

WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR BASIC SYSTEMS

**MEETING OF CBS EXPERT TEAM ON
MODELLING ATMOSPHERIC TRANSPORT FOR
NON-NUCLEAR EMERGENCY RESPONSE ACTIVITIES**

Montréal, Canada, 4 – 8 June 2007



FINAL REPORT



Executive Summary

CBS-XIII (February 2005) established this Expert Team on Modelling of Atmospheric Transport for non-nuclear Emergency Response Activities (“ET-nNERA”). The Expert Team met at RSMC Montréal, Canada, 4 – 8 June 2007. The Expert Team was chaired by Mr Christopher Ryan (Australia).

The meeting reviewed and discussed the scientific and technical developments for ERA, including ATM backtracking and the design of a backtracking experiment, ATM ensembles techniques and products, biological hazards, access to a chemical data base, sand and dust storms, formats for exchange, the WMO ERA Web pages.

The Expert Team reviewed and updated its Terms of Reference and its Work Plan.

1 Opening of the meeting (Agenda item 1)

1.1 The meeting of the CBS Expert Team on Modelling of Atmospheric Transport for non-nuclear Emergency Response Activities (“ET-nNERA”) opened at 9:30 am, 4 June 2007, at RSMC Montréal, the National Meteorological Centre of Canada. The meeting was chaired by Mr Christopher Ryan (Australia). Opening welcoming remarks were made by Ms Angèle Simard, Director General of Weather and Environmental Operations of Environment Canada, the representative for the Secretary General of WMO, and the Chairperson of the Expert Team.

1.2 Ms Simard noted the very important progress that the ERA programme has made over the years since the early 1990’s with the designation and implementation of the eight RSMCs for ERA, initially for supporting NMHSs in nuclear emergency response, but has evolved to CBS’s recognizing the need to expand the application of atmospheric transport modelling capabilities to emergency response in non-nuclear area. She also underscored the special operational and 24/7 commitment that RSMCs make to assure timely and reliable support to NMHSs. In the recent few years, the Meteorological Service of Canada has been able to invest in a significant amount of scientific and technical developments to improve meteorological aspects of environmental emergency response through the Canadian CBRN Research and Technology Initiative (CRTI) the result of which means much improved meteorological input and systems for responding to airborne hazards.

1.3 Mr Peter Chen of the Secretariat indicated that the 15th WMO Congress had noted the important progress made within the ERA programme, for example in the “backtracking” services, and wished that the programme continues to develop and to establish suitable operational arrangements that will facilitate NMHSs to respond more effectively to environmental emergencies of a variety of incidents in their own countries, and if required, coordinated within regions. The basis of the ERA programme is the application of specialized numerical atmospheric transport and dispersion modelling directly using the outputs of NWP systems. The Expert Team was reminded that its work and plans will be presented to the 14th Session of CBS, planned for late 2008.

1.4 Mr Ryan welcomed the participants and noted several objectives of this meeting: to inform each other of developments in non-nuclear ERA, to design a backtracking demonstration, to clarify the role of the Expert Team relative to volcanic ash hazard, to consider ensembles for atmospheric dispersion modelling, to review the WMO ERA Web pages.

2 Organization of Meeting

2.1 Approval of agenda

The meeting adopted the agenda given in Annex 1.

2.2 Agreement of working arrangements

The meeting agreed on its working hours, organization and work schedule. There were 11 participants at the meeting as indicated in the list of participants given in Annex 2.

2.3 The Chairman acknowledged the absences of Mr H. R. Hatwar (India) and Mr V. Shershakov (Russian Federation) at the meeting due to unexpected problems with travel arrangements.

3 Introduction to the Environmental Emergency Response Activities (ERA) programme

3.1 The main goal of the WMO Emergency Response Activities (ERA) programme is to assist NMHSs, with other relevant agencies of Member countries, and in cooperation with relevant international organizations, to respond effectively to environmental emergencies. The ERA programme has mainly focused its attention on emergencies caused by nuclear accidents (at nuclear power plants) and radiological emergencies, with strong collaboration with the International Atomic Energy Agency. Indirectly, non-nuclear aspects also received attention. The Constituent bodies of WMO have set the direction to expand into non-nuclear environmental emergencies. The first priority is given to expanding to including atmospheric transport and dispersion modeling to support response to chemical accidents; the second priority is regarding smoke from large fires (wild-land, oil and chemical fires).

3.2 At its first meeting (Melbourne, September 2005) Expert Team had concluded that because of the predominately “localized” nature of environmental emergencies related to chemical incidents, that the strategy and plan should be concentrated on developing the necessary capabilities at the NMHSs. In the case of smoke from large fires, a regionalized approach would be appropriate, where designated RSMCs would provide emergency support to NHMSs and at the same time build capacity at the national level.

3.3 It was also recognized that many NMHSs have developed capabilities in providing atmospheric transport modeling support during emergencies of a wide variety of incidents and situations, including for example hazardous gases emitted during volcanic activity, smoke from large oil fires, and hazardous conditions during dust and sand storms. This programme should benefit from the wide range of experiences and examples of how atmospheric dispersion modeling was applied to environmental emergencies.

3.4 CBS-Ext.(06, November 2006) adopted all the key results of the Expert Team, which were reported through the Implementation Coordination Team for the OPAG on DPFS, including:

- Chemical incidents are predominantly of the localized and short-lived nature where very rapid emergency response is essential; therefore concentrate efforts on developing the necessary capabilities at the NMHSs;
- A higher priority would be the trans-boundary transport of airborne hazards such as in the case of smoke from large fires where a regionalized approach would be appropriate, i.e., through a designated RSMC(s) to provide emergency support to and build capacity at NMHSs; and similarly, for large trans-boundary dust or sand storms;
- Cooperation with International Organizations is important, e.g. with the IAEA on nuclear aspects, with ICAO on the airborne volcanic ash advisory service, with the UNEP/UN Office for the Coordination of Humanitarian Affairs (UNEP/UN-OCHA) Joint Unit, and with World Health Organization’s (WHO) International Programme on Chemical Safety (IPCS), in particular operational components that could be linked to the developing operational framework;

- Expanding the official services provided by the RSMCs on Atmospheric Transport Modelling to include backtracking, and that a backtracking experiment is to be planned and undertaken in 2007.

3.5 Congress (Cg-XV, May 2007) continued to support the extension of the ERA programme to include non-nuclear aspects, including airborne and waterborne hazards.

3.6 CBS Recommended Amendments to the Manual on the GDPFS (WMO-No. 485) were adopted in EC Resolution, to be effective 1 July 2007.

New terms of reference

3.7 The meeting reviewed its Terms of Reference, and considering the progress made since CBS-XIII (Feb. 2006), proposed its new Terms of Reference for consideration at the next Session of CBS. The new Terms are given in Annex 3.

4 Scientific and technical developments for ERA

Backtracking and design of backtracking demonstration experiment

4.1 Mr Perron (RSMC Toulouse) informed the meeting that RSMC Toulouse has developed the necessary backtracking capabilities to participate in the proposed experiment. It has demonstrated the performance of its new MOCAGE-Accident model through validation activities.

4.2 The newly incorporated regulations on the functions of the RSMCs for ERA will soon include "backtracking" (amendments to the Manual on the GDPFS (WMO-No. 485)).

4.3 The Expert Team agreed that the main purposes of the experiment are:

- To demonstrate to WMO Members and relevant international organizations the new operational backtracking capabilities and products that the RSMCs will provide, and
- To explore the concept of operations for the requesting and the provision of backtracking products and services.

4.4 The meeting discussed at length various approaches and possible scenarios for the experiment, including some of the past requests for such services, including:

- Smoke
- Biological hazards (Legionnaires Disease, Foot and Mouth Disease)
- Chemicals (deposited materials, odours)
- Volcanic ash
- Dust, coloured precipitation
- Pests (moths, insects)

4.5 Mr Draxler (RSMC Washington) provided a review of several different source-attribution methodologies, which underscored the limitations and uncertainties of the various approaches, using the ANATEX field data set to illustrate them. The design of the experiment took account of these aspects, while focusing on the goals of the experiment.

4.6 The meeting considered many practical aspects of developing and executing the experiment and decided to create a fictitious scenario of a ruptured tanker ship

leaking a volatile chemical. The backtracking scenario is to be selected and modelled by Mr Wortley and Mr Perron (RSMC Exeter and RSMC Toulouse, respectively) based on a high resolution forward ATM, and then suitable receptor concentrations will be computed from hindcasts (based on meteorological analyses) for specific receptor locations (population centres in Western Europe).

4.7 The synthesized receptor observations will be sent to the participating Centres by electronic mail (participant's e-mail address), which will constitute a notification of the request for backtracking services. The Centres will generate SRS (source-receptor sensitivity) fields as well as back-trajectories for each receptor, and send the results to RSMC Washington for processing to produce joint probabilities of the source location.

4.8 The final report of the experiment will be produced by the Chairman of the Expert Team, with input from the participants. The aim is to complete the final report by the end of February 2008.

4.9 The meeting agreed that future experiments would further demonstrate and explore different aspects of the usefulness of this ATM application as well as the concept of operations, such as the development of official request forms and the establishment of preauthorized requests, harmonized as much as possible with the nuclear ERA concept of operations for WMO Members.

4.10 The meeting noted that the current concept of operations for requesting and arranging atmospheric transport modelling products under the ERA programme is by Permanent Representative-to-Permanent Representative ("PR-to-PR") correspondence only. It was agreed that this arrangement should remain as it provides useful flexibility for the development of bi-lateral or multi-lateral arrangements among NMHSs.

4.11 RSMC Montréal will develop a simple backtracking scenario based on an actual incident of smoke of unknown origins, and request back-trajectories from RSMCs. The purpose is to demonstrate the use of very simple parcel back-trajectories to give a general indication of the possible origins of airborne materials. A report will be prepared.

ATM Ensemble techniques and products

4.12 Mr Perron (RSMC Toulouse) presented updates on the MOCAGE-Accident model of MétéoFrance which will replace the currently operational MEDIA for environmental emergency response in the second half of 2007.

4.13 Mr Ryan (RSMC Melbourne) presented an ensemble prediction system run by NMOC Melbourne comprising 33 low resolution (T119) runs off its global NWP model, GASP. The ensemble mode of HYSPLIT is also available for use and a number of test runs have been carried out. Ensemble approaches have the important advantage of providing a sound basis for probability forecasts, which have the potential of being more useful to decision-makers in emergency situations. However, before ensembles can play a larger role in operations it is necessary to select or develop the most effective output products and to ensure users understand how to utilize them.

4.14 The meeting agreed that collaboration with the European Commission Joint Research Centre (EC-JRC, Ispra) in its ENSEMBLE project could assist the WMO ERA programme in exploring and developing ensemble approaches for atmospheric transport modeling. The Secretariat is requested to contact the manager of the

ENSEMBLE project with the goal to develop a suitable cooperative framework for this work.

4.15 The meeting felt that the terminology used in discussing ensemble techniques is sometimes ill defined and can lead to confusion. Mr Perron agreed to conduct a literature survey to develop a glossary of terms relevant to atmospheric transport modelling.

4.16 Recognizing that an initiative for the exchange of model products among RSMCs in GRIB/GRIB2 has started, Mr Servranckx agreed to request all RSMCs to provide their products to the ERA Web servers, for example during the quarterly exercises with IAEA. The goal is to generate both product images and GRIB files at the same time, and to make them accessible. A suitable GRIB ID will be determined before the exchange. This action is a step towards the generation of probabilistic products (e.g. exceedance of concentration thresholds). The backtracking products from the experiment(s) described above could be used in a further investigation of ensemble methods.

Biological hazards

4.17 Mr. Sørensen (DMI, Denmark) presented a veterinary meteorological decision-support system, "VetMet", developed in collaboration between Danish veterinary and meteorological research institutes and authorities. The system, which is implemented at DMI, is used by the Danish Veterinary and Food Administration which has the responsibility for prevention and control of animal diseases in Denmark. By estimating the risk of atmospheric spread of airborne animal diseases, including first of all foot-and-mouth disease (FMD), VetMet improves the preparedness and the disease eradication. The Internet-based automatic system will be used for decision support regarding establishment of surveillance and eradication zones. VetMet can describe both local spread of infectious airborne diseases between neighbouring farms and long-range dispersion, including disease spread from other European countries.

4.18 VetMet utilizes the RIMPUFF local-scale model system, which is capable of simulating atmospheric dispersion up to about 100 km from the source, as well as the Danish Emergency Response Model of the Atmosphere (DERMA), which can simulate dispersion from about 20 km from the source and up to the global scale. Both model systems make use of the operational DMI versions of the numerical weather-prediction model HIRLAM.

4.19 Present understanding of the behaviour and spreading of animal diseases other than FMD by the atmospheric pathway remains poor. Interactions between the meteorological and animal health communities are encouraged. This subject should continue to be monitored by the Expert Team.

HYSPLIT development

4.20 Mr Draxler (RSMC Washington) presented the developments at NOAA on a new chemical interface to the CAMEO chemicals database for the Web-based HYSPLIT dispersion model, used for emergency response applications that will permit the specification of the emission source characteristics from simple pull-down menus. Outputs of HYSPLIT will be shown in contours of concentrations associated with predefined emergency action levels (e.g. US EPA protective action standards). When completed, the interface will be available to other countries using HYSPLIT, selected PC and Web-interface users.

Sand and dust storms

4.21 Mr Song (RSMC Beijing) and Mr Fujita (RSMC Tokyo) presented their respective work on sand and dust storms of their national meteorological services. Episodes of elevated sand and dust concentrations have health impacts. As well they can have impacts on aircraft operations close to the ground and at cruising altitudes due to reduction to visibility. Impacts on aircraft mechanics are not well known.

4.22 The meeting noted the possibility that climate change will result in increasing frequency of sand and dust storms, or their occurrence in regions not previously affected by this phenomenon.

4.23 Both CMA and JMA run specialized sand and dust storm dispersion models on which they base their routine public forecasts and alerts.

4.24 The meeting was informed by the Secretariat of the proposed Sand and Dust Storm Warning System, an initiative of the World Weather Research Programme (WWRP), within the WMO Commission on Atmospheric Sciences, where three regional centres for sand and dust storm modelling and forecasting are being organized for: eastern Asia, Europe and North Africa, and North America. The meeting noted that coordination between CAS and CBS would be highly desirable to ensure operational issues and requirements are considered and addressed.

4.25 The meeting felt that a result of WWRP exploration of a WMO system for sand and dust storm warnings might require the designation of specialized centres (e.g. RSMC) in the GDPFS.

4.26 The WWRP is planning a joint WMO and GEO Expert Meeting on this initiative (Barcelona, 7 - 9 November 2007). The meeting suggested that CBS could be represented by its Chair of this ET. In addition the representative of ICAO suggested that IATA could provide its input through ICAO.

Canadian CBRN Research and Technology Initiative (CRTI)

4.27 Mr Richard Hogue of RSMC Montréal presented examples of how Canada is increasing investments in science and technology to strengthen public security measures. The Canadian CRTI is investing significantly in some projects that focus specifically on better use of meteorological data and systems, in some cases in collaboration with other governments. These CRTI projects include:

- ARGOS/CHIRP – international consortium on radiation dose decision support system
- Airborne component of virus transport
- Quantitative estimates and modelling of wet scavenging processes (e.g. hot-spots)
- Radiation Dispersal Devices and re-suspension of radioactivity
- CFD modelling in the urban dispersal environment

4.28 These projects will also benefit meteorological developments for NWP in weather forecasting and numerous related applications.

Formats for exchange of ATM products

4.29 The RSMCs of the ERA programme provide specialized ATM outputs to WMO Members as well as to the Members' respective national organizations responsible for environmental emergencies and to relevant International

Organizations. In order to ensure rapid and effective communication of time-critical information, data and product formats have to permit efficient exchange and usage, for example for immediate visualization, input and layering of fields within specialized decision support or mapping systems.

4.30 The meeting requested the Secretariat to seek clarification regarding WMO data and product format standards and related policy with respect to exchange of GIS-like products among WMO Members as well as with external users, recognizing that new electronic formats are in wide use and are desired by some users for product exchange.

4.31 The Expert Team members are requested to provide information on the range of ATM products they are producing that support non-nuclear ERA, including the formats that are being used for electronic exchange.

WMO ERA Web pages

4.32 Mr Ryan briefed the meeting on the newly organized and updated WMO ERA Web pages that were developed in October 2006. The intention is to replace the outdated pages with the new pages following a period of review by members. The members agreed to review the contents of the new pages and to provide any additional updates, suggestions, and related references (Web links, including in languages other than English), to the Chairman and Secretariat, by 30 June 2007.

4.33 The meeting noted that the new Web pages include links to documents that have been presented at past CBS Expert Meetings of the ERA programme, by various participants and Centres.

4.34 The Chairman and Secretariat will work together to effect the transition to the new pages as soon as possible, and make a plan for regular quality assurance of the pages.

4.35 The Expert Team suggested that reprinting and redistribution of the paper form of WMO Technical Document 778 was not a high priority and is perhaps unnecessary. The updated Web-pages will include all sections of TD 778 including any approved updates and additions. A complete web version will also be available in "pdf" format from the WMO Web site.

5 Perspectives of relevant International Organizations

5.1 The meeting expressed disappointment in the absence of representatives of the UN-OCHA and WHO, however encouraged the Secretariat to continue to pursue cooperation and if appropriate in the context of Disaster Risk Reduction efforts of WMO. Potential areas of cooperation have been identified in earlier discussions and during participation at WMO sponsored meetings. The Secretariat noted that occasional and even recent contacts have been made with them, however they were unable to participate at this meeting.

5.2 The meeting also noted that while Secretariat-Secretariat dialogue could facilitate cooperation, it is important that programme experts from their respective Organizations' Members (representing national technical means) develop dialogue and understanding of each others' programmes and potential linkages and benefits. This could be achieved through reciprocal attendance at technical meetings.

Future exercises or demonstrations would be good opportunities to facilitate the dialogue and cooperation between NMHSs and their respective national organizations that have responsibilities related to emergency response and civil protection. Relevant International Organizations such as UN-OCHA, WHO, or OECD could provide their respective national contact points for this purpose.

5.3 In the matter of outbreaks of airborne animal diseases the meeting noted that the World Organization for Animal Health (www.oie.int) would be another relevant organization with which to explore areas of mutual interest.

International Civil Aviation Organization (ICAO)

5.4 Mr Raul Romeo (ICAO) noted the present coordination arrangements with ICAO relative to scientific and technical aspects of the ICAO's International Airways Volcano Watch are working well, in particular between the Secretariats and experts. In the event that the IAVW Operations Group has scientific questions, the WMO representative to the Ops Group would direct them to the appropriate Department in WMO. This Expert Team is responsible for matters related to airborne transport and dispersion of volcanic ash.

5.5 Mr Servranckx (RSMC Montréal) informed the meeting about the outcomes of two recent workshops related to volcanic ash:

- WMO/ICAO International Workshop on Volcanic Ash, Rotorua, New Zealand, 26-30 March 2007
- USGS Eruption Source Parameters Workshop, Vancouver, Washington, USA, 18-19 April 2007

5.6 The WMO/ICAO Workshop concluded that the problem of airborne volcanic ash remains important as commercial air traffic is increasing and traversing active eruptive volcanic regions (e.g. North Atlantic, Pacific Ring-of-Fire), in particular as an immediate acute hazard for aircraft, especially jet aircraft. Operational systems that have been implemented under the IAVW, which have depended on WMO and in particular its operational infrastructure have been effective in mitigating the risk of encounters. Some fundamental problems or gaps remain, including the problem of quantifying source parameters to improve transport and dispersion modelling, and early detection of ash-producing eruptions in all regions of the globe.

5.7 The USGS Workshop is a joint effort between the USGS, members of IAVW Ops Group, and officials responsible for volcanic ash and aviation hazards, to identify and quantify model parameters used to forecast the dispersal of volcanic ash clouds, recognizing that the atmospheric transport of volcanic ash clouds could be more accurately modelled and their hazards better anticipated if eruption source parameters (ESP) such as volcanic ash release rates, height distributions in the atmosphere, ash properties, and other factors, were better characterized. The Workshop developed a draft protocol for estimating the ESP and agreed to an action plan.

6 Work Plan for Expert Team

6.1 The meeting reviewed and updated its Work Plan, including activities to be undertaken from the present to its next meeting, likely to take place in the second quarter of 2009. The new Work Plan is found in Annex 4.

7 Other business

Designation of RSMC for ATM

7.1 If a request for the designation for an RSMC in the specialization of Atmospheric Transport Modelling, that centre must demonstrate to CBS its capabilities against the requirements stated in the Manual on the GDPFS for nuclear emergency response and for CTBTO backtracking.

8 Closing

8.1 The meeting closed at 13:30 pm, Friday 8 June 2007.

ANNEX 1

AGENDA

- 1- **Opening**
- 2- **Organization of Meeting**
 - Approval of agenda
 - Agreement of working arrangements
- 3- **Introduction to the Environmental Emergency Response Activities (ERA) programme**
 - Review of highlights from previous meeting
 - Review of the Expert Team's Terms of Reference
- 4- **Scientific and technical developments for ERA**
 - Backtracking
 - Ensemble techniques and products
 - Case studies
- 5- **Perspectives of relevant International Organizations**
- 6- **Work Plan for Expert Team**
- 7- **Other business**
- 8- **Closing**

ANNEX 2

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ANNEX 3

Revised Terms of Reference

CBS Expert Team on Modelling of Atmospheric Transport for non-Nuclear ERA

(ET-nNERA, Montréal, Canada, 4–8 June 2007)

- (a) Monitor the needs of the NMHSs for atmospheric transport modelling and identify those areas in which RSMCs can be of assistance;
- (b) Identify and promote technical resources which can assist NMHSs in developing their atmospheric transport modelling capabilities, particularly for limited area non-nuclear emergencies such as chemical releases to the atmosphere;
- (c) Monitor the atmospheric transport modelling capabilities of RSMCs and other centres for support to transboundary non-nuclear emergencies, such as volcanic eruptions, dust storms, large fires, and biological incidents, with the goal of improving operational arrangements;
- (d) Develop strategies to strengthen operational links with international organizations relevant to non-nuclear ERA, and between NMHSs and relevant national authorities.

ANNEX 4

REVISED
Work Plan for the Non-nuclear ERA programme
(June 2007)

General

Area of Requirement	Component Action	Priority / Timing / Milestone	Responsibility
Observational data (chemical sniffers, etc)	<p>Explore availability of real-time and post-incident measurement data.</p> <p>Define the use of such data from local and national monitoring in real time operations and post event validation and incorporate as a statement of guidance in operational framework document.</p>	Chair to contact Shershakov for update.	Chair, Shershakov
Role of International Organizations (including linkage between NMHS with their national civil protection authority)	<p>Develop interface (program coordination, etc including operations) between WMO and WHO, and with UNEP/OCHA</p> <p>Acquire contacts from WHO and UNEP/OCHA and provide to NHMS. Future consideration to exercises to involve NMHS's and National Authorities.</p> <p>Engage with these organizations to promote the usefulness of ERA products.</p> <p>Explore areas of mutual interest with OIE</p>	<p>Ongoing, although it is noted there are limited resources available at these organizations.</p> <p>On going</p> <p>December 2007</p>	<p>Chair, Secretariat</p> <p>Secretariat</p> <p>Sorensen, Wortley</p>

Promote ERA programme to NMHS via Regional Associations	Role for DPFS Rapporteurs in RAs	On going at future ICT meetings	Secretariat
Articles and updates to WMO Tech. Note 778	Review and update to articles and annexes	Review of annexes to carry on. New printed version of TD 778 not thought to be needed	ET
Format and Range of Products	Summary of range and format of products which are currently being demanded to be catalogued	In time for next ET meeting (2009)	ET
Glossary of terms relating to ATM	Glossary of terms relating to ATM to be compiled for inclusion on ERA web pages.	End October 2007	Perron
Ensemble	Request to be made to "ENSEMBLE" for dedicated space to be made available for use by ET for NN ERA for research purposes. Arrangements to be made in order for ATM Products to be produced and sent to "ENSEMBLE" WMO area in order to research usefulness of ensemble techniques/products.	End of December 2007 End of June 2008	Secretariat ET, Chair (whip)
Backtracking	Conduct Backtracking demonstration/experiment to prove current capability. Report to be prepared on Backtracking Demonstration/experiment	End of October 2007 End of February 2008	All RSMC's, plus invite to DWD and Austrian Weather Service (ZAMG). Chair, Perron, Wortley, Draxler

Chemical Release to the Atmosphere^{1 2}

Area of Requirement	Component Action	Priority / Timing / Milestone	Responsibility
Capacity Building	SG letter to willing provider states regarding what they are prepared to do to support capacity building – request national technical contact point	Not Done but will be considered	Secretariat
	SG letter to all Members to promote PR-to-PR arrangements for capacity building, and basic principles of ERA	Not Done but will be considered	Secretariat
NMHS's to have access to available Mesoscale meteorological models (Aladin, MM5, WRF, GEM LAM, HRM, HIRLAM etc)	WMO secretariat to put relevant point of contact information on web page	Models noted on web page - points of contact will be considered for inclusion.	Chair, Secretariat
Dispersion Model (Air)	Preparation of a document that describes the stratification from basic minimum tools to sophisticated ATMs	End of December 2007	Chair, Wortley to draft

¹ There are a number of areas that could be considered (e.g. chemical releases in the water, biological events, etc) and that have been raised by other international organizations (e.g. UNEP OCHA), but this expert team will give priority to work related to chemical releases in the atmosphere.

² Events might cover all the horizontal scales. Therefore different arrangements might be required. This expert team will focus on local scale chemical emergencies. In the context of this expert team, local scales cover the range up to hundreds of kilometers.

Chemical Release to the Atmosphere (Cont)

Area of Requirement	Component Action	Priority / Timing / Milestone	Responsibility
Develop Operational Capabilities at NMHS's	<p>Preparation of a document describing the proposed operational framework which would contain local response information, including the Melbourne submitted paper, Wortley paper on stratification, and tech 778 doc</p> <p>The following also has to be included in the document:</p> <ul style="list-style-type: none"> - Training and exercising - Preparedness considerations - How to transit from preparedness to an operational outfit? - Quality assurance guidelines, use of test data should be normal procedure within NMHSs to validate the correctness of their approach; Develop guidelines for procedures, standards for outputs, benchmarking, exercises, etc. <p>Reviewing the usage of ERA web pages by NMHS's to guide further developments</p>	<p>First draft End of August 2008 Final version End of December 2008</p> <p>Report for next ET meeting (2009)</p>	<p>Chair, Wortley, Ryan, Perron</p> <p>Secretariat</p>

Chemical Release to the Atmosphere (Cont)

Area of Requirement	Component Actions	Priority / Timing / Milestone	Responsibility
Training (Implementation and Maintenance)	COMET collaboration: - Case studies - Translation of modules ³ - Additional modules Explore web addresses and further discussions with Tim Spangler	Continue to monitor COMET developments.	Secretariat
	Identify On-line training Publish Suitable Internet Links	On going	ET to Chair
	WMO co-sponsored Training Seminars (planning, who is capable of carrying or participating as experts)	Funds not currently available ongoing	Secretariat
	Identify and take advantage of WMO co-sponsored training events of opportunity (few places offered to WMO participants)	Ongoing	Secretariat

³ The availability of training in languages other than English is rather limited. The group is invited to think about practical solutions to alleviate this problem.

Smoke from large fires (wild-land, oil, chemical)⁴

Area of Requirement	Component Actions	Priority / Timing / Milestone	Responsibility
Observational data, monitoring, database ⁵	<p>Explore the role of the Global Fire Monitoring Centre (Freiburg), and other international organizations, GMES (Global Monitoring of Environmental Security), etc, and feedback to ET. e.g. is this real-time, etc</p> <p>Identify relevant remote sensing of large fires and smoke from large fires, in real time to assist in Operations for RSMC's and NMHS's. (NESDIS, etc) To include image based and quantitative.</p>	<p>Not done. Although nice to know it is not considered critical. Some exploration done, current understanding is that they are not real time.</p> <p>Not Done. Further investigation and catalogueing required. End of December 2007</p>	Jean/Servranckx
Interim operational arrangements ⁶	<p>Investigate the role and operational arrangements at Singapore Centre for ASEAN regional smoke and haze prediction.</p> <p>Produce a paper to review current state of the science in particular relating to</p> <ul style="list-style-type: none"> ○ Definition of source term (including satellite measurement techniques), species to consider (e.g. PM2.5) ○ Type of products available 	<p>End of December 2007</p> <p>Next NN ERA ET meeting (2009)</p>	<p>Chair</p> <p>ET members who have the capability</p>

⁴ The group felt that large fire in this context correspond to events that can be detected through space based platform

⁵ Eventually, fire propagation model will become available. In this case, local meteorological monitoring will become extremely important.

⁶ There is a need to understand if this capability is required.... Can the survey help the group have a better grasp on this issue.

Smoke from large fires (wild-land, oil, chemical) (Cont)

Area of Requirement	Component Actions	Priority / Timing / Milestone	Responsibility
Smoke and pollutants transport and dispersion modeling, Ensemble approach	Evaluate tools or standards to facilitate display of different ensemble members	End of December 2007	Perron, Draxler

Sand and Dust Storms

Area of Requirement	Component Action	Priority / Timing / Milestone	Responsibility
Operational arrangements	Determine whether there is a need for Regional/Global arrangements, including international organizations	Awaiting results of WMO/GEO Expert Meeting (Nov. 2007)	Chair, Secretariat
	Explore possibility of co-ordination with the organizers of the expert meeting who are investigating a proposed WMO/GEO sand and dust storm warning system	End of September 2007	Chair
	Develop a web-based information page on the subject	Not done. It would be good to add to the general web page. Links relating to JMA and CMA services could be added.	Chair, Song and Fujita
Modeling	Members to share what they are doing/experience in terms of relevant activities	On going	ET
Specialized Centres	Future consideration, dependant on result of co-ordination with WMO/GEO expert meeting above		Chair, Secretariat

ACTION COMPLETED**In Work Plan September 2005 for the Non-nuclear ERA programme
(June 2007)****General**

Area of Requirement	Component Action	Priority / Timing / Milestone	Responsibility
Promote ERA programme to NMHS via Regional Associations	Role for DPFS Rapporteurs in RAs	Done. On going at future ICT meetings	Secretariat
Dispersion Modeling	Provide an up to date bibliographical list, to be included in chemical accidents framework document	Done	Draxler
Articles and updates to WMO Tech. Note 778	Review and update to articles and annexes	Done, on new web pages.	ET

Chemical Release to the Atmosphere^{7 8}

Area of Requirement	Component Action	Priority / Timing / Milestone	Responsibility
NMHS's to have access to available Mesoscale meteorological models (Aladin, MM5, WRF, GEM LAM, HRM, HIRLAM etc)	WMO secretariat to put relevant point of contact information on web page	Partly done	Chair, Secretariat
Dispersion Model (Air)	Web-based reference (inventory) of modeling tools and services available from provider NMHSs	Done	Chair, Secretariat (with support from ET)

Chemical Release to the Atmosphere (Cont)

Area of Requirement	Component Actions	Priority / Timing / Milestone	Responsibility
Training (Implementation and Maintenance)	Identify and take advantage of WMO co-sponsored training events of opportunity (e.g. few places offered to WMO participants)	2 carried out in 2007 further to be carried out	Secretariat

⁷ There are a number of areas that could be considered (e.g. chemical releases in the water, biological events, etc) and that have been raised by other international organizations (e.g. UNEP OCHA), but this expert team will give priority to work related to chemical releases in the atmosphere.

⁸ Events might cover all the horizontal scales. Therefore different arrangements might be required. This expert team will focus on local scale chemical emergencies. In the context of this expert team, local scales cover the range up to hundreds of kilometres.

Smoke from large fires (wild-land, oil, chemical)

Area of Requirement	Component Actions	Priority / Timing / Milestone	Responsibility
Smoke and pollutants transport and dispersion modeling, Ensemble approach	Explore a hosting site for web-site for real-time ensemble display. Virtual OSOOC (OCHA), member country (?). Members to come back with offers.	mid-2006, explored and discovered not ready for real-time. Action closed.	Chair, Secretariat
	Develop a prototype “poor man’s ensemble” modeling system for smoke dispersion	2007. Action closed to be taken up by more general Ensemble work.	Chair