TODAY'S INNOVATION, TOMORROW'S WARFIGHTER CAPABILITIES

A Modeling & Simulation Framework for Comprehensive CBDP Decision Support

A Unified Modeling Approach in CBRN Detection Systems Deployments and System Analysis

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There are a variety of CBRN analysis applications that require the use of a comprehensive specification of the weather conditions combined with an analysis that uses detailed modeling and simulation. The combination of these two elements can make it difficult to achieve the desired level of fidelity in a logistically feasible way. Furthermore, many applications involve several phenomenological processes making it necessary to couple models into a unified analysis methodology that can resolve the interactions between the phenomena. An example of this type of complex application is the optimal placement of surface-based sensors/samplers, within an urban environment, to optimally detect and characterize emissions emanating from a building of interest. The impact of the building on the material transport from the indoors in conjunction with the non-intuitive dispersion patterns associated with the wind flow around the buildings and through the urban canyons make site selection difficult. Therefore, this presentation demonstrates a methodology for optimally locating air quality monitoring equipment within this complex environment using a comprehensive set of environmental conditions and a coupled framework of material transport models. The methodology involves a) the utilization of a long climatological record of meteorological observations or gridded reanalysis products to better represent the full range of representative meteorological conditions; b) reduction of the full climatological record into a subset of characteristic meteorological patterns and associated frequencies of occurrence, utilizing a multi-dimensional feature extraction and classification technique known as a Self Organizing Map (SOM); c) downscaling and diagnosis of the urban area building-aware wind flow fields for each characteristic meteorological pattern; d) calculating the impact of the weather conditions on the building and the corresponding impact on the interior contaminant transport and exfiltration to the outdoors; e) atmospheric transport and dispersion (AT&D) simulations for each downscaled meteorological pattern, utilizing a building aware Lagrangian particle dispersion model; and finally f) the combination of predicted downwind concentrations/dosages for each meteorological pattern with their associated frequency of occurrence are used to generate Probability of Detection/Exceedence spatial maps for prescribed concentration thresholds or standards. The method is flexible and can be tuned to allow the detailed characterization of Probability of Detection (POD) for a given sampler detection threshold and sampling period (e.g. sampling duration, season, time of day). An example of this methodology will be presented for a single facility in an urban location surrounded by numerous multi-story buildings.