

Integrated outdoor-indoor Dispersion Modelling of Hazardous releases in the Urban Environment

The potential effects resulting from accidental or intentional releases of hazardous materials in urban environments and how to respond to them pose substantial practical and scientific challenges. The importance of these has been recognised by the setting up of COST Action ES1006 'Evaluation, improvement and guidance for the use of local-scale emergency prediction and response tools for airborne hazards in built environments'. One of the primary drivers for the action is that there are a large number of different types of release that could potentially occur in the built environment, and there is a need to be able answer a wide range of questions, depending upon the nature of the incident. These questions might include identification of evacuation routes and a need to advise people whether to evacuate or shelter within buildings, for example. At present answering the second question is difficult as it requires a combined outdoor –indoor prediction that accounts for the infiltration and exfiltration of material from buildings. There is also the potential need to be able to predict the external impact of releases made inside buildings.

Whilst a large number of outdoor and indoor dispersion models of varying complexity exist, the capability has not existed so far to provide rapid hazard predictions in complex scenarios in which outdoor-to-indoor or indoor-to-outdoor dispersion effects are important. This gap is being addressed by the creation of an Urban Sub-System (USS) within the US Defense Threat Reduction Agency (DTRA) Hazard Prediction and Assessment Capability (HPAC). The approach adopted enables coupled outdoor-indoor simulations to be performed by selecting models for inclusion in the modelling chain in a plug-and-play manner that enables the user to select the most appropriate models based on their requirements for timeliness, accuracy or the information they have available.

Whilst access to a range of models is one component of the USS, the availability of a database containing urban building information for the area of interest is an important prerequisite for sophisticated urban dispersion modelling. Within the USS as well as providing the basic characteristics of the urban environment, the urban database also provides the means for introducing indoor building models into the simulation. This is either through the database holding the actual data required for indoor models, or data for pointing the simulation to the required data. Furthermore, the USS may call an urban windfield solver to evaluate the external pressures around buildings to define the boundary conditions for the indoor models.

The prototype USS potentially provides an important step forward in developing tools for emergency guidance and response, through enabling outdoor and indoor models to be coupled together. In addition, it provides a valuable tool for identifying the relative benefits of different models, modelling issues that need to be addressed and a provides a useful basis for determining how the a broader range of questions that first responders might ask can best be answered.

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