


IMAAC

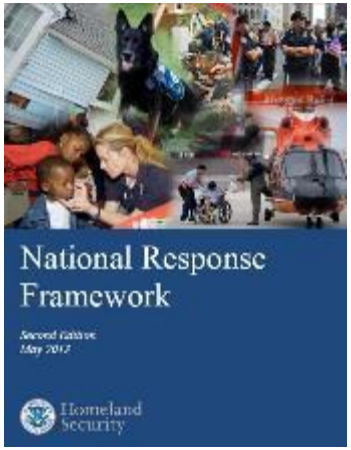
Interagency Modeling and Atmospheric Assessment Center

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.

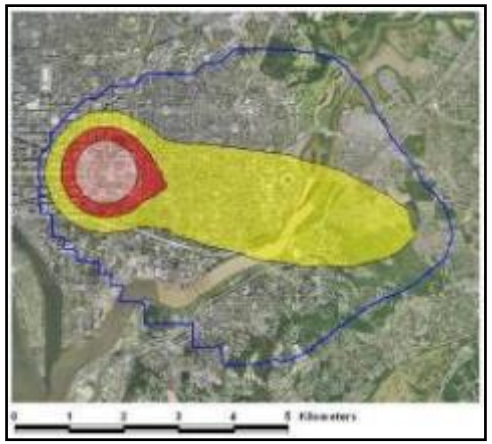
Homeland Security Council Memorandum 2004



Memorandum of Understanding between all IMAAC member agencies

IMAAC SUPPORT & TRAINING

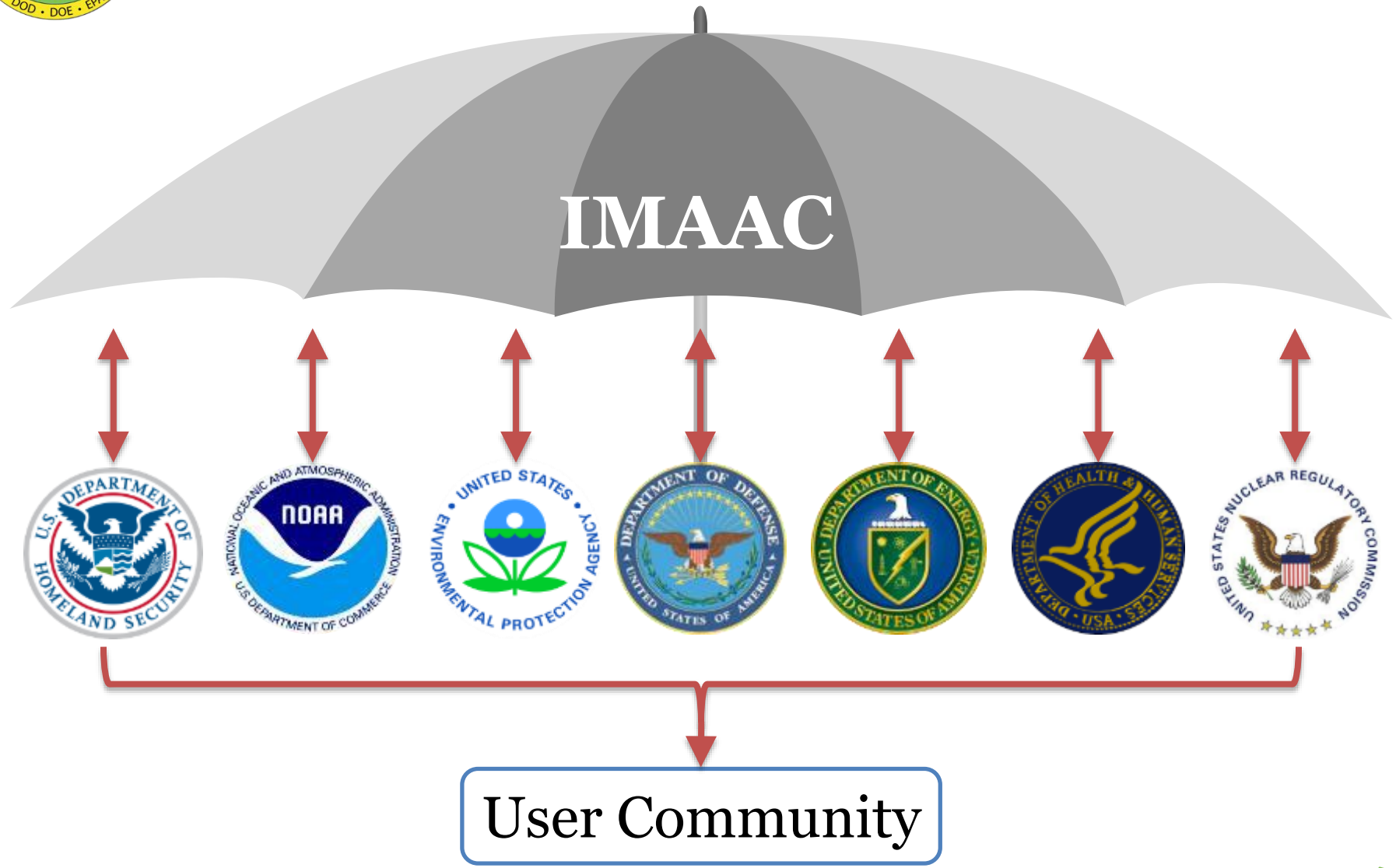
- The IMAAC provides atmospheric modeling support for:
  - Real-world events
    - Emergencies
    - National Special Security Events (NSSEs)
  - Exercises
    - Vibrant Response – 10 kt IND scenario
    - Southern Exposure – NPP
  - Training
    - Webinars
    - On-site
    - Classroom (HPAC)



WHO IS IMAAC?


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

IMAAC UMBRELLA CONCEPT



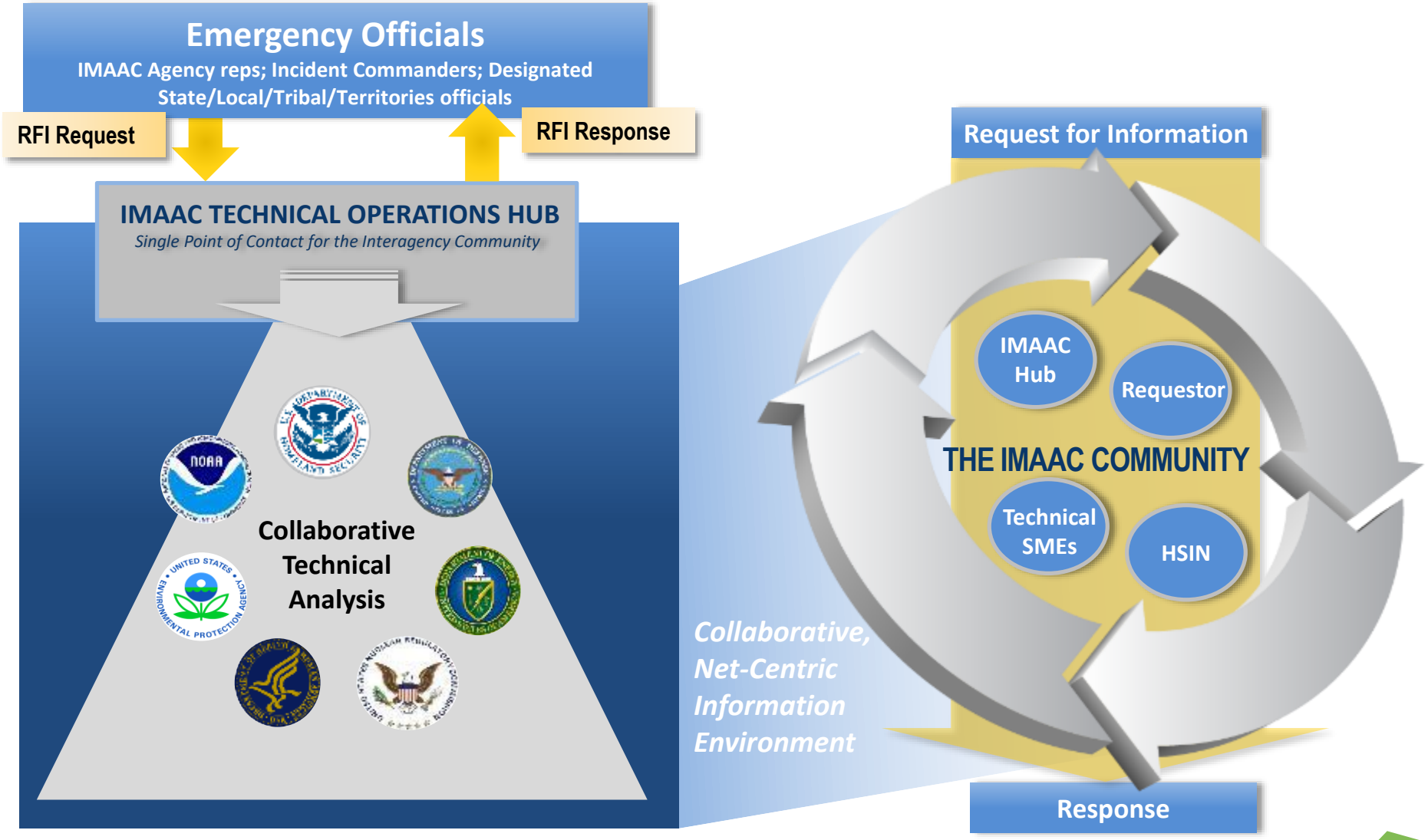
IMAAC TECHNICAL OPERATIONS HUB

- 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

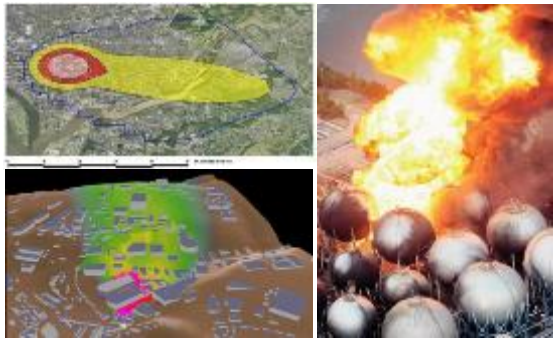
NOAA

NRC
- RASCAL

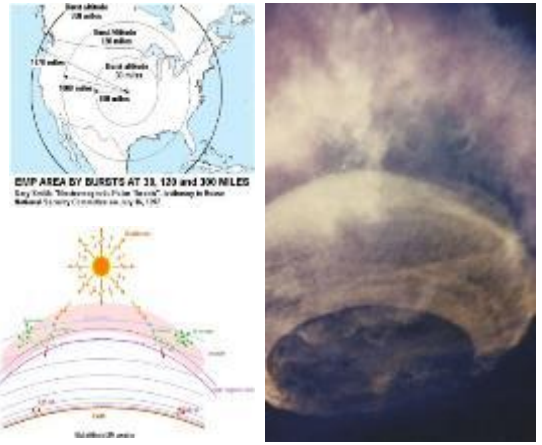
DoD/DTRA
- HPAC
- VAPO

IMAAC MODELING TOOLS, cont.

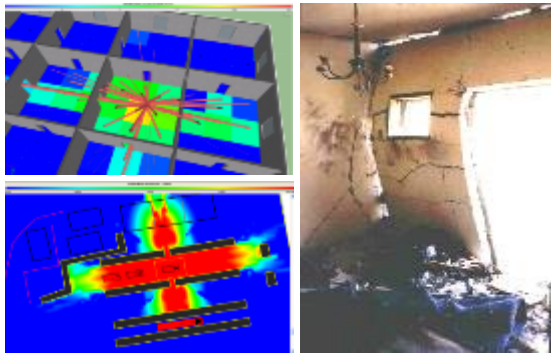
Chem/Bio



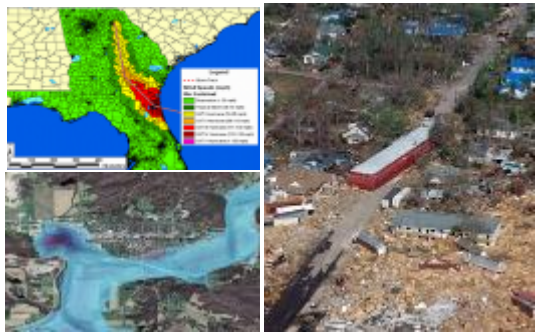
Rad/Nuc



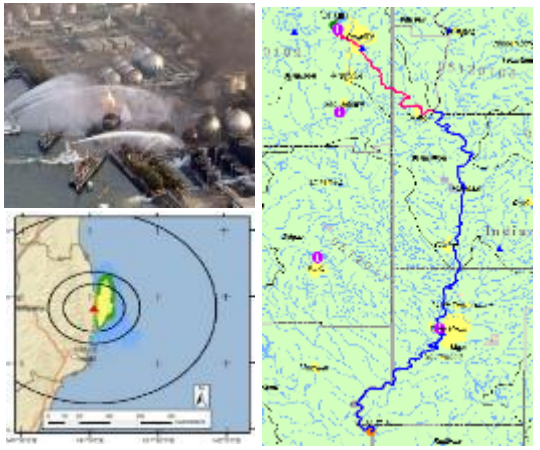
Explosion



Cascading Effects



Waterborne Hazards



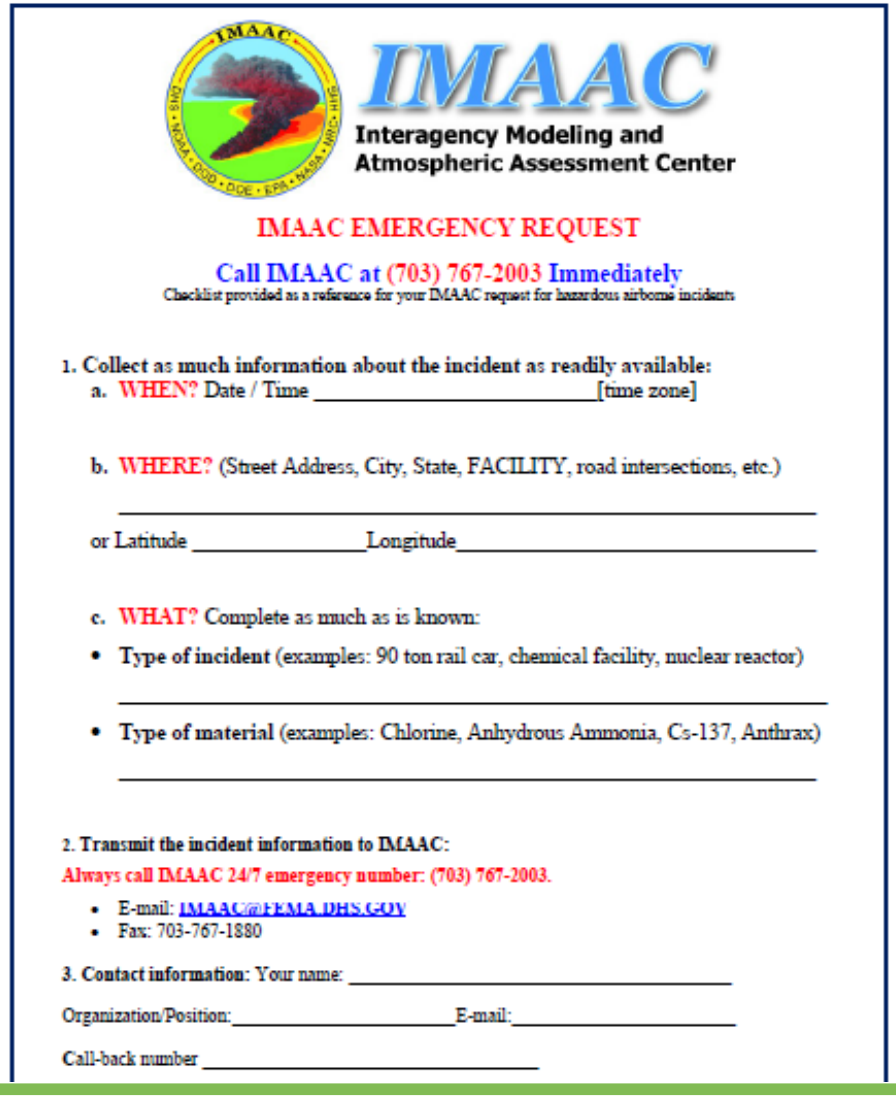
HOW TO ACTIVATE THE IMAAC

- **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

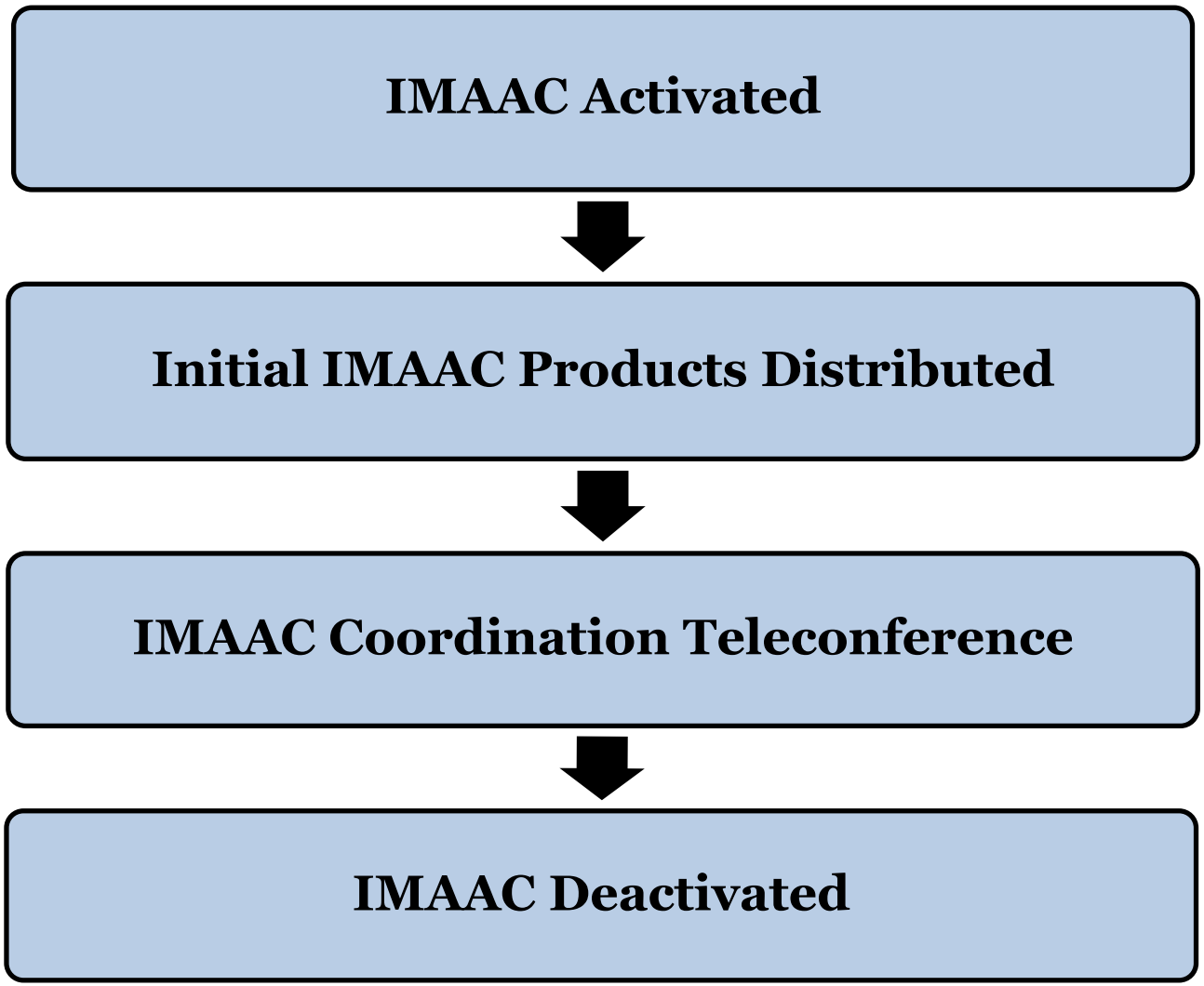
3. Contact information: Your name: _____

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

IMAAC ACTIVATION SEQUENCE



REAL WORLD IMAAC ACTIVATION

- Incident: Aug 29 – Sep 3, 2017; Arkema Chemical Plant, Crosby, TX
- Activated by: EPA Region 6
- Interagency participation: FEMA (IMAAC Dir., National Watch, Region 6), EPA (Region 6 and HQ), NOAA (SDM, Emer. Response Div.), DHS-CSAC, NORTHCOM, JTF-CS, U.S. Dept H&HS, TRANSCOM

Due to Hurricane Harvey, plant was inundated w/ several feet of water.

Organic peroxides at the site required cooling to prevent spontaneous "instability". Inundation caused cooling systems to fail.

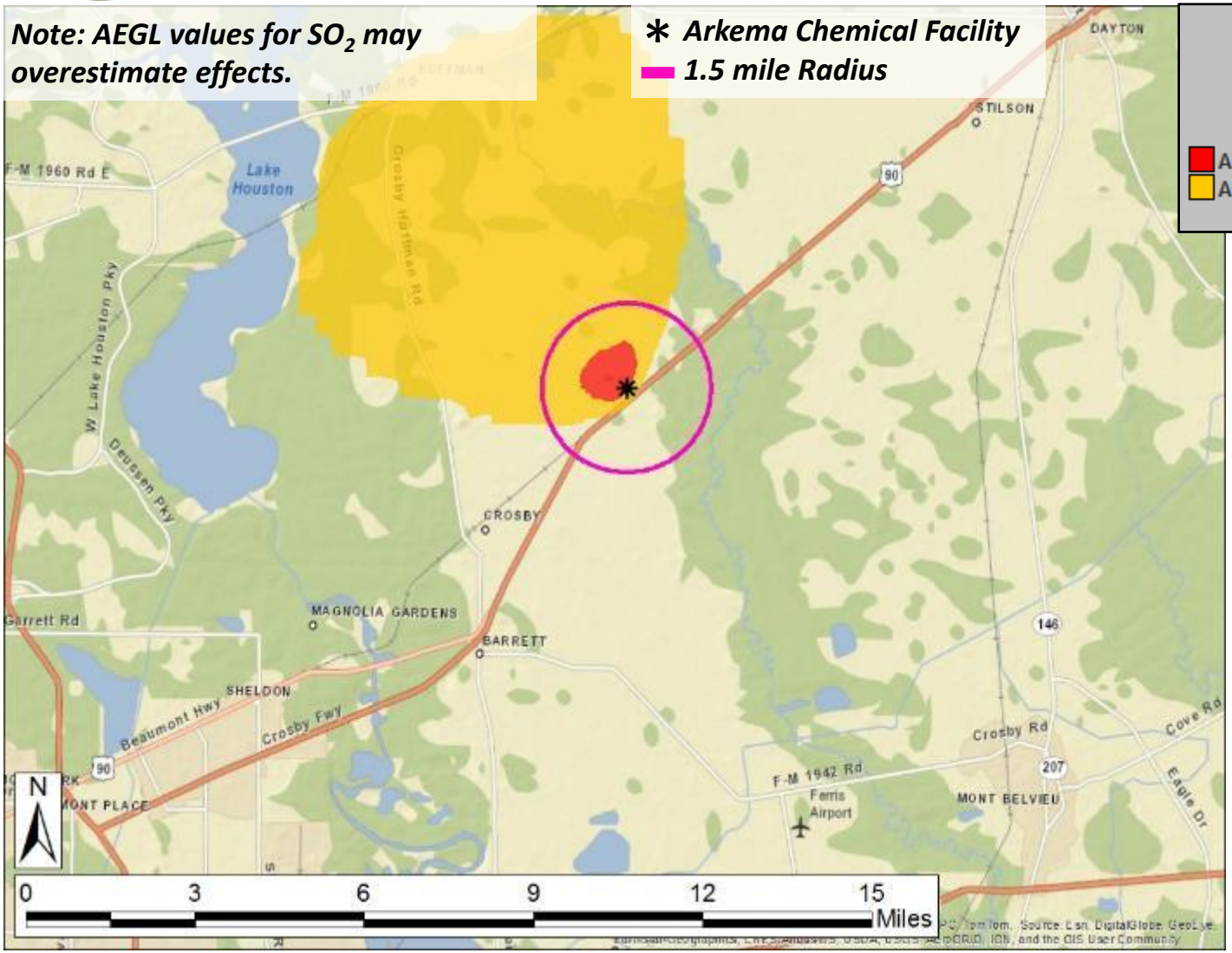
ARKEMA PLANT MODELING UPDATES

- Over the next 6 days, three trailers containing organic peroxides exploded/burned; the rest were intentionally destroyed
- Evacuations were conducted in a 1.5 mile radius
- IMAAC provided nine updates over the course of 6 days

Products included:

- Explosion of a trailer of organic peroxides
- Possible chlorine release
- Possible leak of sulfur dioxide stored nearby
- Possible isobutylene BLEVE
- Vertical cross-section

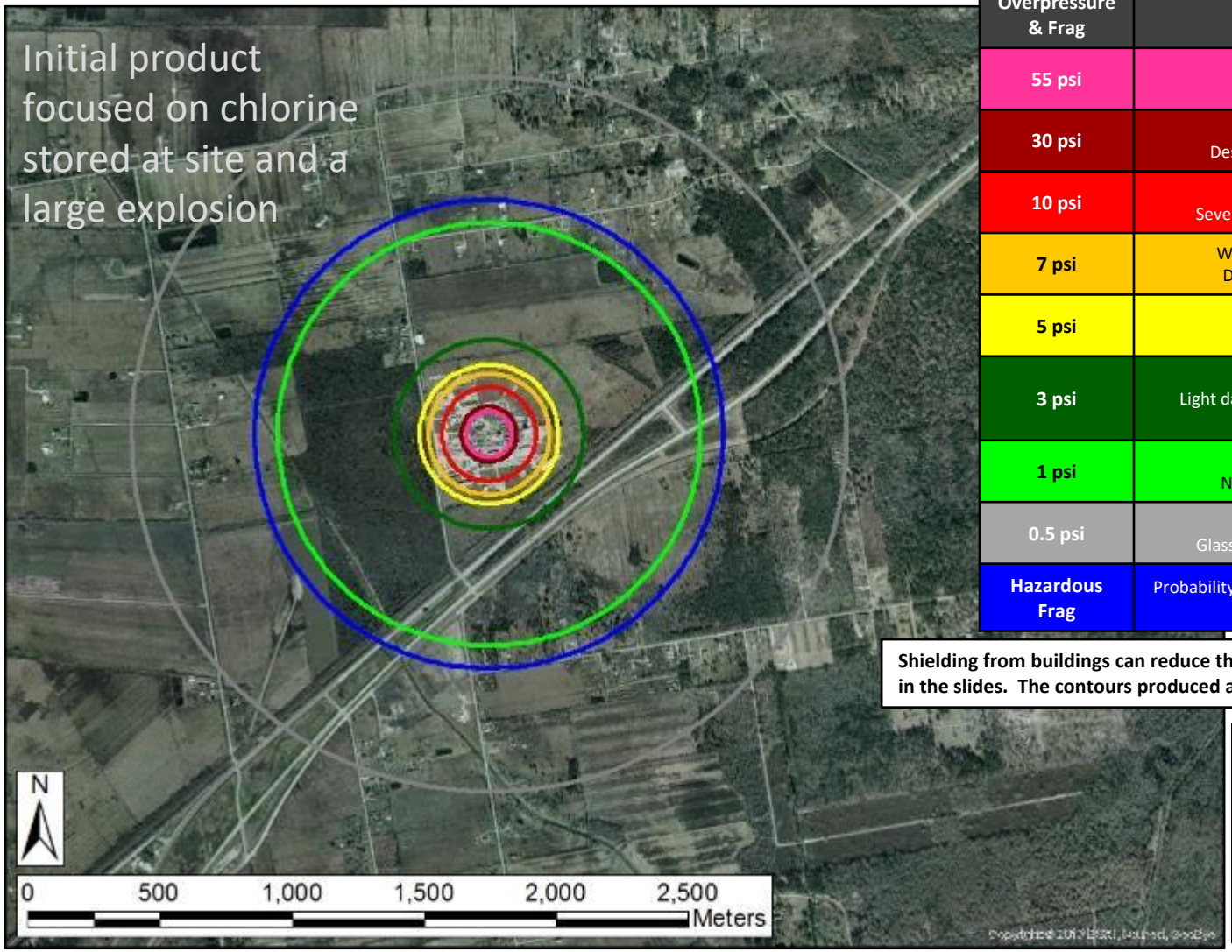
SO_2 (Release Starting @ 02 SEP 9:00 PM CDT) – Update #8



FACTS

Crosby, Texas
Location: 29.9491° N/ 95.0211° W
Event Time: 9:00 PM CDT, 02SEP2017
Type: Sulfur Dioxide
Amount: 32,000 lb (16,000 lbs/hr)
Dissemination: Release over 2 hours
Weather: 3 km NAM
Model: HPAC 6.4
Static Population Estimates:
LandScan 2015

Human Injury & Structural Damage Contours



Overpressure & Frag	Human Injury/Structural Damage (details on following slides)
55 psi	100% fatalities Complete structure blowout
30 psi	Near 100% fatalities Destruction of primary structural components
10 psi	High fatality rate Severe damage to primary structural components
7 psi	Widespread fatalities, 50% eardrum rupture Damage to primary structural components
5 psi	Universal injuries Severe damage to light structures
3 psi	Serious injuries common Light damage to primary structural components, light structures damaged
1 psi	Light injuries occur Non-structural component severe damage.
0.5 psi	Temporary eardrum damage Glass breaks, non-structural components damage
Hazardous Frag	Probability of being struck in the open by primary/hazardous fragmentation is less than 1%.

Shielding from buildings can reduce the hazard-to-effect contour distances shown in the slides. The contours produced are representative of open terrain effects.

FACTS

Crosby, Texas

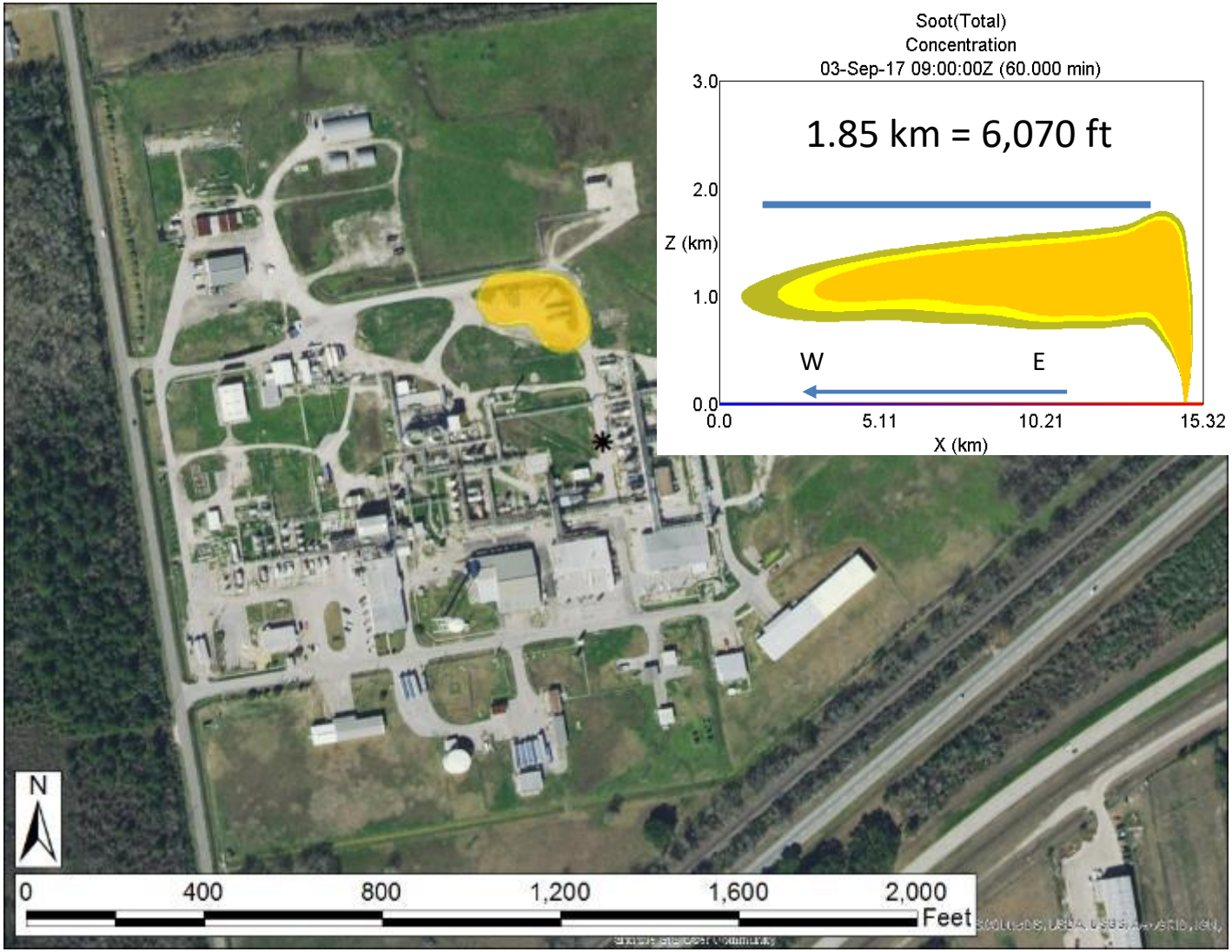
Location:

29.949° N / 95.022° W

Amount: 200,000 lb TNT-equivalent

Model: BOOM (JIEDDO)

Soot – Burning Trailer – (Starting @ 03 SEP 3:00 AM CDT) – Update #8



Soot(Total) 03-Sep-17 09:00:00Z (60.000 min)	Mean Area ug/m3
Hazardous	250.0
Very Unhealthy	150.0
Unhealthy	65.0

Note: Hazard is from estimated incidental material burning (e.g. tires, trailer, insulation). The combustion products from organic peroxide constitute minimal atmospheric hazards.

FACTS

Crosby, Texas
Location: 29.948086° N/ 95.019951° W
Event Time: 3:00 AM CDT, 03SEP2017
Type: Organic Peroxide
Amount: 6 containers (38,000 lb each)
Dissemination: Release over 1 hour
Weather: 3 km NAM
Model: HPAC 6.4
Static Population Estimates:
LandScan 2015

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.

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

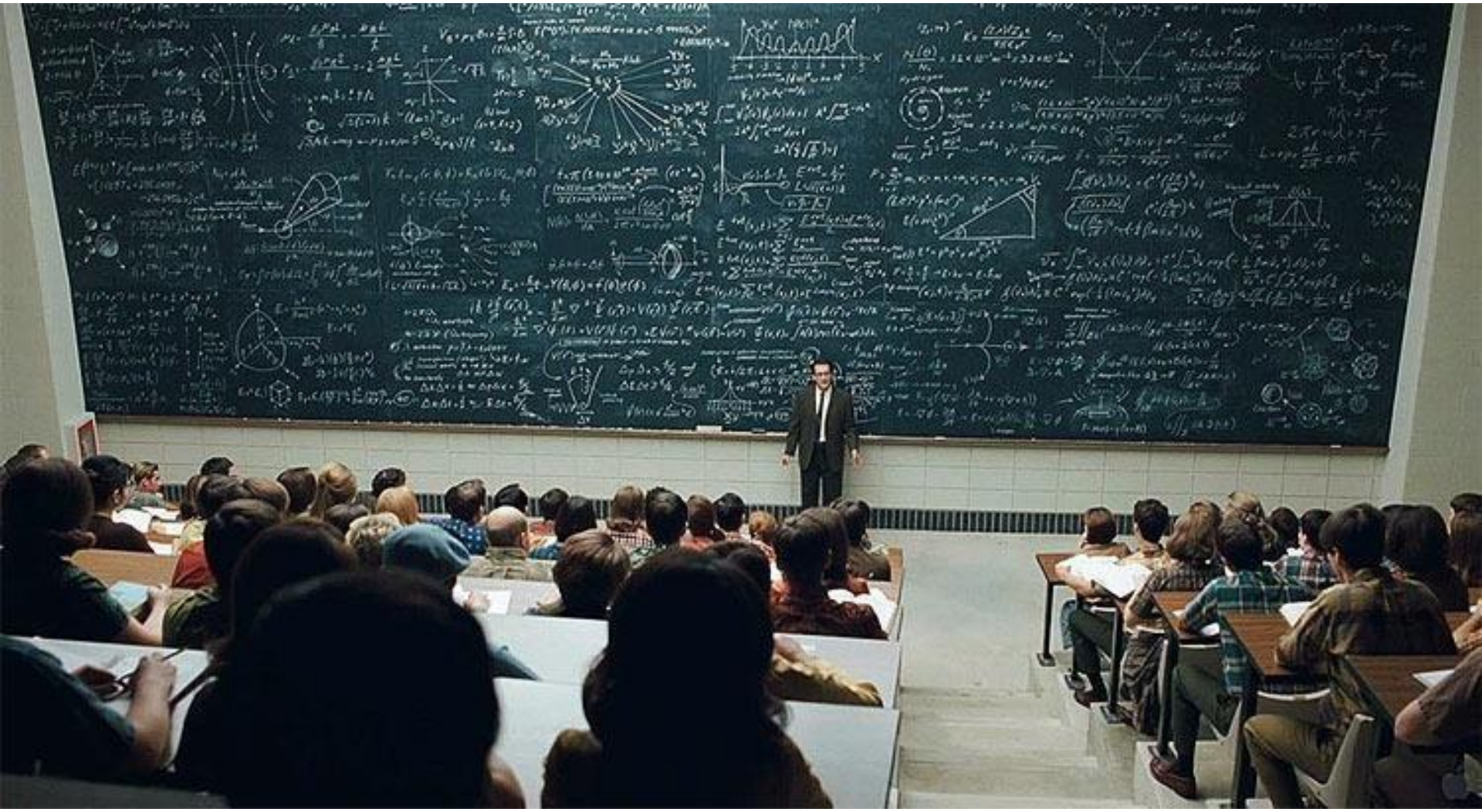
For Emergencies

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

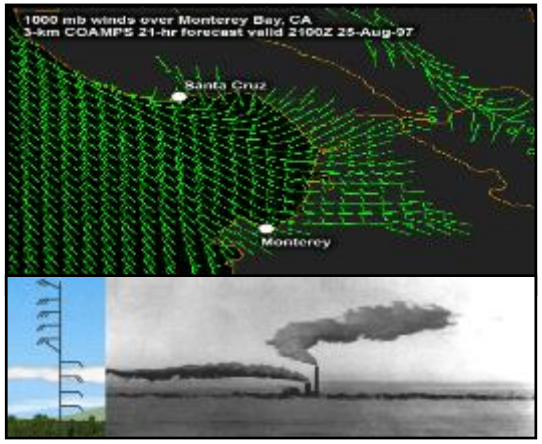
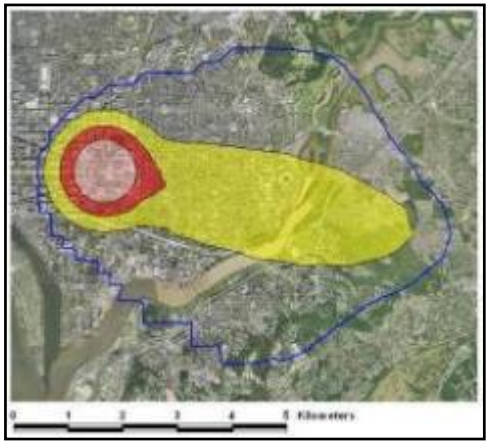
Public website: https://www.dhs.gov/imaac

BACKUP SLIDES



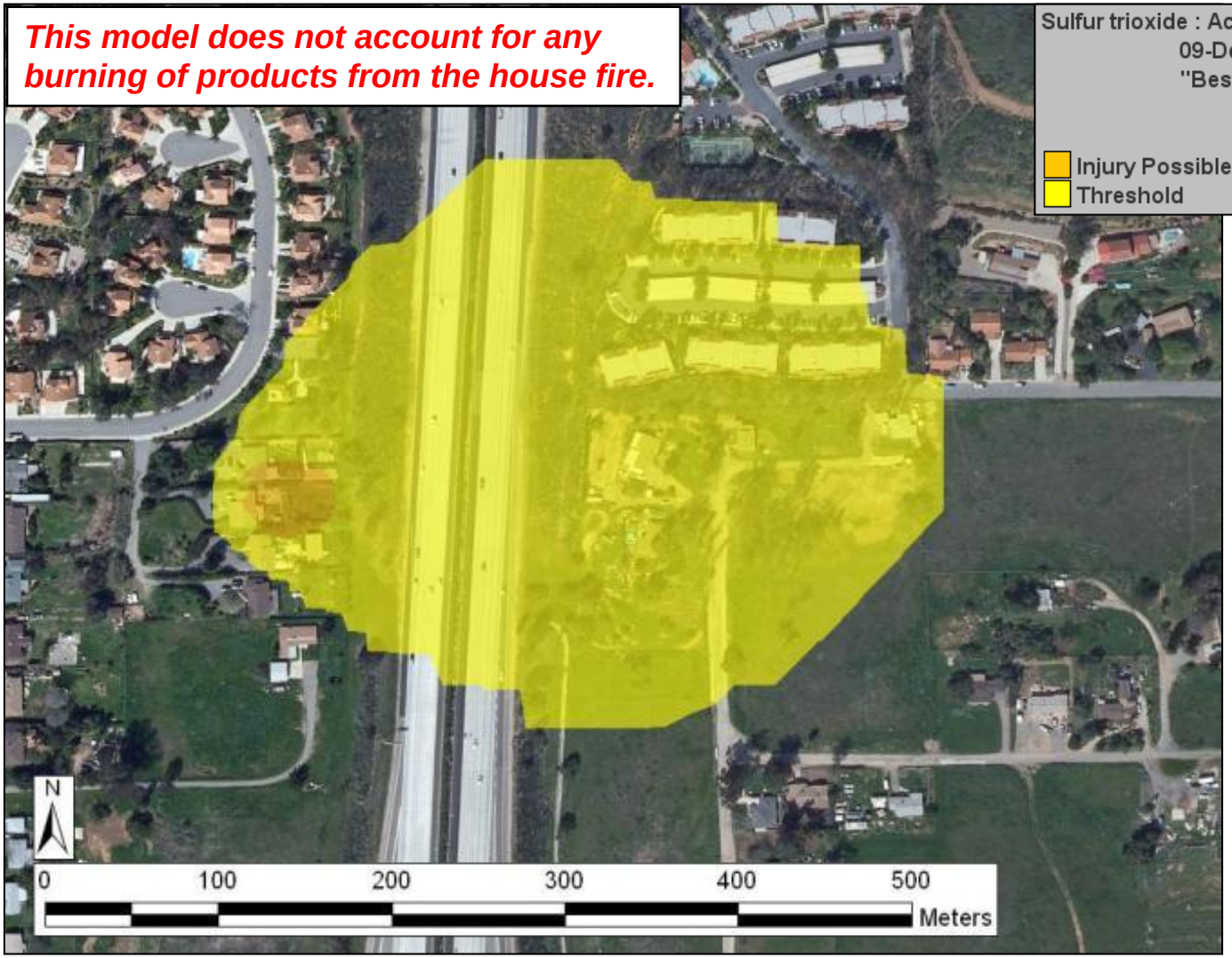
Chem/Bio: HAZARD PREDICTION & ASSESSMENT CAPABILITY (HPAC)

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

This model does not account for any burning of products from the house fire.

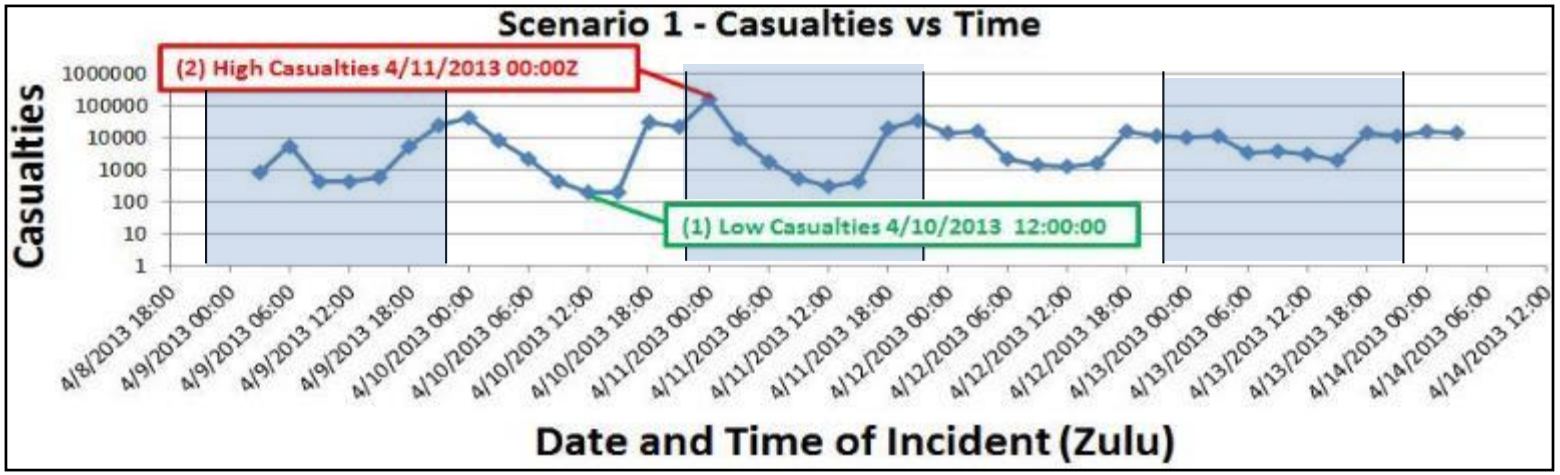


FACTS

Escondido, CA
Location: 33.152371° N / 117.105315° 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

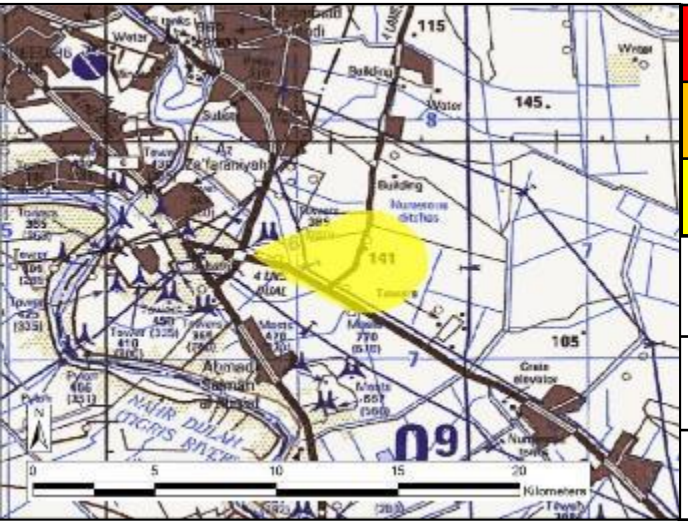
HPAC - Escondido CA "Bomb Factory House" News Coverage 09 Dec 2010

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



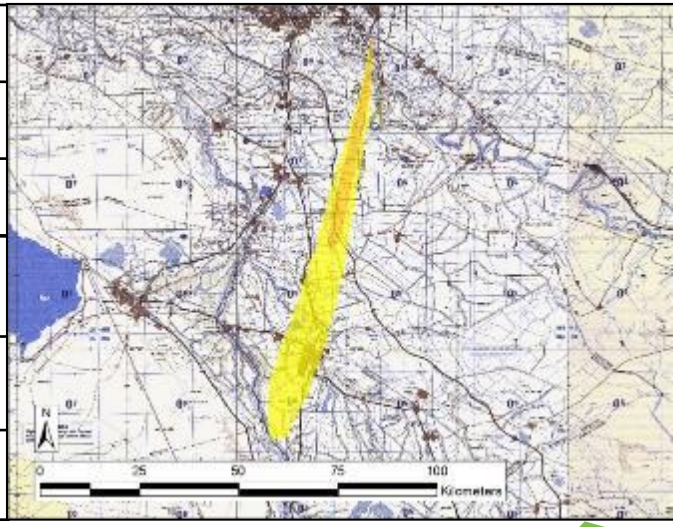
(1) Low – 10APR2013

(2) High – 11APR2013



	50% Mortality
	50% Casualty
	10% Casualty

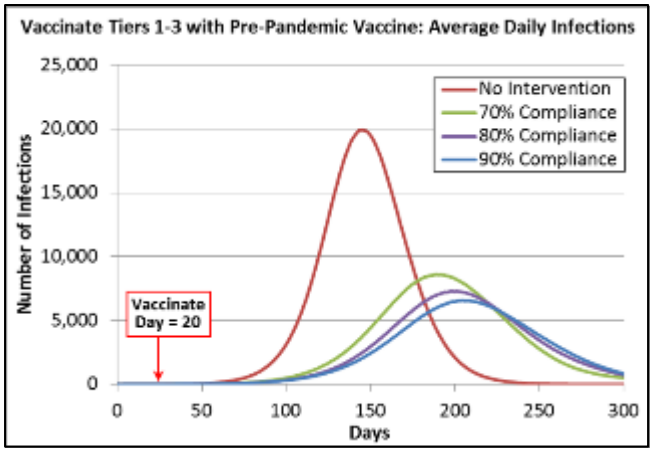
Case	Date	Casualties
High	11APR2013 0000Z	~100,000
Low	10APR2013 1200Z	~200



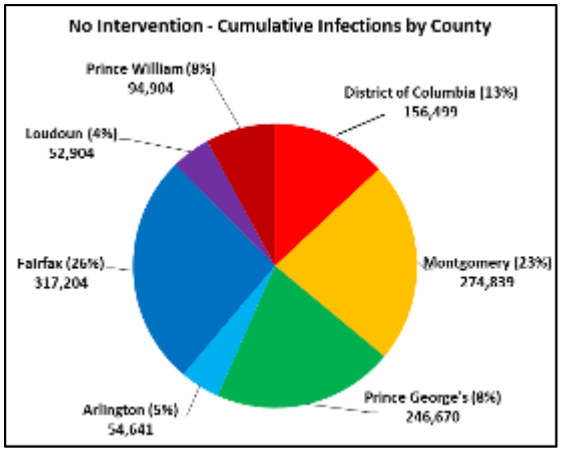
Bio: Comprehensive National Incident Management System (CNIMS)

- 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

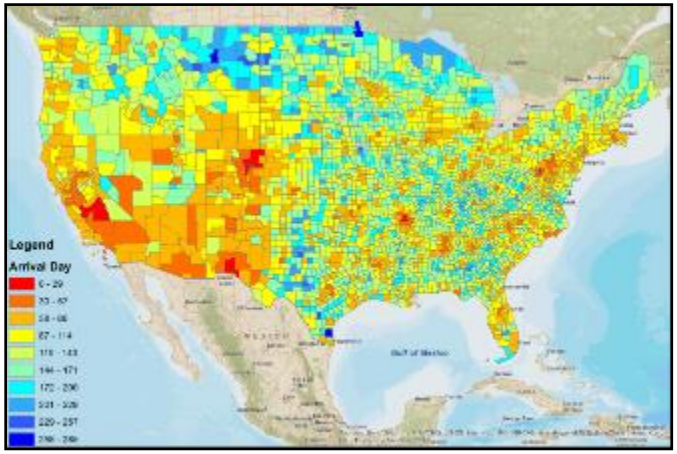
Variations on Intervention Parameters or Multiple Interventions Combined



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



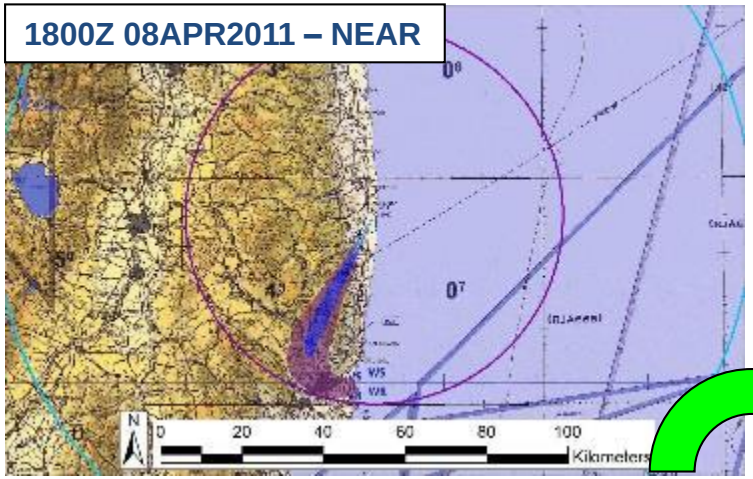
Infectious Disease Spread on the City, State, and National Level



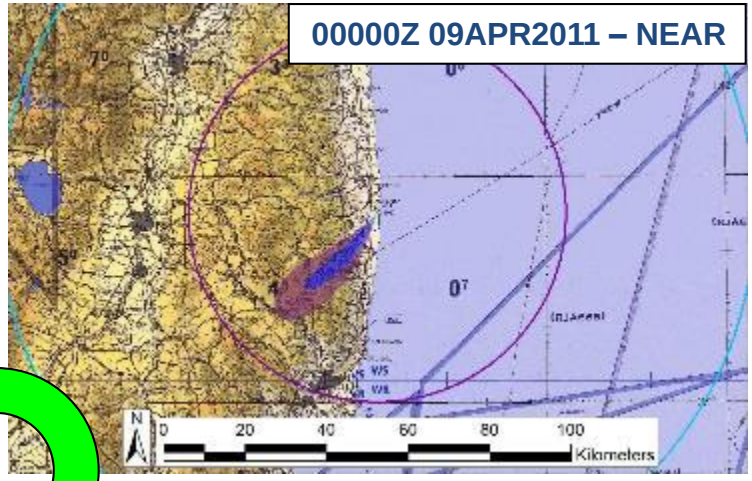
RETURN

HPAC - Japan Nuclear Accident Modeling Isotope Air Concentration - Fukushima

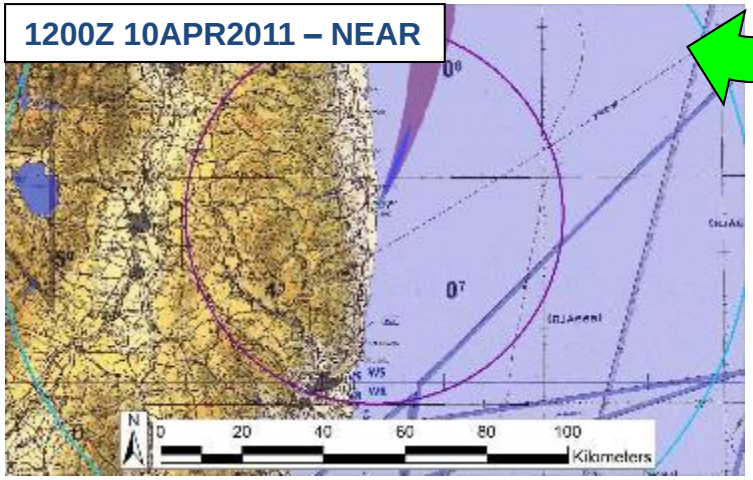
1800Z 08APR2011 – NEAR



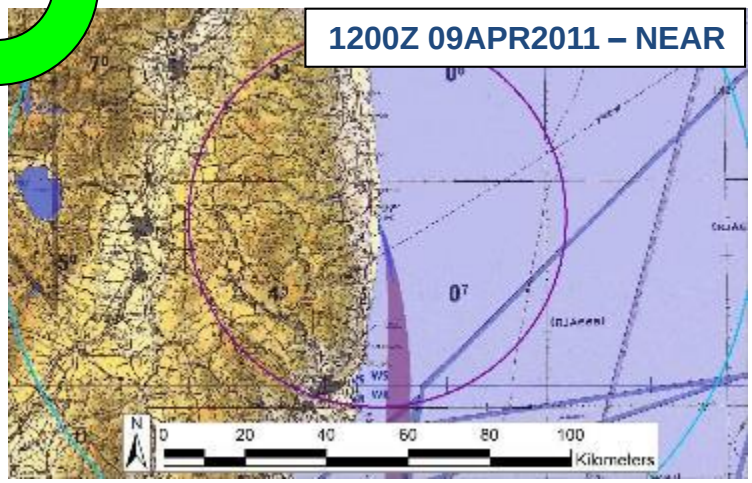
00000Z 09APR2011 – NEAR



1200Z 10APR2011 – NEAR



1200Z 09APR2011 – NEAR



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.

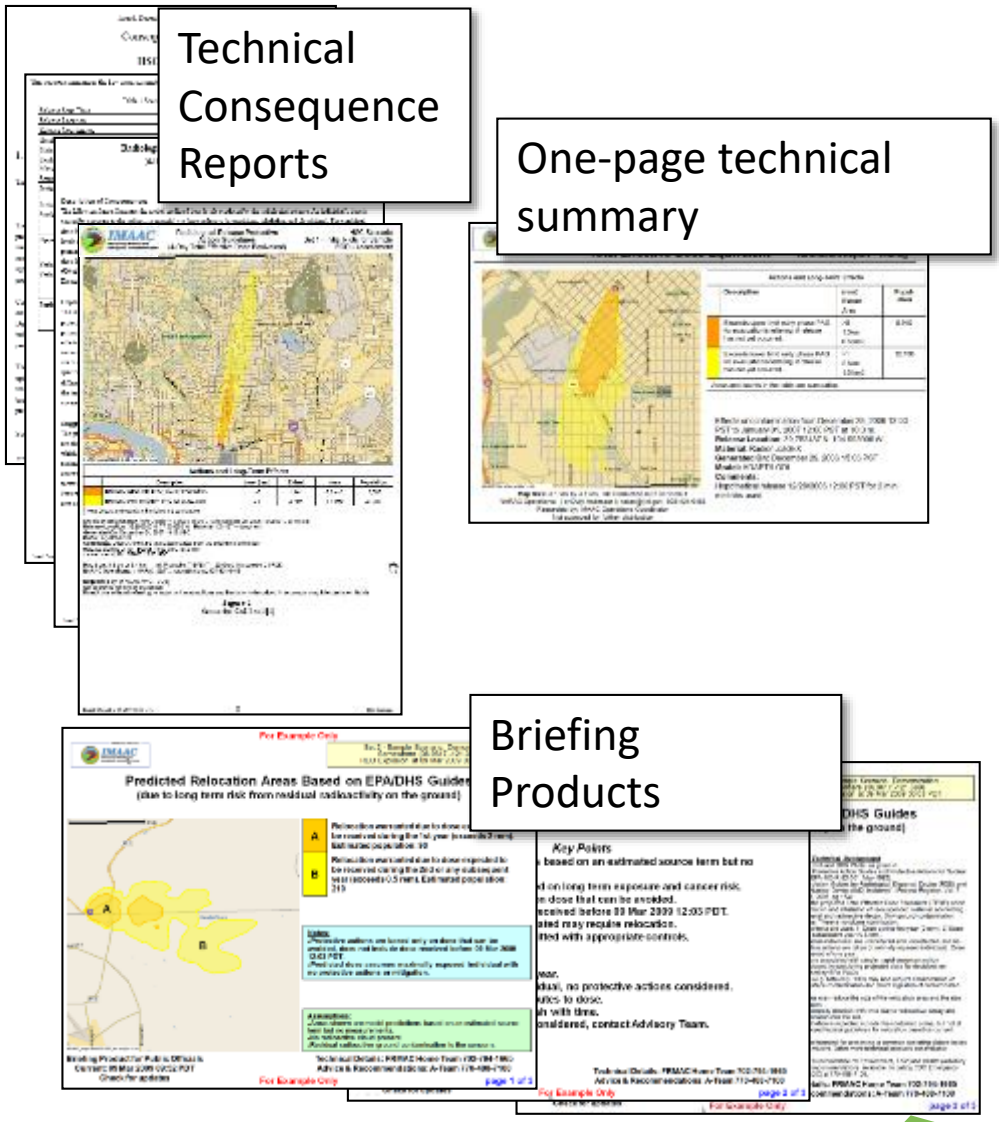
Range Rings
(nautical miles)

- 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.

Rad/Nuc: DOE/NARAC Products

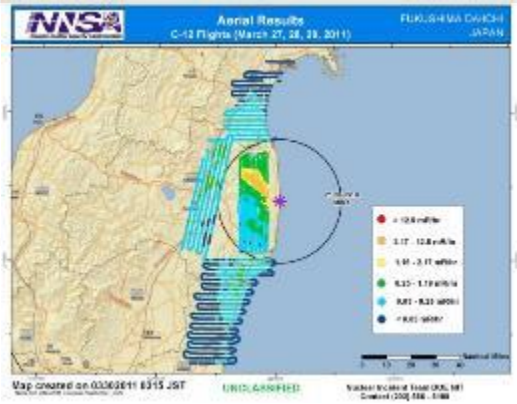
- The DOE National Atmospheric Release Advisory Center (NARAC) develops IMAAC rad/nuc products
- Inform decisions on public and worker protection
- Standardized information
  - Mapped plume hazard areas
  - Affected population and casualty numbers
  - Expected health effects
  - Protective actions to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



Rad/Nuc: DOE/NARAC Products

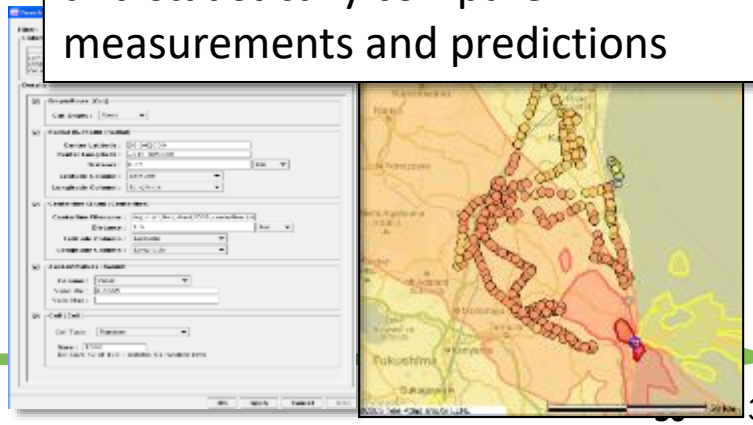
Initial Model Predictions Guide Measurement Surveys

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

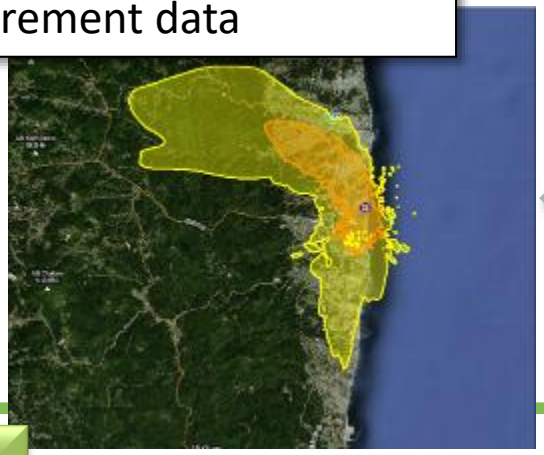


FRMAC measurements transferred electronically to LLNL/NARAC

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



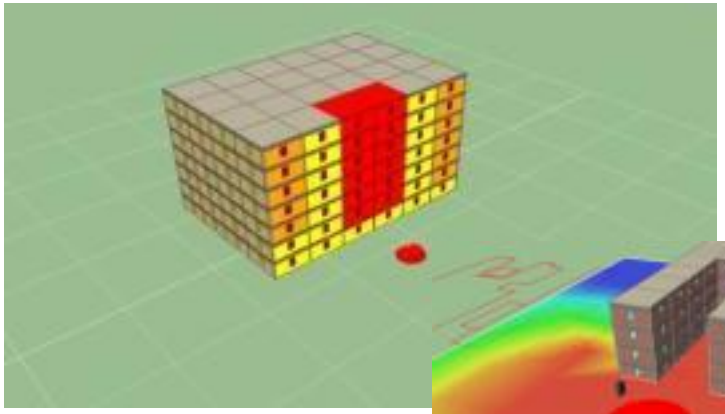
Updated predictions using measurement data

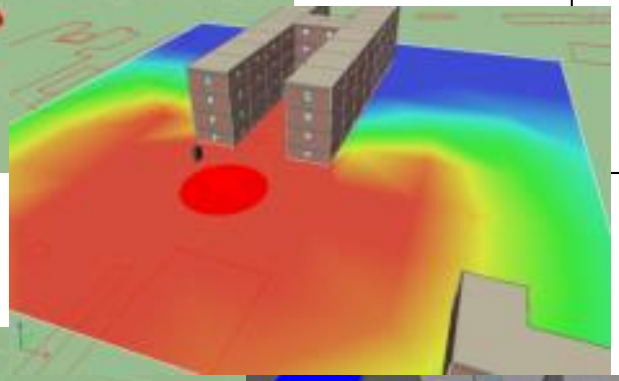


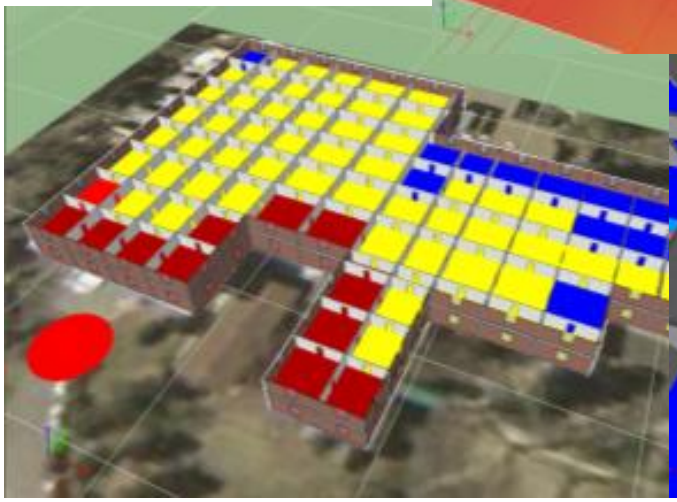
RETURN

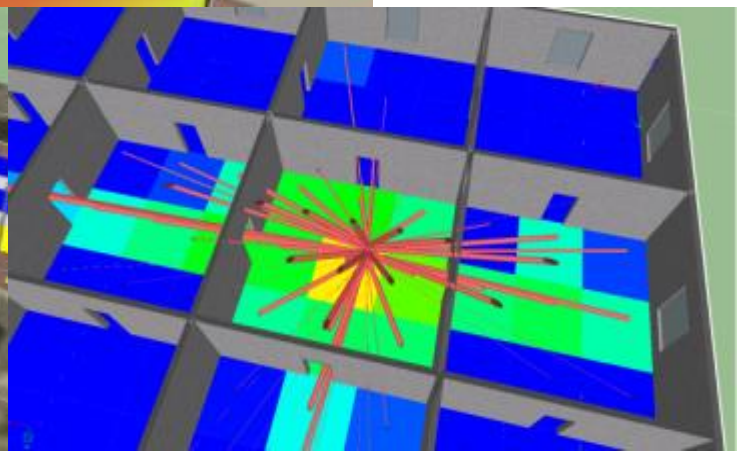
Vulnerability Analysis and Protection Option (VAPO)

- VAPO allows users to assess a multi-facility site for an array of high-explosive threats (i.e., IEDs, VBIEDs)
- VAPO predicts damage to internal and external structural components and windows as well as predictions of personal injury, equipment damage

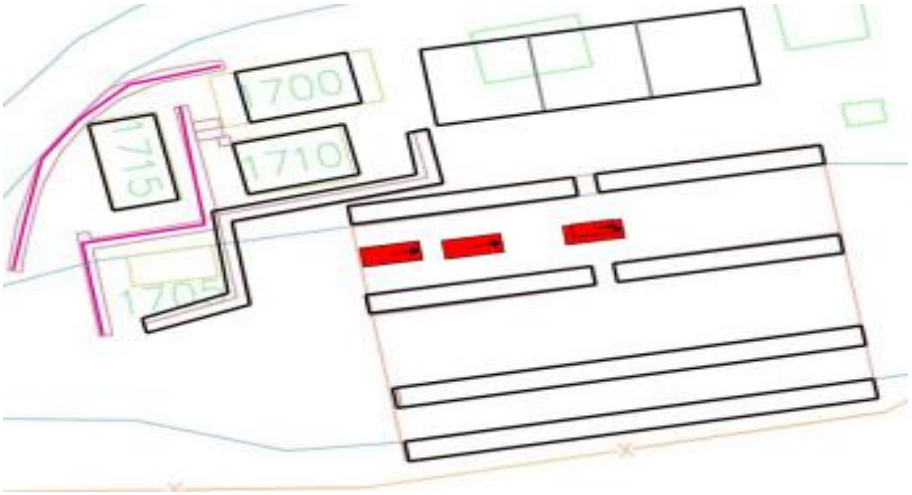


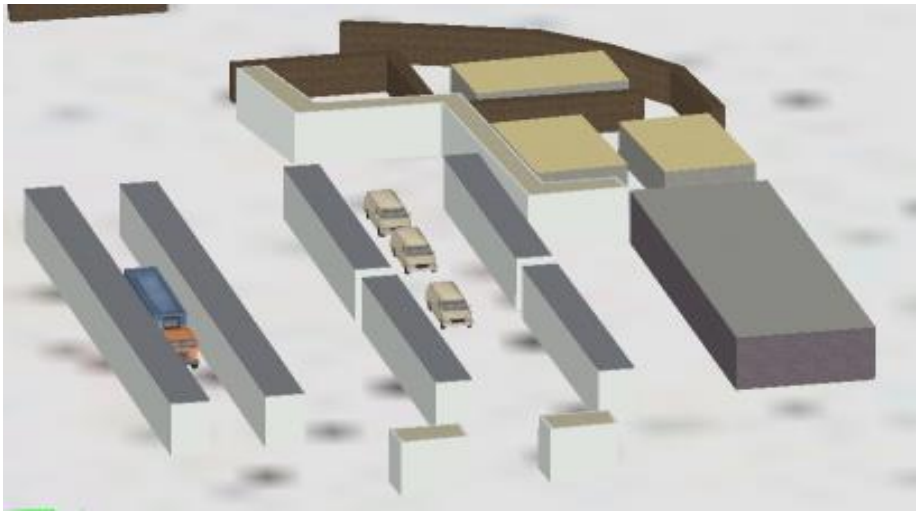


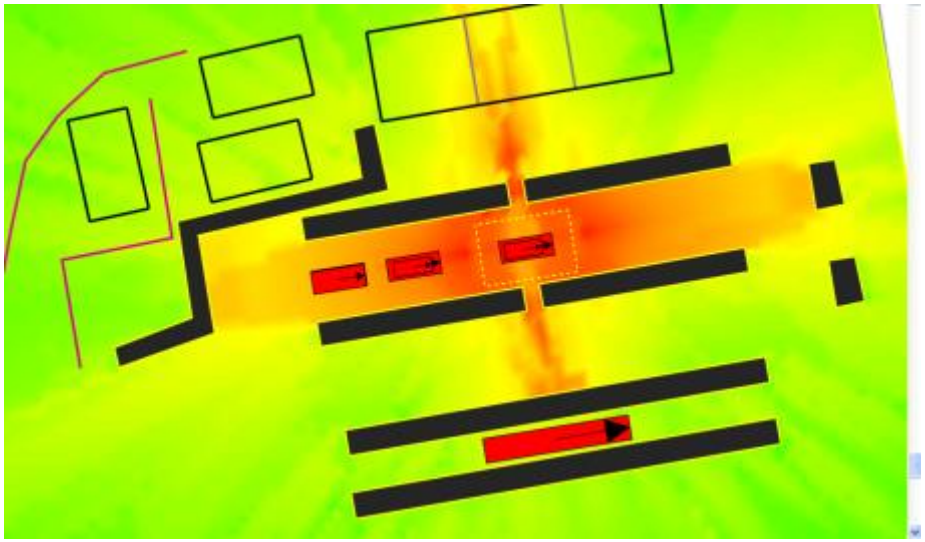


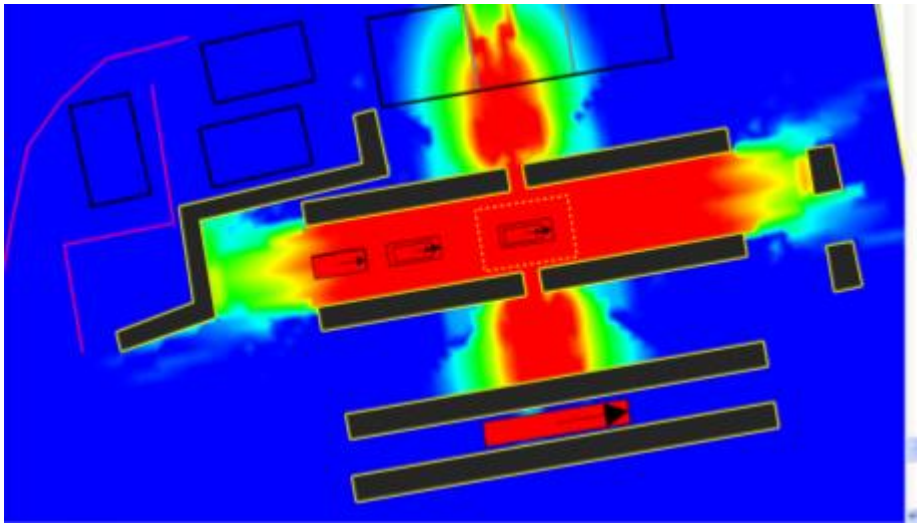


VAPO Force Protection Modeling
VBIED Access Control Point w/ Barriers









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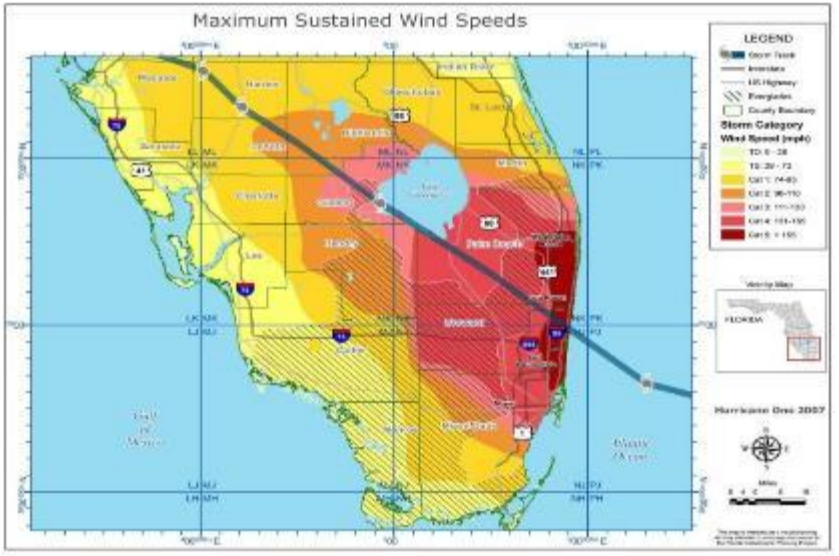
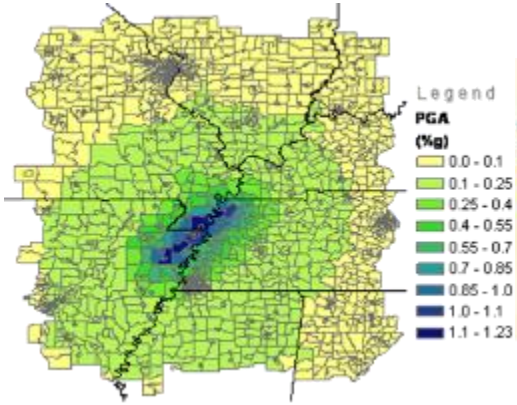
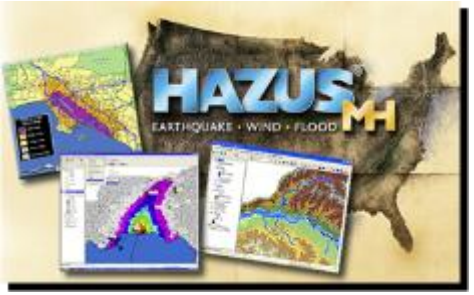
Cascading Effects: HAZUS-MH

- 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)







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

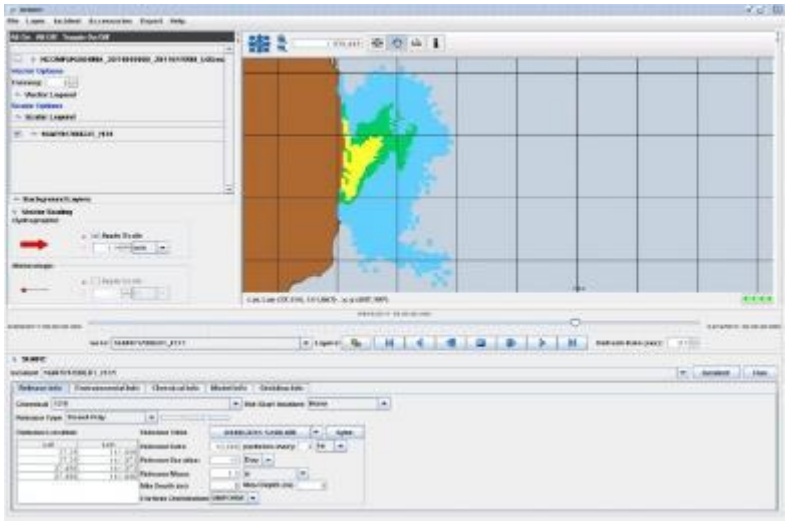
Waterborne Fate and Transport Modeling

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

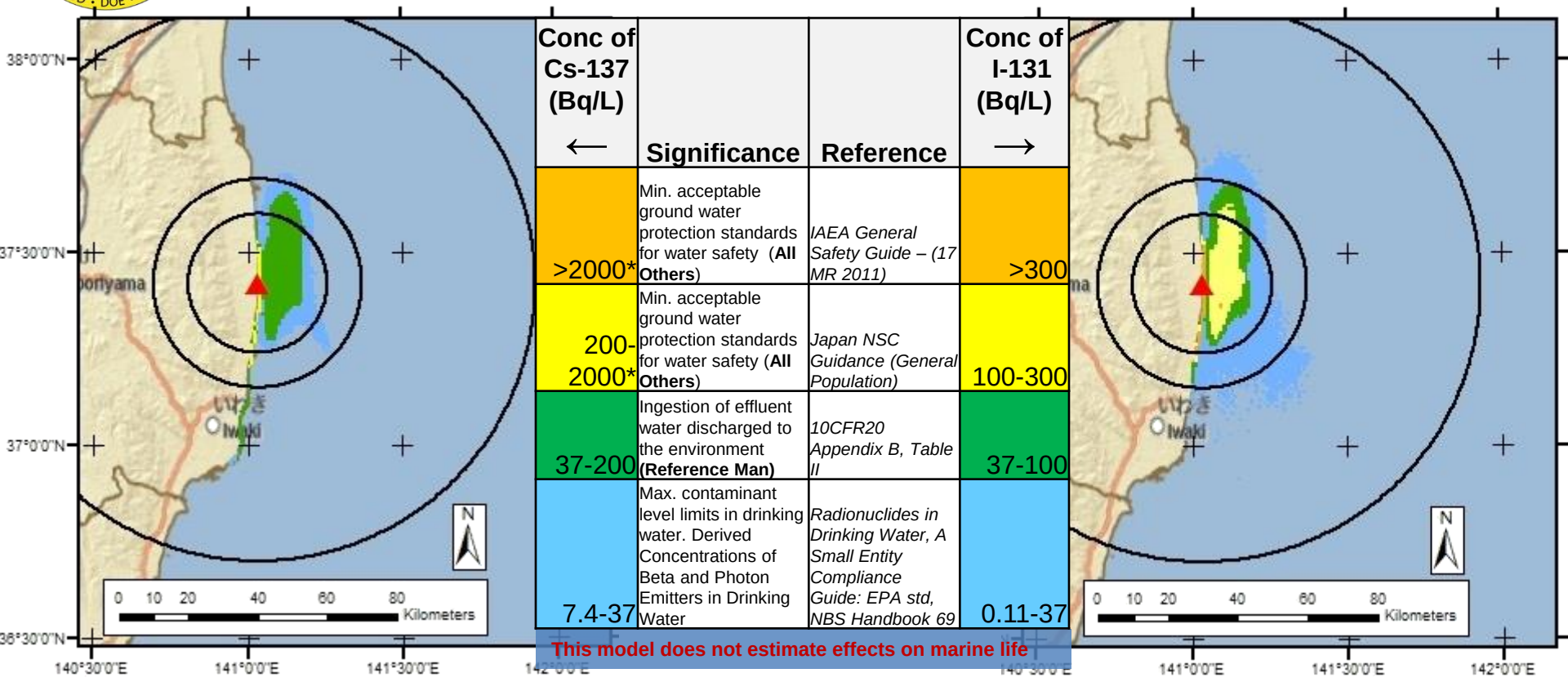


How does it do it:

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.

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