Nuclear weapons: Predicting the unthinkable

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If a nuclear weapon were detonated in a metropolitan area, how large would the affected area be? Where should first responders first go? According to physicist Fernando Grinstein, we have some initial understanding to address these questions, but fundamental issues remain unresolved.

"The predictive capabilities of today's state-of-the-art models in urban areas need to be improved, validated and tested," says Grinstein. "Work in this area has been limited primarily because of lack of consistent funding."

At the upcoming 62nd Annual Meeting of the American Physical Society's (APS) Division of Fluid Dynamics in Minneapolis, Adam Wachtor -- a student who worked with Grinstein at the Los Alamos National Laboratory in New Mexico -- will present his efforts to improve the way that models track the movement of radioactive fall-out carried by the wind. His wind models track the aftermath of a plume of hot gas released by a small, one-ton device in a typical urban setting at a three-meter resolution.

Current models use wind direction and wind speed to draw a predicted cone-shape area of fall-out. Wachtor's results show that these models are too simple in some ways. For instance, they do not include the complex dynamics of wind movements around buildings, which can concentrate fall-out preferentially in certain areas. They also indicate that small changes in the location of the blast and the temperature of the plume released can have a large effect on the contamination patterns.

The simulation is part of a larger coordinated effort between DHS (FEMA), the National Laboratories, DTRA, NRL, and private contractors, each of which has concentrated on a different piece of the project. Other studies have shown that, depending on the situation, buildings can provide some degree of shielding from the radiation.

The hope of the researchers collaborating in this effort is to eventually provide practical information to guide first responders. "We're preparing for [a possible] crisis," says Grinstein -- however unthinkable it may be.

More information: The presentation "Effects of release characteristics on urban contaminant dispersal" by Adam Wachtor of the University of California, Irvine is at 8:00 a.m. on Sunday, November 22, 2009.

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