National Atmospheric Release Advisory Center (NARAC)

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Special OFCM Session

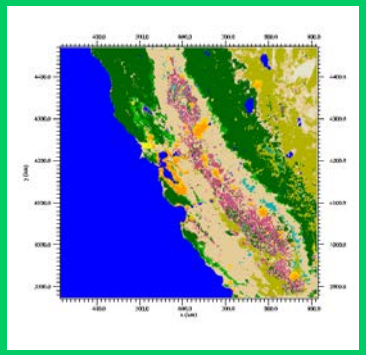
8th Annual GMU Conference on Transport and Dispersion Modeling

July 14, 2004

NARAC Provides Real-time Advisories for Hazardous Releases

Event information

- Real-time weather data
- Nuclear, radiological, chemical, biological source information
- Terrain, land-use, population, health effect databases

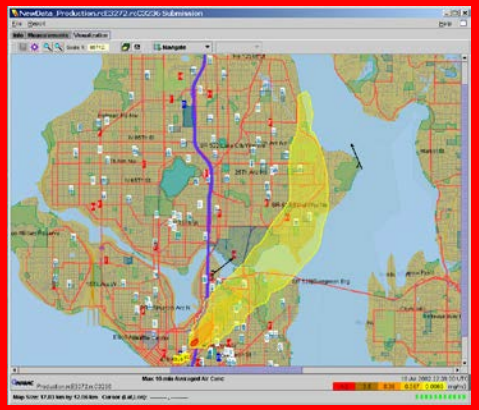


Plume Models and Expertise

- Advanced, automated 3-D plume modeling globally relocatable in real-time
- Scientific and technical staff provides quality assurance, training, assistance and detailed analysis 24 hrs x 7 days

Consequence Management Information

- Hazard areas
- Health effects and exposed populations
- Protective action guidelines
- GIS, facility and map features



NARAC is a DOE/DHS Capability with a Multi-Agency Customer Base

On-line Sites:
- **DOE**
- **DOD**
- **NR**

Major Programs/Customers:
- DOE Atmospheric Release Advisory Capability (ARAC)
  - Nuclear Incident Response Team (NIRT) asset
  - FRMAC, ARG, NEST, RAP
- DHS Science & Technology (S&T)
  - DHS Operations (HSOC, NEOC/NRCC)
  - Local Integration of NARAC with Cities (LINC)
  - Inter-Agency Modeling and Atmospheric Assessment Center (IMAAC)

Advisory Services:
- **FAA**
- **EPA**
- **NRC**
- **Local agencies**

Metdata Suppliers:
- Air Force Weather Agency (AFWA)
- Fleet Numerical Meteorology and Oceanography Center (FNMOC)
- National Weather Service
- Mesonets
- On-line sites

Common Operating Picture is Provided Via Sharing of GIS and Analysis Products

Federal & State Response Teams and Hub Cities

Internet,

Intranet & dial-up

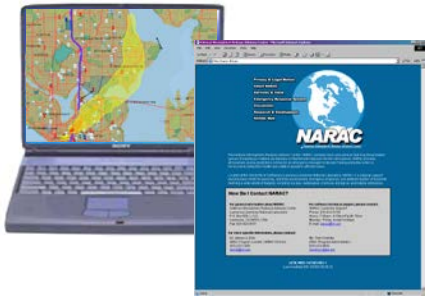
NARAC

NARAC Provides Detailed Analyses

Internet,

Intranet & dial-up

Cities, Counties, State & Federal Agencies



NARAC iClient

Advanced tools to obtain and display NARAC and standalone plume model predictions

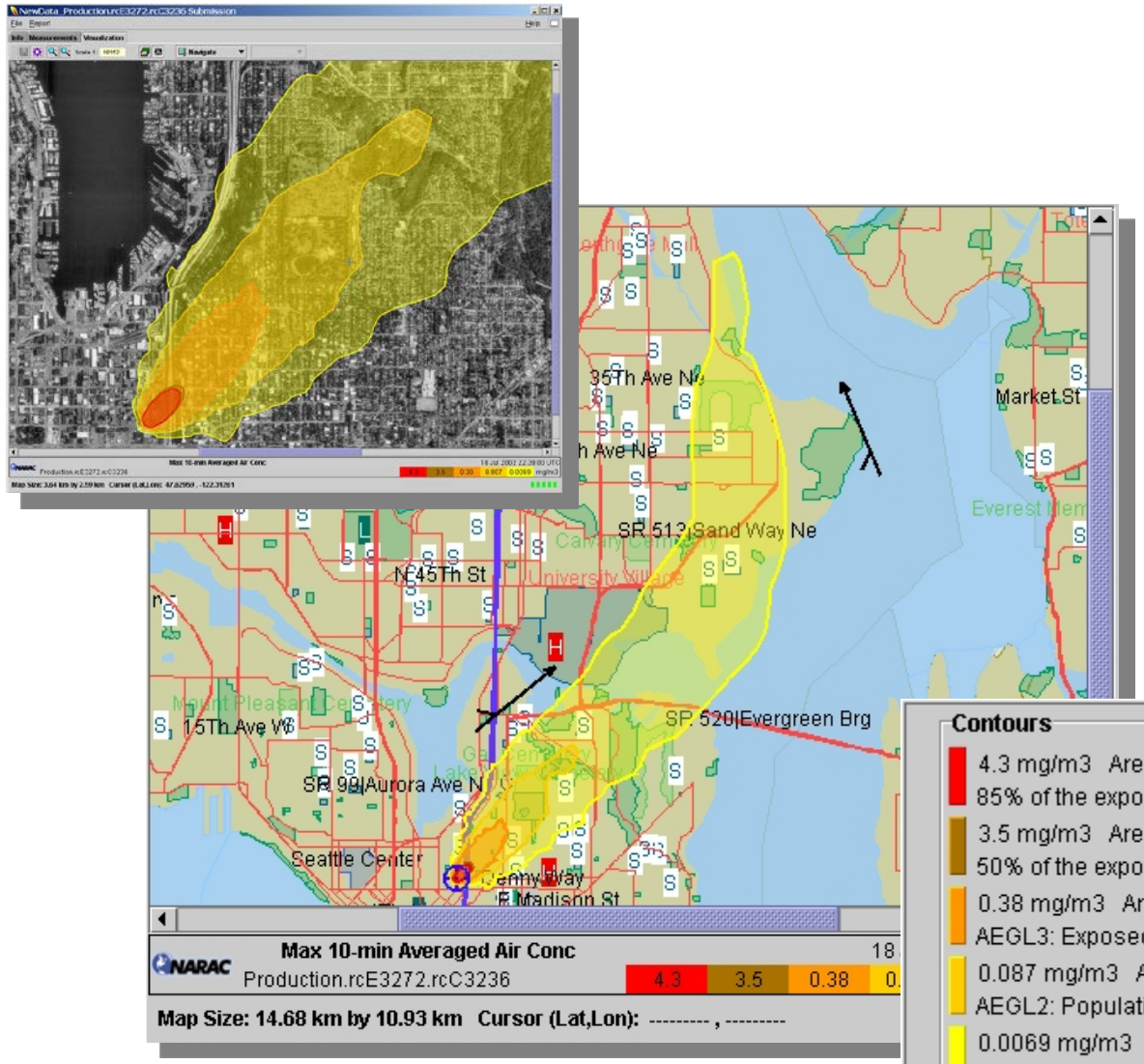
Web Distribution

NARAC Web

Web-based tools to easily request and display NARAC plume prediction and *share* with other users (password controlled secure distribution)

Collaborating Agencies & Additional Stakeholders

Customer Products Provide Important Situation Awareness Information to Customers



- Plume hazard areas
- Affected population counts
- Health effects (w/ECBC)
- Protective Action Guidelines
- Map features
  - Census Bureau TIGER
  - NIMA VMAP & ADRG
  - USGS DRG & DOQ
- Wind observations and derived fields

Contours

4.3 mg/m3 Area: 0.038 sq km Population: 30
85% of the exposed population could receive a lethal dose.

3.5 mg/m3 Area: 0.046 sq km Population: 30
50% of the exposed population could receive a lethal dose.

0.38 mg/m3 Area: 0.378 sq km Population: 3356
AEGL3: Exposed population could experience life-threatening effects.

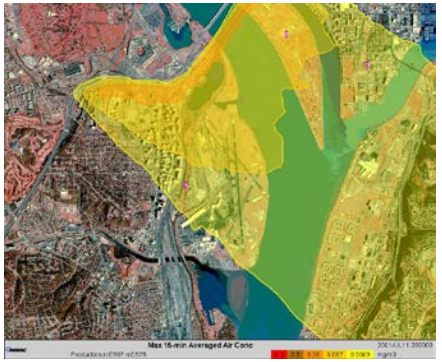
0.087 mg/m3 Area: 1.450 sq km Population: 7482
AEGL2: Population could experience serious long-lasting effects.

0.0069 mg/m3 Area: 15.249 sq km Population: 33001
AEGL1: Exposed population could experience notable discomfort.

Response Tools Support Different Fidelity, Scales, Release Types, and Response Times

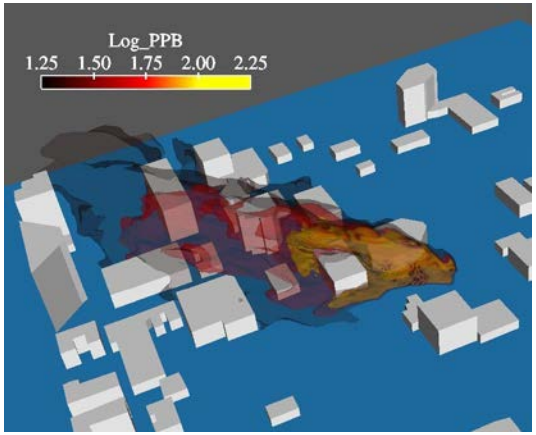
- Deployable rapid-response models
  - Radiological plume model HOTSPOT (Homann, 1994)
  - Toxic industrial chemical model EPIcode (Homann, 1996)
  - ALOHA/CAMEO (NOAA/EPA) – collaboration underway
  - INPUFF (2D puff model, EPA)
  - UDM empirical urban models (Dstl)– collaboration underway
- Regional-scale models
  - ADAPT/LODI (coupled data assimilation/dispersion models)
  - COAMPS (LLNL urban canopy version of NRL's weather forecast model)
  - Specialized codes – fallout prompt blast, thermal, radiation effects (w/SNL)
- Building-scale CFD models for scenario planning and vulnerability studies
  - FEM3MP (DOE) -> AUDM (DHS)

Hypothetical moving vehicle release Washington DC



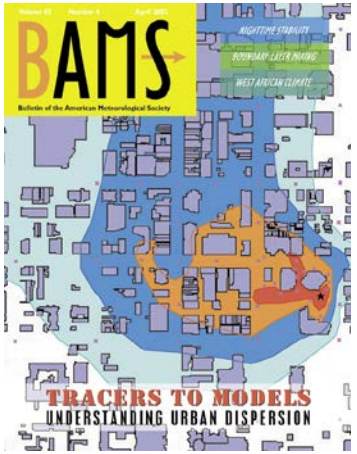
Tracy CA Tire Fire 1998

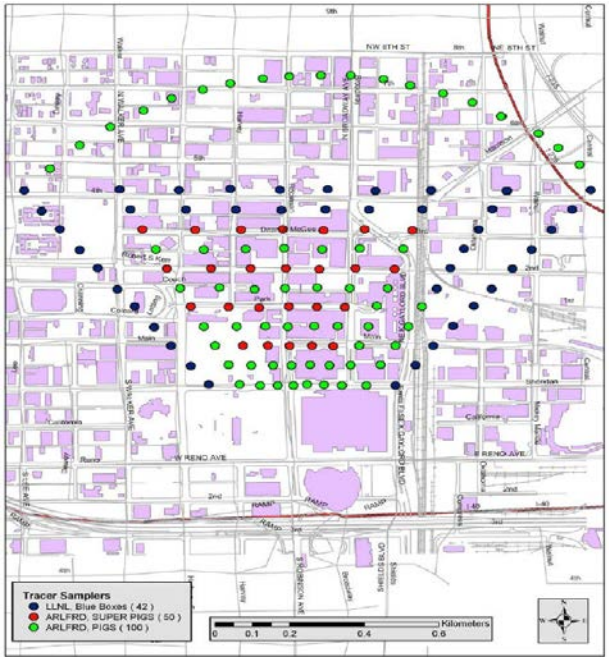
URBAN 2000 Salt Lake City Tracer Study



Urban Field Studies are Crucial for Evaluation of Atmospheric Transport and Fate Models

- DOE URBAN 2000 (Salt Lake City)
  - Data has been quality assured and released to the general scientific community
  - Nocturnal conditions (October, 2000)
- DHS/DTRA JU2003 (Oklahoma City)
  - Data collection completed (July, 2003)
  - Day and night time conditions, outdoor and indoor studies
- DHS Urban Dispersion Program (New York CIty)



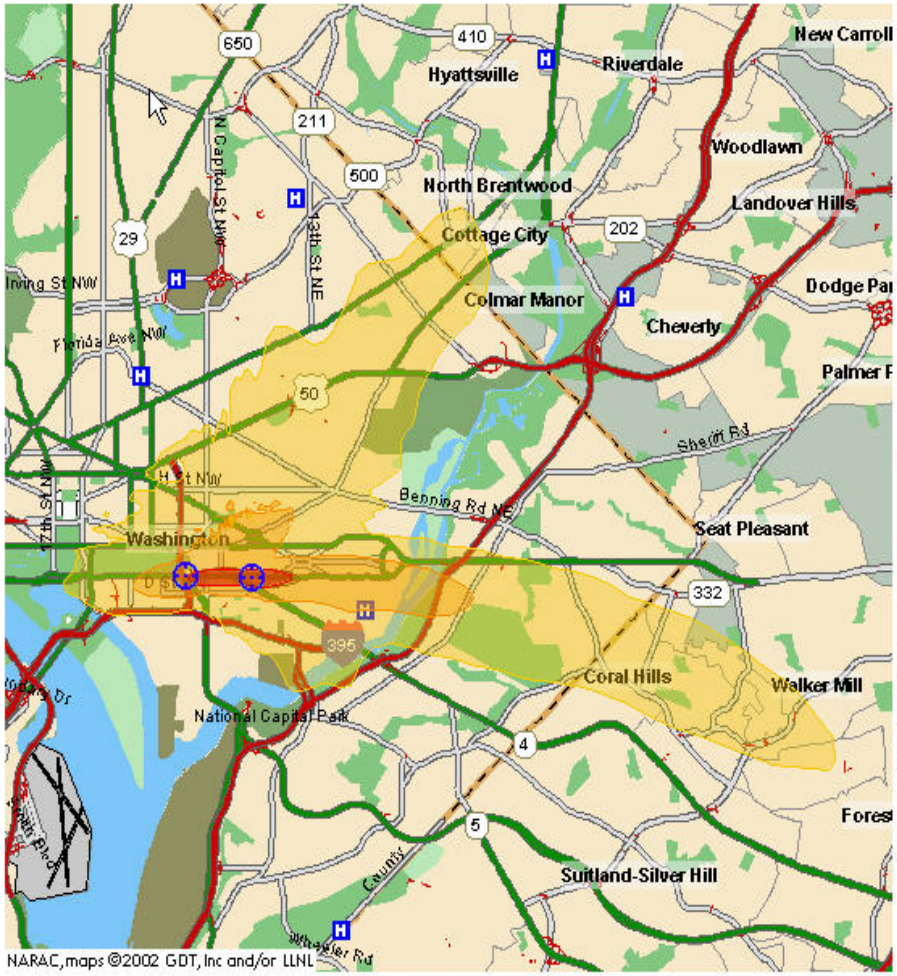


Source and Dose Response Models Are Key to Accurate Predictions

NARAC

Set 1: Max 10-min Air Conc over Period
(Short-Term Population Effects)

ktf-gd
Automated Report - Assessment



Map Size: 15.74 km by 15.74 km Id: Production/EVENT_16348/us_0/prodexec_9/all
NARAC Operations: narac@llnl.gov; (925) 424-6465
Requested by: { }

Effects or contamination from 18 Jun 2004 13:00 UTC to 19 Jun 2004 01:00 UTC at or near ground level.

Acute(Short-Term) Effects			
	(mg/m3) Area Extent	Population Casualties Fatalities	Description
	>7.3 0.4 km2 n/a	2,233 2,232 2,205	>85% of the exposed population could receive a lethal dose.
	>6.0 0.5 km2 n/a	2,628 2,623 2,485	>50% of the exposed population could receive a lethal dose.
	>0.4 4.9 km2 n/a	25,202 3,349 2,641	>AEGL-3: Death or irreversible health effects possible.
	>0.04 37.8 km2 n/a	178,962 3,349 2,641	>AEGL-2: Serious health effects or impaired ability to take protective action.

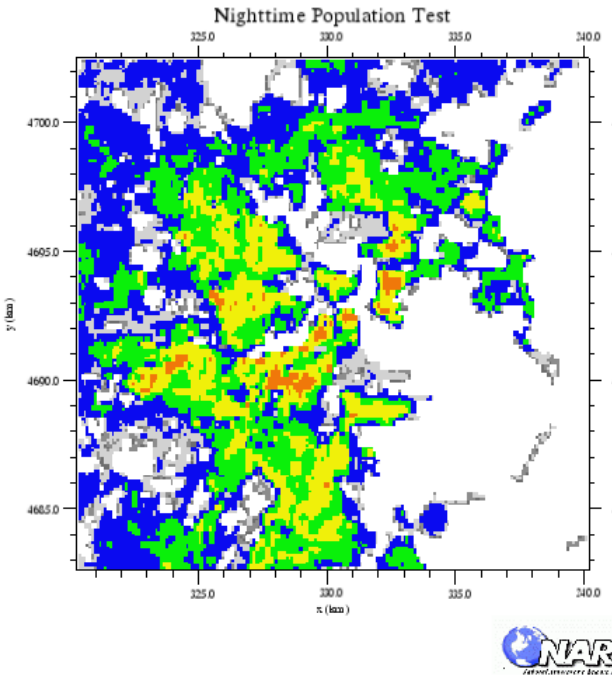
Note: Areas and counts in the table are cumulative. Casualties include both Fatal and Non-Fatal effects.

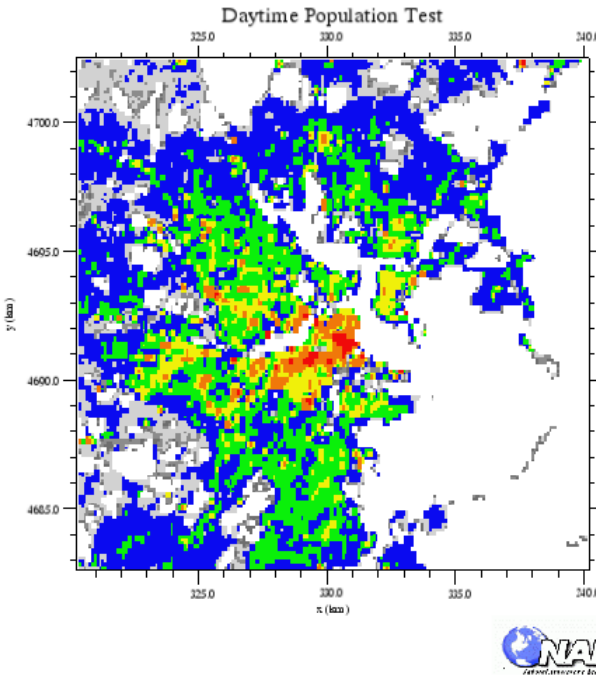
Source Location: 38.887566N, 77.013046W
Material: -ARAC-SOMAN
Comments: Release starting at
06/18/2004 13:00:00 UTC for 16 hr 21 min 30 sec
met obs at 06/18/2004 13:00:00 UTC
met obs at 06/18/2004 14:00:00 UTC
met obs at 06/18/2004 15:00:00 UTC
met obs at 06/18/2004 16:00:00 UTC
Not For Public Dissemination

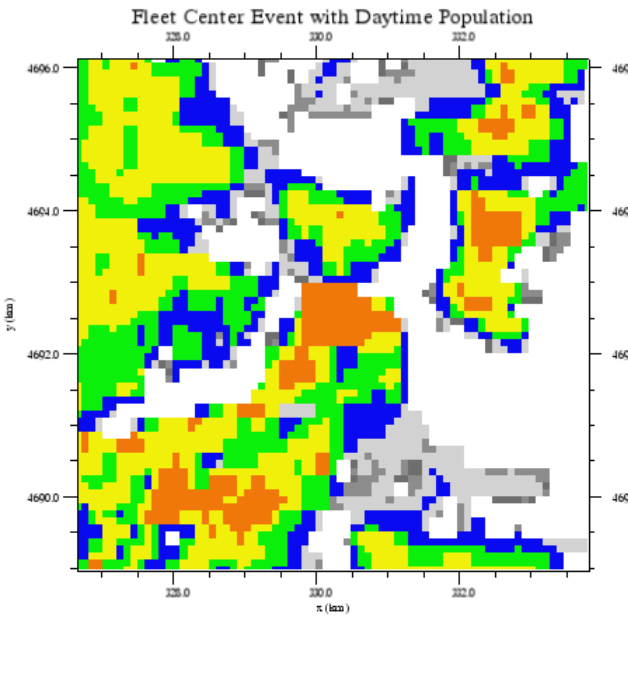
Sandia National Laboratories

- 24% release as vapor; 76% pools (55μ, SGD = 1.8)
- Line source evaporates over the next several hours in shifting wind conditions

LANL Day-Night / LLNL Special Events Data for Affected Population Estimates







Nighttime population for circles centered on Fleet Center

Radius	Population
500 m	5470
1000 m	21150
2000 m	59559
5000 m	378668
10000 m	1032666

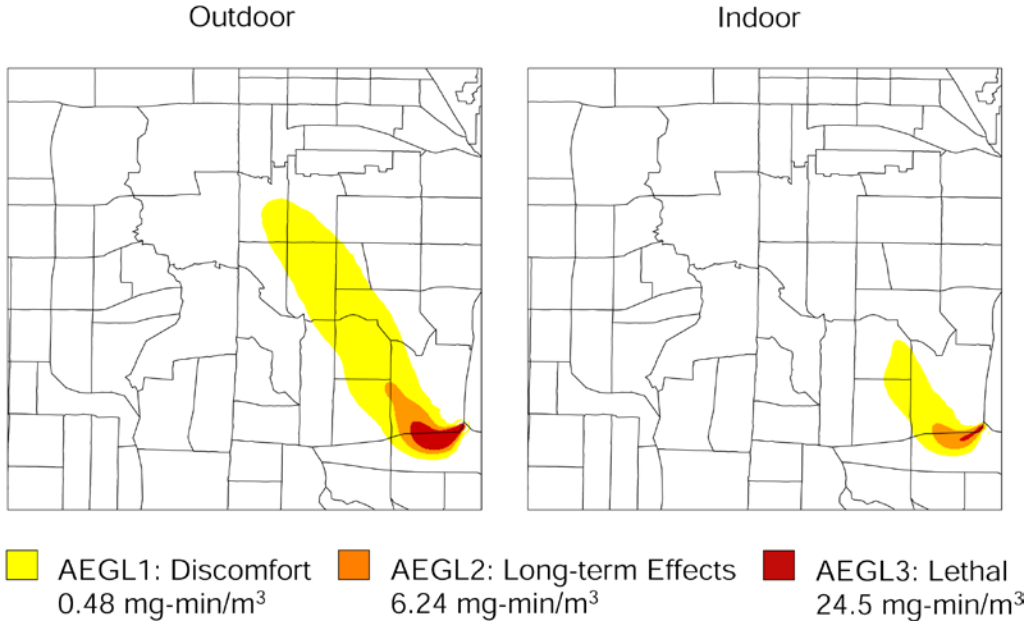
Daytime population for circles centered on Fleet Center

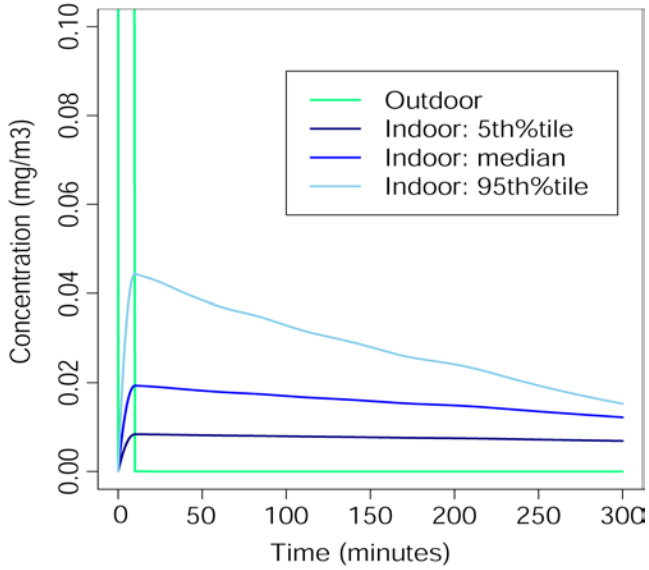
Radius	Population
500 m	10054
1000 m	111679
2000 m	329379
5000 m	741921
10000 m	1257073

Special event population added for circles centered on Fleet Center

Radius	Population
500 m	41300
1000 m	61150
2000 m	99559
5000 m	418668
10000 m	1082666

Indoor and Outdoor Exposures Differ Significantly (LBNL Building Infiltration)





- Goal: new guidance on evacuation or temporary shelter in place (SIP)
- Infiltration rate $Q[m^3/s] = ELA \cdot \sqrt{f_w^{\,2} \cdot \Delta T + f_s^{\,2} \cdot U^2}$ [m³/s] (Sherman, 1980):
  - Effective leakage area (ELA) [m²]
  - Pressure force from U and ΔT
  - LBNL residential air leakage building database
- Maximum indoor concentration << outdoor, but indoor levels higher longer-term

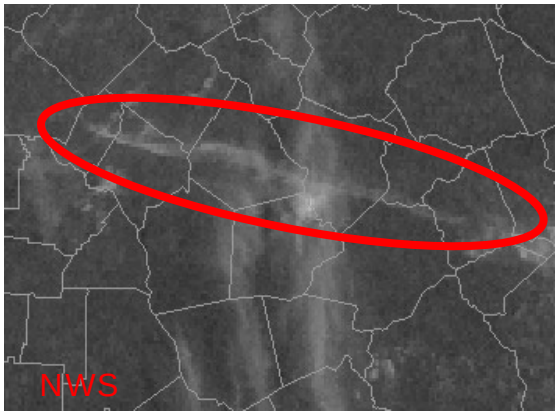
Detection/Warning and Response Systems Demand Rapid Event Reconstruction Tools

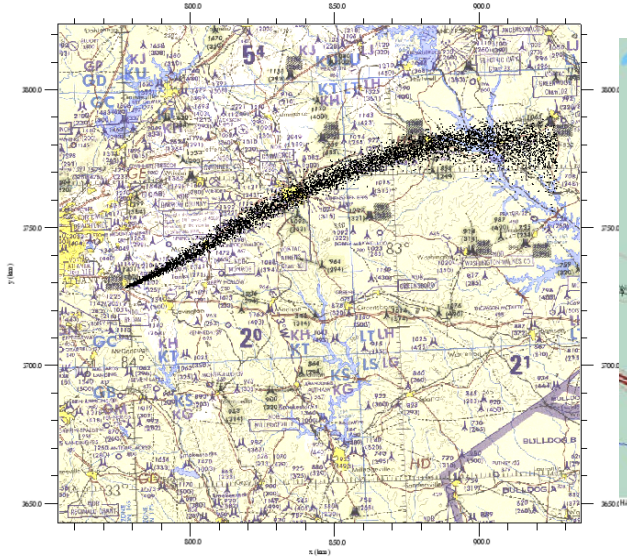
What?
When?
Where?
How much?

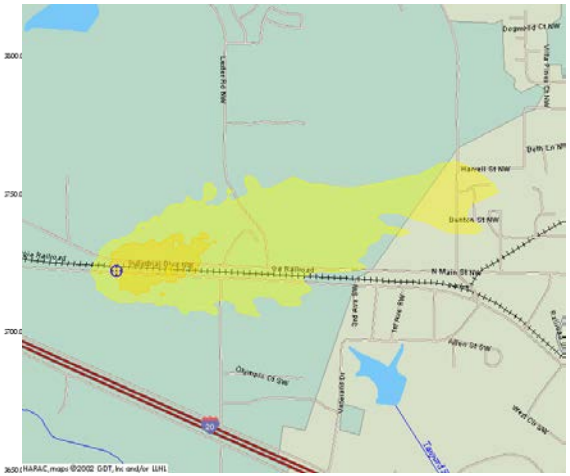
Release Event ***Observations (visual, sensor, casualty)*** ***Unknown Source*** ***Consequence Management***

- Airborne releases are one of the most highly effective and rapid means to impact large populations
- Approach couples data and predictive models to provides
  - Backwards analyses to provide *probabilistic* estimates of unknown source characteristics
  - Use of multiple disparate data types (quantitative, soft, remote-sensing)
  - Optimal forward predictions for consequence assessment
  - Dynamic reduction in uncertainty as data streams continue

Effective Response to Real-World Incidents Requires Inter-Agency Cooperation







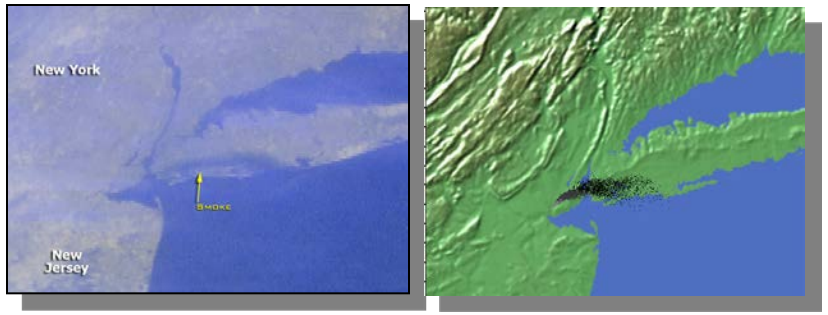
NARAC

- Chemical plant fire, Conyers GA
- 250,000 lbs of Chlorine compounds burned on May 25, 2004
- Products used by Federal (DHS, DOE, EPA), state (GA), and local officials to guide:
  - Emergency Operations Center location
  - Scene approach
  - Scene management
  - Evacuations
  - Medical resource deployment
  - Sampling teams

Support of Local Responders is a Critical Component of Homeland Security

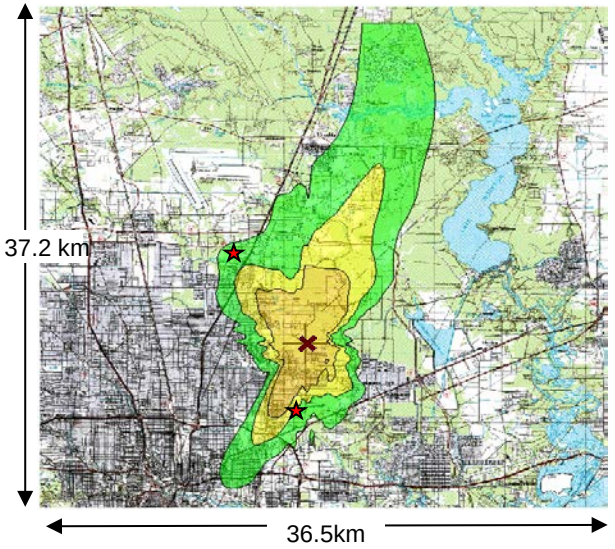
- DHS Local Integration of NARAC with Cities (LINC) demonstration project is developing approaches for support of local agencies
- Five pilot cities: Albuquerque, Cincinnati, Fort Worth, New York, Seattle (180 users)
- Cities have used LINC tools invaluable for decisions on deployments, approach routes, sheltering
  - Pilot cities have invested substantial resources (staff and time) in LINC
  - Pilot cities have engaged surrounding cities, counties and state (emergency management, fire, public health, police, environmental agencies)
  - Supported local agencies in major national exercises and ~400 local exercises in 6 months

LINC support of NYC OEM Staten Island Fuel Fire February 21, 2003

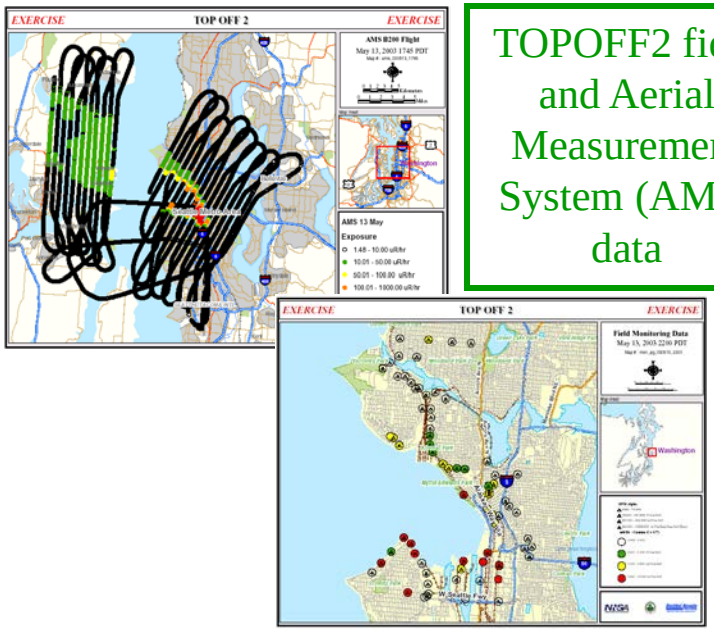


ATD Models are Key Component of Detection, Warning, and Incident Characterization Systems

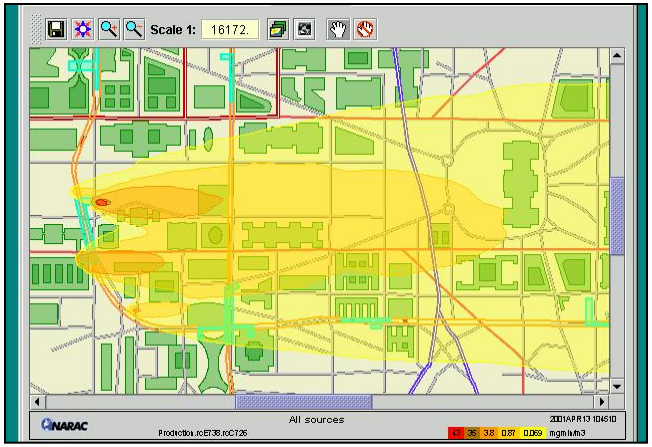
- DHS/HHS BioWatch environmental monitoring
- DHS Biological Warning and Incident Characterization System (BWIC)
- DOT/WMATA PROTECT subway chemical detection system
- DOE Nuclear Incident Response Team aerial and ground measurements



Analysis for environ. monitoring system



TOPOFF2 field and Aerial Measurement System (AMS) data



PROTECT subway crisis response system outdoor venting