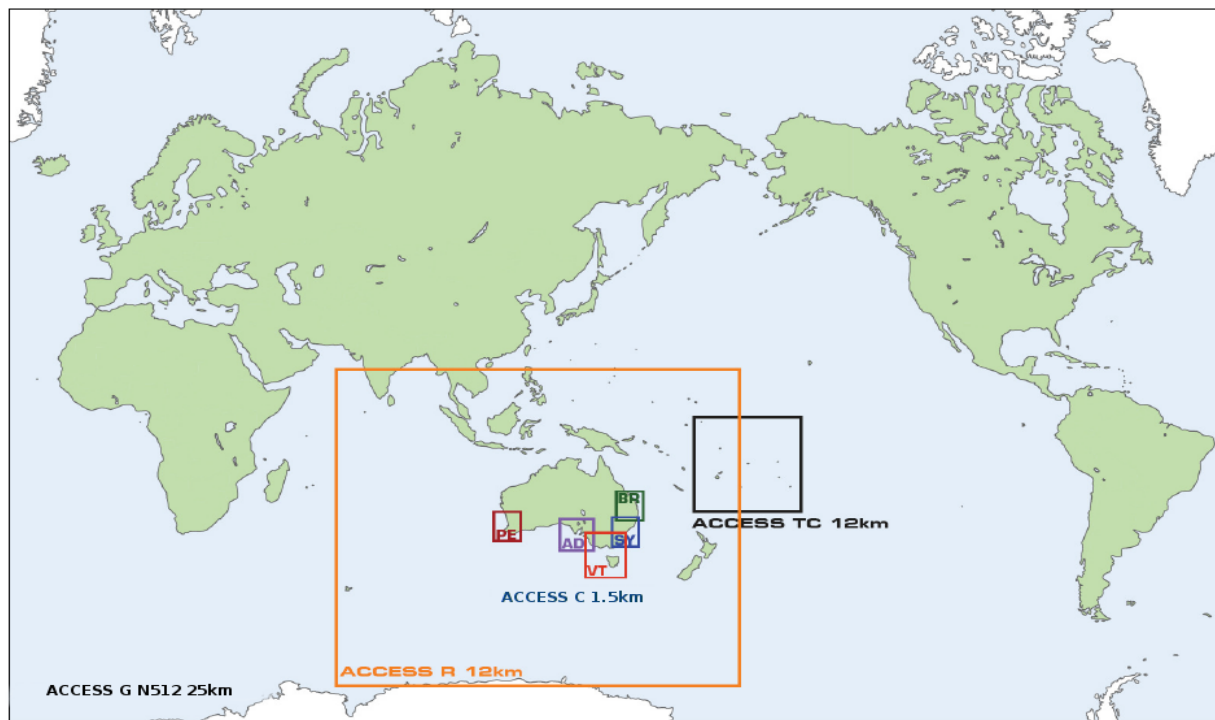for nuclear EER products, ACCESS-G will provide input to the ATM. .

Figure 2: Access Model Domains

2.3   ATM - HYSPLIT

HYSPLIT (i.e. Hybrid Single-Particle Lagrangian Integrated Trajectories, Version 4.9) models the atmospheric transport and dispersion of pollutant plumes originating from a variety of sources (both nuclear and non-nuclear). The "hybrid" part of the acronym refers to the use of both movable 'Lagrangian' (for the advection and diffusion calculations) and fixed 'Eulerian' (for the concentration calculations) modelling frames of reference within the system.

The current operational system runs in 3-dimensional particle mode for all simulations.

HYSPLIT also includes a number of other processes for removing, adding to, or changing the composition of the pollutant plume. Dry deposition is the transport of pollutant gaseous or particulate species onto surfaces (in the absence of precipitation). In the system, a dry deposition velocity can be defined explicitly or can be calculated using details about the nature of the surface. For particles, gravitational settling, requiring estimates of particle shape, size and density, is another option. In wet deposition, the pollutant is scavenged by the atmospheric hydrometeors and is thus delivered to the earth's surface. HYSPLIT allows for both within-cloud ("washout") and below-cloud ("rainout") scavenging. If the winds are sufficiently strong, and the pollutant is not bound to the surface, then resuspension can also occur. In the case of nuclear incidents, radioactive decay is incorporated.

HYSPLIT can be run in a purely trajectory, or advective, mode producing either forward or backward trajectory plots beginning and ending at specified levels. Trajectories may use data, if available, to calculate vertical motion or, alternatively, confine the vertical position of the trajectory to a pressure, temperature or sigma surface. HYSPLIT can also be run in a dispersion mode producing exposure (or concentration) and surface deposition charts

integrated over various time periods and layers. The nature of a source can be defined according to its strength, height and size, and duration of emission.

SYSTEM NAME	ACCESS-G	ACCESS-R	ACCESS-C
FULL NAME	Global	Regional	City Mesoscale
DOMAIN	Global	17.125⁰N-65.00⁰S, 65.00⁰E-184.625⁰E	ADELAIDE: 29.4965⁰S-39.500⁰S, 131.00⁰E-142.002⁰E PERTH: 26.9965⁰S-37.00⁰S, 112.00⁰E-124.001⁰E BRISBANE: 21.9955⁰S-31.000⁰S, 148.00⁰E-156.006⁰E SYDNEY: 27.9965⁰S-38.000⁰S, 147.00⁰E-155.0060⁰E VICTAS: 32.9995⁰S-46.00⁰S, 139.00⁰E-151.001⁰E
TYPE OF MODEL	Grid P.E., Assimilation and Prognosis	Grid P.E., Assimilation and Prognosis	Grid P.E. Prognosis
NESTING	Stand Alone	In ACCESS-G	In ACCESS-R
HORIZONTAL RESOLUTION	N512 (Approx.25km)	0.11⁰	0.0135⁰
GRID (Arakawa-C in horizontal, Charney Phillips in vertical)	769x1024 Lat./Long.	746x1068 Lat./Long.	ADELAIDE: 742x816 Lat./Long. PERTH: 742x890 Lat./Long. BRISBANE: 668x594 Lat./Long. SYDNEY: 742x594 Lat./Long. VICTAS: 964x890 Lat./Long.
NUMBER OF LEVELS	70	70	70
TOP OF MODEL	80 km	80 km	40km
ANALYSIS TYPE	4DVAR	4DVAR	Not applicable
DATA INSERTIONS	6 hourly	6 hourly	
DATA CUT-OFF TIMES	(H+5) hour	(H+2) hour	
OROGRAPHY	Included	Included	Included
SURFACE EXCHANGES	Included	Included	Included
RADIATION	Modified Edwards-Slingo scheme	Modified Edwards-Slingo scheme	Modified Edwards-Slingo scheme
LATENT HEATING	Included	Included	Included
CONVECTION	Modified Mass-flux (based on Gregory & Rowntree)	Modified Mass-flux (based on Gregory & Rowntree)	Modified Mass-flux (based on Gregory & Rowntree)
PRECIPITATION	Wilson & Ballard single moment bulk microphysics	Wilson & Ballard single moment bulk microphysics	Wilson & Ballard single moment bulk microphysics
PROGNOSTIC VARIABLES	u, v, w, ρ, θ, mixing ratio (3 phases)	u, v, w, ρ, θ, mixing ratio (3 phases)	u, v, w, ρ, θ, rain mixing ratio (3 phases)
EQUATION SET	Non-Hydrostatic	Non-Hydrostatic	Non-Hydrostatic
TIME STEP	720 sec	300 sec	100 sec
FORECAST PERIODS	+240 hour	+72 hour	+36 hour

Table 1.   Characteristics of the operational Numerical Weather Prediction systems in RSMC Melbourne.

2.4   Operational Running

RSMC Melbourne's EER system is run via NOC's operational scheduling system (viz., SMS – the Supervisor Monitor Scheduler - from ECMWF). This scheduler is monitored 24 hours/day

by operational staff.

2.4.1 EER Scheduling Overview

On completion of a forecast run for any ACCESS domain, pre-processing tasks are automatically initiated in the EER suite which extract the required fields from the NWP output. (including surface pressure, surface height, precipitation and the multi-level temperature, specific humidity and wind components) in a form suitable for direct input into HYSPLIT. A number of ongoing runs of HYSPLIT are then initiated, which provide a series of products for specific registered users and internal use. These ongoing runs have the additional benefit of highlighting any problems with the components of the operational EER system as they arise. These problems may arise, for example, from basic computer or NWP system changes.

A web based form provides an interface for the operator to enter details provided for any EER event. Drop down menus and extensive scripting assist in data entry and reduce error potential.

Scripts within the EER system parse the entered data then generate and disseminate the various products associated with the HYSPLIT runs. In addition, tasks have been set up to produce numerous NWP guidance products and satellite images for the area of interest to help in the formulation of a Joint (or textual) Statement.

2.4.2 Computing Infrastructure for EER System

The scheduling tasks and much of the product preparation and dissemination is performed using a cluster of linux servers. The pre-processing of the NWP data and the running of HYSPLIT are done on the multi(52224)-core Cray-XC40 supercomputer. The pre-processed NWP data, used by HYSPLIT, is archived using the StorageTek Mass Store 9310 ACS (Automatic Cartridge System). Any faxes sent to the main fax machine, in RSMC Melbourne, are also routed automatically as an email attachment to the operational staff.

2.4.3 Online Capability

Pre-processed data for the operational EER system from the NWP models described in Table 1, are available for the following scenarios and time periods:

Forecast Forward and Backward Trajectories, and Dispersion:

  ACCESS-G: +240 hours (with the files from the runs for the previous 5 days kept online)
  ACCESS-R: +72 hours
  ACCESS-C (ADELAIDE, PERTH, BRISBANE, SYDNEY, VICTAS): +36 hours

Analysed Backward trajectories:

  ACCESS-G: -980 hours
  ACCESS-R & C: -96 hours (interpolated analyses)

Analysed retro-plumes:

  ACCESS-G: -980 hours

2.4.4 Product Generation

Comprising trajectory and dispersion forecasts up to 72 hours in length, a description of the

standard ATM product set for a Nuclear request from IAEA, is shown in Table 2. This table also describes the details of the dispersion hindcasts produced for CTBTO requests.

PRODUCT TYPE	TYPE	SETTINGS	PRODUCTS
TRAJECTORIES	Forward (IAEA)	Forecast Period: +72 hour Starting Heights: 500,1500,3000m	1 chart
DISPERSION	Nuclear (IAEA)	Forecast Period: +72 hour Source: Uniform between 0 and 500m Emission Duration: 6 hour Release/hour: 0.1667 Bq Isotope: Cs137 Half-life: 11217 day Dry Deposition: Included Wet Deposition: Included Deposition Velocity: $0.001 ms^{-1}$ In-cloud removal (by vol.): 3.2×10^{5} Below-cloud Removal: $5.0 \times 10^{5} s^{-1}$	3 (24hour ave.) exposure charts 3 (24hour ave.) deposition charts TOA charts are currently produced for internal use only.
RETRO-PLUME (DISPERSION)	Nuclear (CTBTO)	Forecast Period: -980 hour (max) No. Particles: 40000 Release/hour: 5.417E+13 Bq Dry Deposition: Not Included Wet Deposition: Not Included	Compressed text files for CTBTO Charts for internal use

Table 2. Standard settings used in the production of charts (with ACCESS-G meteorological input).

Additional products, arising from different initial or final characteristics, can also be generated, if requested. These include the further refinement of the radionuclide involved. The current list of radionuclides, handled (i.e. in terms of associated half-lives) by the operational system, is shown in Table 3.

In addition, a textual statement is composed by a senior operational meteorologist on duty. This describes the synoptic meteorology in the area of interest and comments on the graphical ATM products from RSMC Melbourne and other RSMCs, as appropriate. This textual statement is also called the Joint Statement.

2.4.5 Current Method of Dissemination for Standard Products

Currently, the forecast nuclear products generated will be faxed to the requesting agency (IAEA) and the RSMCs, when required, and posted on the Joint Web Page (hosted with RSMCs Montreal and Washington). Accessible using a common registered user and password (for all RSMCs), this Joint Web Page incorporates the products from all 8 RSMCs. Joint Statements are sent out by fax and also placed on the Joint Web Page. The additional meteorological products, used in the generation of the Joint Statement, are also made available through a registered user account on RSMC Melbourne's web server. As products are disseminated by fax, web or ftp, accompanying emails are sent to the various centres (including WMO itself, IAEA, CTBTO, the various NMHSs, and other international and national agencies, as appropriate).

In the case of CTBTO requests for retro-plume products, the various products are uploaded in a compressed text format to the CTBTO protected web site. Accompanying emails are again sent out, accordingly. In addition, for reference, a special RSMC Melbourne registered user page also displays the various products for CTBTO (as generated by RSMC Melbourne).

Most fax, web, ftp and email dissemination is performed by tasks run via the operational scheduler.

2.4.6 Additional Product Accessibility

Products from the EER system outside the standard data set may also be found on RSMC Melbourne's registered user web pages. These products may be distributed via fax, email or ftp on request.

2.4.7 Request Protocol

On receipt of a faxed request from IAEA or CTBTO, an acknowledgement fax and accompanying email are sent back to the requesting agency. Email alerts advising that RSMC Melbourne has received an EER request for assistance are also disseminated to WMO, other RSMCs, and NMHSs within RAV, as appropriate. The products are then generated and distributed as described previously (in Sections 2.4.4 and 2.4.5). When the generation and dissemination of products for the particular request have ceased, an "End Notification" fax and email are sent out to the agencies and centres who were initially notified of the receipt of a request for action.

SYMBOL	LONG_RADIONUCLIDE_NAME	SYMBOL	LONG_RADIONUCLIDE_NAME
Am241	Americium	Rh105	Rhodium
Ba140	Barium	Ru103	Ruthenium
Ce141	Cerium	Ru105	Ruthenium
Ce143	Cerium	Ru106	Ruthenium
Ce144	Cerium	Sb127	Antimony
Cm242	Curium	Sb129	Antimony
Co60	Cobalt	Sr89	Strontium
Cs134	Caesium	Sr90	Strontium
Cs137	Caesium	Sr91	Strontium
I131	Iodine	Tc99m	Technetium
I132	Iodine	Te127	Tellurium
Kr85	Krypton	Te127m	Tellurium
Kr85m	Krypton-metastable	Te129	Tellurium
Kr87	Krypton	Te129m	Tellurium
Kr88	Krypton	Te131	Tellurium
La140	Lanthanum	Te132	Tellurium
Mo99	Molybdenum	Xe131m	Xenon-metastable
Nb95	Niobium	Xe133	Xenon
Np239	Neodymium	Xe133m	Xenon-metastable
Pr143	Promethium	Xe135	Xenon
Pu238	Plutonium	Xe138	Xenon
Pu239	Plutonium	Y90	Yttrium
Pu240	Plutonium	Y91	Yttrium
Pu241	Plutonium	Zr95	Zirconium
Rb86	Rubidium	Zr97	Zirconium

Table 3.   Radionuclide database currently available for operations.

2.4.8 Coordination of Responsibilities and Emergency Contact List

Exercises, or Tests, provide the main mechanism RSMC Melbourne has for ensuring the EER system functions correctly during an emergency. Accurate and timely dissemination of information requires a current contact database. RSMC Melbourne endeavours to maintain a

list of operational contact details (phone and fax numbers, email addresses and personnel) for RSMCs, NMHSs, other international agencies, and its own national agencies. During exercises, acknowledgements from other centres are sometimes used to highlight changes to contact details which are then incorporated into the operational EER scheduler scripts.

3. DESCRIPTION OF THE COMPLETE SET OF HYSPLIT OUTPUT CHARTS FOR THE DEFAULT SCENARIO

Figures 3 to 9 show a complete set of the 7 output charts for the default nuclear scenario. For this example, the source is located at 41.962^0N and 83.2578^0W (i.e. Fermi2 NPP, USA). The fictitious release shown started at 1030 UTC on 21 February 2017. The basic set of 7 charts provide forecast guidance up to 72 hours ahead, depending on the release time specified.

Figure 3 shows forecast forward trajectories starting at heights of 500, 1500 and 3000 metres. The lateral, or horizontal, depiction of trajectory paths on a map background are annotated at 6-hourly intervals with different symbols (viz., squares, circles and triangles) for the different heights. A graphical depiction of the vertical motion is displayed at the bottom of the chart for the same 6-hourly intervals and using the same symbols. The chart in Figure 3 has been annotated with circled numbers to highlight the following features:

 1: Identifies the chart as coming from RSMC Melbourne.

 2: Defines the type of trajectories (forward or backward) on the chart.

 3: Shows the starting date/time of the trajectories.

 4: Indicates the operational NWP system providing meteorological input and also shows the base date/time of the NWP forecast used for the current run.

 5: Indicates the nature of the event - in this case a Test or Exercise.

 6: Defines the latitude and longitude of the location of the source of release, in decimal degrees.

 7: Indicates the variable used to calculate vertical motion in the ATM.

 8: Shows the vertical motion of the trajectories, depicted in the display immediately above, for the forecast period. Sequences of symbols (squares, circles and triangles) indicate the trajectory position at 6-hourly intervals.

 9: Indicates the ATM (Atmospheric Transport Model) and version being used.

10: Indicates the date/time at which this particular chart was issued.

11: Shows the source location description and position in decimal degrees.

12: Denotes the starting heights, in metres AGL (Above Ground Level) or hPa, for the forward trajectories.

Figure 4 shows the time-integrated exposure, from the ground to 500 metres, for the first 24-hour period. This chart has also been annotated with circled numbers to highlight the following features:

 1: Identifies the chart as coming from RSMC Melbourne.

 2: Indicates the nature of the event - in this case a Test or Exercise.

 3: Defines the period over which the concentrations apply. The example chart shows the exposure for the 24 hour period ending at 1200 UTC September 9 2010.

 4: Indicates that the air concentration, or exposure, is averaged from the ground to 500 metres, in units of "*Becquerel* second / metre^3 " (note: the units of measurement may change with different scenarios).

5: Indicates the values of the 4 concentration contours (with the units as specified in item 4 above).

6: Lists the maximum and minimum concentrations found on the concentration grid. A red square denotes the location of the maximum value while a star symbol is used to denote the source location.

7: Shows the date/time at which the release of nuclear radiation started

8: Shows the source location description and position in decimal degrees.

9: Four lines which provide information about the release and its simulation. This includes;
- the nuclear radionuclide released and its half life
- duration
- rate of the release and the units used.
- assumed deposition rates
- number of particles
- Shows the height and vertical extent of the release (in metres).

10: Indicates the operational NWP system providing meteorological input and also shows the base date/time of the NWP forecast used for the current run.

11: A note to remind users contours may change between charts and runs.

12: Indicates the date/time at which this particular chart was issued.

Figure 5 shows the time-integrated exposure, from the ground to 500 metres, for the second 24-hour period.

Figure 6 shows the time-integrated exposure, from the ground to 500 metres, for the third 24-hour period.

Figure 7 shows the time-integrated ground level deposition (0-24 hours) for the first 24-hour period. This chart has also been annotated with circled numbers to highlight the following features:

1: Identifies the chart as coming from RSMC Melbourne.

2: Defines the period over which the concentrations apply. The example chart shows the exposure for the 24 hour period ending at 1500 UTC February 21 2017.

3: Indicates the nature of the event - in this case a Test or Exercise.

4: Indicates that the chart shows deposition at ground-level, in units of "*Becquerel*metre^2 " (note: the units of measurement may change with different scenarios).

5: Indicates the values of the 4 concentration contours (with the units as specified in item 4 above).

6: Lists the maximum and minimum concentrations found on the concentration grid. A red square denotes the location of the maximum value while a star symbol is used to denote the source location.

7: Shows the date/time at which the release of nuclear radiation started

8: Shows the source location description and position in decimal degrees.

9: Four lines which provide information about the release and its simulation. This includes;
- the nuclear radionuclide released and its half life
- duration
- rate of the release and the units used.
- assumed deposition rates
- number of particles
- Shows the height and vertical extent of the release (in metres).

10: Indicates the operational NWP system providing meteorological input and also shows the base date/time of the NWP forecast used for the current run.

11: A note to remind users contours may change between charts and runs.

12: Indicates the date/time at which this particular chart was issued.

Figure 8 shows the time-integrated ground level deposition (24-48 hours) for the second for the second 24-hour period.

Figure 9 shows the time-integrated ground level deposition (48-72 hours) for the third 24-hour period.

4. OTHER PRODUCTS AVAILABLE FROM RSMC MELBOURNE AND CONTACT FOR ADDITIONAL INFORMATION

Many different transport and dispersion products can be produced from the various modes (see section 2.4.3 above) of the operational EER system. Various products, associated with non-nuclear incidents, such as the dispersion of volcanic ash, smoke (associated with forest fires) and air-borne viruses, and the back-tracking of paths taken by atmospheric aerosols can be generated and disseminated on request. In addition to the EER products, standard meteorological charts (depicting, for example, wind and precipitation fields) and satellite imagery can be produced for the region of interest.

For any additional information, please contact RSMC Melbourne directly (srod@bom.gov.au).

5. FUTURE DEVELOPMENTS

The development of RSMC Melbourne's operational EER capacity is ongoing. Enhancements currently planned include the capacity to generate products with high resolution geographic backgrounds, and the generation of ensemble products. The ability to handle nuclear and other emergencies, on scales from local to global, is also being reviewed in light of recent changes to both NWP systems and computing platforms. Interaction is continuing with Australian national agencies on the use of the decision support system, ARGOS (Accident Reporting and Guidance Operational System), for CBRN (Chemical, Biological, Radiological, and Nuclear) emergency management. Improved communications and interaction with regional colleagues is ongoing.

6. REFERENCES

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NWP Input - ACCESS:

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ATM - HYSPLIT:

Draxler, R.R., Stunder B.J.B., Rolph G.D., Stein A.F., Taylor A.D. 2009: "HYSPLIT4 User's Guide."   http://www.arl.noaa.gov/documents/reports/hysplit_user_guide.pdf

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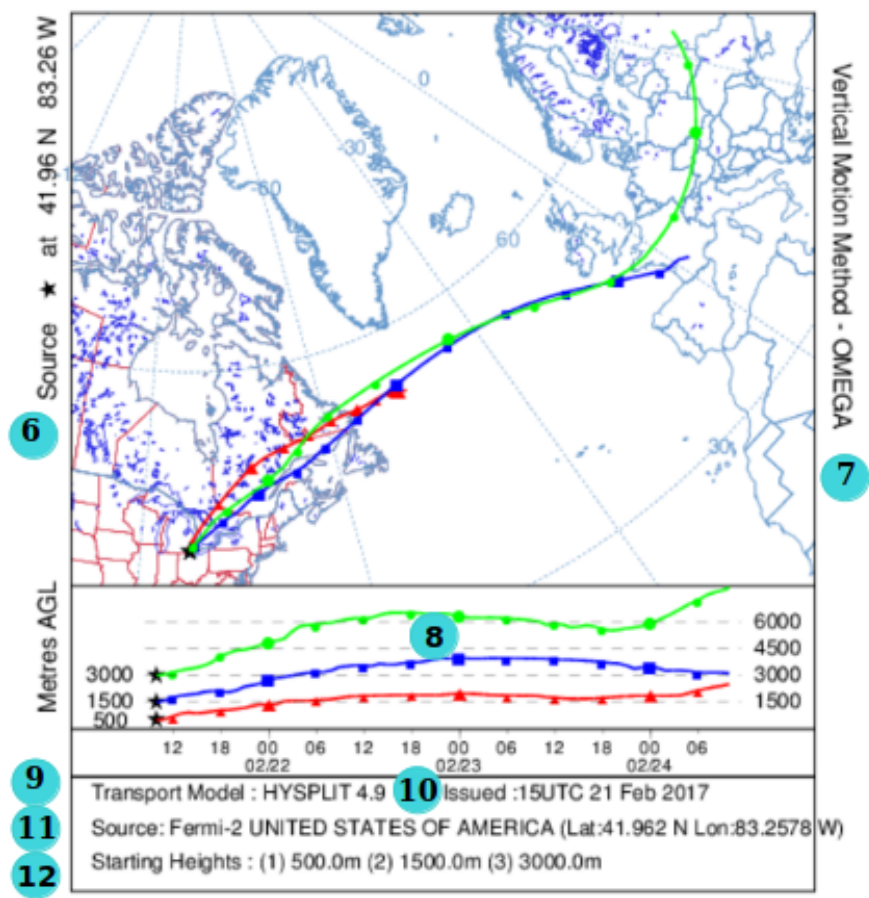
Figure 3: Itemised chart showing forecast forward air parcel trajectories starting at heights of 500, 1500, and 3000 metres AGL (Above Ground Level). (The itemisation, shown here by circled numbers does not appear on registered products)
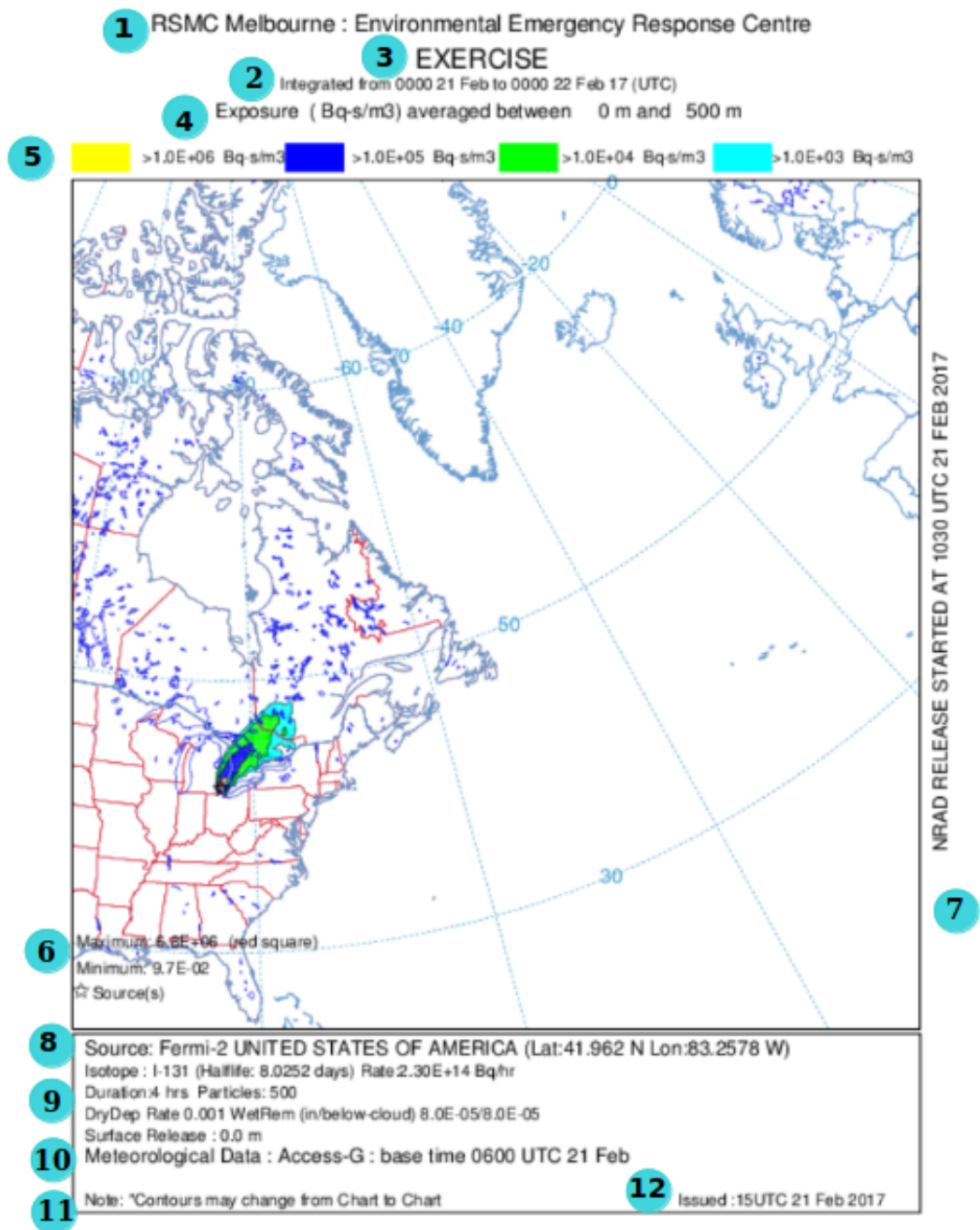
Figure 4: Itemised chart showing the first 24-hours (of a 72-hour forecast) time integrated average exposure from the surface to 500 metres. (The itemisation, shown here by circled numbers does not appear on registered products)
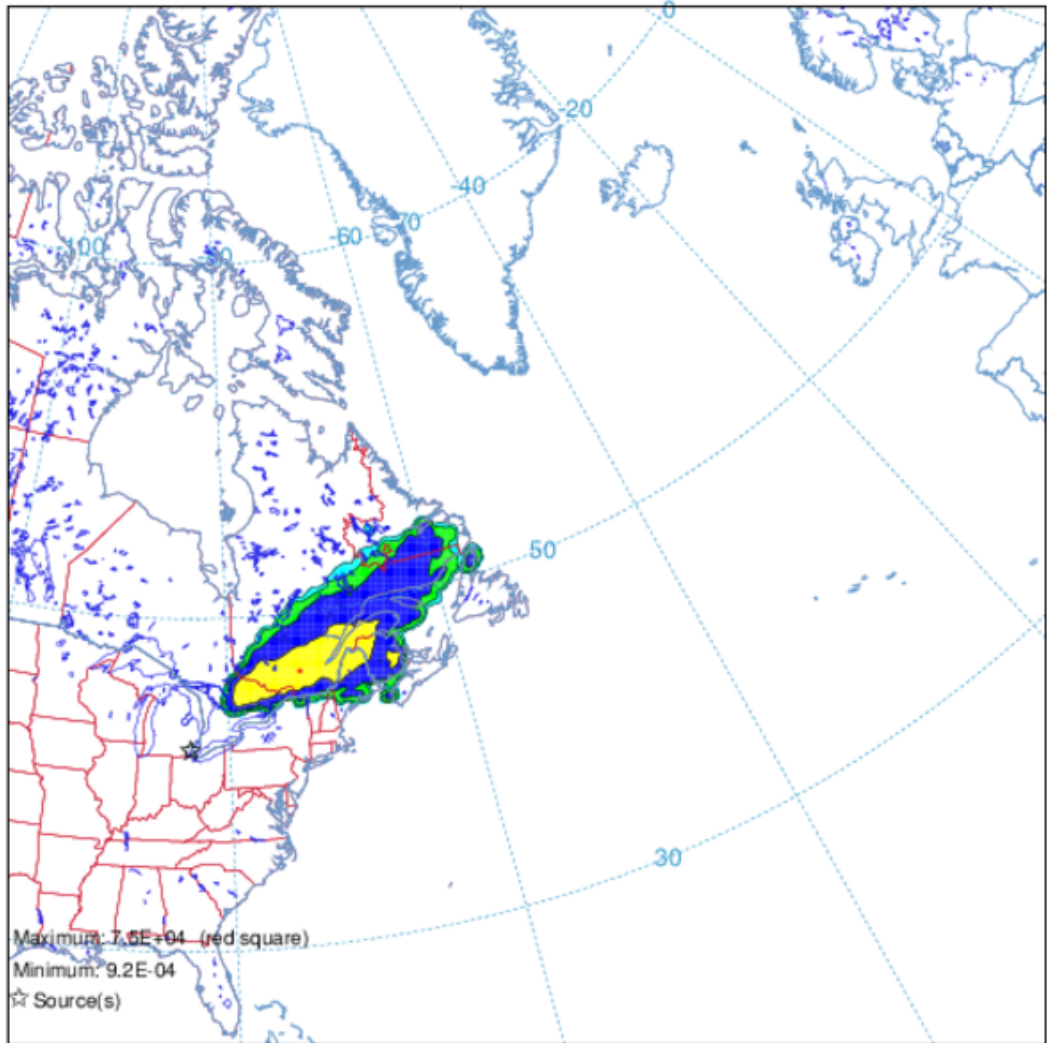
Figure 5: Chart showing the second 24-hours (of a 72-hour forecast) time integrated average exposure from the surface to 500 metres.
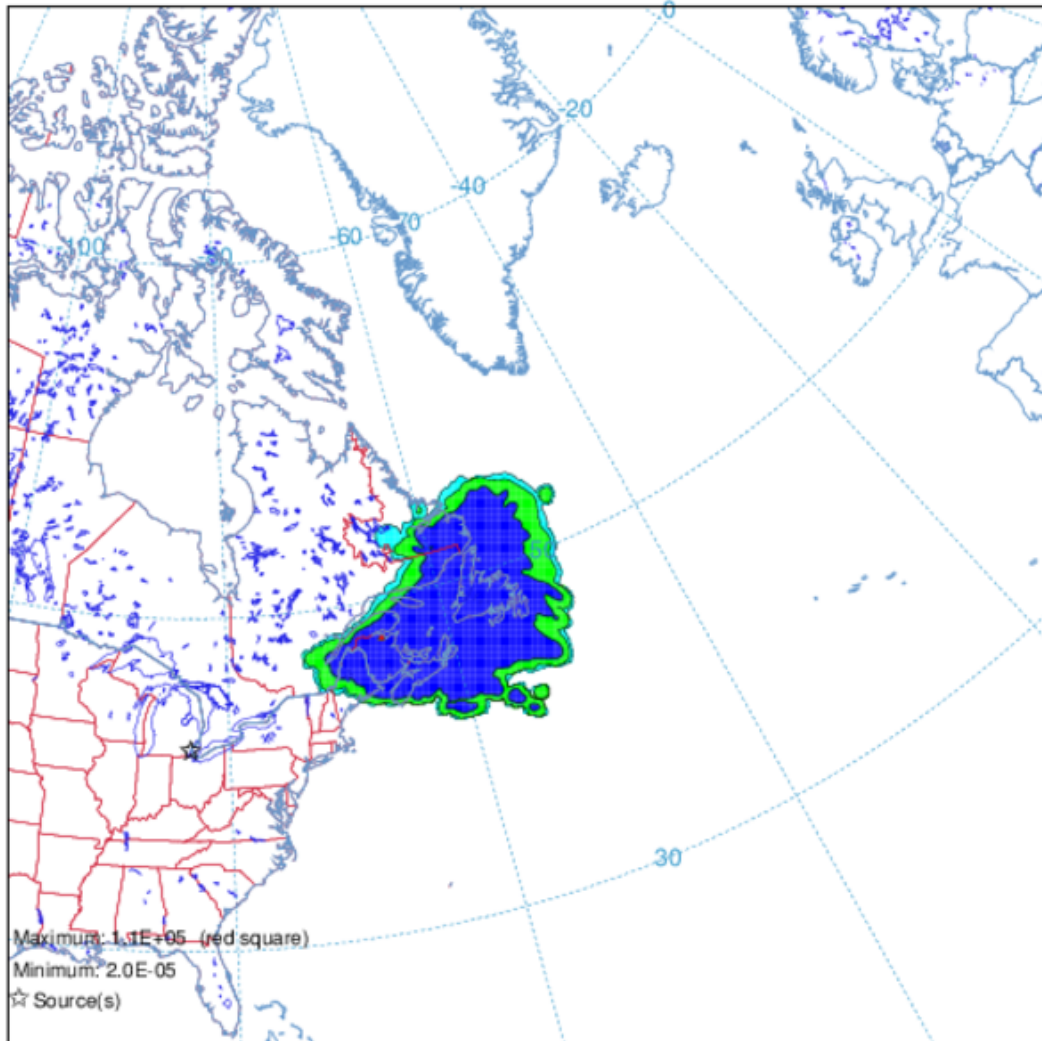
RSMC Melbourne : Environmental Emergency Response Centre
EXERCISE
Integrated from 0000 23 Feb to 0000 24 Feb 17 (UTC)
Exposure (Bq-s/m3) averaged between   0 m and 500 m

>1.0E+05 Bq-s/m3   >1.0E+03 Bq-s/m3   >1.0E+01 Bq-s/m3   >1.0E-01 Bq-s/m3

NRAD RELEASE STARTED AT 1030 UTC 21 FEB 2017

Maximum: 1.1E+05 (red square)
Minimum: 2.0E-05
☆ Source(s)

Source: Fermi-2 UNITED STATES OF AMERICA (Lat:41.962 N Lon:83.2578 W)
Isotope : I-131 (Halflife: 8.0252 days) Rate 2.30E+14 Bq/hr
Duration:4 hrs Particles: 500
DryDep Rate 0.001 WetRem (in/below-cloud) 8.0E-05/8.0E-05
Surface Release : 0.0 m
Meteorological Data : Access-G : base time 0600 UTC 21 Feb

Note: "Contours may change from Chart to Chart   Issued :15UTC 21 Feb 2017

Figure 6: Chart showing the final 24-hours (of a 72-hour forecast) time integrated average exposure from the surface to 500 metres.

1 RSMC Melbourne : Environmental Emergency Response Centre

3 EXERCISE

2 Integrated from 0000 21 Feb to 0000 22 Feb 17 (UTC)

4 Deposition (Bq/m2) at ground-level

5   >1.0E+04 Bq/m2   >1.0E+03 Bq/m2   >1.0E+02 Bq/m2   >1.0E+01 Bq/m2

NRAD RELEASE STARTED AT 1030 UTC 21 FEB 2017

7

6 Maximum: 4.2E+04 (red square)
Minimum: 1.0E-03
☆ Source(s)

8 Source: Fermi-2 UNITED STATES OF AMERICA (Lat:41.962 N Lon:83.2578 W)

Isotope : I-131 (Halflife: 8.0252 days) Rate 2.30E+14 Bq/hr

9 Duration:4 hrs Particles: 500

DryDep Rate 0.001 WetRem (in/below-cloud) 8.0E-05/8.0E-05

Surface Release : 0.0 m

10 Meteorological Data : Access-G : base time 0600 UTC 21 Feb

12

11 Note: "Contours may change from Chart to Chart   Issued :15UTC 21 Feb 2017
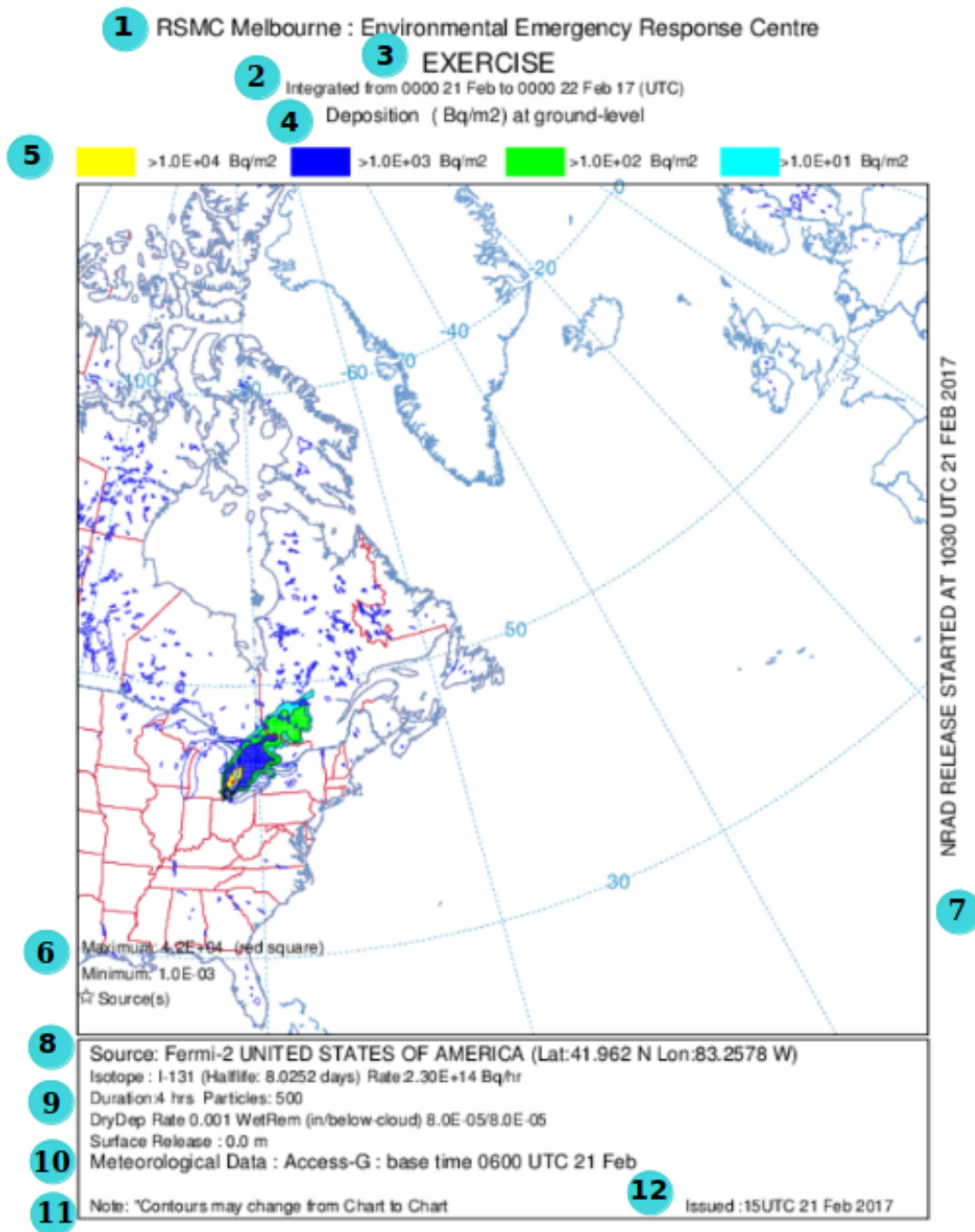
Figure 7: Itemised chart showing the first 24-hours (of a 72-hour forecast) time integrated surface deposition (The itemisation, shown here by circled numbers does not appear on registered products).
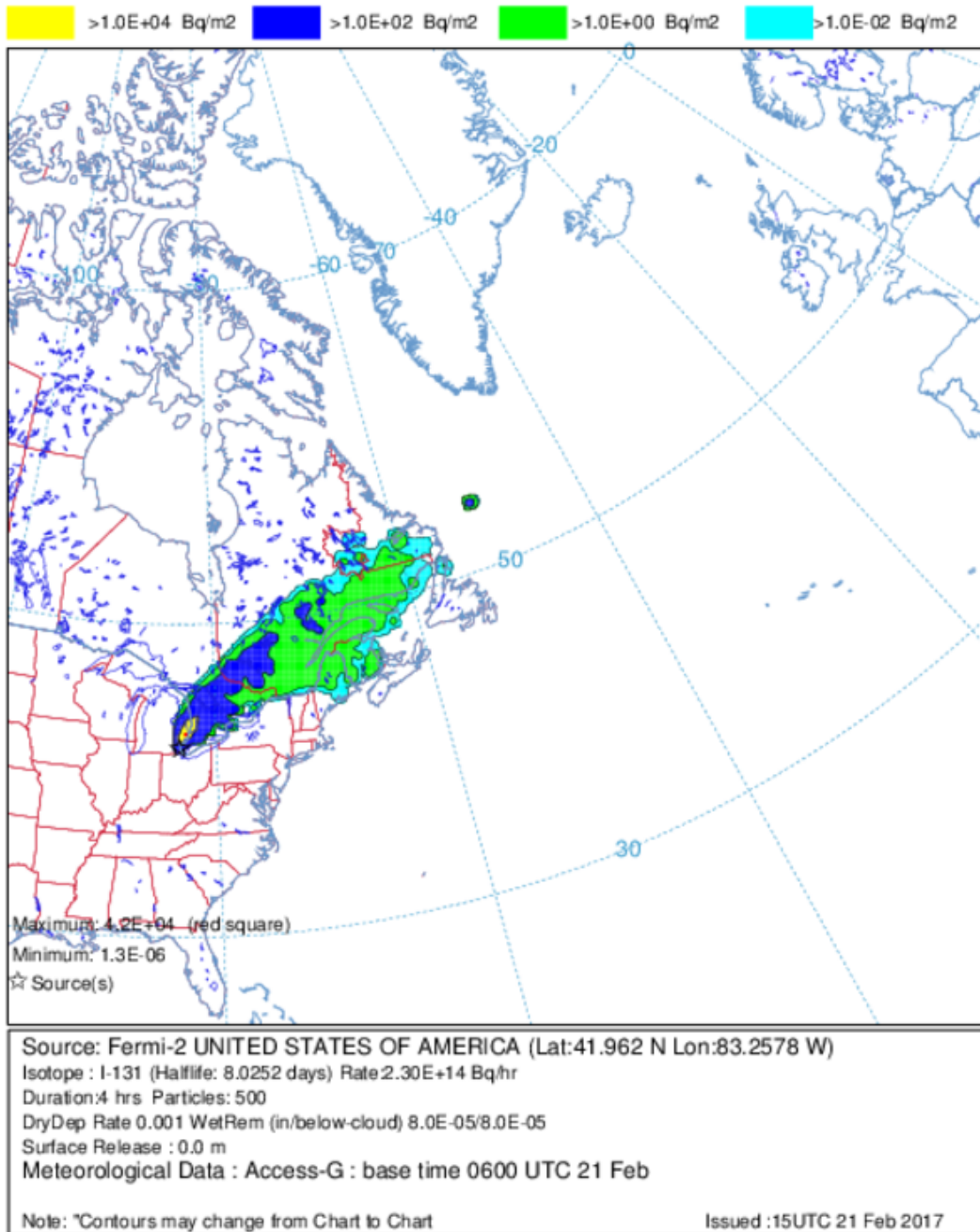
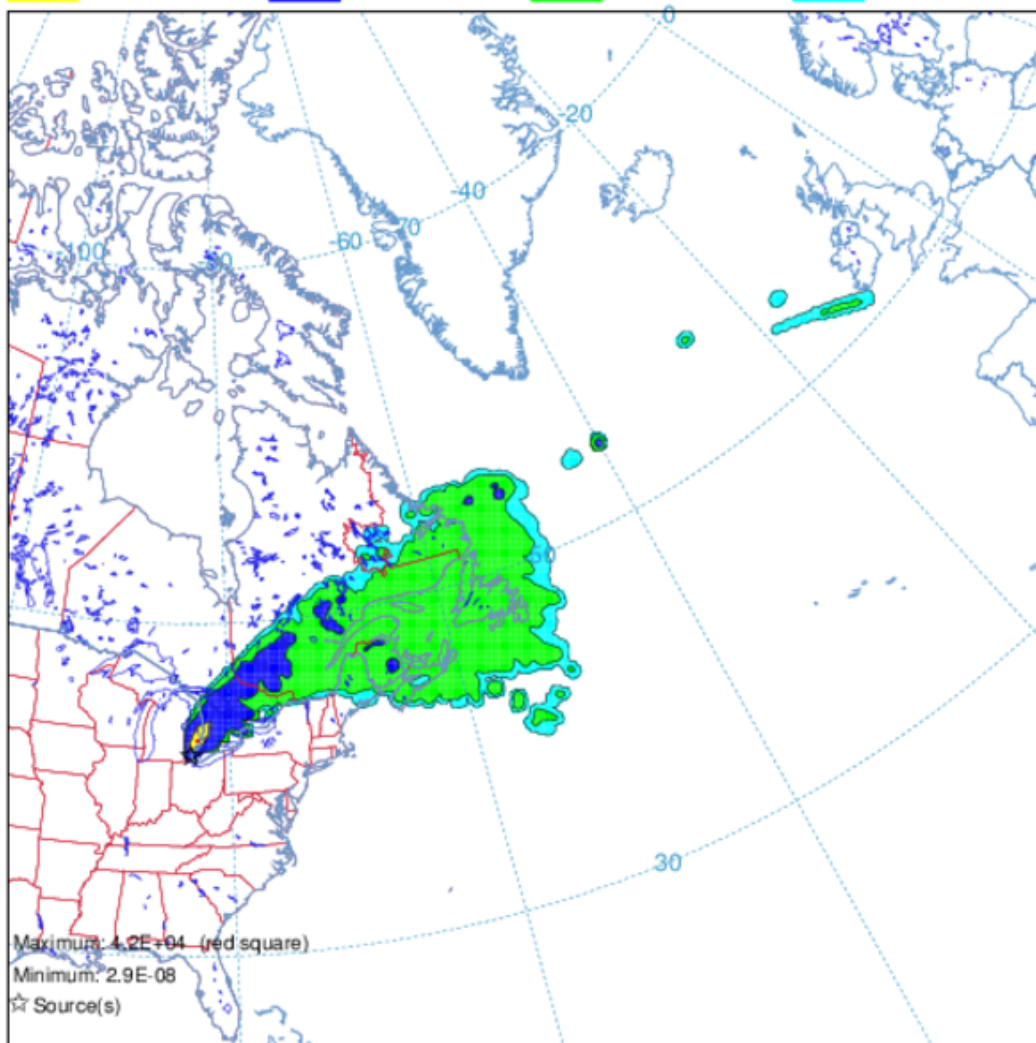**Figure 8: Chart showing the second 24-hours (of a 72-hour forecast) time integrated surface deposition.**

RSMC Melbourne : Environmental Emergency Response Centre
EXERCISE
Integrated from 0000 21 Feb to 0000 24 Feb 17 (UTC)
Deposition (Bq/m2) at ground-level

>1.0E+04 Bq/m2   >1.0E+02 Bq/m2   >1.0E+00 Bq/m2   >1.0E-02 Bq/m2

NRAD RELEASE STARTED AT 1030 UTC 21 FEB 2017

Maximum: 4.2E+04 (red square)
Minimum: 2.9E-08
☆ Source(s)

Source: Fermi-2 UNITED STATES OF AMERICA (Lat:41.962 N Lon:83.2578 W)
Isotope : I-131 (Halflife: 8.0252 days) Rate 2.30E+14 Bq/hr
Duration:4 hrs Particles: 500
DryDep Rate 0.001 WetRem (in/below-cloud) 8.0E-05/8.0E-05
Surface Release : 0.0 m
Meteorological Data : Access-G : base time 0600 UTC 21 Feb

Note: "Contours may change from Chart to Chart   Issued :15UTC 21 Feb 2017

Figure 9: Chart showing the final 24-hours (of a 72-hour forecast) time integrated surface deposition.