Perspectives on Biosurveillance Data for Use in Transport and Fate Modeling

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IMAAC Provides Critical Information to Protect the Public and the Environment

The Interagency Modeling and Atmospheric Assessment Center (IMAAC) "provides a single point for the coordination and dissemination of Federal dispersion modeling and hazard prediction products that represent the Federal position" during actual or potential incidents under the National Response Framework.

The IMAAC is not intended to replace or supplant the atmospheric transport and dispersion modeling activities that are currently in place to meet agency-specific mission needs.

IMAAC is Led by DHS and Supported by Seven Other Federal Agencies

- Created by the Homeland Security Council in 2004
- Led by the Department of Homeland Security (DHS), which provides the IMAAC Director
- Partnership between eight Federal agencies each with supporting capabilities and/or responsibilities for plume modeling
- DOE's National Atmospheric Release Advisory Center (NARAC) serves as the IMAAC operations hub

Department of Homeland Security (DHS)

Department of Energy (DOE)

Department of Defense (DoD)

National Oceanic and Atmospheric Administration (NOAA)

National Aeronautics and Space Administration (NASA)

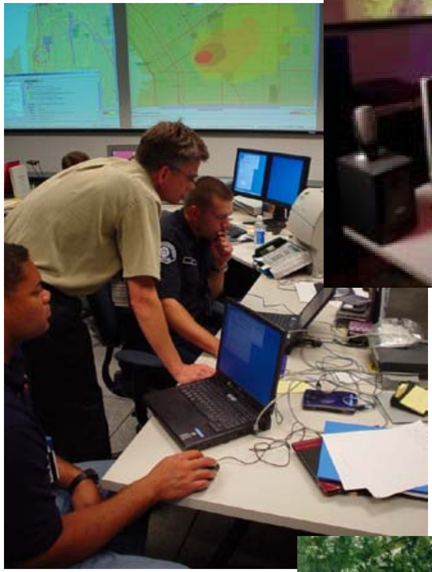
Environmental Protection Agency (EPA)

Nuclear Regulatory Commission (NRC)

Department of Health and Human Services (HHS)

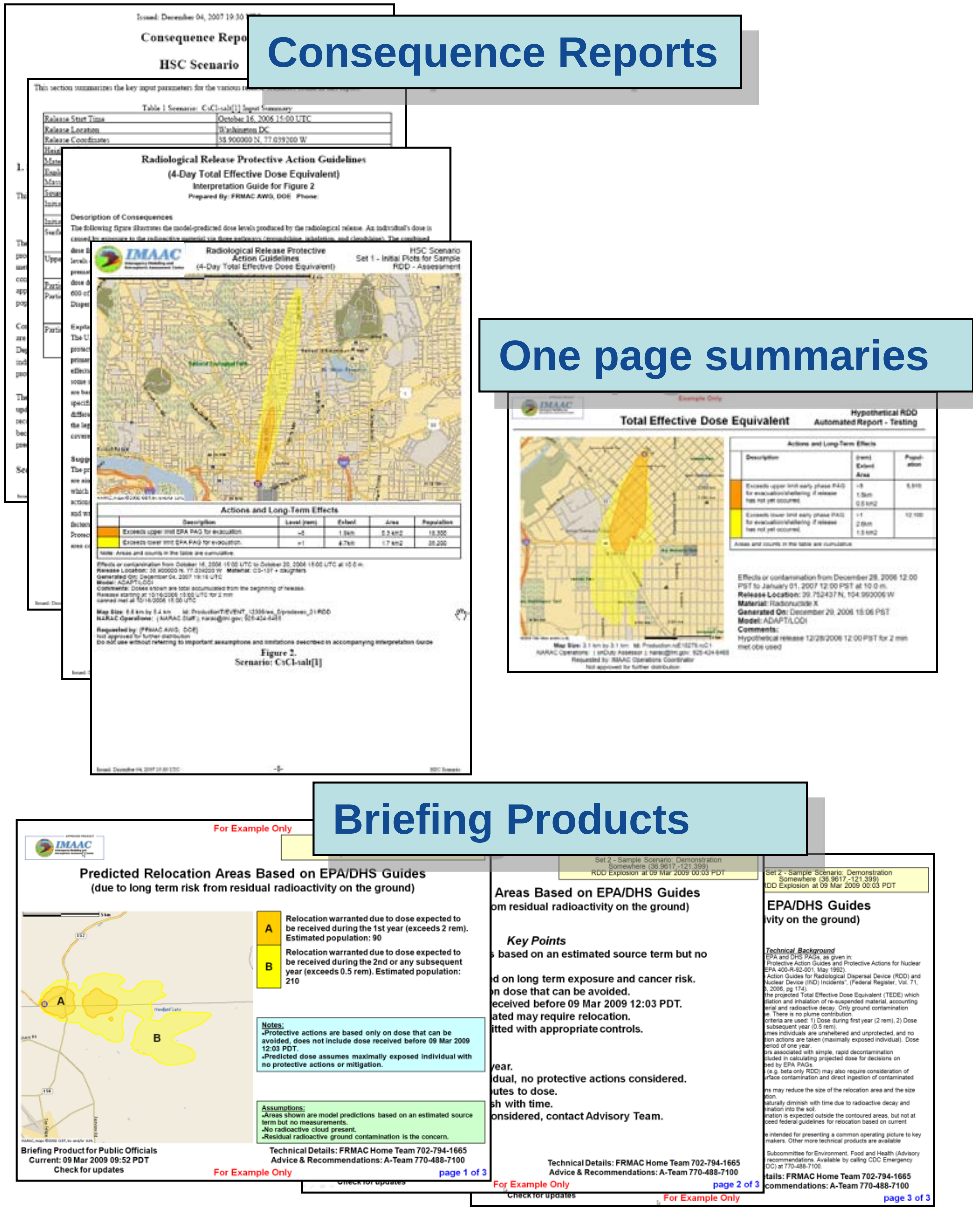
IMAAC/NARAC Provides Services and Products to Inform Emergency Response Decisions

- Provides 24/7 modeling analyses for major airborne releases of hazardous chemical, biological or radiological material
- Quality assures products before distribution
- Updates modeling based on field measurement data
- Distributes product to agencies involved in the response
- Explains and interprets plume model results, assumptions, and uncertainties
- Maintains subject matter experts along with a suite of simulation tools and associated databases and real-time data feeds



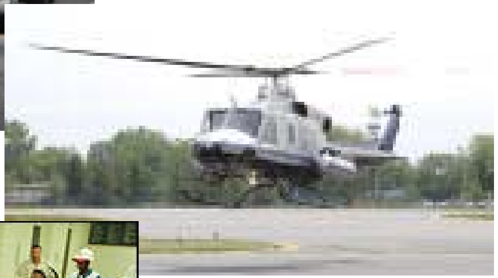
IMAAC/NARAC Standard Products Are Developed with Interagency Review and Consensus

- Standard technical plot sets
  - Plume hazard areas
  - Affected population numbers
  - Health effects based on public exposure guides
  - Protective action guide levels
  - Geographical information
- Multi-page consequence reports
  - Expanded descriptions
  - Input data and assumptions
  - Interpretation guides
- Plain language Briefing Products providing guidance on actions decision makers should consider
- GIS layers
  - ESRI / GIS Shape fileoutput
  - Google KMZ output



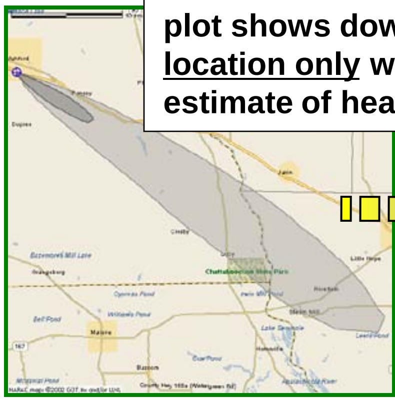
Products Inform Decisions on Evacuation/Sheltering, Relocation, Worker Protection, and Sampling Plans

- Guide safe approach routes
- Site incident command posts or resources
- Deploy field monitoring teams (sampling plan guidance)
- Assist in evacuation, sheltering-in-place, and relocation decisions
- Inform need for personal protective equipment (PPE)
- Estimate potential impacts on and contamination of critical infrastructure
- Estimate potential number of casualties requiring hospital or medical treatment
- Determine areas where agricultural crops may be contaminated (human food and animal feed)



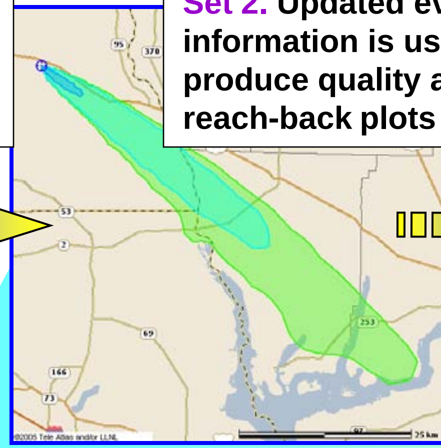
Standard Operational Procedures Couple Modeling and Monitoring in a Cyclical Process

Set 1. An initial automated plot shows downwind location only with no estimate of health effects



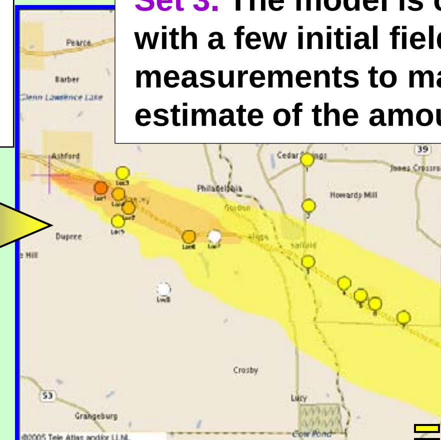
Automated Web-Initiated or via Emergency Call; Only know release time and location

Set 2. Updated event information is used to produce quality assured reach-back plots



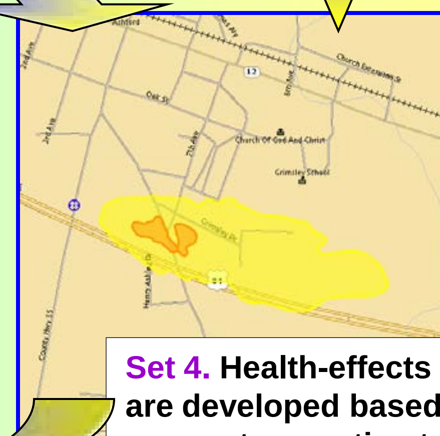
Example revised data: Updated source location, detailed weather

Set 3. The model is compared with a few initial field measurements to make an initial estimate of the amount released



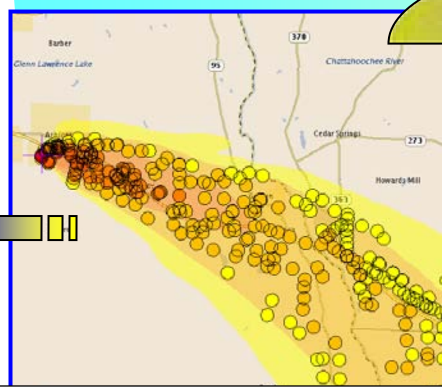
Source scaled to initial set of measurements

Set 4. Health-effects plots are developed based on a source term estimated from field measurements

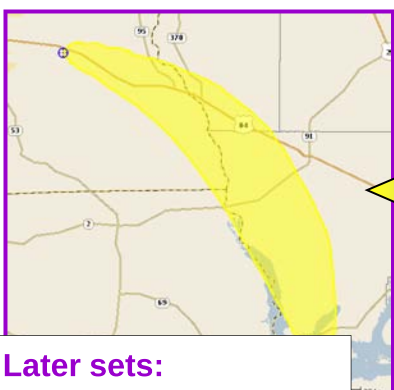


Cycle of new products based on updated sets of measure-ments

Set 5. More extensive sets of field measurements are used to improve the accuracy of the source term calculation

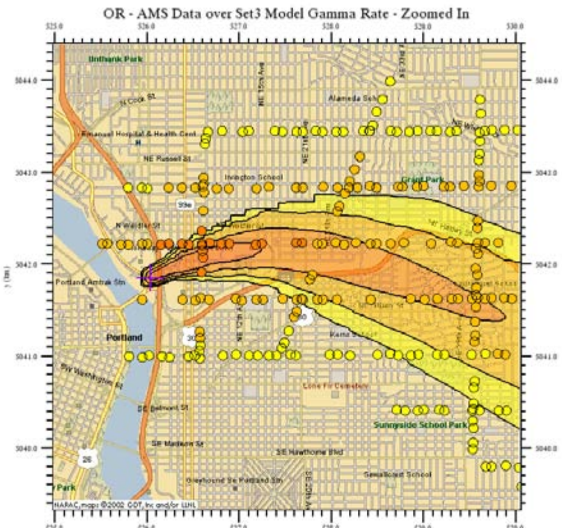


Later sets: Relocation and food-Ingestion plots are developed.



Fate and Transport Modeling Can Benefit from a Wide Range of Biosurveillance Data

- Fate and transport analyses use both models and data
  - Characterization of hazard areas and degree of contamination
  - Estimation of potential human impacts (casualties)
  - Event reconstruction (scenarios consistent with data)
  - Identification of priorities for further sampling
- Models support quality assurance, interpretation of data, and reduction of uncertainty
  - Graphical comparison of data and plumes
  - Data analysis tools to filter, group, identify / eliminate measurement data outliers
  - Interpolation / extrapolation of data
  - Tools for measurement-to-calculation ratio comparison, statistical analysis, and determination of improved source term



> "No one believes a model like the person that made it. Everyone believes a measurement, except the person who made it."

Effective Data Sharing Requires Approved Access and Interagency Protocols

- Pre-existing interagency data sharing agreements are critical to ensure timely response and analysis during an event
  - Appropriate notifications
  - Effective *two-way* communications
- Development of data-sharing protocols
  - Pre-approved access (credentialing)
  - Selection and control of type and level of data to be shared with different user communities
  - Proper handling of sensitive data
  - Secure electronic data access and push/pull distribution methods
- Challenges
  - Diversity and number of different biosurveillance data providers and systems
  - Diversity and different types of biosurveillance data consumers
  - Federal, state, and local coordination

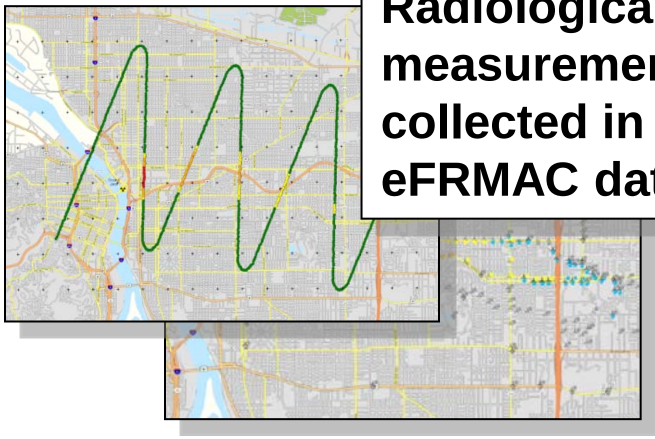
Standardized Data and Formats Are Key to Effective Use and Interpretation of Biosurveillance Data

- Common standards for biosurveillance data collection (e.g., swab / swipes / vacuum, air collection, laboratory analysis)
- Standardized data formats for easy interpretation and documentation
  - Location (in standard coordinates)
  - Indoor/outdoor
  - Time of sample
  - Sample collection period (if appropriate)
  - Sampling type and volume (air collections) or area (surface sampled)
  - Detection sensitivity
    - Qualitative (yes/no) vs quantitative
    - Threshold
    - Expected sampling error
    - Instrumentation precision
  - Viability information
  - Particle size distribution for bio-aerosols (not generally available)

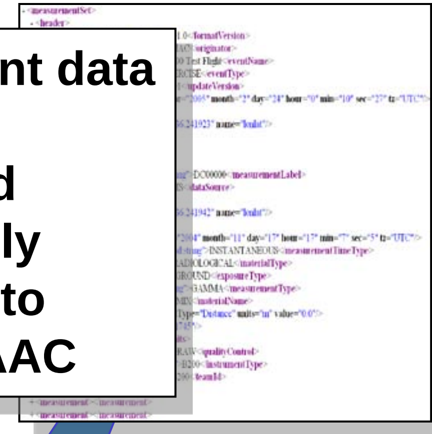
Data Quality Assurance and Standard Interpretational Criteria are Important to the User Community

- Community (clearinghouse) mechanism to provide:
  - Awareness of available data and providers
  - Quality assurance
  - Review of data provided from non-standard sources
  - Deconfliction of data
  - Improved speed of data sharing
  - Prioritization of further sampling to answer specific questions
- Development of interagency data interpretation standards
  - Ensure model output and data being compared are commensurate
    - Collection and integrated air concentrations for same periods
    - DNA to non-decayed concentrations
  - Ensure proper interpretation of data (e.g., mPCR cycles -> concentration levels)
  - Dose response, health effect and protective action guidelines
  - Documentation

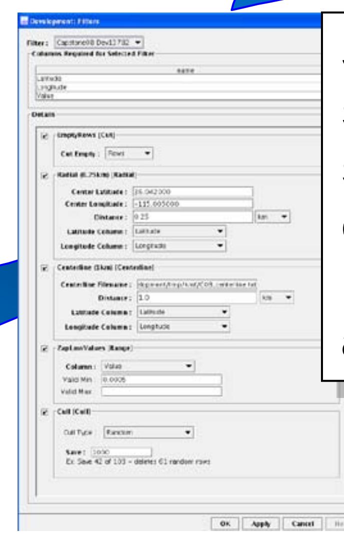
FRMAC Collects, Conducts Quality Assurance, and Electronically Transfers RadData for Model-Data Products



Radiological measurements are collected in eFRMAC databases

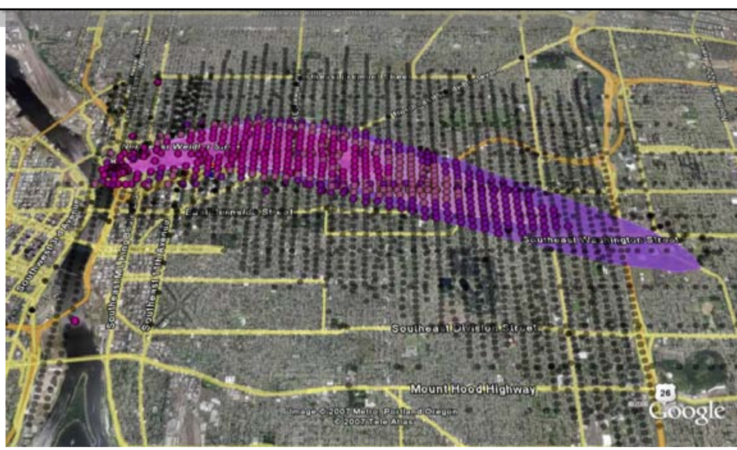


Measurement data are quality assured and electronically transferred to NARAC/IMAAC



Software tools to select, filter and statistically compare measurements and predictions

NARAC/IMAAC tools are used to update predictions using measurement data



Spatial and Time Resolution is Critical for Accurate Event Reconstruction and Estimates of Impacts

- Time resolution of data is critical for atmospheric releases
  - Variability of weather over the collection window
  - Dynamic physical processes (winds, temperature, humidity, precipitation)
- Spatial resolution from multiple data points needed
  - Sufficient sampling to ensure representative data (hot/cold spots)
  - Null data as important as positive detections
- Environmental heterogeneity affects data samples
  - Urban structures and surfaces
  - Vegetation
- Details of outdoor release determine indoor impacts (infiltration)
  - Release duration
  - Building air-exchange rate (duration relative to plume duration)
  - Non-linearity of dose-response relationship

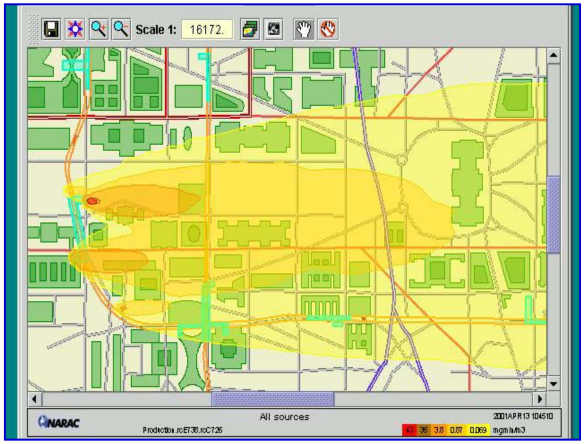
Background, Degradation, and Secondary Transport Can Complicate Biosurveillance Data Interpretation

- Pre-event characterization of environmental background may be critical to post-event interpretation of airborne bioagent data
- Degradation processes may significantly affect detection (and viability)
  - Sorption
  - Weathering
  - UV
  - Humidity
- Contaminants move within the environment
  - Deposition rates vary with surface type and environmental conditions
  - Resuspension
  - Tracking (people, vehicles, animals)
  - Fomite transfer
  - Re-aerosolization / re-deposition
  - Precipitation and run-off

Incorporation of Diverse Data Types has the Potential to Improve Consequence Assessment

- Non-traditional data
  - Indoor exposures (infiltration / exfiltration)
  - Medical data / epidemiological analyses to inform bioaerosol release event reconstruction and vice versa
  - Intel
  - Airborne animal and plant disease spread
- Challenge: communications between different scientific communities
  - Proper interpretation of disparate data by different users
  - Coupled models (indoor, outdoor, epi)
  - Development of community standard data and data-model products to be shared by and with biosurveillance community

Source: EPA ENERGY STAR



The coupling of diverse biosurveillance data and models can reduce uncertainties and speed confirmation and characterization of biological release events.

Contact Information

IMAAC
Interagency Modeling and Atmospheric Assessment Center

National Atmospheric Release Advisory Center
NARAC

NARAC/IMAAC

Web: https://narac.llnl.gov https://imaacweb.llnl.gov

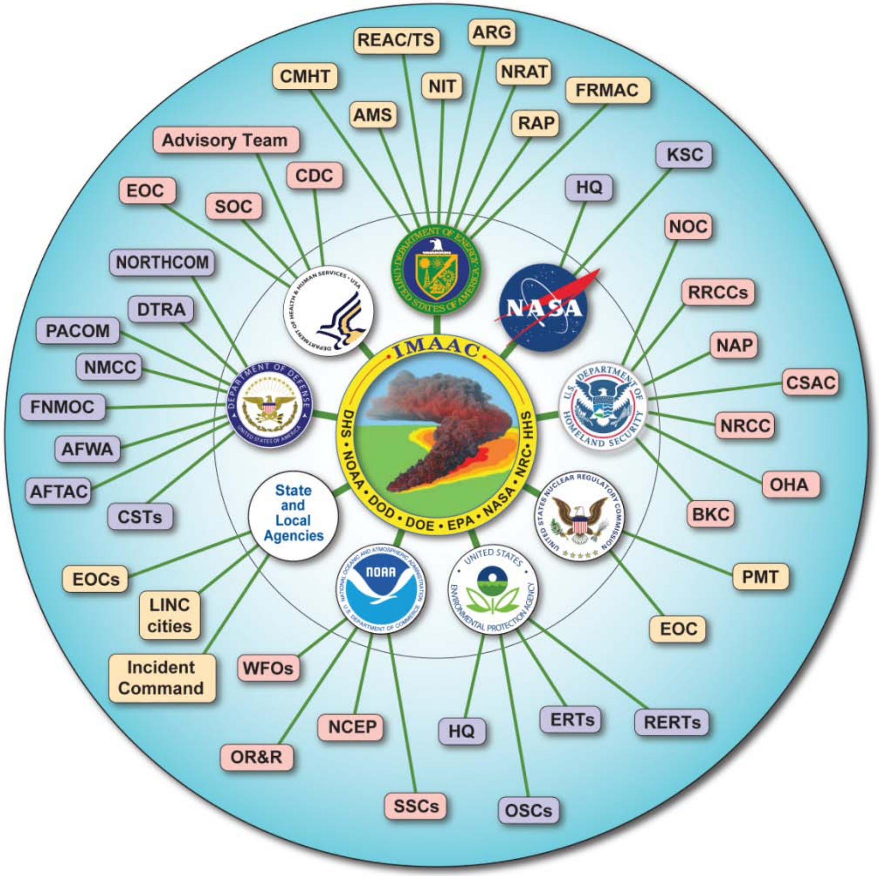
Email: narac@llnl.gov imaac@llnl.gov

Routine Business: 925-424-2722

24/7 Emergency Phone: 925-424-6465

IMAAC/NARAC Provides Integrated Emergency Response in Collaboration with Over 300 Agencies

- DHS national and regional operations centers (NOC Watch, FEMA Response Watch Center, NRCC, IMATs, RRCCs)
- DOE national operations center and nuclear response assets
- DOD national operations centers and teams
- EPA operations centers and regional response teams
- HHS Secretary's Operations Center and CDC Emergency Ops Center
- NASA launch facilities and mission operations
- NOAA national centers and teams (NCEP, NOAA Response and Restoration Division)
- NRC national and regional operations centers and teams
- Interagency radiological response centers and teams (e.g., DOE-led FRMAC, Advisory Team)
- Naval Nuclear Propulsion Program
- State operations centers and response teams
- Civil Support Teams (National Guard Bureau)
- Local Integration of NARAC with Cities (LINC) pilot cities and partners



IMAAC Has Provided Support for Numerous Real-World Emergencies

Examples of incidents for which IMAAC assistance was provided

May 25-26,2004 pool-chemical chlorine processing plant fire in Conyers, GA

July 28, 2005 solvent plant industrial fire in Ft. Worth, TX

July 17, 2007 Barton solvents fire in Valley Center, KS

Jan 16, 2007 train derailment fire in Sheperdsville, KY

April 7-10, 2008 Kilauea, Hawaii sulfur dioxide releases

May-June, 2010 Deepwater Horizon in-situ burns