EMS Annual Meeting Abstracts,
Vol. 6, EMS2009-333, 2009
9th EMS / 9th ECAM


9th EMS Annual Meeting
9th European Conference on Applications of Meteorology
High resolution meteorology
- applications and services

# MOCAGE-accident: From research to operational applications

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MOCAGE (Modèle de Chimie Atmosphérique à Grande Echelle) is the multi-scale 3D Chemistry and Transport Model of Météo-France. From air quality forecasting to the study of interactions between climate and chemistry, MOCAGE is a flexible tool that is currently used for both research on atmospheric composition (over 35 publications in the international literature) and operations in Météo-France and at several collaborating institutes. In particular, MOCAGE products are used for the French operational Air Quality platform Prév'Air as well as in projects building up the GMES Atmospheric Service. Here, we present a new specific configuration "MOCAGE-accident", currently used in pre-operations trial by Météo-France forecasters, in support of our international responsibilities as RSMC (Regional Meteorological Specialized Centre) and VAAC (Volcanic Ash Advisory Centre).
Briefly, a semi-lagrangian scheme is used for advection (Williamson and Rash, 1989), while turbulent diffusion, using the Louis scheme (Louis, 1979) and convection, using the Bechtold scheme (Kain and Fritsch, 1990 and Bechtold, 2001) are parameterized. In the specific "accident" configuration, no chemical reactions are considered and a module allows to specify the temporal and geometrical characteristics of the release. Three types of pollutants can be considered :
- tracers: no interactions between this tracer and the other atmospheric components are considered ; only transport, wet and dry deposition are taken into account.
- radionucleides: in this case, radioactive disintegration is treated following the type of radionuclide and its lifetime.
- volcanic ashes: solid materials are considered and sedimentation of the particles is also considered.
Concerning the current pre-operations trial, the horizontal resolution of MOCAGE-accident is 0,5° all over the globe, with 47 levels from surface to 5 hPa. This model is thus able to represent accidental emissions on every place of the world, in troposphere and lower stratosphere. Dispersion and deposition forecasts strongly depend on the meteorological forecast fields used as an input. Within MOCAGE-accident, the choice of the NWP trajectory is left to the forecaster, who has several options for global forecasts depending upon his appreciation of the best NWP model in the area and in the period concerned with the accidental or volcanic release.
An interesting additional capability of MOCAGE-accident is to calculate backwards 3D simulations, using its adjoint. This backtracking mode is used in Near-Real-Time to infer location and release period of possible nuclear explosions, in the context of a collaborative network of international centres jointly set up by the secretariats of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) and the World Meteorological Organization (WMO). An example from a recent exercise will be illustrated.
Last, on-going research activities targeted at improving performance and assessing uncertainties will be shown. We will focus on the use of two types of ensemble approaches that have been tested:
- using a range of different dispersion models, relying on the same meteorological forecasts or not. This is done in the context of the ENSEMBLE project.
- using only MOCAGE-accident, but driven by meteorological fields from the members of Ensemble Predictions Systems.