

# LA-UR-13-22170

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Title: Progress on Institutional Computing Urban EMP project, 2012

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Intended for: Progress Report for ICN computing. Viewgraphs will be placed on open WEB access.



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Progress on Institutional Computing Urban EMP project, 2012.  
LA-UR-XXXX

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The purpose of the Institutional Computing Urban EMP project is to simulate NUDET (nuclear detonation) in an urban environment, and determine what forensic information can be obtained from the resulting EMP (electromagnetic pulse) produced by the detonation. The effect of EMP on telecommunications and power infrastructure is also being studied.

The overall scheme involves the coupling of the MCNP particle transport code with an FDTD (finite-difference time domain) Maxwell solver in order to capture all of the physics in the NUDET that lead to the EMP pulse. We have conducted many tests of this coupled scheme against legacy codes in order to ensure that the predicted EMP pulse propagation is accurate even at several kilometers distance in an urban environment.

Our ICN computing resources have been used to demonstrate the MCNP/FDTD concept for EMP propagation in an urban environment to our sponsors at DTRA, STRATCOMM, and FEMA. The Urban EMP program is part of a larger overall LANL effort to develop a capability to model the effects from a NUDET from the initial burst to gamma and neutron propagation, to later time fire ball and fire initiation in an urban environment. The success of this effort has resulted in a unique LANL 3-D urban EMP capability that exists nowhere else. Funding from our sponsors listed above has increased accordingly as concern for the effects of NUDET driven EMP and fire on urban areas has increased.

This year, NUDET driven EMP simulations were done for Boston, Houston, and Albuquerque in order to map the propagation and impact of EMP for these metropolitan areas. In the course of these studies, we identified a number of technical issues, including memory requirements for MCNP, passing data from MCNP to FDTD when the spatial and temporal resolution of the two codes are significantly different, ringing of the FDTD EMP due to instability in the air chemistry package. We are presently addressing each of these issues to improve the quality of our simulations for our sponsors.

The attached figures include a program flowchart for the urban EMP project, and a sample NUDET EMP simulation for the downtown Houston area. The maximum expected EMP magnitude as a function of distance in the Houston area is compared to the expected EMP for a NUDET over flat ground. The last figure shows a time snapshot of the maximum expected EMP for downtown Houston.

Publications:

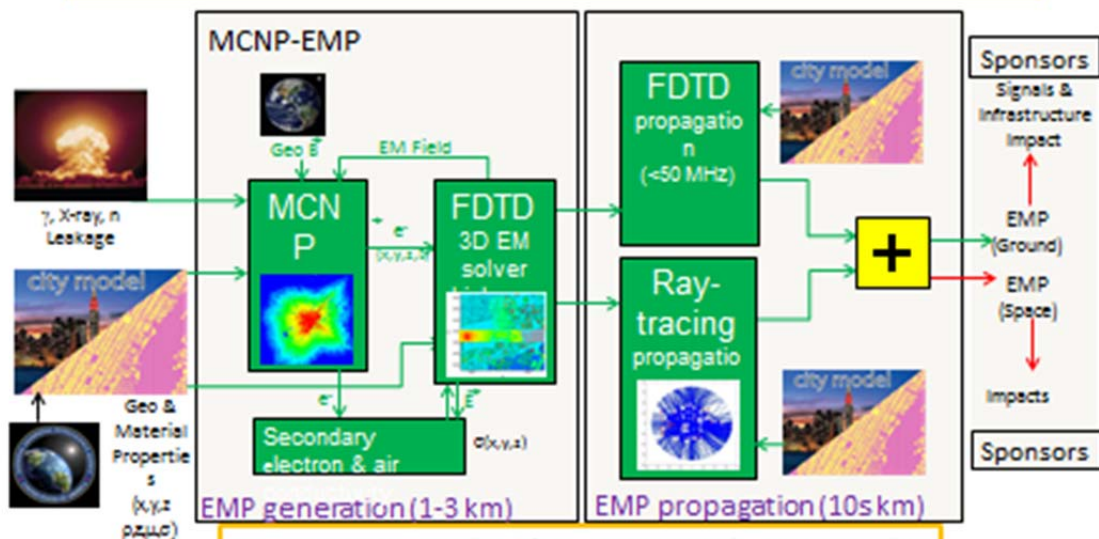
W. S. Smith, A. Razmadze, X.-M. Shao, and J. L. Drewniak, A Hierarchy of Explicit Low-Dispersion FDTD Methods for Electrically Large Problems, IEEE trans. Antennas propagat., 60(12), p5787-5800, Dec., 2012.

W. S. Smith., J. Bull, T. Wilcox, et al., Nuclear EMP simulation for large-scale urban environments. JOWOG 43, Aug 2012, Los Alamos National Laboratory, LA-UR-12-24078.

W. S. Smith, X-M. Shao, T. Goorley, et al., Unified nuclear EMP simulation for large-scale urban environments. Discrete Oculus meeting, Mar., 2012, Los Alamos National Laboratory, LA-UR 12-01238.



## NEMP4d Capability: E & B (x,y,z,t) in Urban Environments



Progress on initial self-consistent code suite, early results for Houston and Boston, V&V still needed.

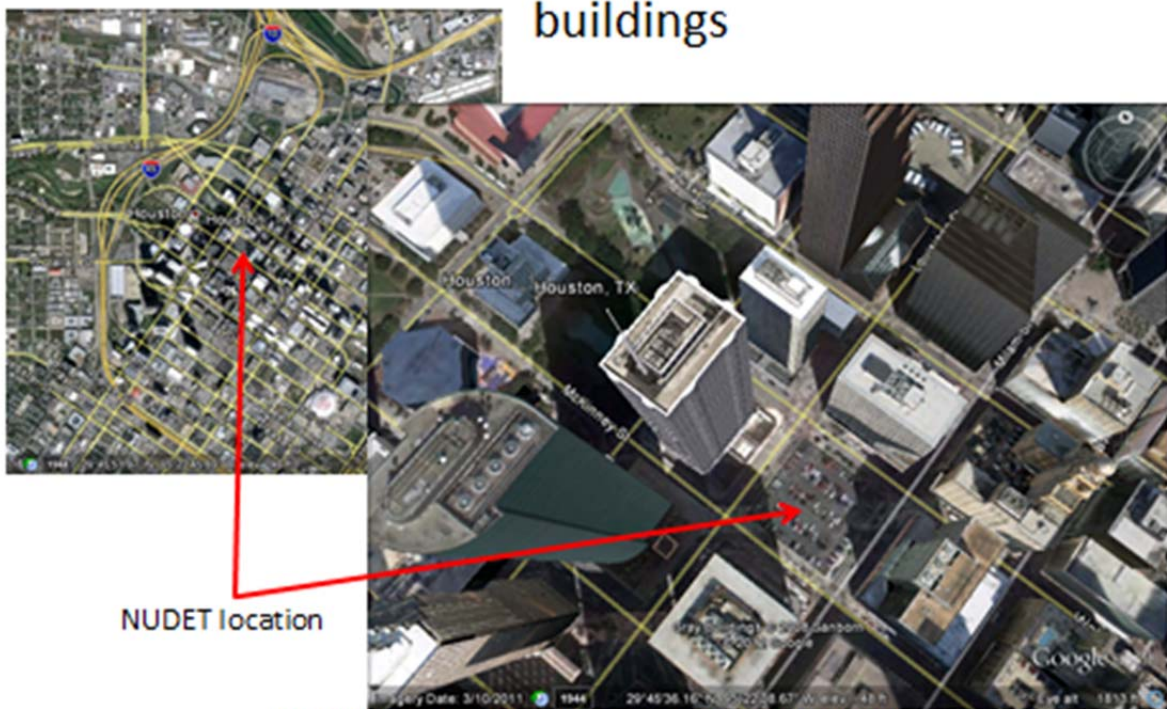


From "Nuclear EMP simulation for large-scale urban environments. FDTD for electrically large problems." LA-UR-12-24078





## NUDET location and surrounding buildings



NUDET location

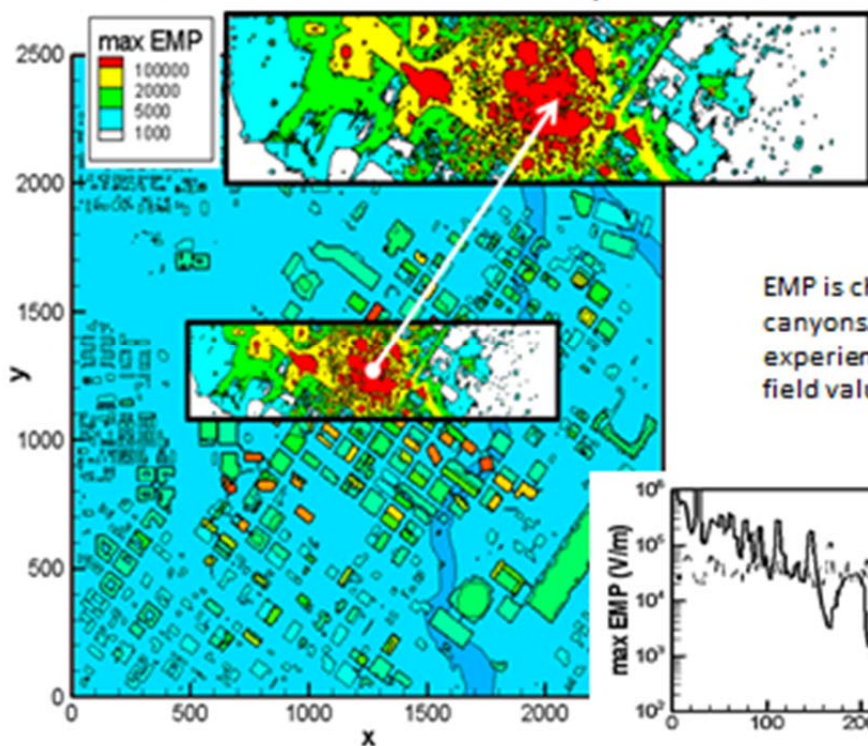


From "Nuclear EMP simulation for large-scale urban environments.FDTD for electrically large problems." LA-UR-12-24078



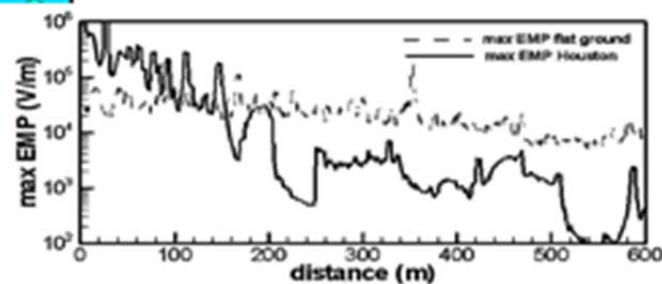


## 3-D Urban EMP FDTD; downtown Houston, TX



Horizontal cross section of downtown Houston - expanded inset showing the maximum magnitude EMP (V/m).

EMP is channeled outward along street canyons. Yellow and red contoured areas experience maximum electromagnetic field values above 20 kV / m.

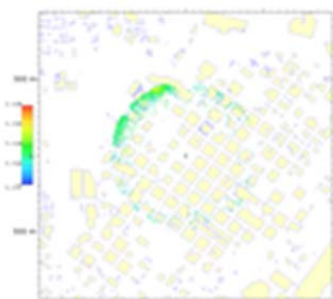


From "Nuclear EMP simulation for large-scale urban environments.FDTD for electrically large problems." LA-UR-12-24078

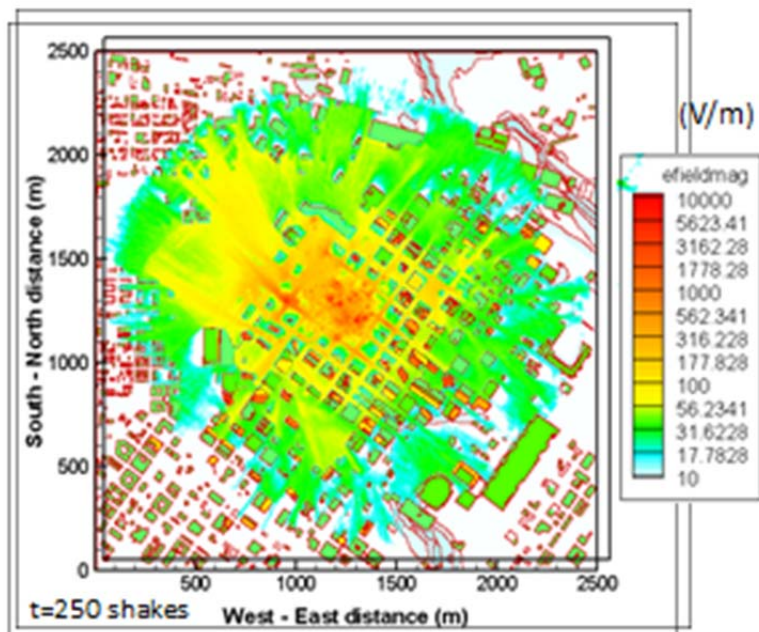




# Compton currents and maximum magnitude EMP downtown Houston, TX



t=180 shakes



From "Nuclear EMP simulation for large-scale urban environments.FDTD for electrically large problems." LA-UR-12-24078

