

ATMOSPHERIC DISTURBANCE

Federal Center Helps Predict Dispersion of Atmospheric Hazards

When thousands of chemical storage drums in an Ohio container recycling facility erupted in flames one evening in August 2004, Cincinnati faced a fire generating large quantities of potentially toxic smoke that rapidly spread across residential and business sections of the city. Fearing the airborne plume could pose a danger to citizens, Cincinnati officials turned to the Interagency Modeling Atmospheric Assessment Center (IMAAC), which provides atmospheric hazard predictions under the auspices of the Department of Homeland Security (DHS). Cincinnati officials needed to learn the estimated chemical concentration of the smoke and the direction it would spread to determine the need for evacuation or other protective actions.

Within minutes of receiving notification of the Queen City Barrel Company chemical fire, IMAAC provided initial predictions about the size and direction of the toxic smoke plume. City officials used this information to develop a shelter-in-place strategy for occupants in the affected areas. According to Ed Dadosky, District Fire Chief for the Cincinnati Fire Department, “[IMAAC models] were driving much of the decision-making and incident-specific information disseminated to the public.”

IMAAC scientists at Lawrence Livermore National Laboratory (LLNL) in Livermore, Calif. provided forecasts of the likely changes in the plume’s path as wind conditions shifted the predicted course from northeast to southeast.



The Interagency Modeling Atmospheric Assessment Center accurately predicted the sulfur dioxide plume released from two volcanic vents in Hawaii in 2008 using in-house special high-resolution Weather Research and Forecast (WRF) model simulations. Image courtesy of IMAAC.

They also refined their predictions of potential impacts based on chemical inventory information and field measurement data provided by Cincinnati responders. Fortunately, the chemicals in the plume did not require evacuation. “This was an excellent demonstration of the value IMAAC can provide to local responders and the importance of the working relationships between federal resources and emergency responders,” said Dr. Gayle Sugiyama, National Atmospheric Release Advisory Center (NARAC) and IMAAC Program Leader at LLNL.

DHS established IMAAC in 2004 to coordinate the generation and dissemination of federal plume models and provide atmospheric hazard predictions to state and local governments during major incidents. IMAAC is a partnership between DHS and seven other federal agencies: the Department of Energy (DOE), the National Oceanic and Atmospheric Administration (NOAA), the Environmental Protection Agency (EPA), the Department of Defense (DoD), the National Aeronautics and Space Administration (NASA), the Nuclear Regulatory Commission (NRC), and the Department of Health and Human Services (HHS). This partnership is guided by the leadership of IMAAC Director Nicholas L. Wong, a U.S. Coast Guard Lieutenant Commander detailed to DHS’ Office of Operations Coordination and Planning (OPS).

Using resources from federal partners, IMAAC Operations at LLNL produces and distributes predictions for atmospheric hazardous material releases during incidents requiring federal coordination. LLNL provides an around-the-clock facility with subject matter experts, computer systems, and Internet-based remote access to request and share plume modeling simulations and analyses. Scientists at LLNL gather information about an airborne hazard, such as where, when, what, and how much material was released. This is combined with meteorological and geographical data to calculate the dispersion of the material and the results are processed with other data, such as health effect levels and population, to generate plume model graphical plots – maps showing the affected areas and likely impacts of the release. Plume modeling results help first responders make decisions on protective actions, safe locations for incident command posts, and guidance for monitoring teams sent to obtain chemical samples. Sugiyama said, “Early in an incident, the IMAAC models provide key information to first responders to make potentially life-saving decisions.”

Atmospheric Disturbance (continued)

Key leaders and decision-makers who do not have a technical background might need additional assistance in interpreting the plume products. IMAAC Operations staff and other interagency experts are available to provide interpretations. In addition, DHS and DOE are leading efforts to produce IMAAC “plain language briefing products,” which are used to brief public officials and facilitate public safety recommendations. These products use non-technical language, highlight key points, and cite the guidance being used to create the product. They are designed to complement IMAAC technical products, not replace them.

Local agencies rely on IMAAC for advice during an emergency. When a fire broke out at Valley Solvents and Chemicals in Fort Worth, Texas in July 2005, city officials worked with IMAAC to determine the likely size of the plume. Based on predictions that the release could send hazardous potassium hydroxide up to five miles downwind, officials recommended residents within that range shelter in place. “During real events, it’s incredibly valuable,” said Keith Wells, Senior Emergency Management Officer at the Fort Worth Office of Emergency Management.

Fort Worth officials also collaborated with IMAAC during the planning for a downtown high-rise building demolition. IMAAC developed model simulations predicting how dust would disperse during the explosion. The city used this information to determine where to place barriers around the site and to locate seating areas for observers. The model result was remarkably close to the actual size of the dust cloud, Wells noted.

IMAAC technology and expertise has been applied to natural disasters as well. In 2008, IMAAC was called upon to provide 24-hour forecasts of the plume resulting from unusually large releases of toxic gases from two volcanic vents on Hawaii’s Big Island. Wind conditions were transporting the plume in the direction of the city of Hilo. LLNL staff members worked closely with the EPA, the National Park Service, the U.S. Geological Survey, the National Guard Civil Support Teams, and the state and county governments in Hawaii. IMAAC’s plume modeling assisted local first responders in determining what parts of the island might be exposed to dangerous levels of sulfur dioxide during the venting of Kilauea and Pu’u O’o.

IMAAC is also an invaluable tool for the preparedness community, capable of generating assessments and scenario predictions for disaster planning, National Special



The Interagency Modeling Atmospheric Assessment Center supported the EPA’s response to a major volcanic eruption at Hawaii Volcanoes National Park. Image courtesy of IMAAC.

Security Event (NSSE) contingencies, or training exercises, from simple drills to current national level exercises. According to Daniel Blumenthal, DOE Consequence Management and NARAC Program Manager, IMAAC can prepare plume modeling simulations for a potential disaster to assist first responders and emergency planners in developing plans. “Before anything ever happens, IMAAC helps responders in developing their response plans and work on preparedness,” he said. “If someone is concerned about a potential release, IMAAC can run a calculation and provide estimates of what might happen.”

If first responders find themselves responding to an emergency situation involving a major hazardous release to the atmosphere where lives are at risk and federal dispersion modeling assistance would be beneficial, they should contact one of the following operations centers to request IMAAC support:

- For emergencies only – IMAAC Operations, 925-424-6465.
- For federal assistance with a major incident or weapons of mass destruction incident – DHS National Operations Center, 202-282-8101.

“One of our priorities is to expand the awareness of IMAAC amongst the preparedness and response community so they understand what it is and when it may be appropriate to use it,” Wong said.

For more information, visit <http://imaacweb.llnl.gov>.