RTH/RSMC Offenbach (DWD) status report for 2016

Executive Summary

Primary activities in the year 2016 consisted of the quarterly IAEA/RTH/RSMC tests including several CONVEX exercises conducted for different scenarios and accident countries and of the monthly communication tests with the IAEA. In the framework of the CTBTO/WMO commitment, a number of backtracking calculations were performed on request for level-5-events. Incremental updates and improvements were made to the DWD's dispersion model software, and to the response procedures. Also the model code was further adapted to the new global NWP model ICON, which had replaced the old GME model in January 2015. The online-coupled dispersion modelling system ICON-ART substantially extends the dispersion modelling capabilities of DWD. The status of the system, its core applications at DWD and further plans will be presented.

1. Introduction

The RTH Offenbach is one of the 18 major Regional Telecommunication Hubs within the Main Telecommunication Network (MTN) of the Global Telecommunication System (GTS). Offenbach is also one of the currently 15 Global Information System Centres (GISC) of the WMO Information System (WIS). RTH Offenbach is the operational counterpart of the Incident and Emergency Centre (IEC) of the IAEA with respect to the distribution of the notification of an accident and additional information. In the framework of the IAEA Convention on Early Notification and Assistance RTH Offenbach has to make sure that the NHMSs are informed as fast as possible of a nuclear accident. Additionally, in the context of the CTBTO/WMO backtracking arrangements Offenbach is one of the WMO-RSMCs for atmospheric dispersion modelling/backtracking. A new comprehensive online-coupled dispersion model ICON-ART is in operation and its main features are outlined in this report.

2. Operational Contact Information

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3. Standing operational procedures

According to the regional and global arrangements for the provision of transport model products in the case of a nuclear environmental emergency, the RTH Offenbach is in charge of the global dissemination of emergency messages.

In the framework of the Convention on Early Notification of nuclear accidents, the IAEA informs the WMO Secretariat and the RTH Offenbach (Germany) of the status of the emergency. If needed, the IAEA will request support from the WMO RSMCs. Beginning with a site area emergency, RTH Offenbach will disseminate the EMERCON message on the GTS in the form of an alphanumeric bulletin in plain-text English language under the abbreviated heading WNXX01 IAEA for global distribution to the NMCs and RSMCs. The messages are not destined to the general public and should not be accessible on the public internet. (See also the WMO Manual on the Global Telecommunications System, WMO Publication-No. 386).

When the IAEA no longer requires WMO RSMC support, the IAEA will send an EMERCON termination message to the RSMCs, WMO Secretariat and RTH Offenbach. RTH Offenbach will also disseminate the ERMERCON termination message on the GTS under the heading WNXX01 IAEA for global distribution.

Therefore, in case of an accident occurrence and/or whether emergency meteorological support is required. RTH Offenbach will

(a) receive a message from IAEA (email/fax/USIE website),

(b) verify its content by a phone call to the IEC of the IAEA,

(c) put the EMERCON message on the GTS in the form of an alphanumeric bulletin in plain-text English language under the abbreviated heading WNXX01 IAEA for global distribution to the NMCs and RSMCs,

(d) check that the Lead-RSMCs have received the same information (email/fax),

(e) forward the email (fax) with the notification or additional information to the Lead-RSMCs if they did not get it directly from the IAEA.

4. Programme of exercises - Regular tests

The communication between IAEA and RTH Offenbach is tested every month. According to the actual valid procedures the tests are performed each third Tuesday a month except from one unannounced test per year. Once every quarter RSMCs and the delivery (but not the distribution) of products are included. The GTS link can be tested at every quarterly exercise. Additionally, GTS messages are distributed in the framework of full scale tests like ConvEx-3 exercises.

5. Evaluation of exercises

In 2016 communication test between IAEA and RTH Offenbach were conducted on a regular basis on each third Tuesday of a month.

In this period the standard exercises (and also several CONVEX tests via USIE web site) were performed, using the email (fax) and phone contacts between IAEA and RTH Offenbach. Since 2014 monthly tests consist of email communication and USIE web site information on default.

Additionally, every third month a quarterly exercise was conducted to test the communication procedures and contacts between IAEA, RSMCs and RTH Offenbach. In these exercises accident scenarios in different WMO regions were chosen and only the corresponding Lead RSMCs had to respond according to the distributed messages. The GTS link was utilized during these exercises.

The monthly and quarterly communication exercises were performed without any deviations or only minor ones (see list below) from the agreed procedures.

Some deviations are listed here:

- missing email/fax messages
- incorrect subject information
  (e.g. “communication test” instead of “quarterly exercise”)
- missing exercise termination message

6. Lessons learned from experience

The regular monthly communication exercises are helpful to keep the procedure in mind and to test the handling of the information. But they are very simple and no significant problems are expected to show up except perhaps short disruption of the web system or similar technical problems.

It is therefore not surprising that the major problems or deviations from the agreed procedures only happened during the quarterly tests because they were the only tests with several steps in predefined accident scenarios which also include the distribution of GTS messages.

Following a proposal of WMO experts the text of the IAEA message will be strictly adapted to the IAT2 rules in future.

The WNXX01 IAEA emergency messages are meant to inform the WMO, NHMSs and RSMCs. They are not destined for the general public. Therefore the dissemination conditions were modified that the messages are not accessible on the public internet.

Regarding the distribution of alarm messages the confirmation checks done by RTH Offenbach are very useful and necessary activities. They are important backup features in the emergency response communication context.

7. RTH Offenbach Backup Procedures

The German Weather Service (DWD) plans to establish backup procedures for institutions connected to RTH Offenbach. The standard backup procedure would be that all IAEA data sent to RTH Offenbach for further dissemination are sent in parallel (active backup) to a Backup RTH. It is intended to choose RTH Vienna for the Backup RTH. They will then take over the data dissemination in case of an outage of RTH Offenbach.

In 2016 this was discussed with Austria who confirmed to in principle be able to take over this responsibility. However it was stated that Austria would need a direct RMDCN-connection with Toulouse first. Work on backup procedures is to be continued in 2017.

8. Participation in the WMO/CTBTO inverse dispersion modeling calculations

WMO and the Provisional Technical Secretariat (PTS) of the Comprehensive Test Ban Treaty Organization (CTBTO) cooperate according to adopted arrangements for the provision of inverse dispersion modeling by the WMO designated Centres to CTBTO. At present 10 WMO Centres (RSMCs) are active participants in these backtracking calculations. The 10 WMO Centres are asked to provide if requested inverse dispersion modeling as far back as 7 weeks and for up to 36 stations and to upload (to the CTBTO web-site) their results within 24 to 96 hours of receiving the request. RSMC Offenbach was successful in meeting these requirements. CTBTO then combines the results in various ways to generate ensemble products.

Beginning with September 2008, which was the official start of the operational phase of the CTBTO/WMO system, until autumn 2015, more than 150 backtracking calculations were performed from RSMC Offenbach on request for level-5-events. In the context of the Fukushima radioactive releases about 90 backtracking request were received since March 2011 (2014: 14 requests, 2015: 6, 2016: 2). Additionally, in 2014 upload procedures were modified and tested for the new operational upload server addresses. Since March 2015 the calculations are based on the ICON model. In the context of a National Data Centre Preparedness Exercise (NPE15) supporting backtracking calculations were also performed in 2015.

9. Status of the DWD’s operational atmospheric transport and dispersion model (WMO/CTBTO)

As a part of the German radioactive emergency systems IMIS/RODOS a Lagrangian Particle Dispersion Model (LPDM) is applied at the DWD. The LPDM calculates trajectories of a multitude of particles emitted from a point source using the grid-scale winds and turbulence parameters of the NWP-models and a time scale based Markov-chain formulation for the dispersion process. Concentrations are determined by counting the number and mass of particles in a freely eligible grid. Dry deposition parameterisation follows a deposition velocity concept and wet deposition is evaluated using isotope-specific scavenging coefficients. Also included is radioactive decay, a vertical mixing scheme for deep convection processes and optionally particle-size depending sedimentation coefficients. The LPDM was successfully validated using data of the ANATEX and ETEX tracer experiments.

The dispersion model is driven by the DWD's weather forecast models (ICON, ICON-EU, COSMO-DE). In case of emergency the model output will be transmitted to the national 'Integrated Measurement and Information System' (IMIS) for the surveillance of radioactivity in the environment and the real-time decision system RODOS in Germany.

The model is also a member of the multi-model backtracking ensemble of the CTBTO (Comprehensive Nuclear-Test-Ban Treaty Organization). The code was optimised for MPP computers (e.g. CRAY-XC 40, NEC-SX8/SX9, IBM P5 575) utilising MPI-based parallelisation features. The model is also implemented at MeteoSwiss based on the Swiss COSMO-version.

The NWP modelling suite of DWD consists of two models, namely the global **ico**sahedral-hexagonal **n**on-hydrostatic grid point model **ICON (**13 km, 90 layers), which replaced the GME in January 2015, including the two-way nested region **ICON-EU** (grid spacing 6.5 km, 1377 x 657 grid points, 60 layers), and the convection permitting **COSMO-DE**, covering Germany and its surroundings with a grid spacing of 2.8 km, 421 x 461 grid points and 50 layers.

Independent 4-dimensional data assimilation suites are performed for both NWP models, ICON and COSMO-DE. For ICON, analyses are derived for the eight analysis times 00, 03, 06, 09, 12, 15, 18 and 21 UTC based on an ensemble data assimilation using Kalman-filter techniques combined with a three-dimensional variational data assimilation scheme. For COSMO-DE, a continuous data assimilation system based on the nudging approach provides analyses at hourly intervals. Analyses and forecasts are currently run on a CRAY-XC40.

During the release phase of the Fukushima accident (March/April 2011) the DWD provided dispersion forecasts for the public mainly based on GME data. Additionally, the COSMO model (7 km grid spacing) was set up and run in an operational mode for the relevant region covering Japan and its surroundings.

In the last two years incremental updates and improvements were made to the DWD’s dispersion model software, and to the response procedures (e.g. for GRIB2, preparations for the new DWD global model “ICON”).

10. Status of the DWD atmospheric transport and dispersion model ICON-ART

The **ICON-ART** system (Rieger et al. 2015), where ART stands for ‘Aerosols and Reactive Trace gases’, is an extension of the operational global non-hydrostatic ICON model (Zängl et al. 2015). The ART modules developed at the Institute for Meteorology and Climate Research at the Karlsruhe Institute of Technology (KIT) are online-coupled in a tightly integrated way to the ICON model. I.e. the same routines for transport and diffusion of the gas phase and aerosol tracers are used as for the prognostic moisture quantities in NWP. The possible applications of ICON-ART range from simple tracer dispersion problems to complete aerosol-radiation and aerosol-cloud interaction studies and will soon also include the formation of secondary aerosol particles from the gas phase. ICON-ART inherits further flexibility from ICON – namely the option for multiple 2-way nesting or to use the model in a limited area mode.

The core applications at DWD are the dispersion modelling of radionuclides, volcanic ash, mineral dust and chemical hazards from point sources.

Apart from the operation of the LPDM described in the previous section ICON-ART also has the capability to make forward calculations of the dispersion of radionuclides. It uses the same input files to specify the emission scenario and the same set of radionuclides is treated. As it is an Eulerian online-coupled model the scale and sub-scale transport processes as well as the deposition processes are treated with the same time step as the one applied for pure NWP – opposed to the e.g. 1-hourly updated meteorological data used to drive an offline-coupled model. This most likely leads to a better representation of the overall 3D structure of a radioactive cloud and therefore is of special importance for aviation. A study of the Fukushima incident using ICON-ART was shown in summer 2016 during a meeting of the ICAO METP WG-MISD workstream “Release of Radioactive Material” in Montreal.

In case of a volcanic eruption with relevance for the German air space ICON-ART is run in the global configuration for NWP, i.e. on a grid with a horizontal mesh size of approximately 13 km. The model results are visualized and can be put on an emergency website; they will also be made available on the NinJo workstations which is the central platform used by the aviation forecasters. The volcanic ash forecasts are a secondary source of information besides the one distributed by the VACCs. ICON-ART uses a modal 2-moment approach, as it forecasts the mass and number concentrations of three log-normal distributed modes. To get the shape parameters of the distributions they are fitted against aircraft measurements of the particle size distribution (Schumann et al. 2011). The emission of volcanic ash is parameterized following an empirical relation between the observed plume height and the mass eruption rate (Mastin et al. 2009). At KIT a LIDAR forward operator was developed which gives the attenuated backscatter due to the prognosed concentrations of volcanic ash. This operator will ease the comparison of model results and observations of the ceilometer network of DWD and is a prerequisite for the data assimilation of such measurements.

In March 2016 a project dealing with the loss of photovoltaic power gain due to Saharan dust has started. The project is collaboration between KIT, meteocontrol GmbH – a service provider for photovoltaic power forecasts – and DWD. The strong Saharan dust event beginning of April 2014 was investigated in a joint effort of DWD and KIT. Runs including the aerosol-radiation interaction and aerosol-cloud interaction in combination with a 2-moment cloud-microphysics scheme of the simulated dust showed a significant reduction of the short-wave radiation at the surface. This for example had a big impact on the power produced by solar energy.

The ART modules have been structured in a way to streamline further expansions and developments using the object oriented capabilities of FORTRAN 2003 and XML configuration files to specify the additional tracers which are specific for the different applications together with their accompanying meta data and the processes to be treated. This concept is also used set up the dispersion model for application in the non-nuclear section, e.g. chemical hazards and industrial fires, where tracers from a list of either gaseous or liquid chemical components can be chosen. In addition the information about the source(s) and the emission scenario(s) is also given via an XML file.

The (internally mixed) aerosol modes for the interaction with the gas phase chemistry will be implemented. For a flexible configuration of the gas phase chemistry the Kinetic Pre-processor KPP is used. The modules for pollen forecast and vegetation fires will be adapted from versions which were developed in combination with the COSMO model.

11. Plans for 2017

- The schedule of tests (monthly, quarterly and others) has been set up and defined in cooperation with the IAEA.
- Continuation of the participation on WMO/CTBTO backward ensemble calculations.
- Intended application to become a RSMC for Volcanic Contaminants, Nuclear Environmental Emergency Response and Non-Nuclear Environmental Emergency Response based on ICON-ART and the LPDM.

References:

Glaab, H., Fay, B., and Jacobsen, I. (1998): Evaluation of the emergency dispersion model at the Deutscher Wetterdienst using ETEX data, Atmos. Environ., 32, 4359–4366, doi:10.1016/S1352-2310(98)00173-3.

Glaab, H., Fay., B., Jacobsen, I., and Klein, A. (2006), Emergency Dispersion Models at the Deutscher Wetterdienst - Model Evaluation using Ensemble Techniques - Proc. of the 9th ANS Emergency Preparedness and Response Meeting, pp. 181-187, Salt Lake City, 2006.

Mastin, L. G., Guffanti, M., Servranckx, R., Webley, P., Barsotti, S., Dean, K., Durant, A., Ewert, J. W., Neri, A., Rose, W. I., Schneider, D., Siebert, L., Stunder, B., Swanson, G., Tupper, A., Volentik, A., and Waythomas, C. F. (2009): A multidisciplinary effort to assign realistic source parameters to models of volcanic ash-cloud transport and dispersion during eruptions, J. Volcanol. Geoth. Res., 186, 10–21.

Rieger, D., Bangert, M., Bischoff-Gauss, I., Förstner, J., Lundgren, K., Reinert, D., Schröter, J., Vogel, H., Zängl, G., Ruhnke, R., and Vogel, B. (2015): ICON–ART 1.0 – a new online-coupled model system from the global to regional scale, Geosci. Model Dev., 8, 1659–1676, doi:10.5194/gmd-8-1659-2015.

Schumann, U., Weinzierl, B., Reitebuch, O., Schlager, H., Minikin, A., Forster, C., Baumann, R., Sailer, T., Graf, K., Mannstein, H., Voigt, C., Rahm, S., Simmet, R., Scheibe, M., Lichtenstern, M., Stock, P., Rüba, H., Schäuble, D., Tafferner, A., Rautenhaus, M., Gerz, T., Ziereis, H., Krautstrunk, M., Mallaun, C., Gayet, J.-F., Lieke, K., Kandler, K., Ebert, M., Weinbruch, S., Stohl, A., Gasteiger, J., Groß, S., Freudenthaler, V., Wiegner, M., Ansmann, A., Tesche, M., Olafsson, H., and Sturm, K. (2011): Airborne observations of the Eyjafjalla volcano ash cloud over Europe during air space closure in April and May 2010, Atmos. Chem. Phys., 11, 2245–2279, doi:10.5194/acp-11-2245-2011.

Zängl, G., Reinert, D., Rípodas, P., and Baldauf, M. (2015): The ICON (ICOsahedral Non-hydrostatic) modelling framework of DWD and MPI-M: Description of the non-hydrostatic dynamical core, Q. J. Roy. Meteor. Soc., 141, 563–579, doi:10.1002/qj.2378.