# QUIC (Quick Urban & Industrial Complex)
## Dispersion Modeling System

Due to the threat of a terrorist releasing a chemical or biological (CB) agent in a city, University of Utah and Los Alamos National Laboratory researchers have developed a fast response urban transport and dispersion modeling system. Fast models are essential for vulnerability studies where many cases must be simulated in a limited amount of time or for emergency response scenarios when an answer is needed quickly. However, the dispersion of a CB agent released in an urban area is difficult to predict due to the presence of buildings. Most emergency response dispersion models currently in use have little or no building "awareness".

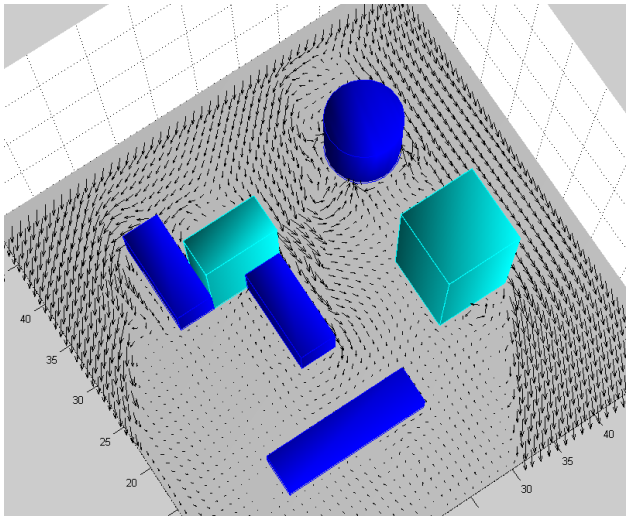


*Figure 1. A QUIC-URB computer simulation of the air flow around a group of buildings. Wind vectors from one of the horinzontal planes are shown. Note the steering of the wind, reverse flow, and pockets of calm air that develop downwind of the buildings.*

The QUIC fast-response urban dispersion modeling system computes the three-dimensional wind patterns and dispersion of airborne contaminants around clusters of buildings. The system is comprised of a wind model, QUIC-URB; a Lagrangian dispersion model, QUIC-PLUME; and a graphical user interface, QUIC-GUI.

QUIC-URB uses empirical algorithms and mass conservation to estimate the wind velocities around buildings (Röckle, 1990). Although not as accurate as computational fluid dynamics modeling, it captures the major flow features for a fraction of the computational cost. The 3D simulation shown in Fig. 1, for example, required about 10 seconds on a laptop PC.

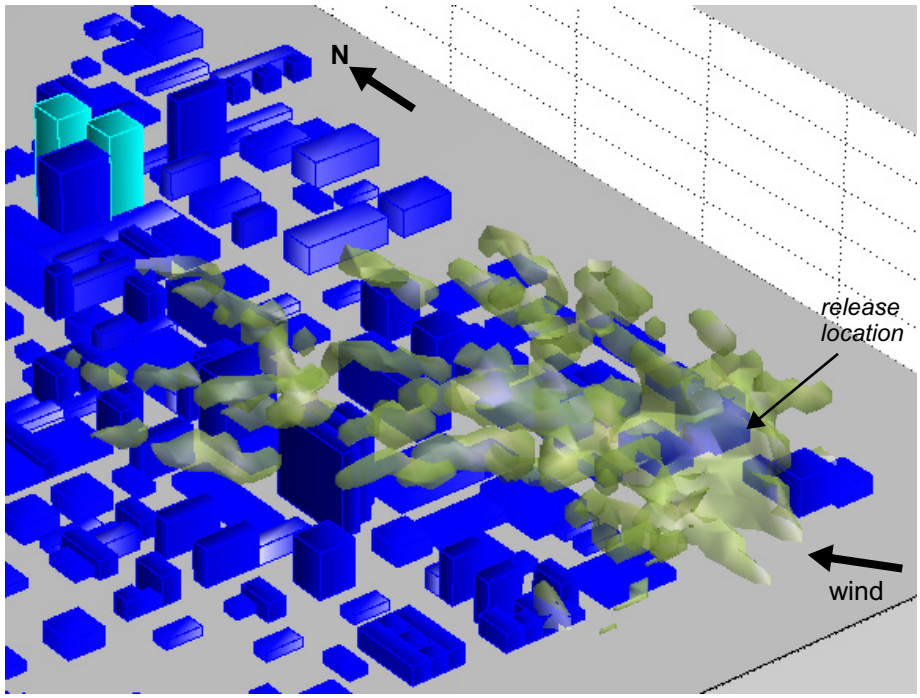


*Figure 2. QUIC-PLUME simulation of CB agent transport and dispersion in downtown Salt Lake City. The agent cloud is quickly lofted into the air due to the presence of tall buildings. The inflow wind is from the southeast.*

The QUIC-PLUME dispersion model is Lagrangian, that is, it tracks the movement of particles as they disperse through the air. QUIC-PLUME utilizes the mean wind fields computed by QUIC-URB and produces the turbulent dispersion of the airborne contaminant using random walk equations. QUIC-PLUME has been specially adapted to account for particle reflection on building surfaces and for the additional dispersion due to horizontal inhomogeneities in the turbulence field.

Model testing and evaluation with actual building-scale data has been a top priority and has resulted in significant improvements in the empirical algorithms and physical parameterizations in the code. A library of CB agents and deposition physics have also been added to QUIC. The GUI has been improved substantially, providing new 3D visualization capabilities. A user's guide was written and theory guides are being updated.

QUIC provides credible agent dispersal patterns in an urban environment, while still achieving very quick turnaround and ease-of-use. It is ideal for planning and assessment where many CB agent attack scenarios must be run. It could be used in next-generation training with unscripted table-top exercises and immediate feedback. Due to its speed it could be run around the clock at a military base or high-profile target (e.g., DC Mall). The code is also the underlying engine in the QUIC Sensor Siting tool, used for determining the optimal placement of CB agent sensors around building

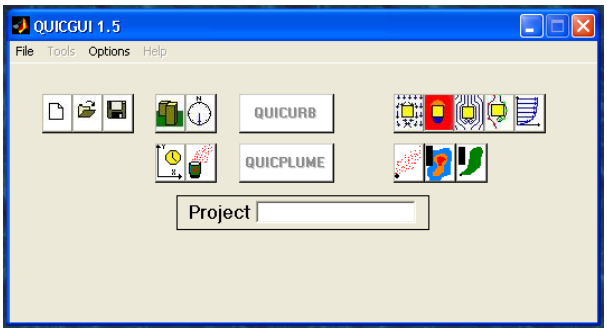


*Figure 3. An easy to use graphical user interface has been developed for setting up the problem, running the codes, and visualizing the results.*

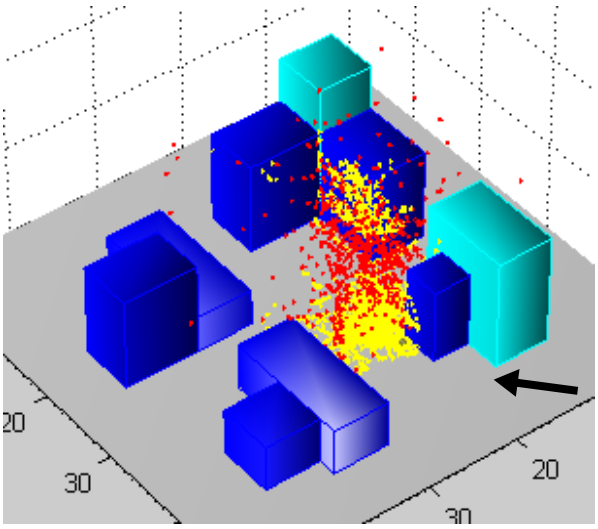


*Figure 4. Illustration of QUIC-computed bio agent dispersion (red particles - airborne) and deposition on the ground and walls (yellow particles).*

complexes. QUIC fills a significant void between fast, but low fidelity convential plume dispersion models and high fidelity, but slow, computational fluid dynamics models. The QUIC tool satisfies a critical need in the CB Countermeasures arena.

References:

Boswell, D. and M. Brown, 2003: The QUIC Quick Start Guide.

Pardyjak, E. and M. Brown, 2002: Fast response modeling of a two building urban street canyon, 4th AMS Symp. Urban Env., Norfolk, VA, LA-UR-02-1217.

Pardyjak, E. and M. Brown, 2001: Evaluation of a fast-response urban wind model – comparison to single-building wind-tunnel data, Int. Soc. Environ. Hydraulics, Tempe, AZ, LA-UR-01-4028, 6 pp.

Röckle, R., 1990, Bestimmung der stomungsverhaltnisse im bereich komplexer bebauungsstrukturen. Ph.D. dissertation.

Williams, M. D., 2002: QUIC-PLUME User's Guide, LA-UR-02-375.

Williams, M., M. Brown, and E. Pardyjak, 2002: Development of a dispersion model for flow around buildings, 4th AMS Symp. Urban Env., Norfolk, VA, LA-UR-02-0839.

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