WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR BASIC SYSTEMS

MEETING OF THE WMO TASK TEAM ON METEOROLOGICAL ANALYSES FOR FUKUSHIMA DAIICHI NUCLEAR POWER PLANT ACCIDENT

LONDON, UK, 1-3 MAY 2012

FINAL REPORT

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Olivier Isnard, Peter Bedwell, Gerhard Wotawa, Matt Hort, Florian Gering, Roland Draxler, Peter Chen, Alain Malo, Kazuo Saito.

GENERAL SUMMARY OF THE WORK OF THE SESSION

1. Opening

1.1 The second meeting of the WMO Technical Task Team (TT) on Meteorological Analyses for Fukushima Daiichi NPP Accident was held at the offices of the Met Office UK, at Gray's Inn House, London, UK, and opened by the TT's chairperson, Mr Roland Draxler. Mr Draxler welcomed and expressed appreciation to all the participants. Mr Peter Chen, the representative of the WMO Secretariat recalled that the current task is to examine how the use of meteorological analyses and the introduction of additional meteorological observational data could improve the atmospheric dispersion calculations as validated against radiological monitoring data. The work of the TT will contribute to the requirements which the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) has stated in its request for assistance from WMO. In this regard, two experts of the UNSCEAR Study were invited to participate at this meeting: Mr Olivier Isnard of the French Institut de Radioprotection et de Sûreté Nucléaire (IRSN), and Mr Florian Gering of the German Bundesamt für Strahlenschutz (BfS). As well, UNSCEAR Study's UK experts of the Health Protection Agency, who are working in the UNSCEAR dose assessment group, were also invited to participate on one part of the agenda.

2. Adopting of agenda and working arrangements

2.1 Mr Draxler introduced the provisional agenda, which meeting adopted, and is found in Annex I.

2.2 The list of participants is found in Annex II. The meeting was informed that Mr René Servranckx (Canada), Chairperson of the CBS Coordination Group for Nuclear Emergency Response Activities, had notified the Secretariat that he was unable to attend this meeting. Instead, the work of RSMC Montréal contributing to the output of the TT was represented by Mr Alain Malo.

2.3 Daily working arrangements were agreed by the meeting.

3. Review of preliminary ATM runs for 11 – 31 March 2011

3.1 Mr Draxler provided a summary of the outcomes of the first meeting of the TT (Geneva, Dec. 2011), and also a summary of the progress made on the preliminary ATM runs for the period 11 – 31 March 2011, carried out by NOAA, JMA, Met Office UK, CMC. ZAMG (Austria) will soon provide its computations. JMA provided a regional ATM run using its high resolution mesoanalyses, while the other used their respective global analyses.

3.2 As per agreement from the first TT meeting, all members implemented the computational scheme for ATM simulations (Draxler, 2012). The meeting discussed various issues around the configuration of the ATM runs, including the source term and species, and the release height(s).

3.3 While waiting for the conclusion of the work of the UNSCEAR source term expert sub-group, these ATM runs were based on a source sequence following Chino (2011). Mr Isnard indicated that he was using a different source sequence, and agreed to provide the TT with a 3-hourly sequence of emissions and release height.

3.4 The group discussed as to whether the published source term data were valid at the time of release or at the time the fission reaction stopped. There was some uncertainty about this matter as Mr Wotawa indicated that for all their source term inversion calculations using measured data, the release amounts were decay corrected back to the time of the earthquake. Mr Isnard and Mr Gering will check with the UNSCEAR source term group and report back to the TT.

3.5 As for the release height, the different ATMs used different values for the releases, while Mr Isnard had computed with time varying release heights. While the TT agreed that it would be best to use a point release at a height of 100 metres above ground level, there was interest to understand the sensitivity of the results to varying release heights (to reflect explosive releases), and Mr Isnard agreed to also provide these data to the TT so that they could conduct sensitivity tests.

3.6 Mr Isnard noted that not all events are equally important and that getting the meteorological conditions correctly simulated on high emission days is critical in the assessment.

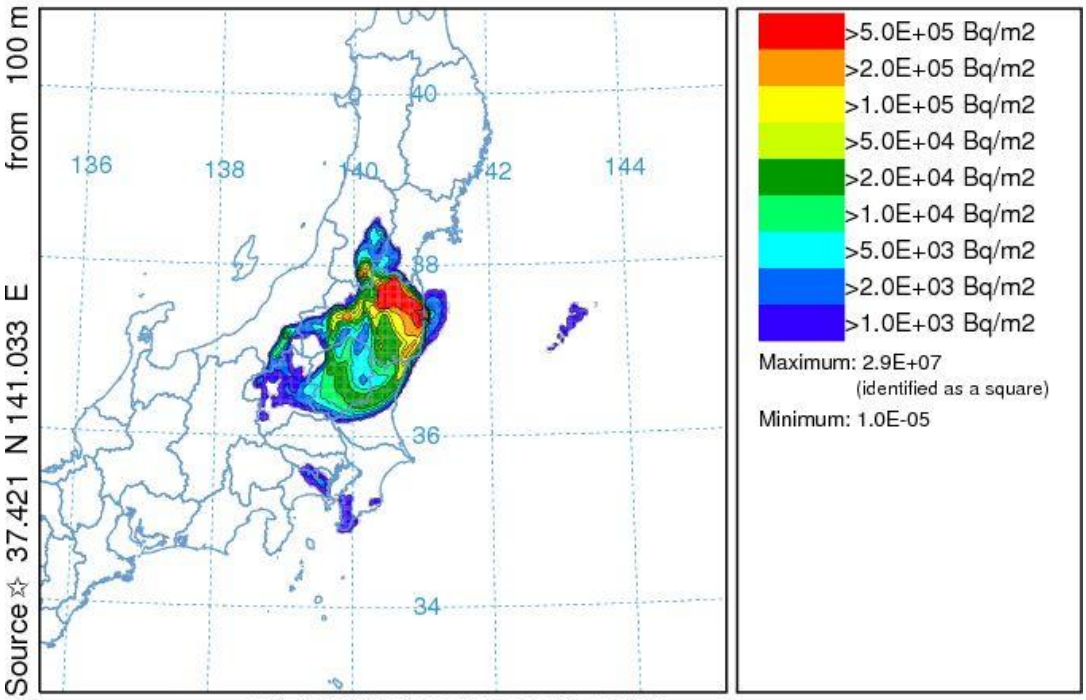
3.7 The meeting agreed that at this time the ATM results should be computed at 3-hourly intervals and at 5-km horizontal resolution. In addition to the graphical output and text based time series, the UNSCEAR representatives expressed the desire to have the ATM output also available in a binary format such as in NetCDF. Mr Draxler agreed to provide this option through the web interface and make the converter available to the TT members.

3.8 All ATM runs have accounted for wet deposition with NWP estimated rainfall rate, but have not as yet used the JMA high resolution precipitation analyses (derived from radar and raingauge data). These data will be available soon to TT members from a WMO, and from a JMA ftp site.

3.9 Mr Saito presented the Cs-137 deposition results from the JMA ATM using their mesoscale analyses, currently the only ATM to use these high-resolution data, which showed considerably more spatial structure than any of the other ATM calculations that used lower resolution global meteorological fields. He noted that the results are very sensitive to the source term and slight adjustments to the release rate could have a significant effect on the deposition pattern. The TT is awaiting the updated source term information that will be provided by UNSCEAR Group-B.

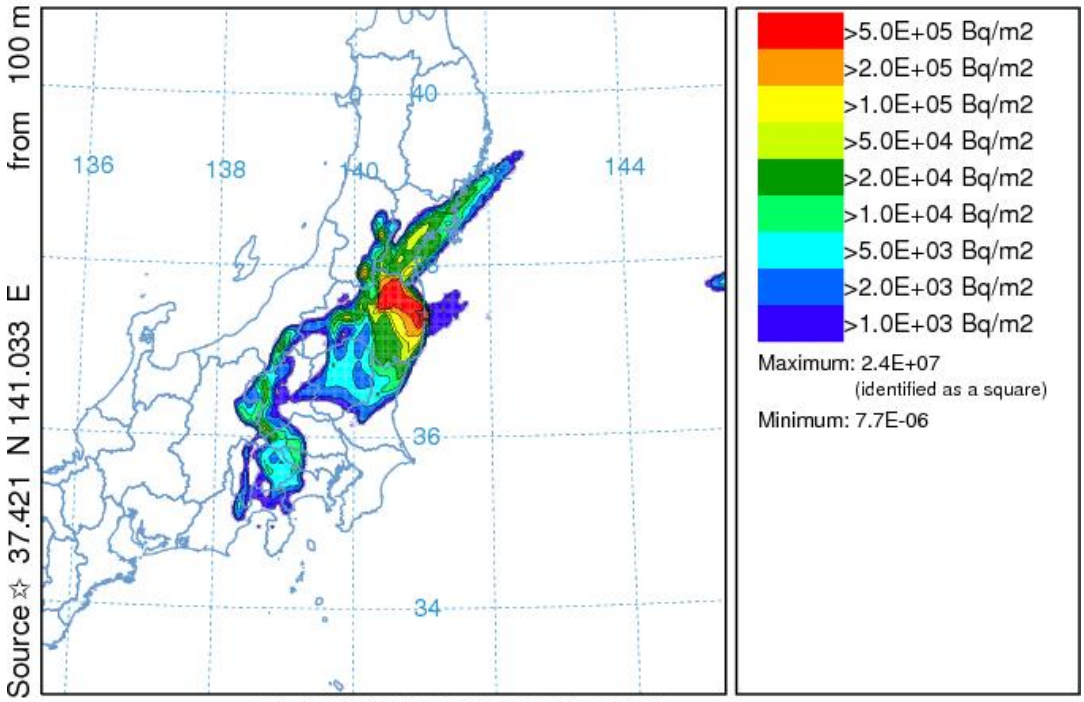
3.10 The meeting discussed the JMA results using their mesoscale analyses which suggested sensitivity of the ATM calculations to the vertical motion field. The JMA ATM results for Cs-137 deposition are shown below for calculations without (top panel) and with (bottom panel) vertical motion. Mr Saito noted that the observed pattern lies somewhere between the two calculations.

JMA Regional ATM (vad=0)
Cs-137 Deposition (Bq/m2) at ground-level
Integrated from 1500 14 Mar to 1500 15 Mar 11 (UTC)
Cpar Release started at 1800 11 Mar 11 (UTC)



RJTD METEOROLOGICAL DATA

JMA Regional ATM
Cs-137 Deposition (Bq/m2) at ground-level
Integrated from 1500 14 Mar to 1500 15 Mar 11 (UTC)
Cpar Release started at 1800 11 Mar 11 (UTC)



RJTD METEOROLOGICAL DATA

3.11 The following table summarizes the ATM runs that have been carried out.

Preliminary ATM Calculations (11-31 March 2011)

Center	Meteorology	ATM	Release	Output
CMC	GEM 0.30d 30 levels 6-hourly	MLDP0 dt=5min	1 unit/h 0-100 m AGL 300K p/3h	601x401 grid 0.05d x 100m 3-hr averaged
NOAA	GDAS 0.50d 56 levels 3-hourly	HYSPLIT dt=6min	1 unit/h 100 m AGL 300K p/3h	601x401 grid 0.05d x 100m 3-hr averaged
JMA	Meso Analysis 5-km 50 levels 3-hourly	Regional dt=10min	1 unit/h 0-100 m ASL 100K p/3h	721x577 grid 0.05d x 100m 3-hr averaged
UKMet	Unified 0.35x0.23 deg 70 levels 3-hourly	NAME dt=10min	1 unit/h 0-100 m AGL 300K p/3h	600x400 0.05d x 100m 3-hr averaged
ZAMG	ECMWF 0.2x0.2 deg 92 levels 3-hourly	FLEXPART dt=variable	1 unit/h 0-100 m AGL 300K p/3h	

3.12 The task team members agreed to provide a short technical document describing their ATM calculations which will be posted on the web site linked to each ATM. Mr Isnard and Mr Gering also agreed to provide to the TT members a short description of their atmospheric transport and dispersion model ATMs.

4. Evaluation of the sample JMA mesoscale meteorological analysis data files

4.1 Mr Saito presented the details of the JMA meso-analyses produced by a 4DVar system (ref. JMA, also see report of first TT meeting), and provided to members the entire dataset for the period 11 – 31 March 2011, at 3-hourly and 5-km horizontal resolution, in Lambert conformal map projection, which he had brought on memory sticks. The total dataset size is approximately 57 GB in GRIB2 format; a description of the dataset is included with the dataset. These data will also be made available to the larger UNSCEAR community from a WMO Internet accessible site, the exact URL is to be determined and provided by WMO Secretariat.

4.2 The meeting welcomed the offer of Mr Saito to provide a software tool to convert these files to latitude-longitude grid, while retaining the vertical hybrid terrain-following grid and also with an option to convert these data to pressure-level surfaces. Mr Saito indicated that this tool could be made available by the end of June 2012.

4.4 Mr Isnard and Mr Gering agreed that this JMA mesoanalyses dataset was probably very suitable for use by their own ATM and dose calculation systems, and will attempt to use it for their own ATM trials, compare their results with those produced by TT members and communicate these results with the TT.

4.5 The meeting noted that the intent of the TT was to provide guidance to UNSCEAR about the best meteorology to use for ATM calculations in their assessment. The issue was no longer a question of which meteorological analyses was most suitable to use, but how can the ATM models be optimized to work with the JMA data, whether computing vertical motion, stability, mixing, or deposition. Several TT members noted they will have to make changes to use these data which should provide valuable feedback to UNSCEAR groups planning to use the mesoscale analyses.

5. Status of verification data for ATM and meteorological evaluation

5.1 The meeting discussed the potential usefulness of CTBTO/IMS/RN data for verification of ATM results. Mr Wotawa explained to the meeting regarding CTBTO's data policy for these data, through informal consultations with the CTBTO/PTS. Aside from publishing actual data values, all other information generated from the use of such data may be made openly available to the public. While these data would be very useful for validating regional/global scale ATM results, there is only monitoring data from one such RN station (Takasaki) in Japan, located approximately 220 km west-southwest of Fukushima-Daiichi. The meeting agreed that they would not pursue this matter further with respect to verification of ATM calculations over Japan, but it might be useful for global calculations. Several TT members agreed to pursue this matter further, outside and independently of the current WMO TT ToR.

5.2 Mr Isnard will investigate the availability of other air concentration measurements at selected sites that could be used for verification.

5.3 Another approach is to use the deposition monitoring data that has been used to show the complex deposition pattern around the accident site. Mr Gering described sampling data from Japan, of 2000 data points, that are available from a high density of soil sampling sites within 100-200 km of the NPP, and he agreed to provide these data to the TT to evaluate the ATM outputs. Mr Draxler has already put in place a statistics package to compute the overall performance and ranking of the ATM outputs compared to measurement data which could then be added to the existing web interface and distribute to TT members.

6. Discussion on UNSCEAR requirements

6.1 Mr Peter Bedwell from the UK Health Protection Agency presented an overview of the work HPA conducted for the World Health Organization's assessment and the requirements that the UNSCEAR dose assessment group-C would need from the UNSCEAR dispersion modeling group-B. He noted that all the initial ATM calculations for WHO showed large under-predictions of particulate air concentrations outside of Japan with under-predictions increasing with distance. This was attributed to either excessive wet scavenging or uncertainty in the source term. Several TT members have reached similar conclusions using their own ATMs. This confirmed the TT focus on integrating higher resolution precipitation analysis with the ATM calculations

6.2 Mr Bedwell reviewed some of the ATM technical requirements for UNSCEAR's dose calculations. Although he expressed a desire for higher spatial resolution, the TT's configuration of 3-hourly and 5-km horizontal resolution was consistent with their requirements.

6.3 The meeting discussed the relationship of the TT ToR with the UNSCEAR requirements and clarified their respective roles. The WMO TT will be providing the higher resolution meteorological fields for UNSCEAR ATM calculations and technical guidance on how to use these analyses. WMO TT will not be doing any dose calculations for UNSCEAR. However, the UNSCEAR dispersion modeling group may access the TT ATM calculations to provide uncertainty estimates to their ATM calculations within the existing evaluation framework.

7. Review of the Terms of Reference of the WMO Task Team

The TT members reviewed and made one modification to its Terms of Reference, which is found in Annex III.

8. Revised Work plan and timetable

The TT reviewed and updated its work plan and time table as follows:

1 - 3 May 2012 – TT meeting, and meeting report

23 May 2012 - 59th session UNSCEAR progress and preliminary report (TT input provided from TT meeting of Dec. 2011)

31 May 2012 - TT members provide ATM model configuration summary

31 May 2012 - Mr Gering agreed to investigate the provision of surface measurement data; Mr Isnard agreed to investigate the provision of surface air concentration measurement data.

June 2012 - JMA high-resolution precipitation analyses and the JMA mesoscale analysis data converter be shared with TT members

June 2012 - TT discuss via email or teleconference the verification potential of measurement data

Early July 2012 - (before UNSCEAR all-experts meeting) – teleconference on progress of TT activities

July 2012 - NOAA (Draxler) to provide DATEM statistical results linked with model evaluation framework

September 2012 - TT to complete and provide ATM results using JMA meso-analyses. JMA to provide a comparison of the JMA mesoanalyses of precipitation with the JMA high-resolution precipitation analyses

December 2012 - third TT meeting, drafting final TT report

9. Closing

The meeting was closed at 15:00, Thursday 3 May 2012.

Reference

- Chino, M., Nakayama, H., Nagai, H., Terada, H., Katata, G., Yamazawa, H., 2011. Preliminary Estimation of Release Amounts of ^{131}I and ^{137}Cs Accidentally Discharged from the Fukushima Daiichi Nuclear Power Plant into the Atmosphere. *Journal of NUCLEAR SCIENCE and TECHNOLOGY*, 48(7), pp.1129–1134.
- Draxler, R. R., Rolph. G.D., 2012. Evaluation of the Transfer Coefficient Matrix (TCM) approach to model the atmospheric radionuclide air concentrations from Fukushima. *Journal of GEOPHYSICAL RESEARCH*, 117 (D05107), 10pp, http://www.agu.org/pubs/crossref/2012/2011JD017205.shtml
- JMA reference to mesoscale analyses and high resolution precipitation analyses

Annex I - Agenda

1. Opening
2. Adoption of Agenda, working arrangements
3. Review of preliminary (11-31 March 2011) ATM runs
4. Evaluation of the sample JMA mesoscale meteorological analysis data files
5. Status of verification data for ATM and meteorological evaluation
6. Presentation and discussion of UNSCEAR requirements
7. Review of the Terms of Reference of the WMO Task Team
8. Revised Work plan and timetable
9. Closing

Annex II - List of Participants

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ANNEX III - Terms of Reference

WMO Technical Task Team on Meteorological Analyses – Fukushima Daiichi NPP Accident

Membership and Chairperson

- Roland Draxler, Chairperson (RSMC Washington, USA)
- Matthew Hort (RSMC Exeter, UK)
- Gerhard Wotawa (RSMC Vienna, Austria)
- Kazuo Saito (Meteorological Research Institute, Japan Meteorological Agency, Japan)
- René Servranckx (Chairperson of CBS Coordination Group on Nuclear ERA, RSMC Montreal, Canada)

Terms of work

(a) Determine the relevant meteorological observational data sets and related information required to support the meteorological analyses and identify their archive location and availability;

(b) Determine which of the existing meteorological analyses are of sufficient spatial and temporal detail that can be used to estimate the atmospheric transport, dispersion, and surface deposition of radionuclides that were released from the nuclear accident and identify their archive location and availability;

(c) Identify gaps in the existing meteorological analyses that if addressed would make them more suitable for estimating atmospheric transport, dispersion, and deposition and in coordination with the WMO Secretariat, identify which members will provide updated analyses;

(d) Based upon the observational data and analyses, prepare a report on the temporal and spatial variations in atmospheric conditions during the nuclear accident;

(e) Evaluate the suitability and quality of the observational data and meteorological analyses for computing atmospheric transport, dispersion, and surface deposition by comparing the computational results with radiological measurements;

(f) Provide a number of atmospheric transport, dispersion and deposition (ATM) outputs from several different ATMs using different meteorological analyses;

(g) Liaise and assist where possible with the UN Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), in their study on the levels and effects of exposure due to the Fukushima Daiichi nuclear accident.

(h) Propose possible enhancements to the WMO EER system, including additional products and/or additional modes of operation with the relevant international organizations.

Duration and working arrangements

It is anticipated that the work of the Task Team spans a period of 12 -18 months from December 2011. The Team will work mainly by e-correspondence, and meet face-to-face, as needed. WMO Secretariat will facilitate the work of the team.

(ToR updated, 3 May 2012)