NEXT GENERATION CB HAZARD PREDICTION AND CONSEQUENCE ASSESSMENT WITH MULTI-ECHELON DECISION SUPPORT APPLICATIONS

Transport And Dispersion Forecasting For Semi-enclosed Venues: A Case Study At Stade De France Using JOULES-NWP

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Accurate, dependable, and scale-appropriate weather forecasts are imperative for the meticulous planning and preparation required for large-scale public events that gather dense crowds in semi-enclosed spaces, particularly in terms of disaster and threat readiness. For airborne hazard threat assessment, these forecasts should include the ability to characterize and quantify venue ventilation driven by atmospheric transport and dispersion (AT&D). At small spatial and temporal scales, AT&D is highly sensitive to the presence of obstacles, such as the structure of a specific venue and the nearby heterogenous urban landscape.

The Joint Outdoor-indoor Urban Large Eddy Simulation (JOULES) has recently evolved to ingest meso- and synoptic-scale forecasts from numerical weather prediction products and downscale atmospheric turbulence and tendencies to resolutions as small as 1m. To demonstrate the use of JOULES as a tool in event preparation, we will present a case-study in which JOULES was driven by Global Forecast System (GFS) 0.25-degree weather forecasts to simulate high-resolution wind fields in a 2.5 km2 area surrounding the Stade de France (SdF) in Paris. This site was chosen because it is the central venue of the 2024 Summer Olympics. The ventilation and subsequent downwind transport and dispersion of a dynamically passive and chemically inert atmospheric tracer was simulated throughout a reconstruction of the SdF architecture and of the neighboring buildings. Results from this study highlight the complex interactions between stadium interior and exterior architecture with the local weather. For example, small changes in prevailing wind direction induce heterogenous trapping of atmospheric gasses inside the stadium via interactions with small windows and openings in the stadium structure. We quantify several metrics intended for airborne hazard emergency planning, such as stadium ventilation time, time-integrated exposure, and concentration of hazards at several interior and exterior locations, and we outline how these metrics are influenced by changes in the weather. Lastly, we detail the logistics of this JOULES simulation in terms of planning and preparation relevance. The graphics processing unit (GPU) resident architecture of JOULES allows these simulations to be run on operationally relevant timescales. Furthermore, the long-range forecasting of the GFS empowers users to begin cycling JOULES AT&D forecasts up to 16 days ahead of a scheduled event schedule.

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