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Title – EMERGENCIES, a forward-looking very high-resolution modelling and decision support to handle a contingent hazardous material release

Authors – Patrick ARMAND* and Christophe DUCHENNE*

***France Atomic and alternative Energies Commission**

Text

Accidental or intentional atmospheric releases of hazardous materials (would it be Chemical, Biological, Radiological or Nuclear) possibly generated by an Explosion are nowadays highly topical and a major concern of the national authorities and civilian security services. While these threats are fortunately quite seldom, they cannot be ignored as the societal impact of such events would be enormous. France Atomic and alternative Energies Commission (CEA) is involved in R&D programmes whose final goal is preparedness, response and recovery in a CBRN-E emergency. A special emphasis is made on industrial sites and urban areas that are the most likely places (compared to obstacle-free spaces) where a variety of potentially deleterious releases could happen and endanger human life. Moreover, these environments are complex and deserve adapted 4D multi-scale flow and AT&D (Atmospheric Transport & Dispersion) models. EMERGENCIES project was launched by the CEA in 2014 as a capacity demonstrator of a high resolution modelling system able to encompass huge built-up (urban) domains. Technically, it is based on the chaining of a meso-scale weather forecasting model and a modelling system explicitly accounting for the buildings at the local scale. This system combines a flow model (optionally mass-consistent diagnostic or momentum solving model) and a Lagrangian Particle Dispersion Model. Furthermore, it is coupled with a multi-zone and a CFD model dedicated to the flow and dispersion computations inside the buildings. Thus, EMERGENCIES allows evaluating the dispersion of noxious materials close to and far from the source of the release whether it is located in a building or in the built-up environment. All models engaged in EMERGENCIES received prior validation on a large experimental basis. The demonstrator was first applied to the "Great Paris" area (around 40 km x 40 km) with a horizontal resolution of 3 m. This area includes Paris city, the urbanized vicinity of the French capital and two major airports. The computations were performed on a CEA massive cluster by splitting the giant domain in more than 1,000 sub-domains computed in parallel and using up to 30,000 computational cores. Multiple fictitious releases were taken as examples near or inside public buildings (administration, museum and train station) meshed internally and externally in 3D to cope with indoor/outdoor transfers. Meso-scale meteorological fields were predicted and downscaled to the whole urban domain (in around 2 hours for the next day forecast) and dispersion computations were carried out with a time acceleration of five. Even if EMERGENCIES is prospective, its performances prove the ability of the system to support decision-making in an emergency by delivering a valuable service to the rescue teams and their authorities. In the paper, we will provide more detail about the modelling system, the computations carried out over Paris, and how it was recently transposed to major cities of the French Mediterranean coast, once more using High Performance Computing at CEA.