
NARAC Update

**Hazards Assessment Subcommittee
EMI SIG Annual Meeting
Washington, DC
May 3, 2004**

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John Nasstrom, DOE/NNSA Program Leader
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NARAC's Primary Sponsors



1. DOE Office of Emergency Management (ARAC Program)
2. DOD Naval Reactors Program (NR)
3. DHS Science and Technology
 - Plume modeling research and development
 - Local Integration of NARAC with Cities (LINC) Demonstration Program

Supported Sites (map at right)

40 DOE, NR, and DoD sites

5 DHS LINC pilot cities

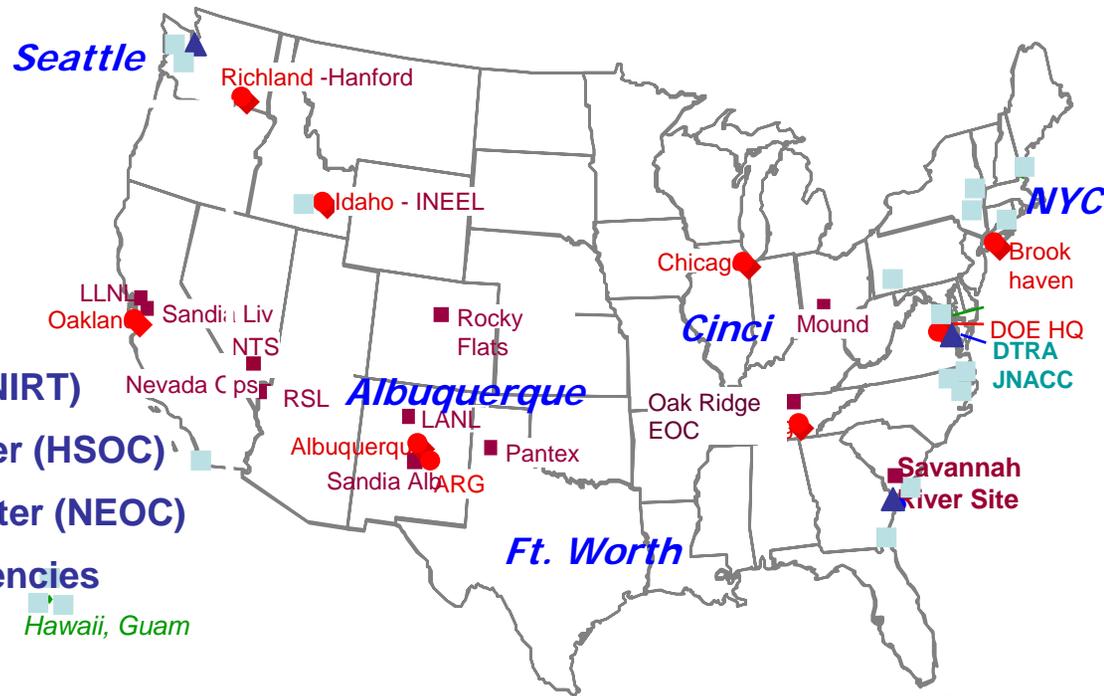
Supported Assets

DOE Nuclear Incident Response Teams (NIRT)

DHS Homeland Security Operations Center (HSOC)

DHS National Emergency Operations Center (NEOC)

100 additional local, state, and federal agencies



User Needs for Emergency Response Modeling



User needs vary:

- **First responders need:**
Quick estimates of hazard levels of concern
- **Specialized response teams and centers need:**
Detailed analysis tools and products
- **Emergency managers and decision makers need:**
Summarized products showing consequences and recommended actions



NARAC uses a suite of models: From fast, simple, stand-alone to complex high-fidelity models

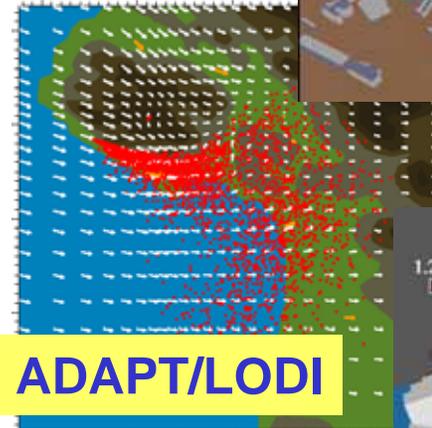
- Deployable rapid-response models
 - **HOTSPOT** radiological Gaussian plume model
 - **ALOHA and EPIcode** toxic chemical Gaussian plume models
 - **UK DSTL UDM** empirical Urban Dispersion Model
 - **Sandia Blast & Nuke, LLNL KDFOC** nuclear fallout and prompt effects codes
- Regional-scale models at NARAC
 - **ADAPT/LODI** meteorological data assimilation and dispersion models
 - Collaborate with **Sandia Source Term** development
 - **NRL COAMPS** weather forecast model with LLNL urban canopy
- Building-scale CFD model at NARAC
 - **FEM3MP** for scenario planning and vulnerability studies



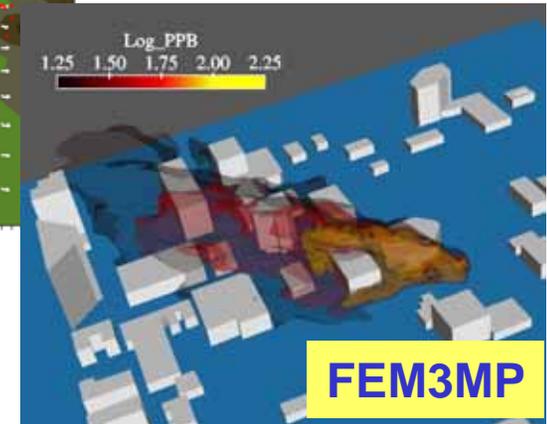
HOTSPOT



UK DSTL UDM



ADAPT/LODI

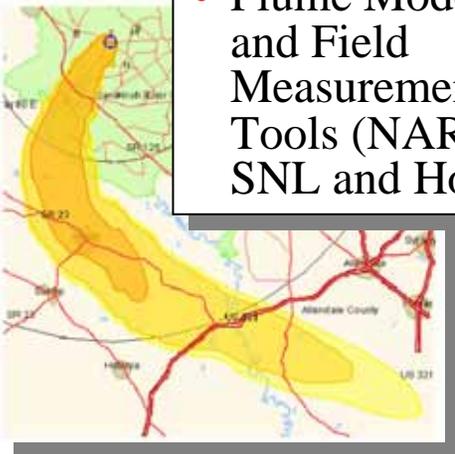


FEM3MP

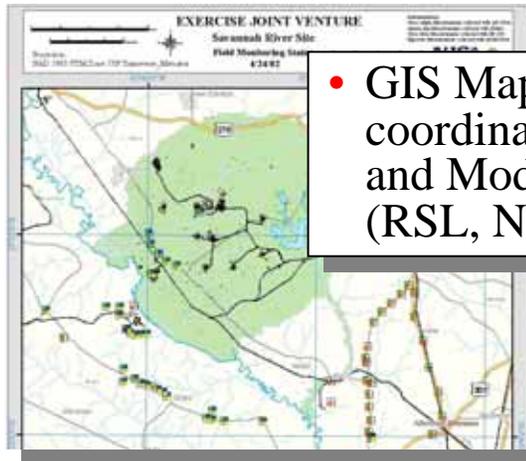
- Integrated mapping system for field measurements, modeling results, and dose assessment for DOE RAP teams with *Sandia National Laboratories (SNL) and Remote Sensing Laboratory (RSL)*
- Prompt (blast, thermal, radiation) effects from explosions with *Sandia National Laboratories, SNL*
- Radiological, chemical and biological source characteristics, release mechanisms with *SNL*
- New civilian population dose-response

Goal: Integration and Automation of LLNL/ARAC, SNL & RSL Assessment and GIS Tools

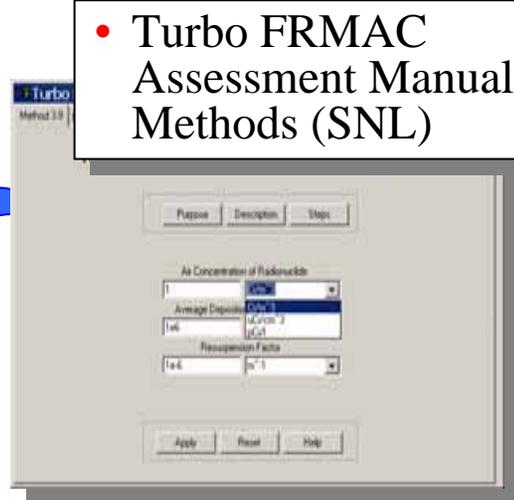
- Plume Modeling and Field Measurement Tools (NARAC, SNL and Hotspot)



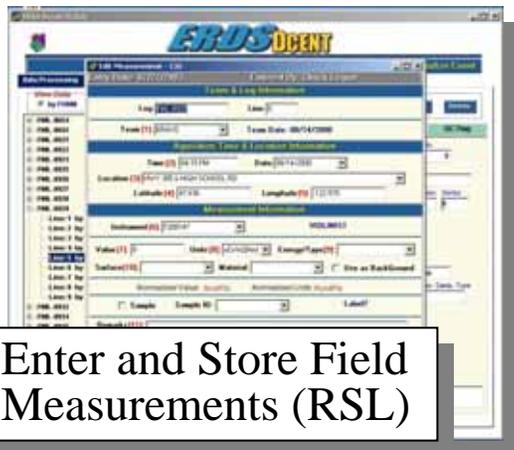
- GIS Mapping, GPS coordinates, Measurement and Model Data Displays (RSL, NARAC, SNL)



- Turbo FRMAC Assessment Manual Methods (SNL)



- Enter and Store Field Measurements (RSL)





Integration of modeling tools in multi-agency emergency response operations

Local/State Emergency Operations Center

Local, Regional, RAP, State Responders at Incident Site



Quick initial projections from guidebooks and fast running models (NARAC iClient)



Information distribution & decision making



National/Regional Expert Teams/Centers



Advanced modeling tools, Detailed Analyses

Internet, dial-up, satellite or wireless communication

Web-based information Distribution (NARAC Web)

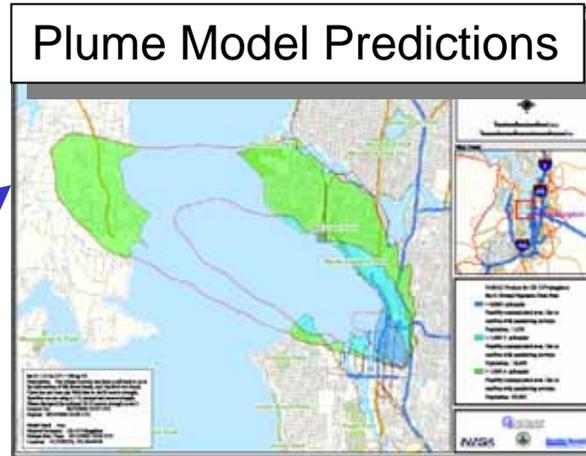
Collaborating City, County, State & Federal Agencies





Modeling and Monitoring is a Connected and Cyclical Process

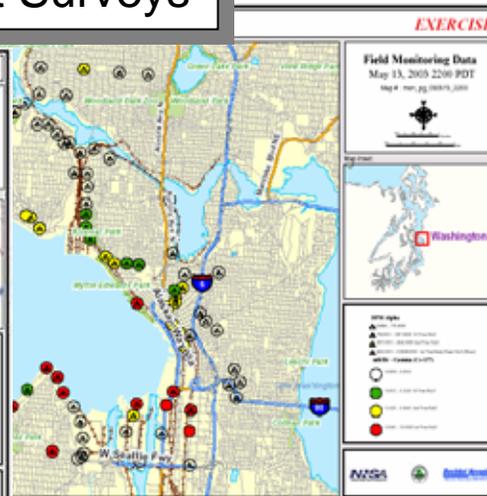
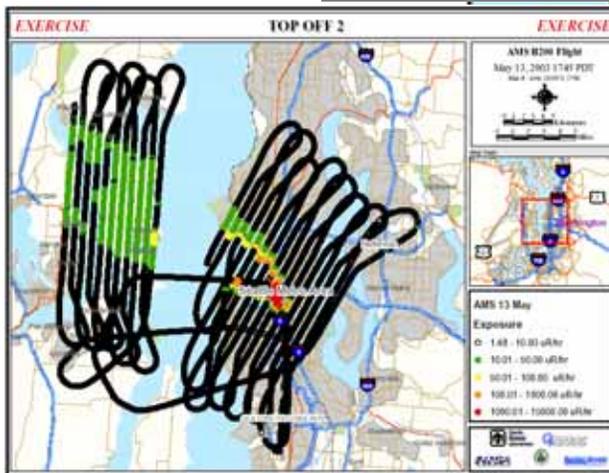
Measurements
refine model
predictions



Model predictions
guide
measurement
surveys

Measurement Surveys

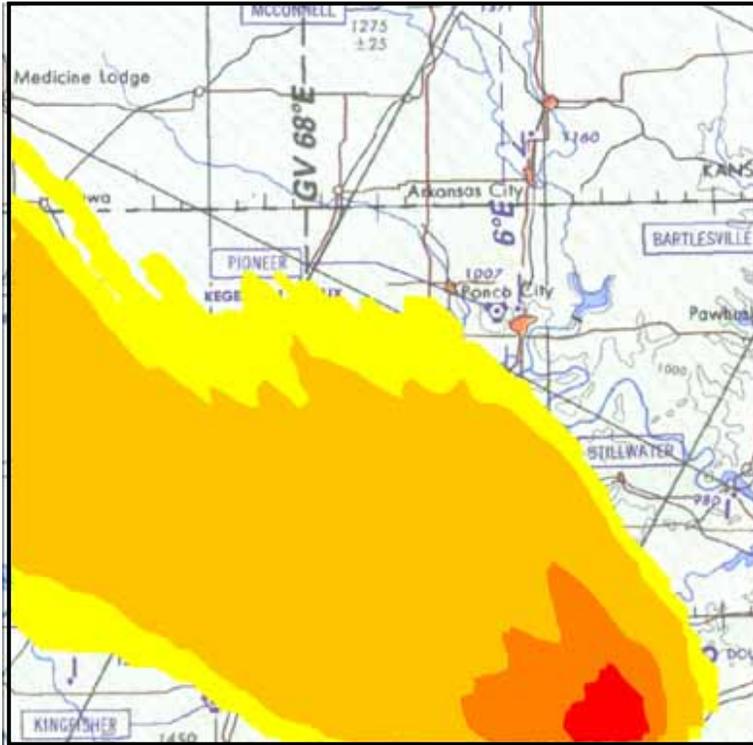
AMS



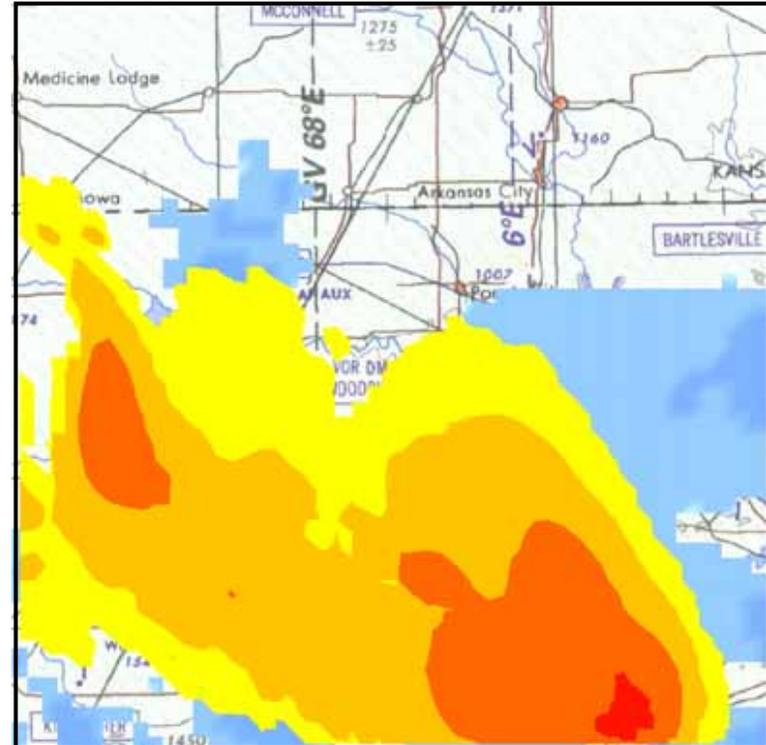
RAP
State
EPA...

Examples from
TOPOFF2
Exercise

High-resolution Weather Radar data and NARAC/LODI Precipitation Scavenging Model Will Be Able to Simulate Wet Deposition Hotspots



Wet deposition pattern from a continuous source using a uniform constant rain rate (30mm/hr)

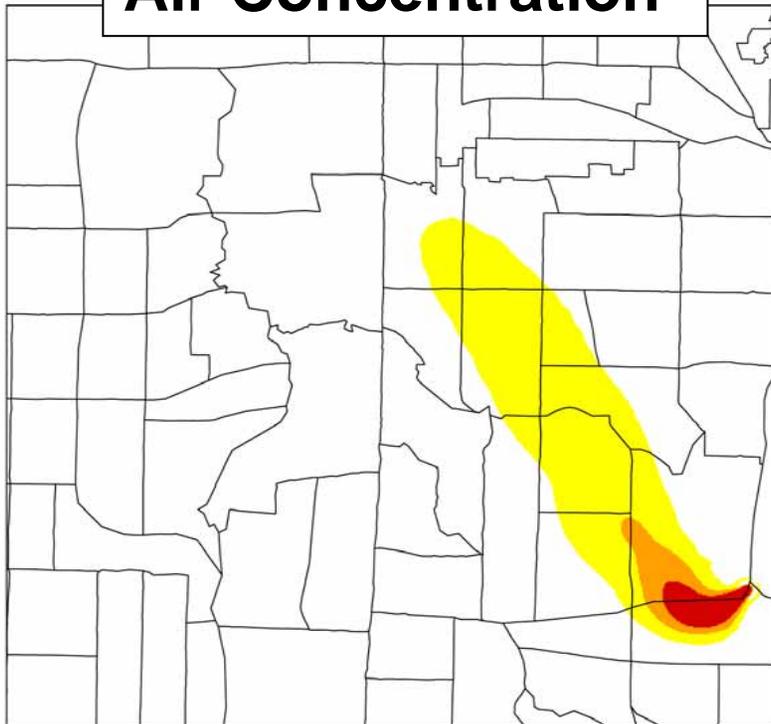


Wet deposition pattern using high-resolution weather radar (NEXRAD) precipitation data: Precipitation (blue) creates wet deposition hot spots (yellow-red contours) during a convective storm

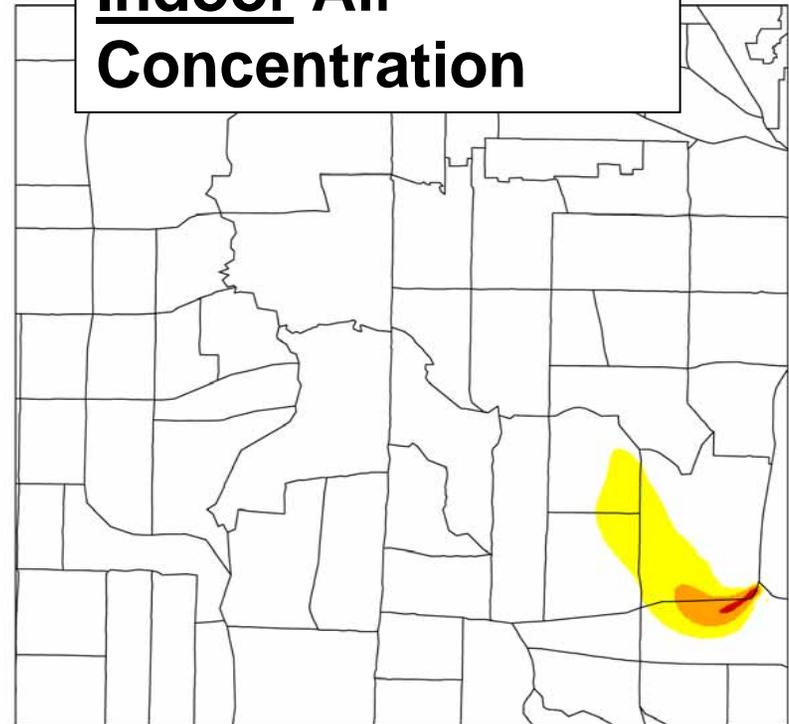
NARAC is Integrating LBNL Research on Outdoor-Indoor Infiltration Models



**Outdoor Plume
Air Concentration**



**Corresponding
Indoor Air
Concentration**



LLNL is Collaborating with multiple federal organizations on urban experiments to test and develop urban flow and dispersion models



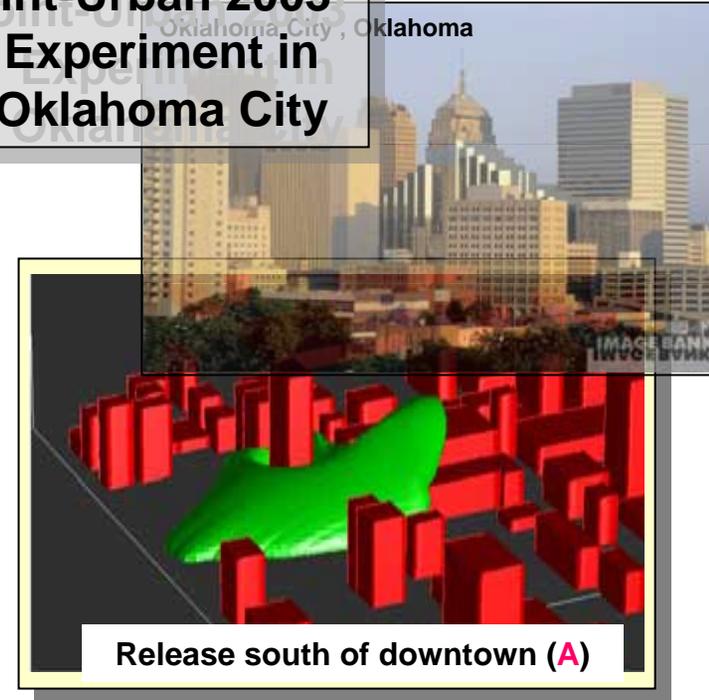
Urban 2000 Experiment in Salt Lake City

Salt Lake City Looking Northwest



Joint-Urban 2003 Experiment in Oklahoma City

Oklahoma City, Oklahoma



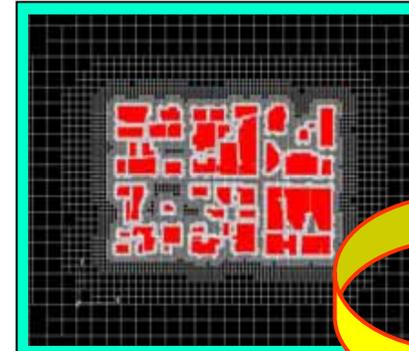
NYC Urban Dispersion Program



LLNL Urban- and Building-Scale Computational Fluid Dynamics Model R&D

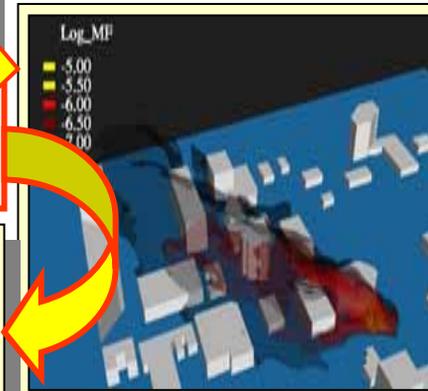
- Develop next-generation operational CFD model
 - Automated grid-to-geometry capabilities
 - Spatially and temporally resolved flows around individual buildings and building groups
 - LES to simulate concentration fluctuations and peak concentrations
 - Faster response building scale simulations (virtual building CFD, empirical models) for operational applications
 - Extension to interior spaces
- Develop improved urban canopy and empirical parameterizations

Rapid geometry-to-mesh and adaptive mesh refinement

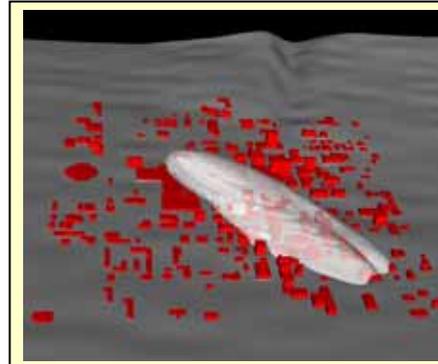


Cut-cell grids for complex geometries

Urban processes (turbulence, coupling)

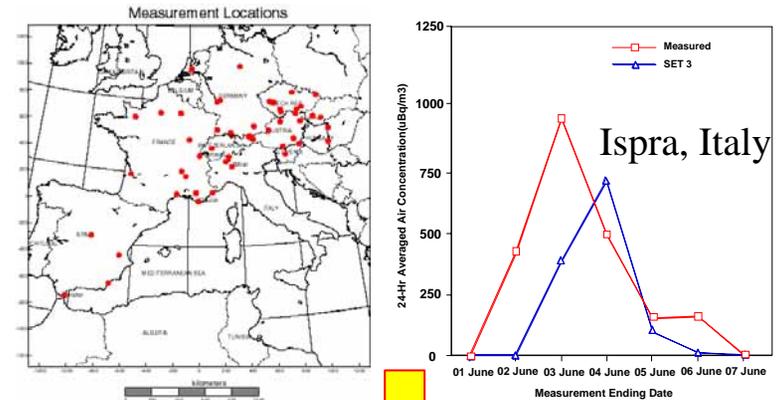


Support for large-scale computer architectures



LLNL is developing data-driven modeling tools to reconstruct events from measurements

- Event reconstruction tools answer the critical questions What? Where? When? How much?
 - Backwards analyses to determine probabilistic distribution of unknown source characteristics
 - Optimal forward predictions for consequence assessment
 - Dynamic reduction in uncertainty as additional data become available
- Approach: couple data and simulation via Bayesian inference, stochastic sampling, and optimization methods
- Reduce dependence on first responders to estimate source terms and utilize increasing number of deployed sensor networks and field measurement data



Reconstruction of Algeciras steel mill Cs-137 release from sensor data

