An Operational Meteorological Forecast System at Mesoscale for Radiological and Chemical Impact Assessment

Pascal Achim 1, Harry Dupont 2, Alexandre Leroy 2 and Patrick Armand 1

1 CEA, DAM, DIF, F-91297 Arpajon, France
2 ALTEM, F-38100 Boulougne-Bilancourt, France

I. Context and Objectives

In most cases, studies of radiological or chemical impact are carried out using average or simplified local weather conditions. This methodology is well appropriate to assess the health impact within a regulatory framework but may be inadequate in case of crisis such as real accidental atmospheric releases. In such situations, the objective is to determine accurately and as quickly as possible a potential danger zone. Taking into account too simplified weather conditions can lead to an underestimation of the consequences. In this context, the operational meteorological forecast system MEDICIS (French acronym for “meteorology at mesoscale dedicated to human health impact assessment”) has been developed to provide realistic meteorological input conditions to radiological and chemical impact assessment models developed by the CEA (French Atomic Energy Commission).

II. Modelling System

• The forecast system MEDICIS is designed to provide automatically forecasts at high resolution over the French territory (Fig. 1).
• The current version of the forecast system includes the mesoscale model MMS [2].
• Calculated wind fields are automatically post-processed. Local data are extracted at the location of specified points (ex: CEA centres) and 3D wind fields are converted as input data for dispersion and impact assessment models.
• Relevant processed data are made available for consultation at any moment to users through an interactive and ergonomic html bulletin (Fig. 3; maps, wind, temperature, rainfall fields, etc.), curves (local evolutions of wind direction and speed, etc.) and wind roses over calculated period.

III. Coupling with dispersion and impact assessment models

• 3D meteorological fields provided by the MEDICIS platform are post-processed and used as input data for dispersion models at mesoscale and urban scale wind fields models and atmospheric dispersion such as MICROSWIFT-SPRAY [3] and SIRANERISK [1] (Fig. 4).
• Local forecast data extracted from 3D fields are input data for dispersion models such as the MITHRA puff gaussian model included in the CERES platform developed by the CEA and devoted to the radiological and chemical impact assessment [4].

IV. Validation of the modelling system

Quality of simulations is assessed according to two ways:

1) By comparing past simulations and observations at the location of 68 selected METAR stations: a score=100% is obtained if the simulated wind-rose represents the observed wind-rose. Score = 0% if there is no common class [5]. These criteria are cumulative and are updated at each new MEDICIS run. For a running period of one month, averaged criteria ranging from 70% (analysis) to 80% (post-run) to 66% (4 days forecasts) results. These results are quite satisfactory, showing that we can be confident in the forecasts produced by MEDICIS (fig. 5).

2) By calculating, a Bravais-Pearson correlation coefficient between the last forecast produced by MEDICIS and the previous one. Such a coefficient allows to estimate the quality of current forecast, for which no observation is yet available.

V. Future work

• Lowest validation scores are obtained in coastal or mountainous regions. It may result from the resolution of the finer grid (9 km) or from chosen physical parameterizations that may not be optimal in these regions. Tests are underway using spatial resolutions of 45 km, 15 km and 5 km (45 km is in better agreement with the resolution of 0.5° GFS input data). Preliminary tests seem to show an improvement of scores.

• Depending on computing time, an additional grid at a finer resolution (~1.5km) could result from the resolution of the finer grid (9 km) or from chosen physical parameterizations that may not be optimal in these regions. Tests are underway using spatial resolutions of 45 km, 15 km and 5 km (45 km is in better agreement with the resolution of 0.5° GFS input data). Preliminary tests seem to show an improvement of scores.

• As MMS is no more supported, tests will be conducted with the WRF mesoscale model in the possible purpose to integrate it into the modelling chain.

References: