NSPSS

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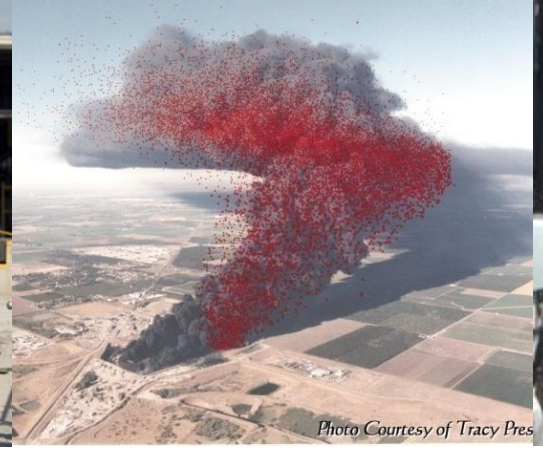
Plenary Presentation

IMAAC as a Decision-making Support Capability for CBRNE Incidents

Scott Runyon, Reachback Analyst, Defense Threat Reduction Agency
Technical Reachback Division



IMAAC

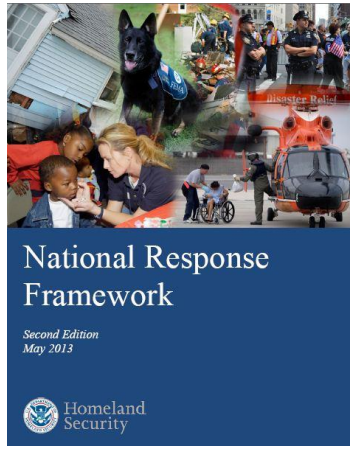
Interagency Modeling and Atmospheric Assessment Center

Distribution Statement A
Approved for public release; distribution is unlimited

IMAAC MISSION

Provide 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 involving hazardous atmospheric releases.

Homeland Security Council Memorandum 2004

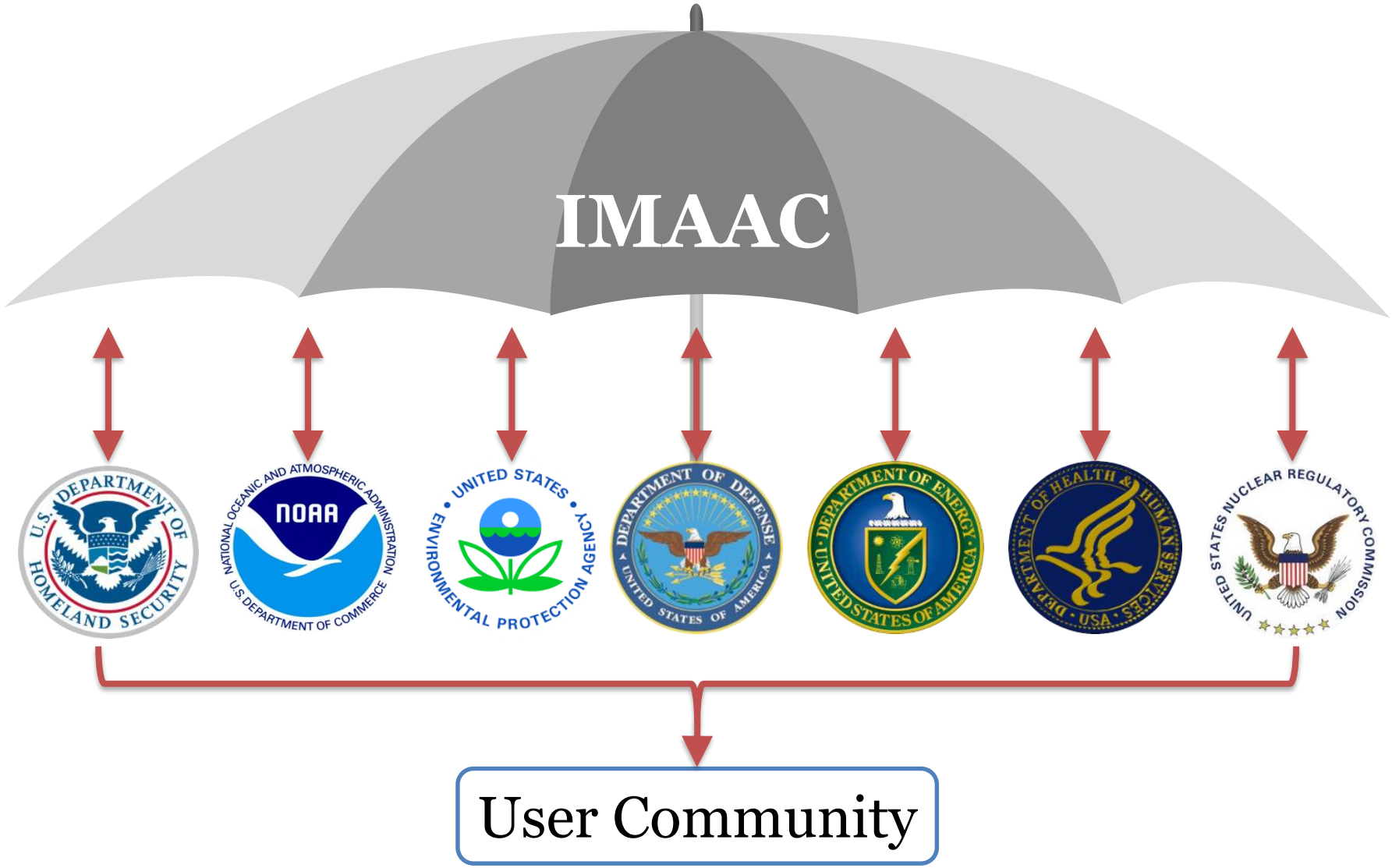


Memorandum of Understanding between all IMAAC member agencies

WHO IS IMAAC?

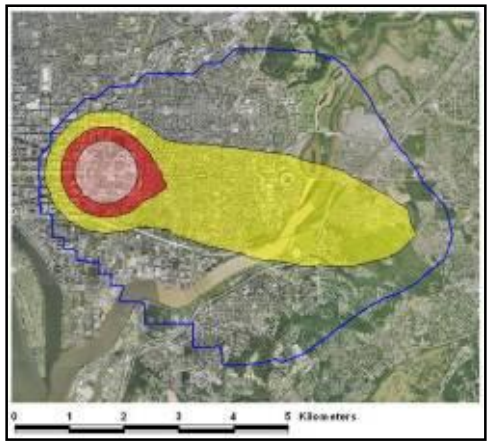
FEMA
NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE
DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
DEPARTMENT OF ENERGY
UNITED STATES OF AMERICA
DEPARTMENT OF HEALTH & HUMAN SERVICES
USA
UNITED STATES NUCLEAR REGULATORY COMMISSION
IMAAC IS A PARTNERSHIP

IMAAC UMBRELLA CONCEPT



IMAAC SUPPORT & TRAINING

- The IMAAC provides atmospheric modeling support for:
  - Real-world events
    - Emergencies
    - National Special Security Events (NSSEs)
  - Exercises
    - Vibrant Response – 10 kt IND scenario
    - Southern Exposure – NPP
  - Training
    - Webinars
    - On-site
    - Classroom (HPAC)



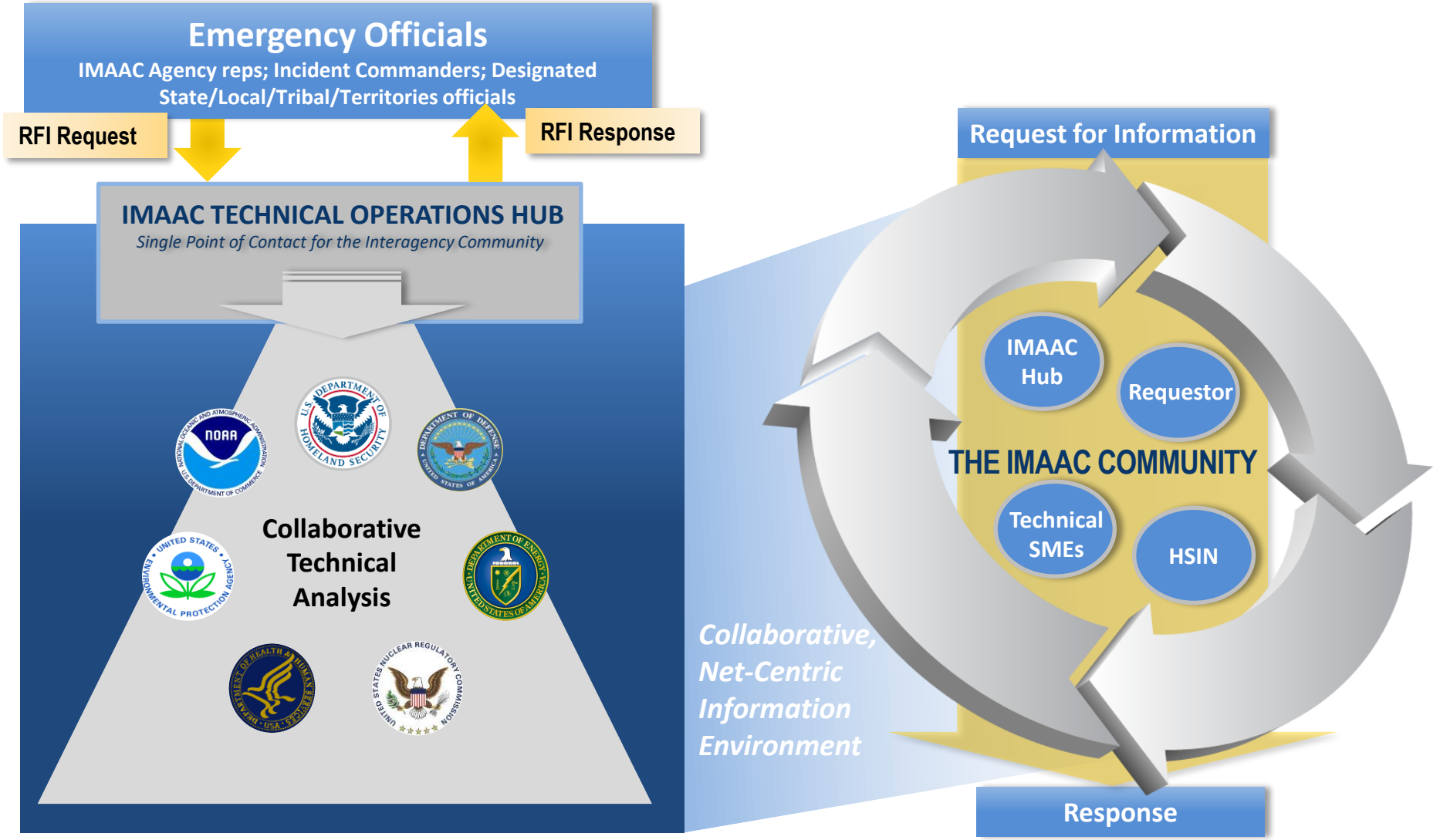
IMAAC TECHNICAL OPERATIONS HUB

- Managed by the Defense Threat Reduction Agency (DTRA).
- The IMAAC Technical Operations Hub, coordinates the production and dissemination of IMAAC plume modeling products.
- Capabilities
  - Staffed 24/7 by CBRNE subject matter experts
  - Turn around requests quickly
  - Numerous decision support tools to assist Interagency customers

IMAAC TECHNICAL OPERATIONS HUB

- Federal, military, and contractor/watch-stander personnel specializing in these fields:
  - Chemistry
  - Nuclear
  - Meteorology
  - Medical/Biology
  - Engineering/Sciences
    - Chemical
    - Nuclear
    - Combustion
    - Structural/Mechanical
    - Computational Fluid Mechanics
    - Mathematics
    - Electrical/Computer
- Degree levels: MD, PhD, ScD, MS

IMAAC: OPERATIONAL CONCEPT



IMAAC MODELING TOOLS

DoD/DTRA
- HPAC

EPA
- CAMEO/ALOHA

NOAA
- CAMEO/ALOHA
- HYSPLIT

HHS
- Population modeling

DoD/DTRA
- HPAC

DOE/NNSA
- NARAC

DoD/DTRA
- HPAC

EPA

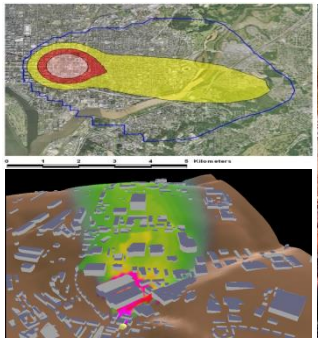
NOAA

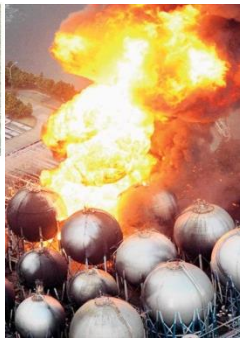
NRC
- RASCAL

DoD/DTRA
- HPAC
- VAPO

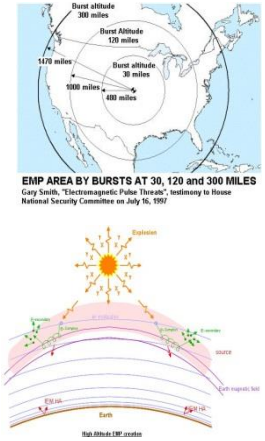
IMAAC MODELING TOOLS, cont.

Chem/Bio

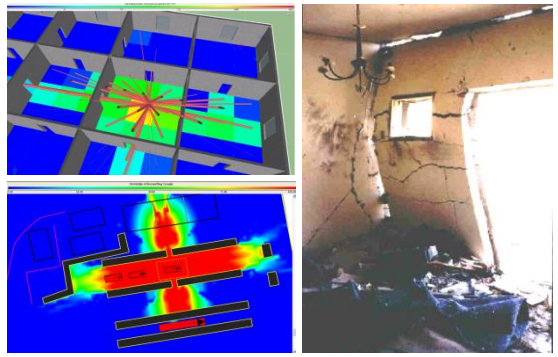




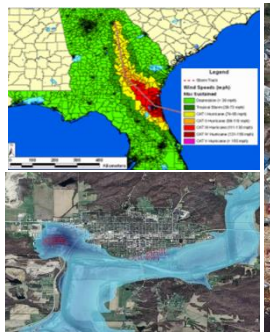
Rad/Nuc



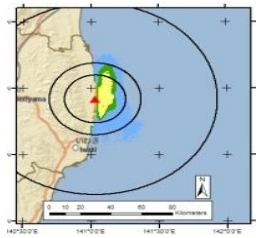
Explosion

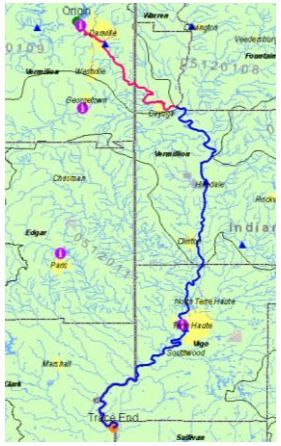


Cascading Effects



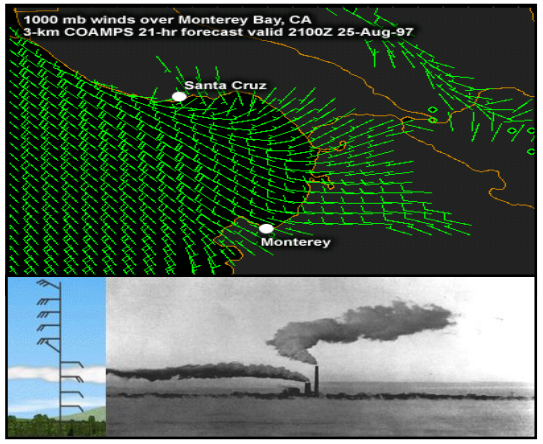
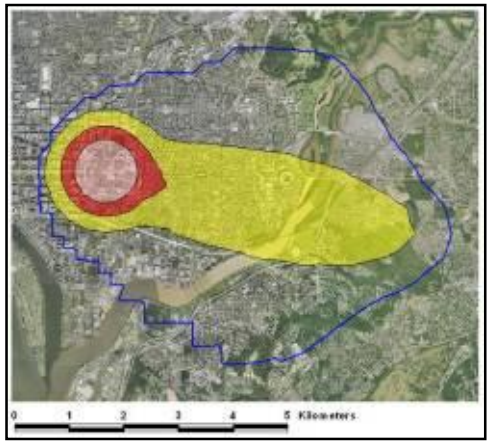
Waterborne Hazards



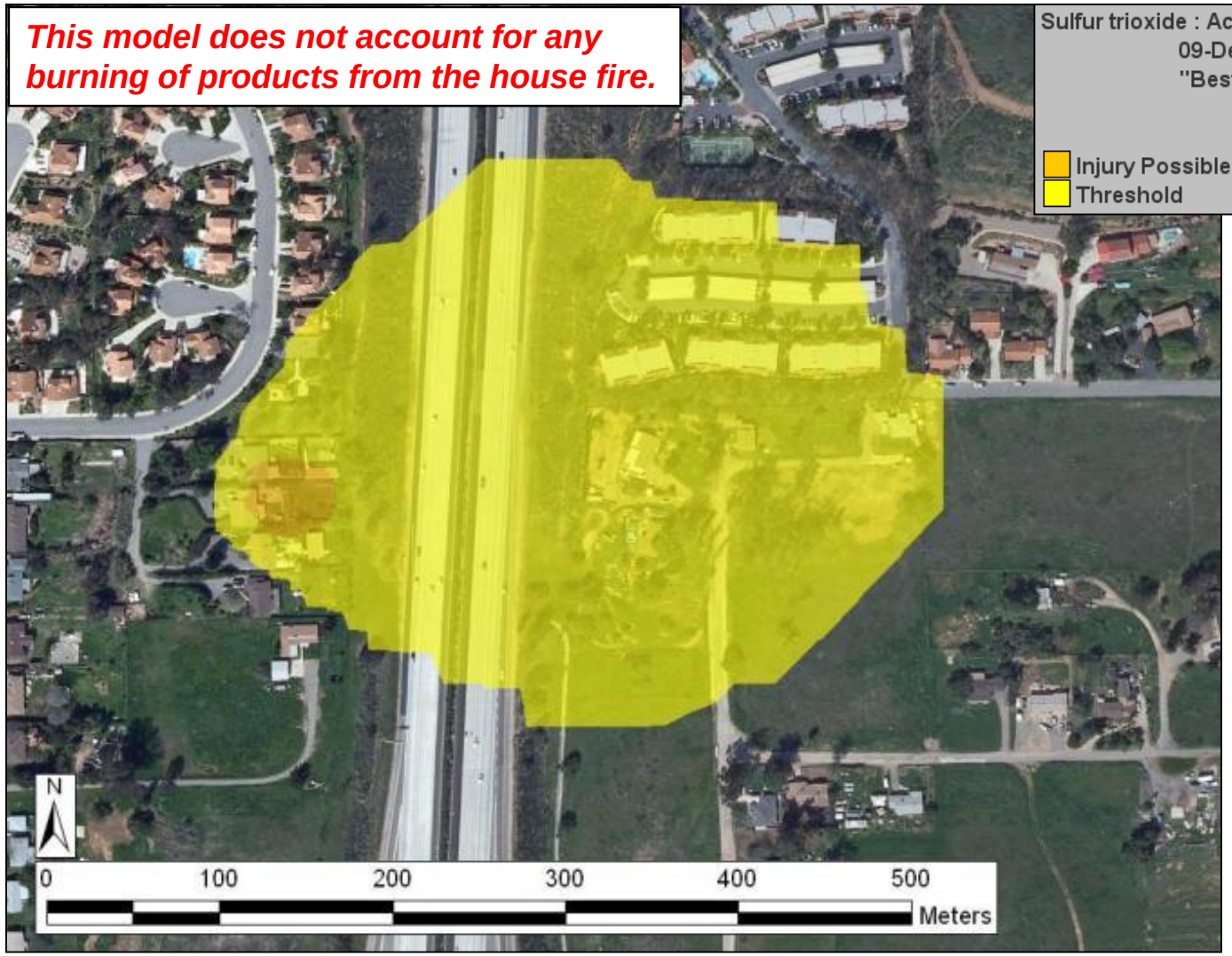


Chem/Bio: HAZARD PREDICTION & ASSESSMENT CAPABILITY (HPAC)

Forward deployable, probabilistic CBRN hazard prediction model that assists the responders in analyzing WMD employment.

Hazard Sources	Weather & Transport	Effects
		
Chem/Bio Facilities **Chem/Bio Weapons** **Nuclear Weapons** **Nuclear Facilities** **Radiological Weapons** **Industrial Facilities** **Missile Intercept**	**Historical Weather** **Forecast Weather** **Current Observations** **Forensic Weather** **Particle Transport** **Urban Transport**	**Human Medical Effects** **Toxicity Levels** **Contaminated Areas** **Population Effects** **Hazard Areas**

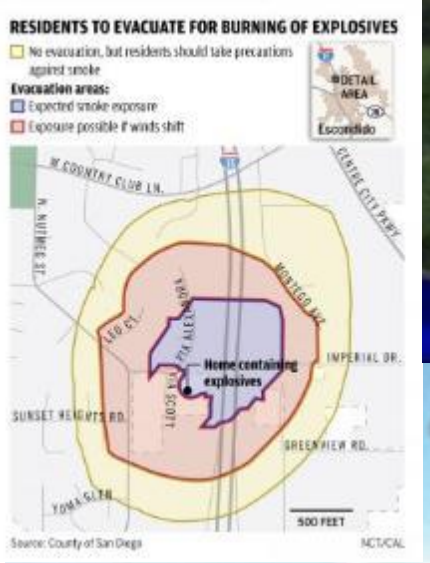
HPAC – First Responder Modeling
Sulfur Trioxide without Thermal Lofting



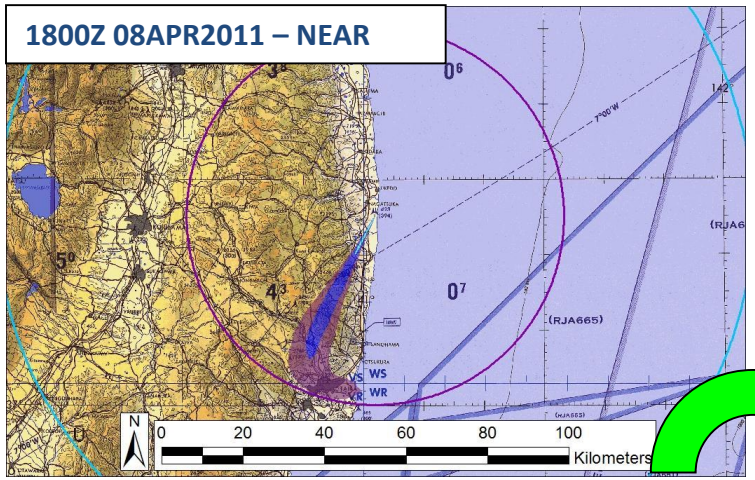
FACTS

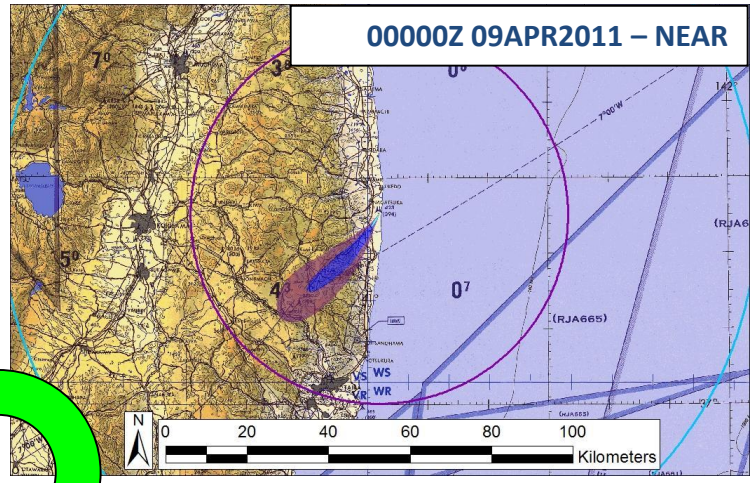
Escondido, CA
Location: 33.152371º N / 117.105315º W
Strike Time: 1900Z 09Dec2010
Type: Sulfur Trioxide
Amount: 2.31 kg
Release: 20 minutes duration
Weather: 12 km NAM
Model: HPAC 5.0 SP1
Static Population Estimates: LandScan 2009

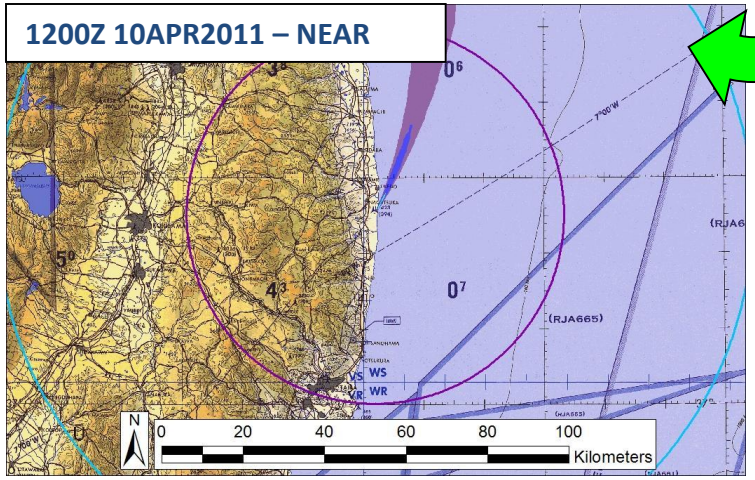
HPAC – Escondido CA "Bomb Factory House" News Coverage (09 Dec 2010)

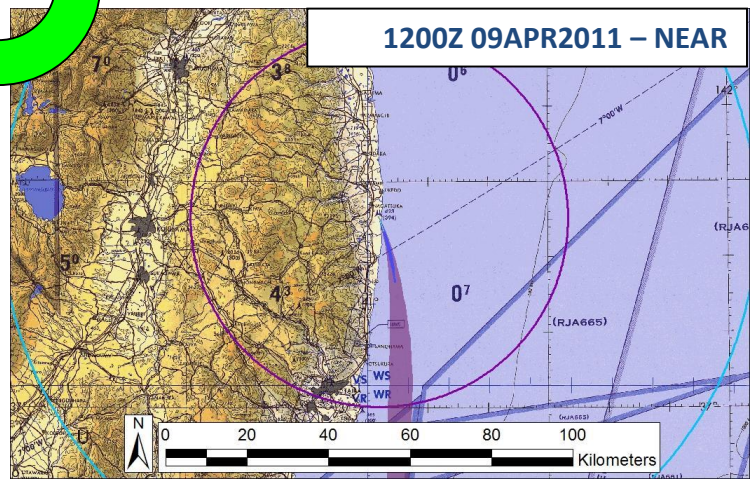


HPAC – Japan Nuclear Accident Modeling Isotope Air Concentration - Fukushima









Total Activity Isotope Air Concentration	uCi/ml
100 mCi/m3	0.1
10 mCi/m3	0.01
1 mCi/m3	0.001
100 uCi/m3	1.0E-04
10 uCi/m3	1.0E-05
1 uCi/m3	1.0E-06
100 nCi/m3	1.0E-07
10 nCi/m3	1.0E-08
1 nCi/m3	1.0E-09

Total Activity Isotope Air Concentration represents standard detectable levels of radioactivity from all possible radioactive isotopes released by the reactor at that exact time.

Note: Percent release decreased based on data on 0300Z 08APR2011

These are simulated data and are NOT to be used for dose calculations

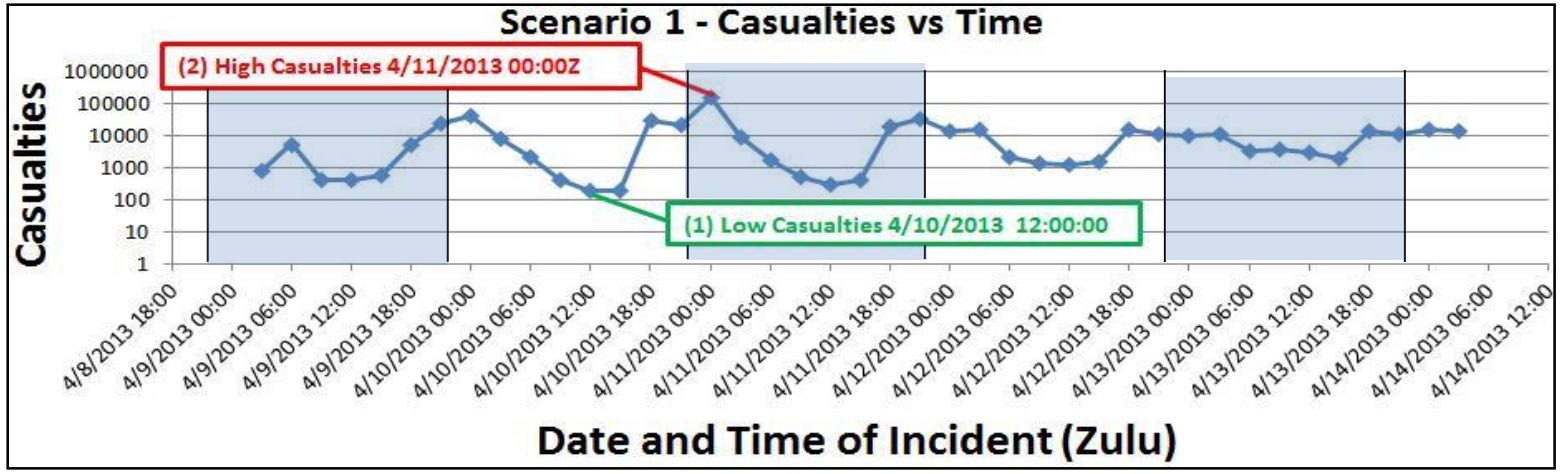
Models are for air dispersion only and do not account for water dispersion.

Range Rings
(nautical miles)

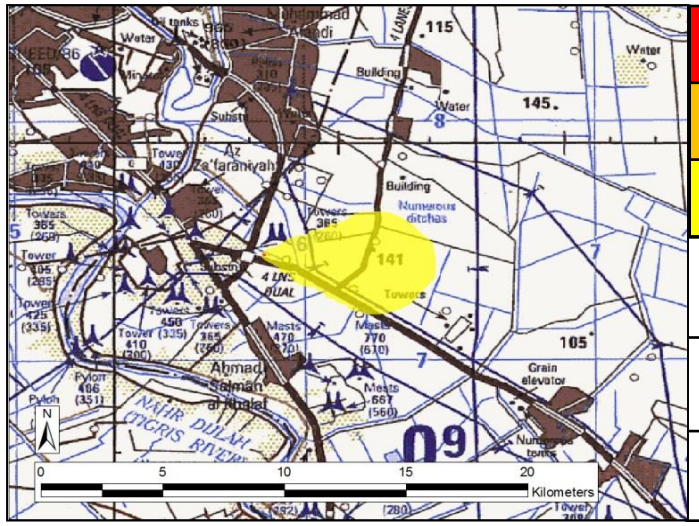
	25 NM
	50 NM
	125 NM

Note: these concentrations are very low and not exceptionally dangerous to human health, but monitoring devices may see hits.

HPAC Batch – Potential Release Planning
Casualties vs. Time – 5 day – GB



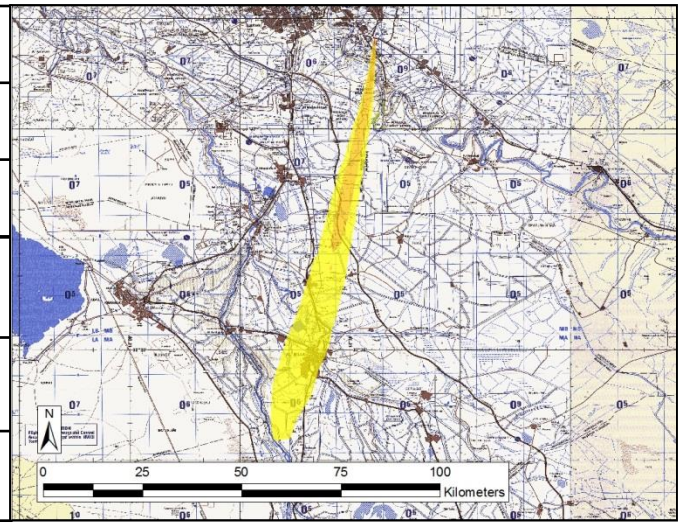
(1) Low – 10APR2013



	50% Mortality
	50% Casualty
	10% Casualty

Case	Date	Casualties
High	11APR2013 0000Z	~100,000
Low	10APR2013 1200Z	~200

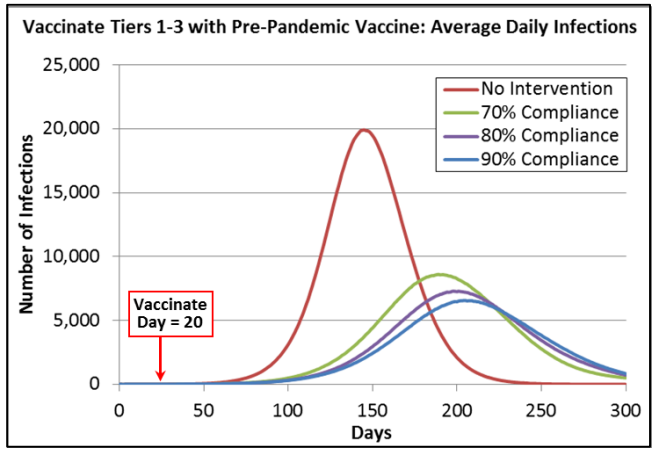
(2) High – 11APR2013



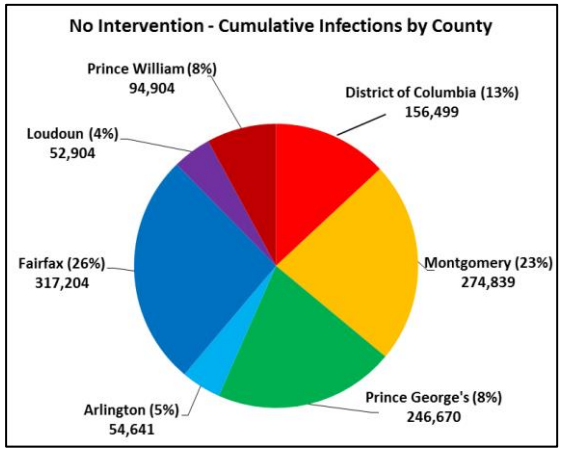
Bio: Comprehensive National Incident Management System (CNIMS)

- Developed for DTRA by Virginia Tech (VT) – Virginia Bioinformatics Institute (VBI)
- CNIMS models the spread of infectious disease by simulating movement, proximity, and interactions between individuals within a geographic region using high-performance computing (HPC)
- CNIMS has been used for real world events (2009 H1N1), exercises (SLE '13), and planning requests (Alabama National Guard, NORTHCOM)
- Utilizes a web-based GUI that allows for user-specification of scenario parameters

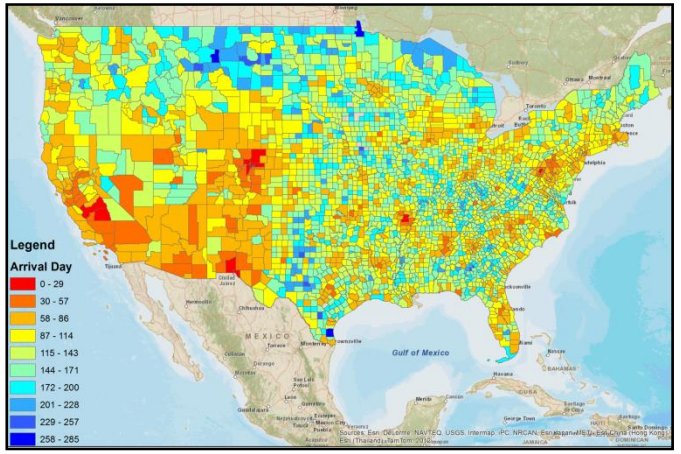
Variations on Intervention Parameters or Multiple Interventions Combined



Infections by Demographics (Age, Gender, County, etc.)

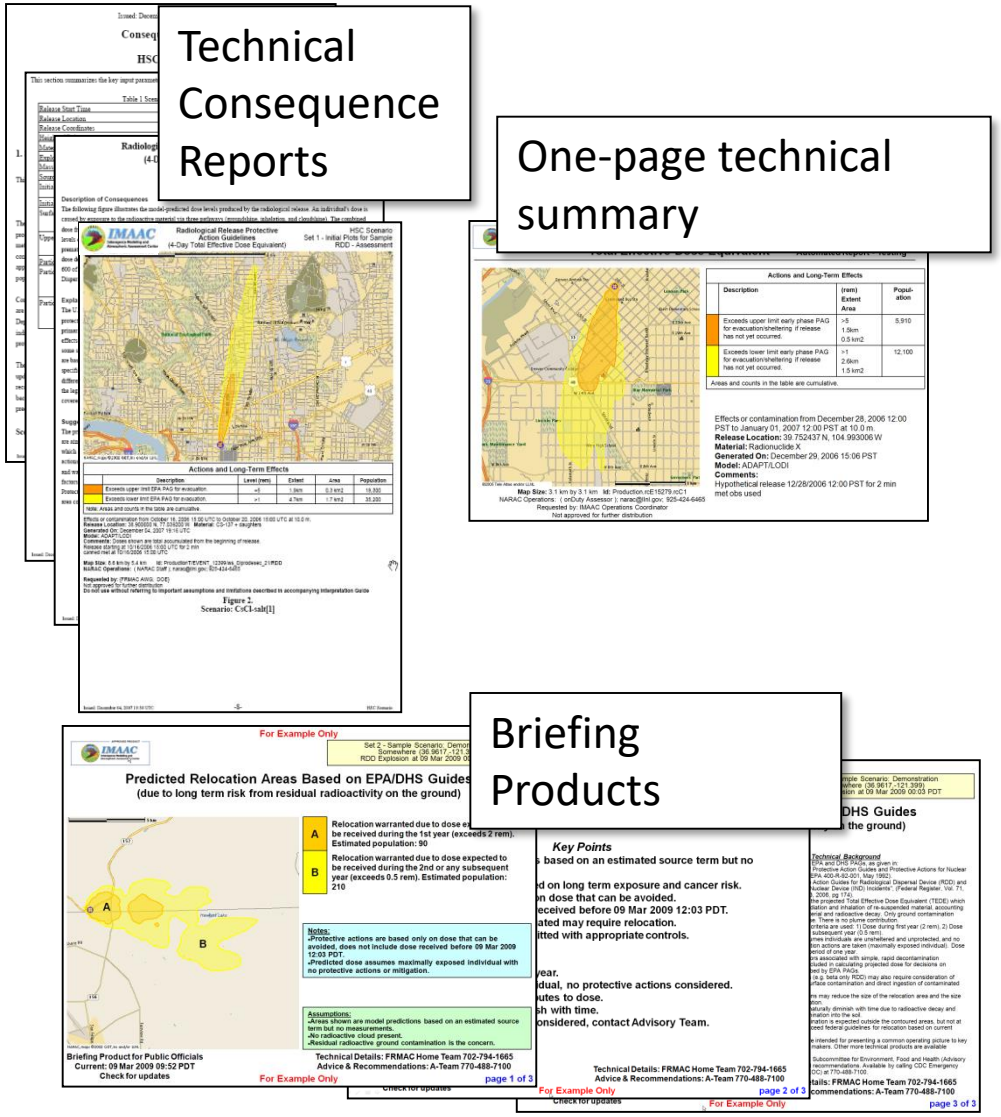


Infectious Disease Spread on the City, State, and National Level



Rad/Nuc: DOE/NARAC Products

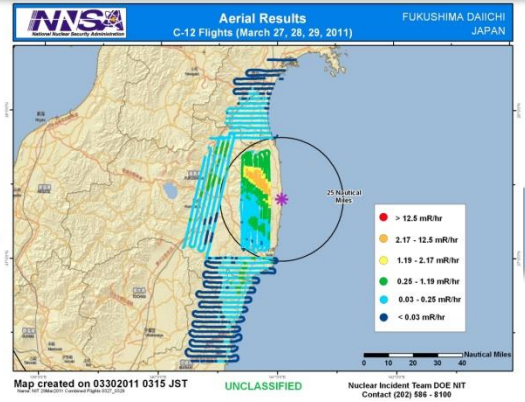
- The DOE National Atmospheric Release Advisory Center (NARAC) develops IMAAC rad/nuc products
- Inform decisions on public and worker protection
- Standardized information
  - Mapped plume hazard areas
  - Affected population and casualty numbers
  - Expected health effects
  - Protective actions to consider: evacuation, sheltering, relocation, worker protection
  - Geographical information
- Distributed on HSIN



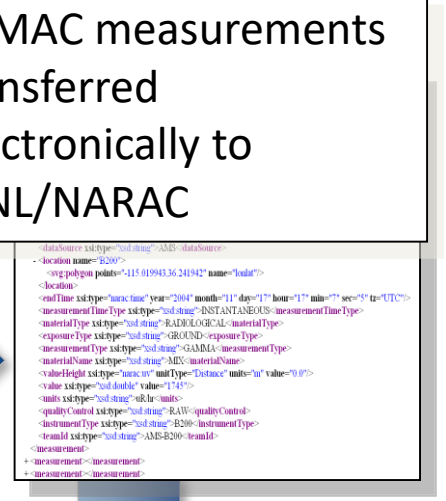
Rad/Nuc: DOE/NARAC Products

Initial Model Predictions Guide Measurement Surveys

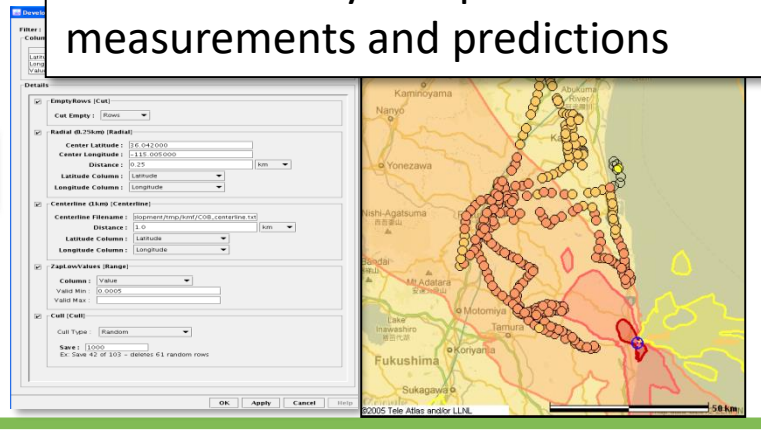
Measurement surveys and sensor data; e.g., DOE AMS, and FRMAC



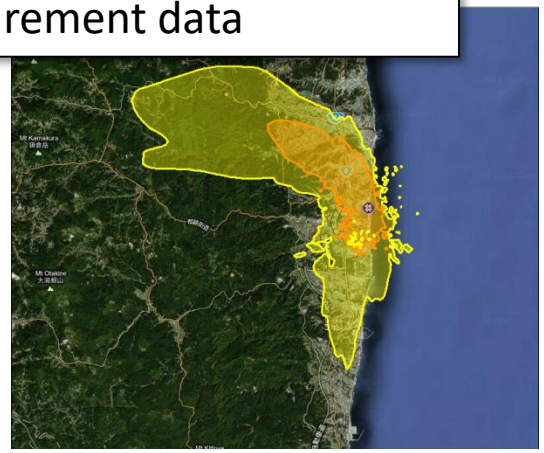
FRMAC measurements transferred electronically to LLNL/NARAC



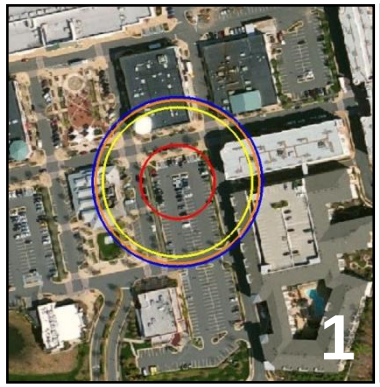
Software used to help select, filter and statistically compare measurements and predictions

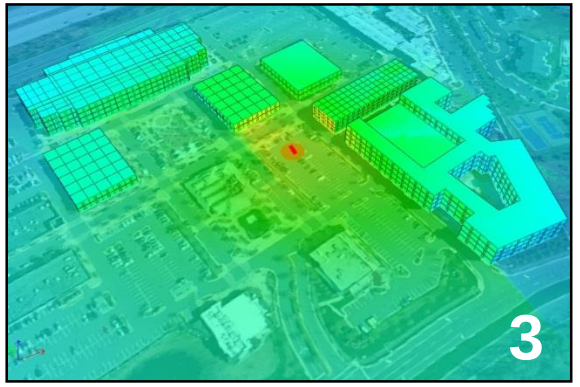


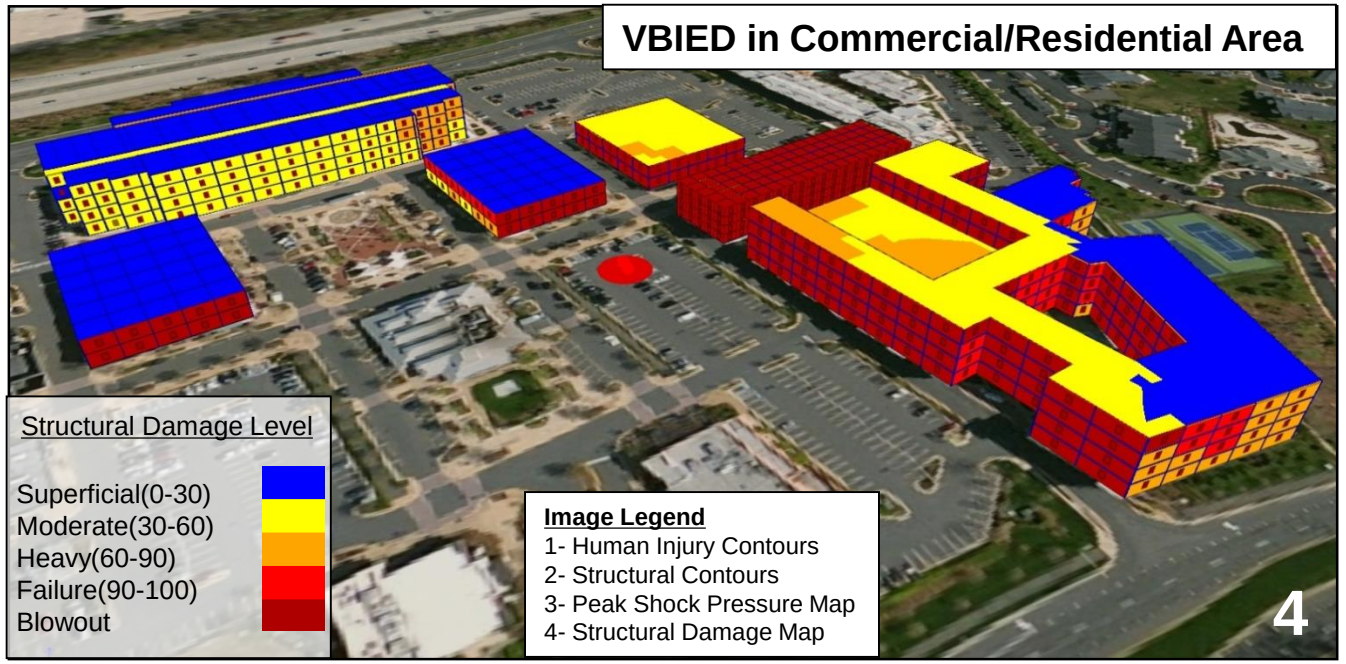
Updated predictions using measurement data



Vulnerability Analysis and Protection Option (VAPO)





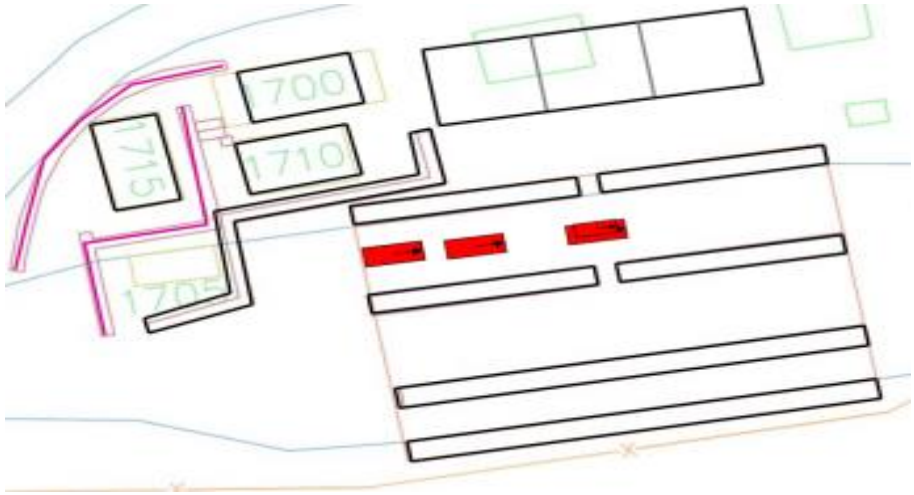


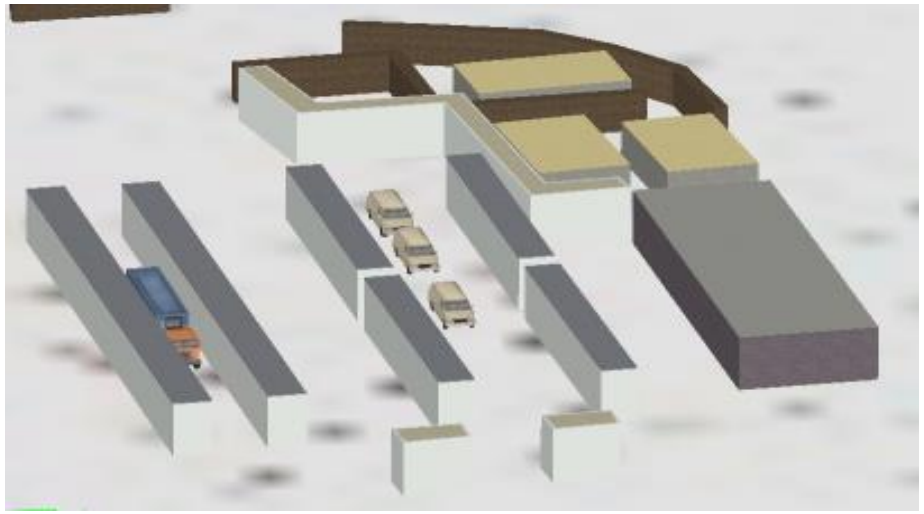
Capabilities

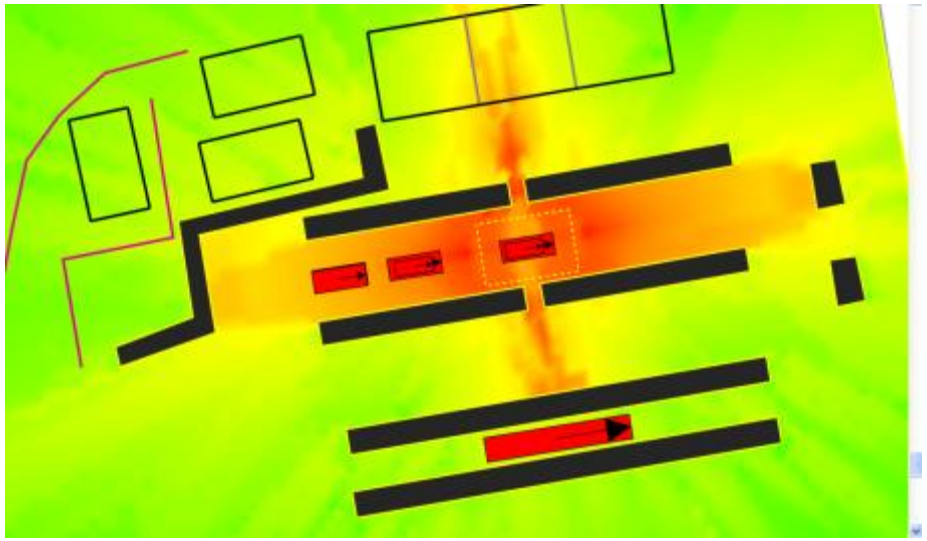
- ✓ 3-D modeling of a multiple building sites
- ✓ Suitable for unconventional weapons and explosives (IEDs, VBIEDs)
- ✓ Provides structural damage maps, pressure, impulse, and structural and human effects offsets
- ✓ Component based analysis using gage points
- ✓ Collapse models available for certain structures
- ✓ Handles orthogonal and non-orthogonal structures
- ✓ Models both interior and exterior structural and human effects

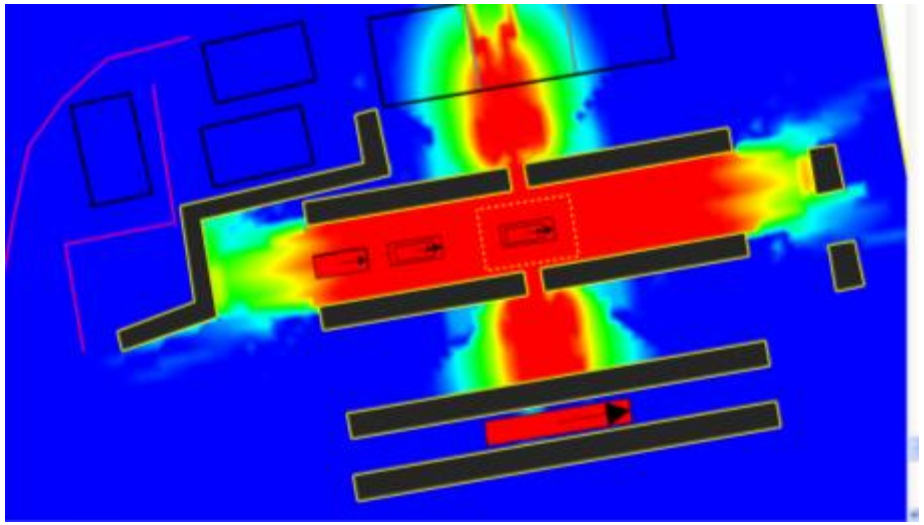
FACTS
Incident: Large VBIED
Model: VAPO 5.1.2

VAPO Force Protection Modeling
VBIED Access Control Point w/ Barriers



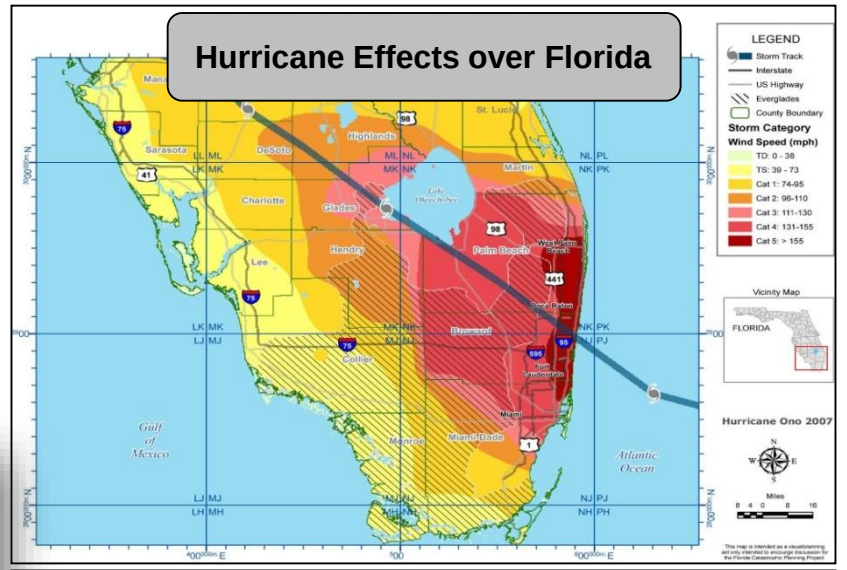


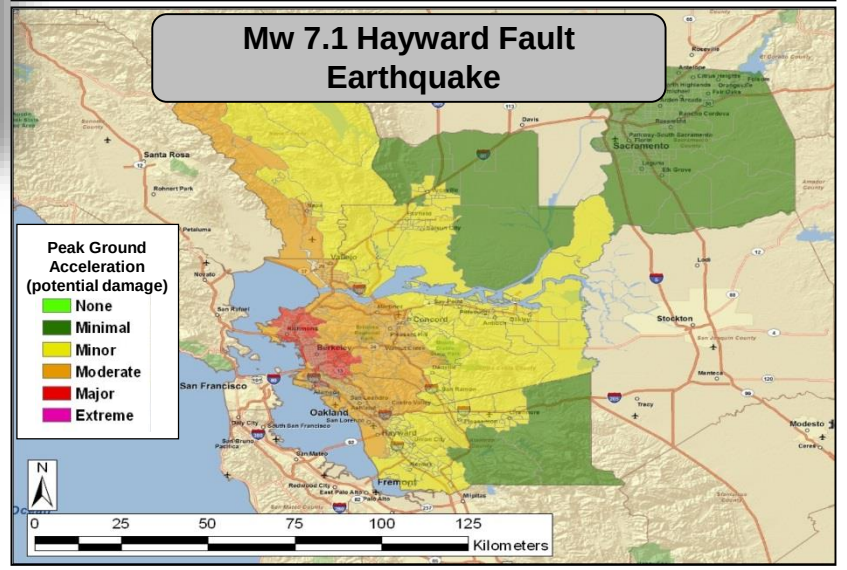




Cascading Effects: HAZUS-MH

- Hazards US – Multi-hazard (HAZUS-MH) is a multi-hazard risk assessment and loss estimation software program developed by the Federal Emergency Management Agency (FEMA).
- The tool can identify hazard related risks, calculate potential losses to life and property, and help define effective ways to reduce losses
- **It is a planning tool**, NOT an engineering tool
  - Engineering-level data (i.e., hydrology & hydraulic studies for flood modeling) can be input to increase accuracy, but results still produce planning-level estimations
  - It estimates physical damage & economic losses
  - It assesses population needs related to emergency management
  - It allows users to compare results from different study case scenarios, including those that result from specific mitigation actions (useful for benefits analysis)





Waterborne Hazards: The System for Hazard Assessment of Released Chemicals (SHARC)

Waterborne Fate and Transport Modeling

What does it do:

Provides an operational capability to predict the trajectory and fate of weaponized chemical agents, toxic industrial chemicals and materials, radiological materials, and oil transport in an aquatic environment.

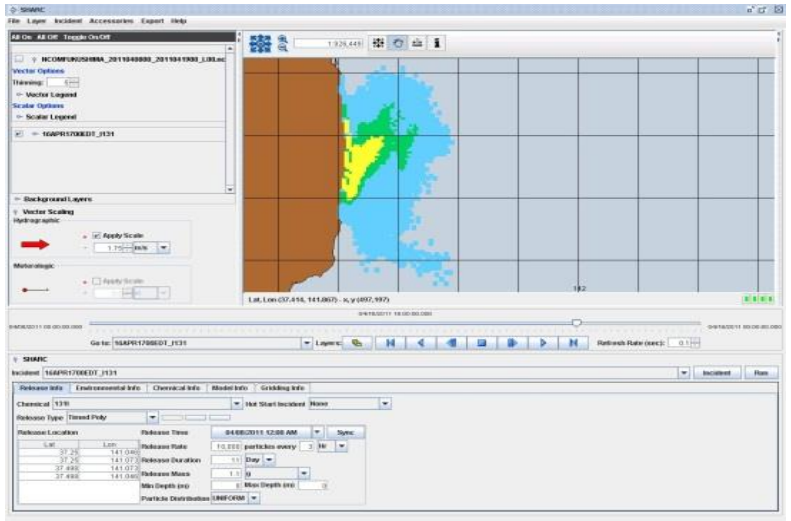
How has it been used:

- Operation Tomodachi
- US STATCOM Planning
- Hypothetical Oil Spills

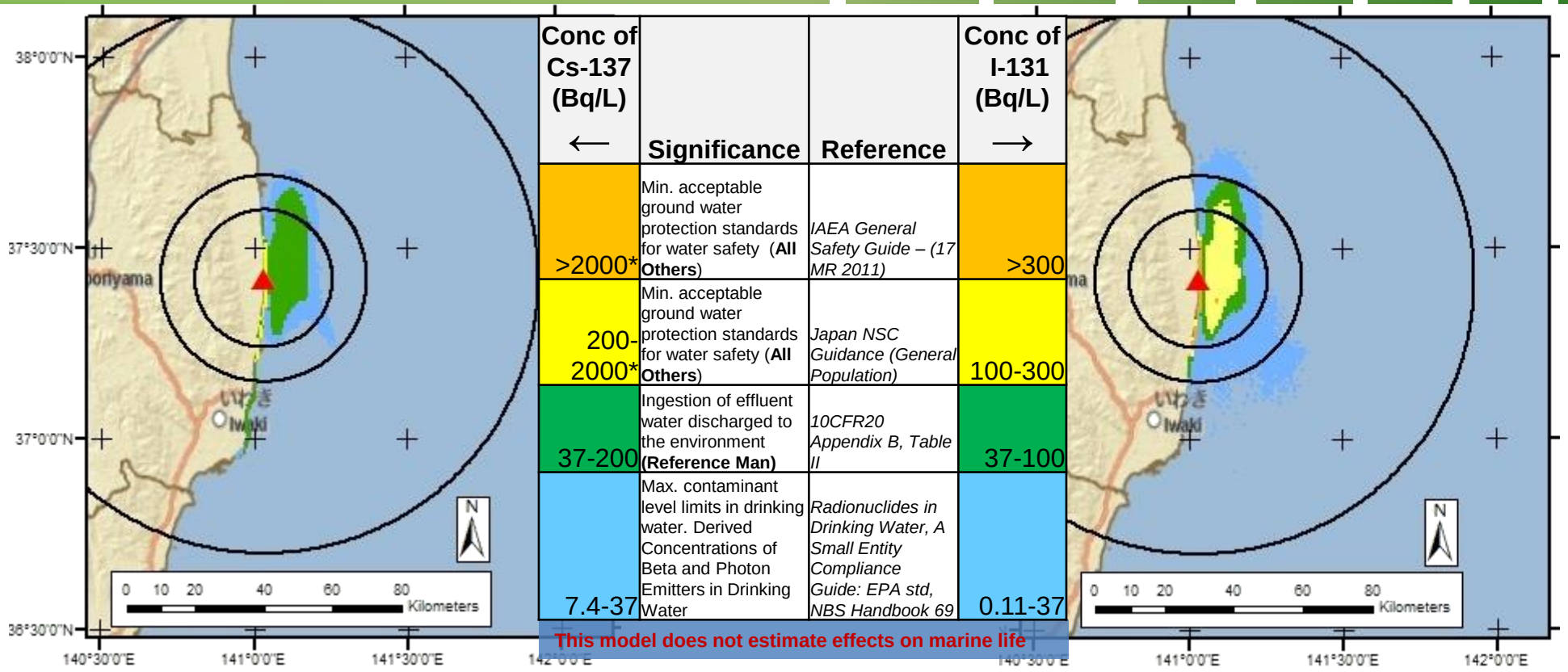
How does it do it:

SHARC integrates 4 separate models:

- Transport Model
- Aqueous Fates Model
- Particulate Fates Model
- Sediment Fates Model



Waterborne Hazard for Nuclear Accident
USF-Japan Limits: 0000Z 25Apr2011

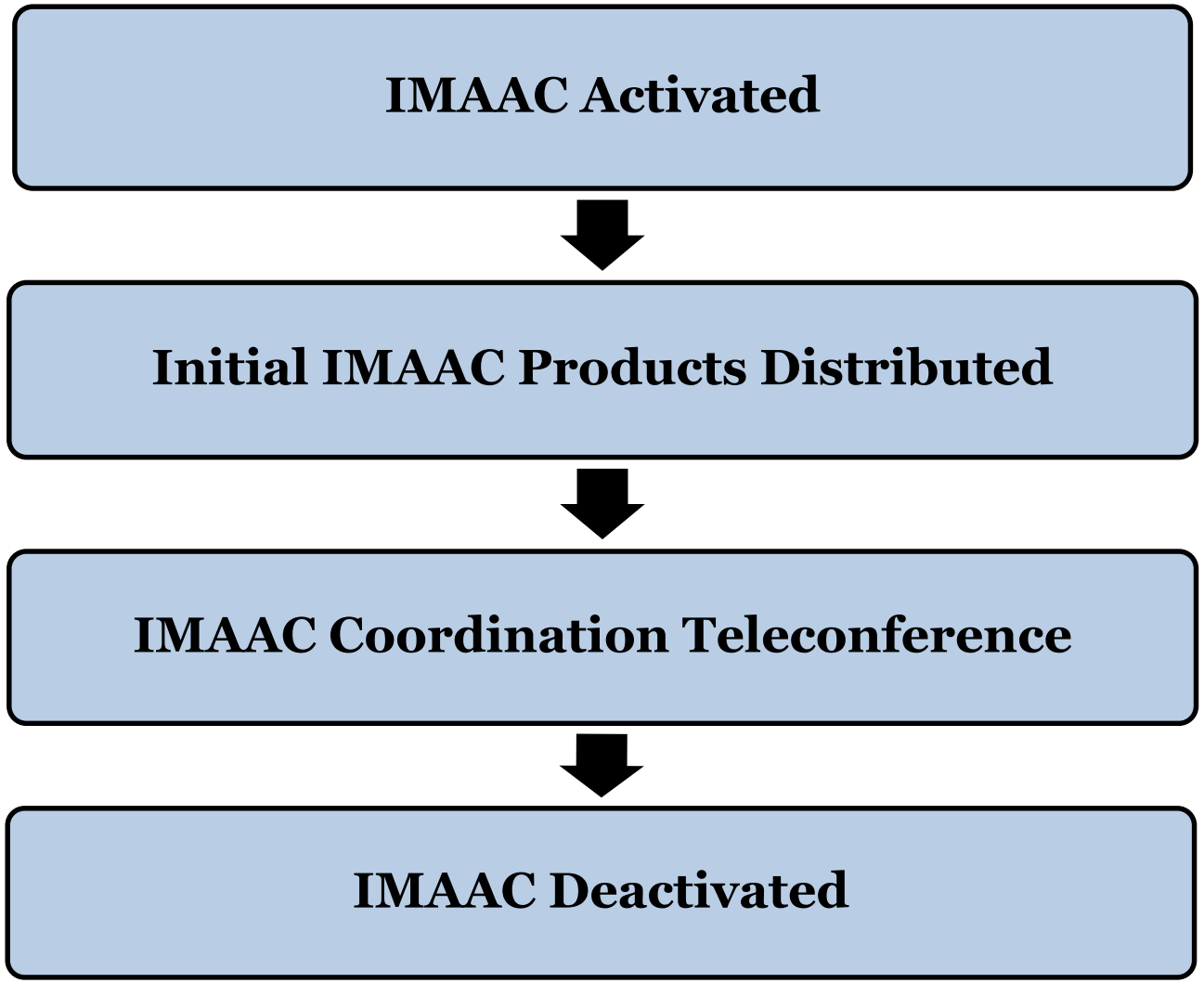


Conc of Cs-137 (Bq/L) ←	Significance	Reference	Conc of I-131 (Bq/L) →
>2000*	Min. acceptable ground water protection standards for water safety (**All Others**)	*IAEA General Safety Guide – (17 MR 2011)*	>300
200-2000*	Min. acceptable ground water protection standards for water safety (**All Others**)	*Japan NSC Guidance (General Population)*	100-300
37-200	Ingestion of effluent water discharged to the environment **(Reference Man)**	*10CFR20 Appendix B, Table II*	37-100
7.4-37	Max. contaminant level limits in drinking water. Derived Concentrations of Beta and Photon Emitters in Drinking Water	*Radionuclides in Drinking Water, A Small Entity Compliance Guide: EPA std, NBS Handbook 69*	0.11-37

This model does not estimate effects on marine life

- Dispersion and activity modeled by a continuous release of a distributed source (constant magnitude) at 0-20m in depth.
- Source magnitude based on MEXT and TEPCO monitoring data.
- Actual total activity may be greater than predicted due to presence of other radionuclides not shown.
- Other constituents will disperse similarly and preliminary simulations suggest that total contamination will not exceed the overall footprint presented above.

IMAAC ACTIVATION SEQUENCE



IMAAC PRODUCTS

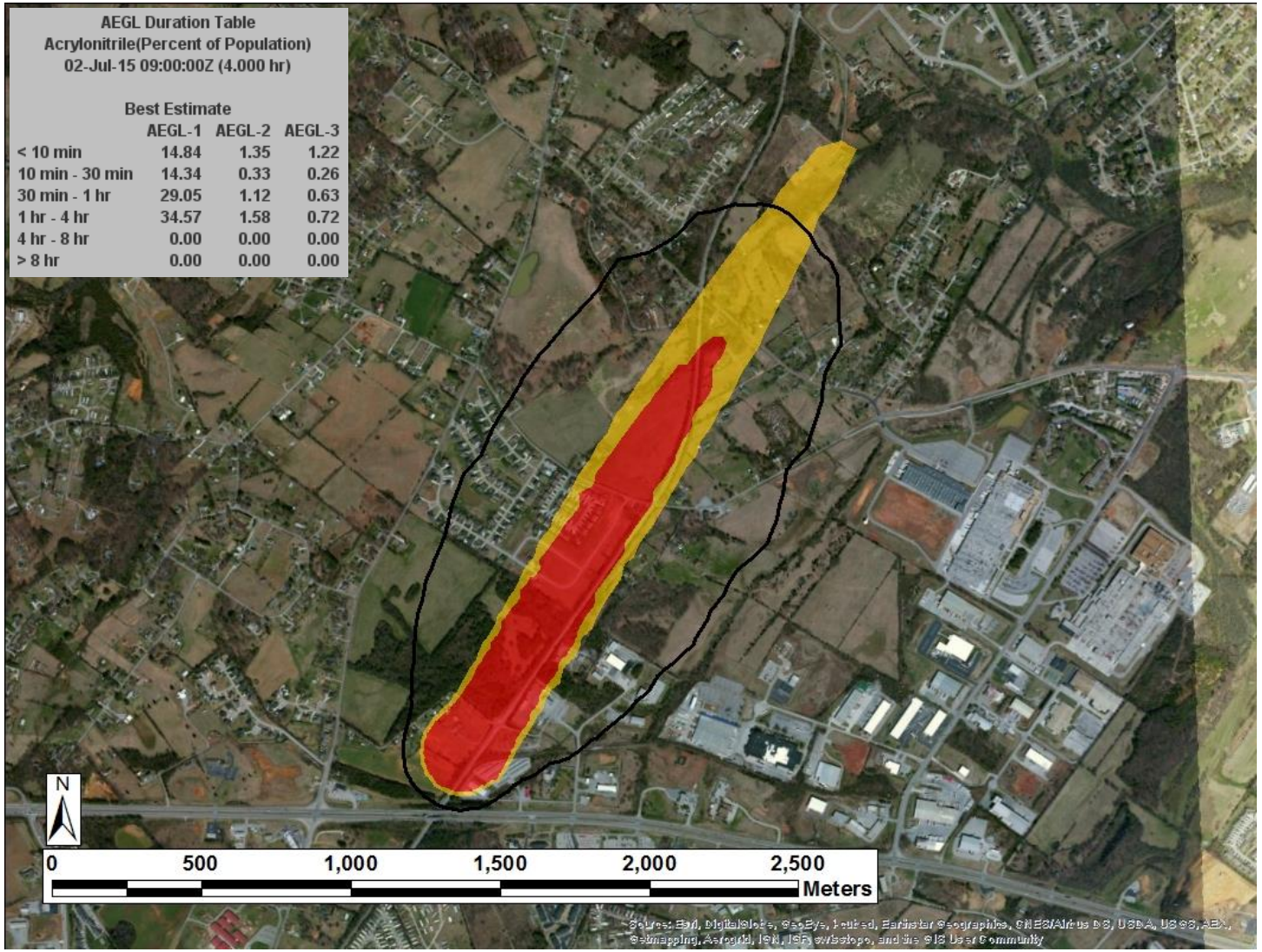
- **Types**
  - Descriptive plume products (PowerPoint/PDF)
  - GIS shapefiles

- **Access**
  - The primary method of product distribution is the Homeland Security Information Network (HSIN) IMAAC page at: https://hsin.dhs.gov/collab/IMAAC
  - Products may be distributed through email upon request
  - If you require an IMAAC account, please send an email to imaacinquiries@fema.dhs.gov.

REAL WORLD IMAAC ACTIVATION

- Incident: July 2, 2015 CSX Rail Accident in Maryville, TN
- Activated by: FEMA National Watch Center at the request of the Tennessee Emergency Management Agency
- Interagency participation: FEMA (IMAAC Dir., National Watch, Region 4), 45th CST, EPA (Region 4 and HQ), State of TN (TEMA East, TDOT Rail, Dept. of Health), NOAA (SDM, Emer. Response Div.), MARNORTH CBRNE, U.S. Dept H&HS (including ASPR, CDC, ATSDR)

Acrylonitrile – Far View – Initial Response



Acrylonitrile : Acute Exposure Guideline Levels (INTERIM)
02-Jul-15 09:00:00Z (4.000 hr)

Mean Area

	Value	In contour population
AEGL-3 Death Possible	3.0	80
AEGL-2 Injury Possible	2.0	130

AEGL-1 not displayed

Area of Concern

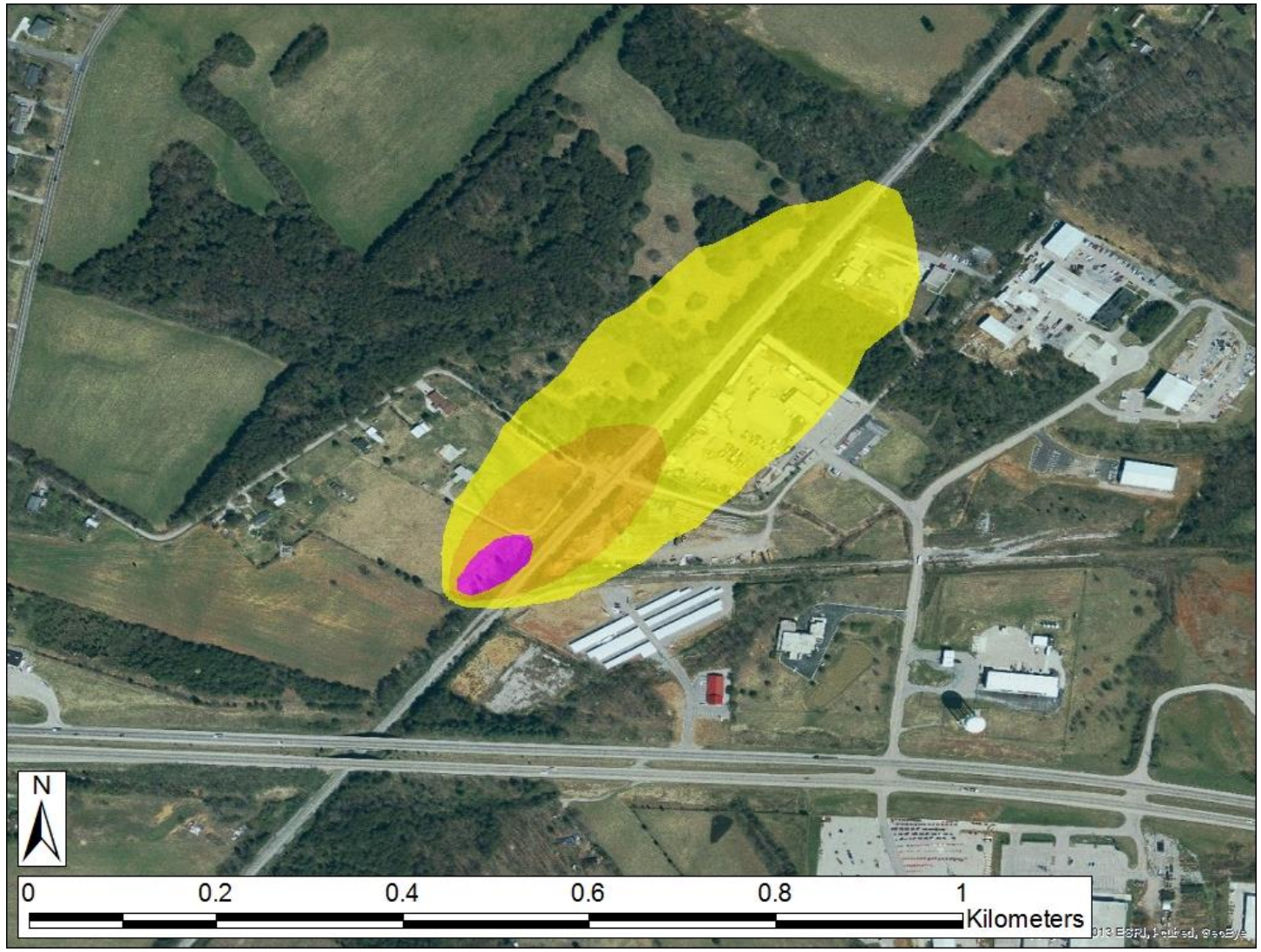
	Value	In contour population
AEGL-2 Injury Possible	2.0	324

This quick response used a weather prediction model; and was not coordinated with other IMAAC participants. Coordination will follow, and product will be updated as needed.

Maryville, TN

Location: 35°45’27.56” N / 84°01’44.97”W
Event Time: 0100 EDT, 02JUL2015
Type: Acrylonitrile
Amount: Single Tank Car
Dissemination: Rail Accident
Weather: 12 km NAM
Model: HPAC 5.3
Static Population Estimates:
LandScan 2012

HCN Concentration – 0900 Local 2 July 2015 – Updated product



Hydrogen Cyanide (AC, HCN)(Total) Concentration 02-Jul-15 13:00:00Z (60.000 min)	ppm	In contour area (km²)
IDLH	50.0	2.76E-3
NIOSH STEL	4.7	2.19E-2
Odor Threshold	1.0	9.67E-2

Maryville, TN

Location: 35°45’27.56” N / 84°01’44.97”W

Event Time: 0100 EDT, 02JUL2015

Type: Acrylonitrile (combusting to HCN)

Amount: Single Tank Car

Dissemination: accident (10 gal/min leak)

Weather: 12 km NAM

Model: HPAC 5.3

Static Population Estimates: LandScan 2012

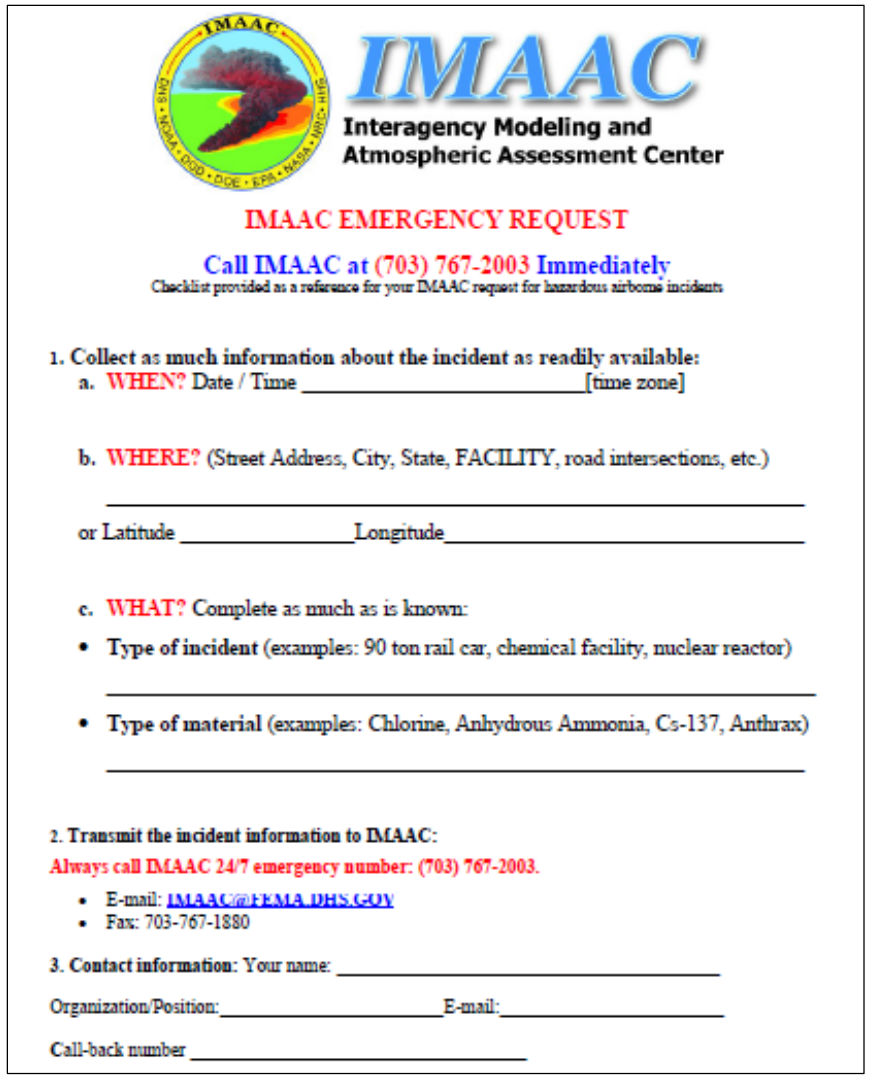
HOW TO ACTIVATE THE IMAAC

- **The IMAAC is activated for current or potential real-world emergencies involving significant hazardous atmospheric releases.**

- **ANY Federal, State, Tribal Territorial, and Local official can request the activation of IMAAC.**

To activate IMAAC or request assistance, please call
(703) 767-2003

IMAAC MODELING REQUIREMENTS



IMAAC
Interagency Modeling and Atmospheric Assessment Center

IMAAC EMERGENCY REQUEST

Call IMAAC at (703) 767-2003 Immediately

Checklist provided as a reference for your IMAAC request for hazardous airborne incidents

1. Collect as much information about the incident as readily available:
   a. WHEN? Date / Time _____[time zone]

   b. WHERE? (Street Address, City, State, FACILITY, road intersections, etc.)

   _____

   or Latitude _____Longitude_____

   c. WHAT? Complete as much as is known:
   - Type of incident (examples: 90 ton rail car, chemical facility, nuclear reactor)

     _____
   - Type of material (examples: Chlorine, Anhydrous Ammonia, Cs-137, Anthrax)

     _____

2. Transmit the incident information to IMAAC:

Always call IMAAC 24/7 emergency number: (703) 767-2003.

- E-mail: IMAAC@FEMA.DHS.GOV
- Fax: 703-767-1880

3. Contact information: Your name: _____

Organization/Position:_____E-mail:_____

Call-back number _____

- The IMAAC Emergency Request form describes the type of information required for modeling
  - When (incident time)
  - Where (address, intersection, coordinates, etc.)
  - What (hazard, amount, dispersal method; any details you know)
  - Contact information

- Phone call is best to ensure rapid response
  - Form can be filled out and sent later to confirm details

EXERCISE SUPPORT & TRAINING

- To request IMAAC support for an exercise or training session, please send your request to IMAACINQUIRIES@FEMA.DHS.GOV.

- Optional, in-classroom technical training to use the HPAC model is available to all federal employees at no cost. For information, please contact the DTRA Training Manager at (703) 767-3419 or dtra.belvoir.J9.mbx.reachback-training@mail.mil.

CONTACT INFORMATION

For Emergencies

IMAAC Operations: (703) 767-2003
Email: IMAAC@FEMA.DHS.GOV

For general inquiries and exercise support requests, please send an email to IMAACINQUIRIES@FEMA.DHS.GOV

Public website: https://www.dhs.gov/imaac

Questions?

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