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USING DIRECT NUMERICAL SIMULATIONS TO DEVELOP AND VALIDATE A SIMPLIFIED STREET NETWORK DISPERSION MODEL

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Short-range dispersion of localized releases in urban areas is difficult to model accurately. The most reliable numerical tools are Large Eddy Simulations (LES) and Direct Numerical Simulations (DNS), which typically require large amounts of computing time even for the simplest building configurations. At the same time, there is a need for simplified models that capture the most important dispersion processes and are able to predict dispersion through an urban area with reasonable accuracy, but fast enough to be usable for emergency response modelling. Network models aim to capture these processes by dividing the street network into boxes around each street, connected at the intersections. Following from earlier work (Soulhac, 2000; Belcher, 2005; Hamlyn, Hilderman & Britter, 2007), and as shown in this talk, the resulting models are computationally cheap and capture important processes observed in dispersion in urban areas. In addition, we will show that in simple geometries and for a steady source, the network model can be solved analytically, which then shows how the parameters of the model combine to determine the salient features of the solution, such as the lateral spread, the detrainment into the boundary layer above, and the temporal evolution of concentration through the network. We will also show how data from a DNS over a regular array of buildings is used to develop appropriate parameterizations for use in the network model. Validation of results from the network model with experimental and DNS data will then be demonstrated.