MOCAGE-accident: From research to operational applications

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Introduction

MOCAGE (Modèle de Chimie Atmosphérique à Grande Echelle) is the multi-scale 3D Chemistry-Transport Model of Météo-France. From air quality forecasts to climatic simulations, MOCAGE is a performing tool for many applications. A specific version will become operational soon for emergency response in support of Météo-France responsibilities of RSMC (Regional Meteorological Specialized Center) and VAAC (Volcanic Ash Advisory Center).

Operational Applications

Fig 1: Example of MOCAGE Accident results during a simulate radioactive problem in a nuclear reactor (September 10th 2009).

Parametrisations:

- semi-Lagrangian scheme for advection (Williamson and Rash, 1989),
- turbulent diffusion, (Louis, 1979),
- convection (Kain and Fritsch, 1990 and Bechtold, 2001).

Types of pollutants are considered:

- chemical pollutants. No interactions between this local source and the other components of the atmosphere are considered.
- nuclear emissions. Radioactive disintegration is treated following the type of radionuclide
- volcanic eruptions. Solid materials are considered and sedimentation of these particles is added.

Resolution:

- horizontal resolution: 0,5° all over the globe,
- vertical resolution: 47 levels from surface to 5 hPa.

Meteorological fields:

The choice of the best NWP model is made by Météo-France forecasters: ARPEGE (Météo France model) or IFS (ECMWF model).

Ensemble approaches

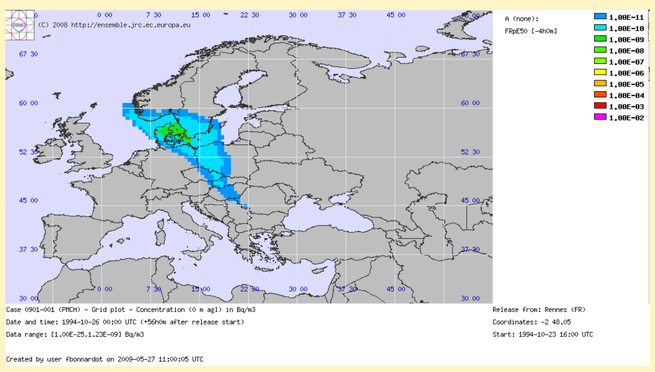

Fig 2: Example of MOCAGE results using EPS fields (median of the 51 runs).

Applications are tested using ensemble predictions. These applications are useful to exclude meteorological bias or transport bias of the models. For instance, during ETEX case, the agreement in threshold level is:

- 58% using the deterministic NWP model,
- 65% using meteorological fields from ensemble weather predictions,
- 71% using various Chemistry-Transport Model (ENSEMBLE project).

Backward simulations

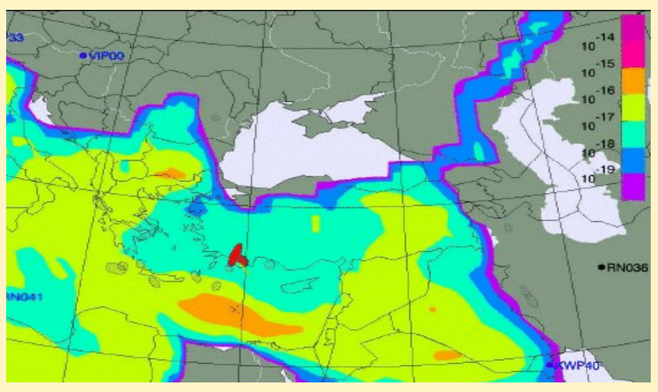

Fig 3: Example of 3D source retrieval using 9 Chemistry-Transport Models (MOCAGE is one of them).

By applying a technique called atmospheric transport modelling, the three-dimensional travel path of a radionuclide particle is backtracked from where it was detected by a monitoring station to the area where it may have originated. This technique is possible thanks to the capability of Chemistry-Transport Model such as MOCAGE to simulate backward transport of pollutants.

Conclusion

MOCAGE Accident is a performing tool to represent accidental emissions. It could be used in operational applications to respond to Météo-France responsibilities of RSMC and VAAC. This model is able to represent accidental emissions on every place of the world (nuclear explosion may happen everywhere), in troposphere and stratosphere (which is important especially during volcanic eruptions). Moreover, this model is participating to research projects in order to validate and improve the representation of pollutant dispersion.

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