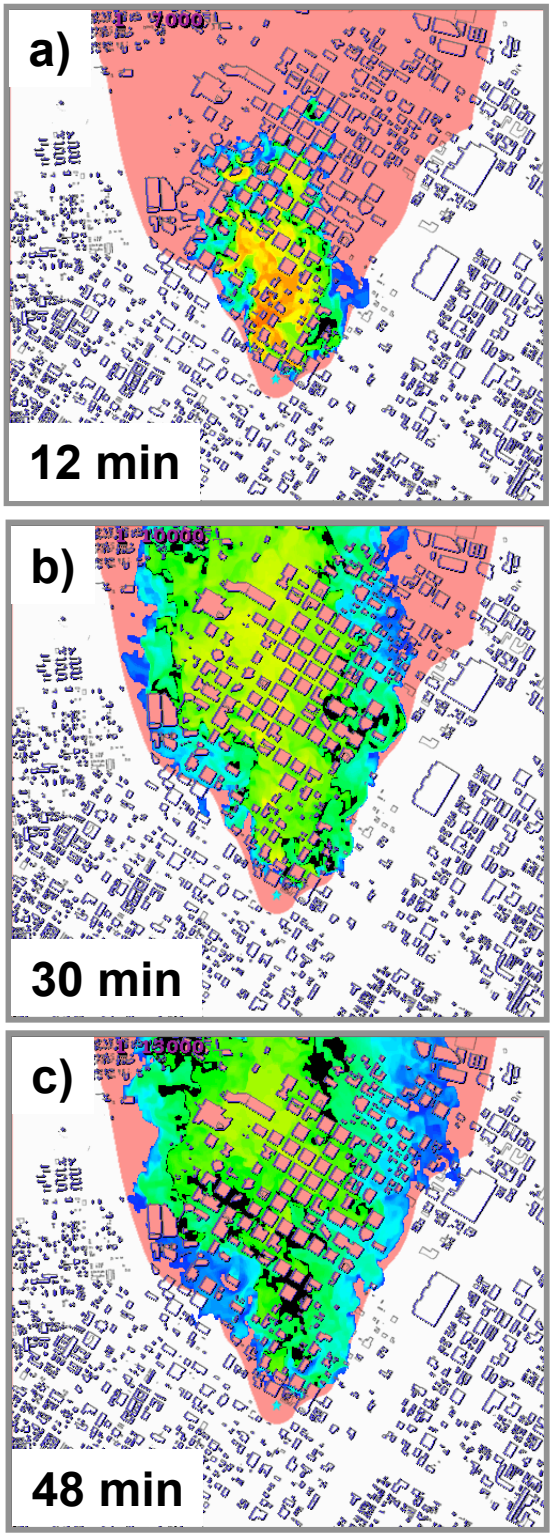
CT-ANALYST®

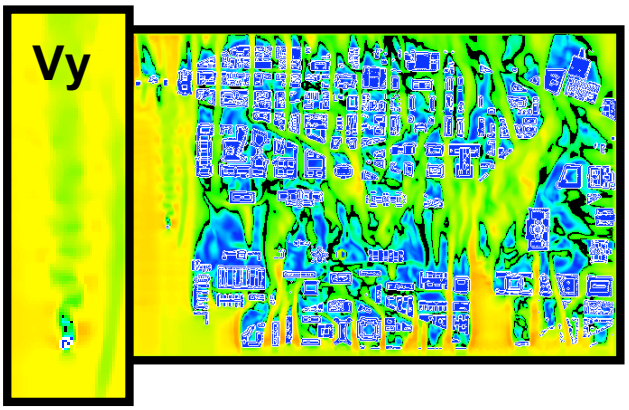
Verification & Validation

CT-Analyst® is attractive to prospective users because it does things no other contaminant transport (CT) model can do. It is also much faster and is capable of greater accuracy in urban conditions because it is built on a database of detailed, 3D runs using NRL's FAST3D-CT CFD model and real building geometry. Here we present validation information showing that the CT-Analyst system works. This testing includes end-to-end comparison with realistic urban tracer experiments simulating an acute terrorist attack.

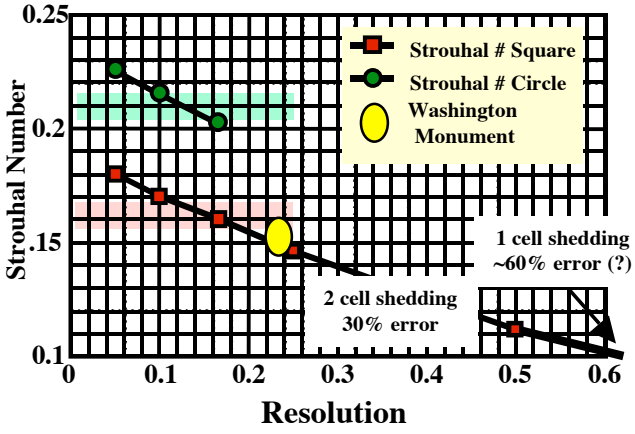
CT-Analyst effectively interpolates into a precomputed database so it is evaluated by how closely the footprint and plume envelope predictions agree with the data on which they are based. As an example, the figure at the right shows FAST3D-CT concentration plots overlaid on the corresponding CT-Analyst contamination footprint (pink) at three times after a "release" in downtown Houston. CT-Analyst is conservative by design but the influence of buildings and the close correspondence between the two models is evident. The metric for this comparison is a quantitative Figure of Merit that shows an 80% to 90% agreement between the CT-Analyst predictions and the envelope of CFD realizations of the evolving 3D flow in many different cases.

NRL's FAST3D-CT CFD model underpins CT-Analyst and has an extensive history of verification and validation (V&V). It has also been more formally reviewed through the DoD HPCC CHSSI program. Validation of both CT-Analyst and the FAST3D-CT CFD model is now being supported by MDA. The validation is based on standard benchmark tests, wind tunnel studies, and available full-scale data sets including the 911-BIO ACTD field trials for exterior-interior coupling and the more recent Tracer ES&T, Inc. field trials in Los Angeles.

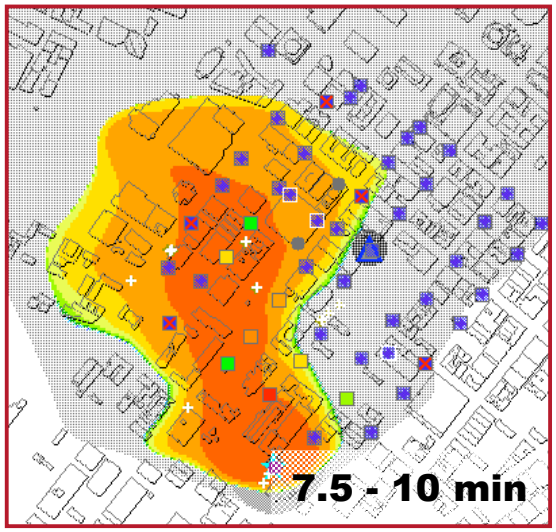


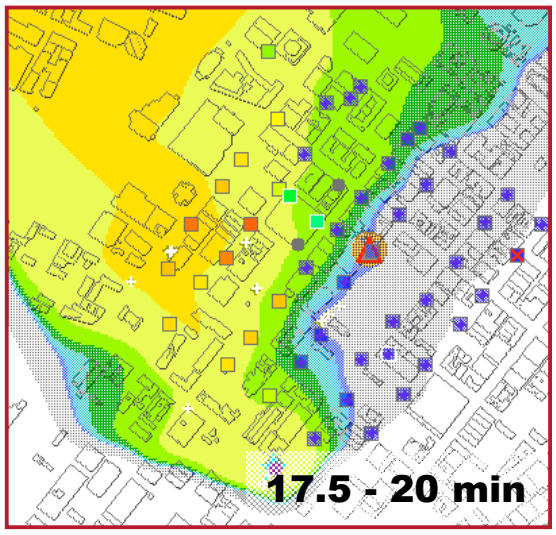


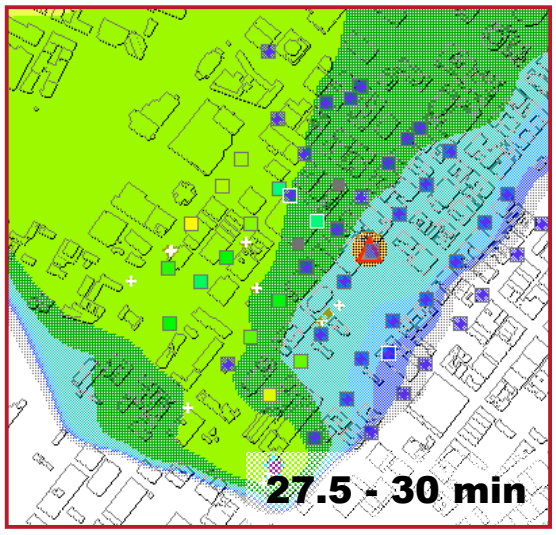
Time-dependent vortex shedding from buildings and other obstacles is a main source of turbulence in a city and controls the dispersion of a contaminant. The figure above shows the vortex wake behind the Washington monument computed by FAST3D-CT. The plot of Strouhal number vs resolution below shows errors of only 3-5% in the simulated shedding frequency at the resolution of 4 cells across the monument as actually used in developing the Dispersion Nomograf database for CT-Analyst.



The "end-to-end" validation of CT-Analyst predictions against field trial data is also an important step to build a basis of confidence. One such example is illustrated at the right. Tracer ES&T, Inc. sampler data (the colored squares) and the corresponding CT-Analyst predictions are compared for a 5 minute SF6 release in Los Angeles simulating a possible terrorist attack. The Chi-square probability of agreement between CT-Analyst and the field data is in excess of 99% for this case. CT-Analyst also gives a 94% assurance that being outside the plume enveloped means safety.







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