Informal Workshop on Meteorological Modeling in Support of CTBT Verification Vienna, Austria, 4 – 6 December 2000

Assessment of Needed Next Steps

1. Introduction

An informal workshop on meteorological modeling in support of CTBT verification was held at the kind invitation of the Department of Meteorology of the Agricultural University of Vienna, 4-6 December 2000. The list of participants and the agenda are provided in Appendix A.

Discussions were held on current systems being used and developed in various organizations in North America and Europe. Operational aspects and issues associated with meteorological modeling in the context of CTBT verification, uncertainties and limitations of existing systems and research and development currently being done have been discussed.

Two previous informal workshops dealing either directly with this issue (Montréal Informal Workshop in October 1996) or as part of a radionuclide workshop (Paris Informal Workshop in September 1998) have already taken place. Experts present from National Meteorological Services (Canada, France, Germany), National Data Centres (France, Canada, Israel and the United States), CTBTO IDC, IMS and Evaluation divisions, universities (Hamburg, Vienna) and research centres (LMD in France and EC Joint Research Centre in Italy) came up with the following assessment of needed next steps. It was recognized by the group that the time was an important factor in setting priorities and/or practical ability to carry out implementation, so the list has been set in three general time categories. The long-term category includes ideas that should be considered when planning future/continued research and development activities. In addition to the suggestions, potential point-of-contacts to lead the short or medium term work have been indicated.

2. Short-term considerations (6 months)

2.1 Ad hoc expert group

- The concept of an ad hoc expert group described by the PTS Evaluation section was supported (PIDC was invited to consider participating).

2.2 Modeling

- OMEGA post-processor to provide high resolution data to HYSPLIT - *PIDC is the best candidate to do the work*.

2.3 Transport and dispersion model input data

- Use higher resolution Medium-Range Forecast model feed for the daily HYSPLIT runs - *PIDC is the best candidate to do the work*.
- In more general terms, make the meteorological preprocessors more flexible to allow the ingest of meteorological models input data that follows WMO specifications (Grib code). At the present time, there are no operational backup feed to the IDC - *PIDC is the best candidate to do the work*.

2.4 Fields of Regard

- Revision of certain definitions (i.e. the probability) should be opened as an ECS discussion to gain WGB agreement on use in Manuals, IDC products and web pages.
- Field-Of-Regard (FOR) outputs look patchy and discontinuous. To improve visualization and avoid misinterpretation of the data the following should be considered :
    - In the model, the number of particles released and transported to produce the FOR should be revisited (a large number would avoid patchy-looking outputs) - *PIDC is the best candidate to do the work*.
    - Change from a point source approach to an area source approach for forward or backward simulations - *PIDC is the best candidate to provide the answer*.
    - Consider the use of backward methods for FOR computations - *PIDC is the best candidate to provide the answer*.
- Presentation of contour lines on the FOR visualization indicating source location proportion is not considered to be useful. It is suggested that only one overall envelope contour is used, set at a very small number or the 5% - *PIDC is the best candidate to do the work*.
- Consider taking into account the altitude of arrival of the air masses at the receptor in the calculation of FORs - *PIDC likely candidate*.

2.5 Local meteorological conditions at IMS sites

- For purposes of operating the radionuclide stations properly and for results interpretation purposes, the IDC will need a better understanding of how local meteorological conditions are impacting measurements at each site - *IDC to carry out*.

3. Medium term considerations (6-12 months)

3.1 Documentation

- A comprehensive documentation of softwares needs to be available – *PIDC to deliver*.

3.2 Model intercomparisons

- Modeling intercomparisons would help in understanding the use of available tools, capabilities of the tools, and confidence in the results. One suggested study for long-range transport and dispersion is using carbon monoxide (CO) from large forest fires as an air mass tracer - *IDC in cooperation with WGB S&T Task Leader (for further thoughts and consideration).*

3.3 Global network coverage

- A better understanding is needed of how to present radionuclide network coverage to the State Signatories. This will involve development of definitions and concepts of how to calculate and visualize coverage. Working group B and PTS should work together to arrive at a concept of global network coverage that takes into account minimum detectable concentrations of the key species Xe-133 and Ba-140 at IMS stations and the related minimum release strengths. This is the radionuclide analogon to seismic threshold monitoring. - *WGB experts in collaboration with the PTS*.

3.4 Source term assumption

- One issue that was discussed was the need to assume a source term if expected concentrations at radionuclide stations were to be estimated - *WGB experts in collaboration with the PTS*.

3.5 Fields of Regard

- Consideration of how to generate FORs for sources above the surface (e.g. atmospheric explosion). At the present time, the release is assumed to be at ground level. - *PIDC likely candidate*.

4. Long-term considerations (beyond one year)

The workshop participants listed a number of research areas relevant to meteorological modeling and source determination in the CTBT verification context. A number of important questions are still to be answered. It was noted that the group was not recommending that these topics be pursued by the IDC. However, exchange of information about ongoing research and its results from the community present at this and previous workshops would be very valuable. More outreach to other segments of the relevant scientific community should also be pursued. Whenever possible, experiments and model intercomparisons of opportunity should be done. A committee (chaired by Michel Jean from the Canadian Meteorological Centre) to encourage and organize cases for intercomparisons could be formed.

4.1 WMO-CTBTO collaboration

- WMO-CTBTO collaboration for specific events
  - Consideration of a web-based system to be used for comparison and uncertainty assessment of atmospheric transport and dispersion model (for example, in the context of WMO RSMC - CTBTO cooperation).

4.2 Uncertainties

- Assessment of uncertainties
  - Long-term R&D required
  - Consideration of ensemble approaches (web-based system for statistical use of different modelling results)
- What criteria should be used to provide a meaningful measure of this?
- Quantification of uncertainties is a major unsolved problem
- Using tracer experiments (planned or unplanned)
  - Validation of transport and dispersion models (ANATEX, CAPTEX, Algeciras, ..)
  - Problem of tuning models to specific tracer experiments; see how all tracer experiments fit into one tuning

4.3 Synergistic use of all of the verification data

- Consideration of further concepts for linking the radionuclide measurements to the waveform data using FORs

4.4 Transport and dispersion models

- Drawbacks/advantages of different model types (Eulerian, Lagrangian)
- Integration/use of precipitation data in dispersion modeling
- Using input such as actual sea surface temperature and meteorological satellite data and applying 4 dimensional variational analysis schemes
- Parameterisation of diffusion, K-_ model
- Get a better knowledge of the influence of local conditions at IMS radionuclide monitoring stations
  - are relevant scales resolved by our models?
  - description of local climatology (e.g. conditions on small islands)
- Boundary layer decoupling
- realistic shape/characterization of source term for underground and atmospheric nuclear test is required

4.5 Inversion/source determination modeling tools

- This is an active area of research and development. More knowledge about tools for/from national agencies is needed

4.6 Exercises - refining IDC operations and tools

- Play with different products for given scenario(s) and through exercises with WMO RSMCs
- S&T group at WG B as forum to discuss a WMO RSMC+ (NDC+...) exercise
- Use not readily available source term (e.g. volcanic ash, carbon monoxyde) for real-time event (or historical cases) such as
  - volcanic eruptions
  - large forest fires
- Chernobyl is still an interesting event that can be used for model validation even though the uncertainties associated with the source term are important
- Xenon data appears to be interesting – very sensitive data – can be extremely useful for meteorological modeling work
- What can be learned from measurements of natural nuclides like ^{7}Be?
- Whenever possible, experiments and model intercomparisons of opportunity should be done; committee (to be led by Michel Jean from the Canadian Meteorological Centre) to select cases and organize intercomparisons.

APPENDIX 1
AGENDA

Monday, 4 December

9.00-10.00 Registration

10.00 Welcome Addresses

Petra SEIBERT (Local Organiser)
Robert ZISCHG (Federal Ministry of Foreign Affairs, Vienna, Austria)
Michel JEAN (Expert Group Leader Meteorology, CTBTO PrepCom WG B)

10.30 Session 1: Introduction I (Chairperson: Petra SEIBERT)

10.30 Michel JEAN (Canadian Meteorological Center, Canada)
The application of atmospheric modeling to the design and the verification of the CTBT - a historical perspective and current areas of work

11.30 Mona DREICER (US Department of State)
How can meteorological modelling support CTBT verification - a policy perspective

12.30: Lunch Break

Session 1: Introduction II (Chairperson: Michel JEAN)

13.45 Petra SEIBERT (Institute of Meteorology and Physics, BOKU, Vienna)
Methods for source determination in the context of the CTBT radionuclide monitoring system

Session 2: Operational Aspects I (Chairperson: Michel JEAN)

14.30 Ananthakrishna SARMA (Center for Atmospheric Physics, SAIC, USA)
Atmospheric transport for CTBT

15.00 Martin B. KALINOWSKI (CTBTO/PTS/IDC, Monitoring Section)
IDC needs for atmospheric transport modelling and first experiences with the IDC release 2.1 application software including HYSPLIT, OMEGA, and EDGE

16.00 Coffe Break

16.30 Gerhard WOTAWA and Martin B. KALINOWSKI (CTBTO/PTS/IDC, Monitoring Section)
Evaluation of the operational CTBTO/IDC ATM products by comparing HYSPLIT backward analysis, forward analysis and OMEGA forward forecast Fields-of-Regard during a number of events at Northern European radionuclide stations

17.00 Craig SLOAN (U.S. National Data Center)
CTBT meteorology at the US NDC

17.30 Steven G. HOFFERT (Autometric, Inc., A Boeing Company, Springfield, VA) and Thomas J. DUNN (Science Applications International Corporation, McLean, VA)
Site planning, monitoring and analysis of hazardous material releases in the atmosphere using the OMEGA modeling system and EDGE visualization environment

18.30 "Heuriger" (with Dinner) at "Zum Alten Gersthofer", Gersthofer Strasse 106 (15 min walk from the meeting place). The warm meal (buffet) will be served around 8 p.m. so those who need to pass by their hotel or home have a chance to to so after the afternoon session.

Tuesday, 5 December

Session 2: Operational Aspects II (Chairperson: Mona DREICER)

9.15 Francois BOMPAY (Meteo-France, SCEM/SERV/ENV, Toulouse)
Operational modelling of atmospheric transport at Meteo-France

9.45 Stefano GALMARINI (Environment Institute, Joint Research Center Ispra, Italy), R. BIANCONI (Enviroware s.r.l., Agrate Brianza, Italy), G. GRAZIANI (Environment Institute, Joint Research Center Ispra, Italy) and W. KLUG (Darmstadt, Germany)
RTMOD: a web based system for long-range atmospheric dispersion model inter-comparison and nuclear emergency preparedness

10.15 Discussion of Operational Aspects

11.00 Coffe Break

Session 3: Research & Development I (Chairperson: Gerhard WOTAWA)

~~Janusz PUDYKIEWICZ (Canadian Meteorological Center)~~
~~*Numerical Solution of forward in time and inverse atmospheric transport problems*~~ (presentation cancelled)

11.30 Abderrahmane IDELKADI, Frederic HOURDIN and Jean-Pierre ISSARTEL (LMD-CNRS, Paris)
Validation of forward and backward transport in LMD-ZT model using ETEX experiment

12.15 Jean-Pierre ISSARTEL (Departement Analyse Surveillance Environnement) and Bertrand CABRIT (X Recherche Service, Le Chesnay, France)
Localization of Sources for Events Detected during the Noble Gas Equipment Test

13.00 Lunch Break

Session 3: Research & Development II (Chairperson: Jean-Pierre ISSARTEL)

14.15 Vyacheslav M. SHERSHAKOV, R.V. BORODIN and P.N. SVIRKUNOV (SPA "Typhoon" Roshydromet, Russia)
Method for estimation of parameters of instantaneous release of radionuclides to the atmosphere based on remote observations

15.00 Philippe HEINRICH and Y. GRILLON (DASE, CEA)
Localization of an atmospheric source by inverse modeling

15.45 Coffee Break

16.15 Petra SEIBERT (Institute of Meteorology and Physics, BOKU, Vienna)
Uncertainties in atmospheric dispersion modelling and source determination

16.45 Discussion on Research & Development

17.30 End of Session

Wednesday, 6 December

Final discussion & formulation of recommendations

Chairperson: Michel JEAN, Rapporteur: Petra SEIBERT

9.00 Introduction by Michel Jean

9.15 Philippe DENIER (CTBTO / PTS / Evaluation Section), L.-E. DE GEER, M.B. KALINOWSKI, H. TOIVONEN and G. WOTAWA
Ad Hoc Expert Group for the Evaluation of Atmospheric Models Used at the PTS for Radionuclide Transport

9.30 Discussion

10.15 Coffee break

10.45 Discussion (continued)

12.00: End of the general part of the workshop

APPENDIX 2
List of participants

Mr. Francois Bompay
SERV/ENV
Meteo-France
42 Avenue Coriolis, F-31057 Toulouse, France
E-mail: francois.bompay@meteo.fr
Tel: +33-5-61078086, Fax: +33-5-61078079
URL: http://www.meteo.fr

Mr. Guy Brachet
Departement Analyse Surveillance Environnement
Commissariat à l'Energie Atomique
, F-91680 Bruyères le Chatel, France
E-mail: gbrachet@dase.bruyeres.cea.fr
Tel: +33-1-69295029, Fax: +33-1-69267023
URL: http://

Mr. Philippe Denier
Evaluation Section
CTBTO
Vienna International Centre, P.O. Box 1200, A-1400 Vienna, Austria
E-mail: Philippe.Denier@ctbto.org
Tel: +43 1 26030-6218, Fax: +43-1-26030-5121
URL: http://www.ctbto.org/

Ms. Mona Dreicer
Verification and Compliance Bureau, Office of Nuclear Affairs
U.S. Department of State
2201 C Street NW, Washington DC 20520, USA
E-mail: dreicemo@acda.gov
Tel: +1 202 647-6405, Fax: +1 202 736-7634
URL: http://

Mr. Stefano Galmarini
Environment Institute
Joint Research Center
TP321, I-21020 Ispra, Italy
E-mail: stefano.galmarini@jrc.it
Tel: +39-0332-785382, Fax: + 39-0332-785466
URL: http://

Mr. Yves Grillon
DASE
Commissariat a l'Energie Atomique
B.P. 12, F-91680 Bruyères le Chatel, France
E-mail: grillon@dase.bruyeres.cea.fr
Tel: +33-1-69265520, Fax: +33-1-692670-23
URL: http://

Mr. Philippe Heinrich
DASE
Commissariat a l'Energie Atomique
B.P. 12, F-91680 Bruyères-le-Chatel, France
E-mail: heinrich@ldg.bruyeres.cea.fr
Tel: +33-1-692659-56, Fax: +33-1-692670-23
URL: http://

Mr. Steven Hoffert
Autometric, Inc.
A Boeing Company, Springfield, VA
7700 Boston Blvd, 22153, USA
E-mail: shoffert@cmr.gov
Tel: +1 103 247-1868, Fax:
URL: http://

Mr. Jean-Pierre Issartel
Departement Analyse Surveillance Environnement
Commissariat a l'Energie Atomique
B.P. 12, F-91680 Bruyères le Chatel, France
E-mail: issartel@dase.bruyeres.cea.fr
Tel: +33-1-69464823, Fax: +33-1-69267023
URL: http://

Mr. Ingo Jacobsen
Deutscher Wetterdienst
Frankfurter Strasse 135, D-63067 Offenbach, Germany
E-mail: ingo.jacobsen@dwd.de
Tel: +49-69-80622754, Fax: +49-69-80623759
URL: http://

Mr. Michel Jean
Environmental emergency response
Canadian Meteorological Centre, Meteorological Service of Canada
2121 TransCanada Highway, North service road, Dorval, Québec, H9P-1J3, Canada
E-mail: Michel.Jean@ec.gc.ca
Tel: +1-514-421-4614, Fax: +1-514-421-4679
URL: http://www.cmc.ec.gc.ca/cmc/CMOE/A-cmoe.html

Mr. Martin B. Kalinowski
Monitoring Section; IDC/PTS
CTBTO
Vienna International Centre, P.O. Box 1200, A-1400 Wien, Austria
E-mail: martin.kalinowski@ctbto.org
Tel: +43-1-26030-6283, Fax: +43-1-26030-5923
URL: http://www.ctbto.org

Ms Helga Kromp-Kolb
Institute of Meteorology and Physics (IMP)
University of Agricultural Sciences
Tuerkenschanzstrasse 18, A-1180 Wien, Austria
E-mail: helga.kromp-kolb@boku.ac.at
Tel: +43-1-4705820-17, Fax: +43-1-4705820-60
URL: http://www.boku.ac.at/imp/

Mr. Paul Saey
IDC
CTBTO
Vienna International Centre, P.O. Box 1200, A-1400 Vienna, Austria
E-mail: Paul.SAEY@OFFICE.CTBTO.ORG
Tel: +43-1-26030-6336, Fax: +43-1-26030-5973
URL: http://www.ctbto.org/

Mr Joachim Schulze
IMS Radionuclide Section
CTBTO
Vienna International Centre, P.O. Box 1200, A-1400 Vienna, Austria
E-mail: Joachim.Schulze@ctbto.org
Tel: +43 1 26030-6110, Fax: +43-1-260308-6110
URL: http://www.ctbto.org/

Mr. Craig Sloan
HQ Air Force Technical Applications Center
Atmospheric Sciences Division
1030 S. Highway A1A, Patrick AFB FL 32925-3002, USA
E-mail: sloan@aftac.gov
Tel: +1-321-494-7781, Fax: +1-321-494-8521
URL: http://

Mr. Gerhard Wotawa
IDC Division, Monitoring Section
CTBTO
Vienna International Centre, P.O. Box 1200, A-1400 Vienna, Austria
E-mail: Gerhard.Wotawa@CTBTO.ORG
Tel: +43-1-26030-6405, Fax: +43-1-26030-5973
URL: http://www.ctbto.org

Mr. Steven Lewis
Applied Physics Division
Soreq NRC
POB 81800, Yavne, Israel
E-mail: steve@ndc.soreq.gov.il
Tel: +972-8-9434534, Fax: +972-8-9434157
URL:

Mr. Ananthakrishna Sarma
Center for Atmospheric Physics
Science Applications International Corporation
1710 SAIC Drive, McLean, Virginia, 22102, USA
E-mail: sarmaa@saic.com
Tel: +1-703-676-7017, Fax: +1-703-676-5509
URL: http://

Ms. Petra Seibert
Institute of Meteorology and Physics (IMP)
University of Agricultural Sciences
Tuerkenschanzstrasse 18, A-1180 Wien, Austria
E-mail: seibert@mail.boku.ac.at
Tel: +43-1-4705820-20, Fax: +43-1-4705820-60
URL: http://www.boku.ac.at/imp/envmet/

Ms. Katja Winger
Chemie der Atmosphaere und Klimadynamik
Max Planck Institute for Meteorology
Bundesstrasse 55, D-20146 Hamburg, Germany
E-mail: winger@dkrz.de
Tel: +49-40-41173-304, Fax: +49-40-41173-298
URL: http://