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Enhancing Use of Science-based Tools for Emergency Preparedness and Management

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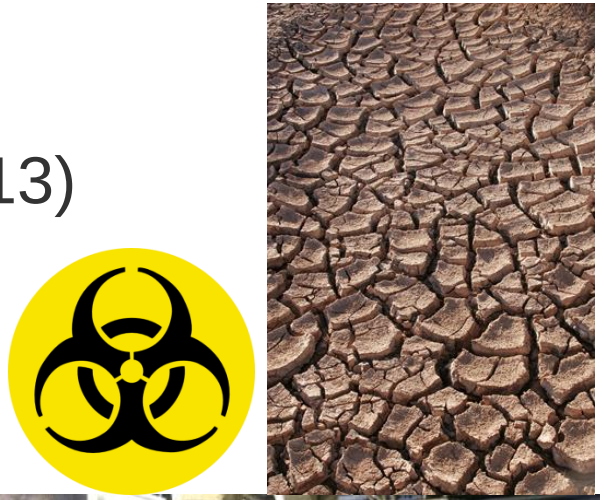
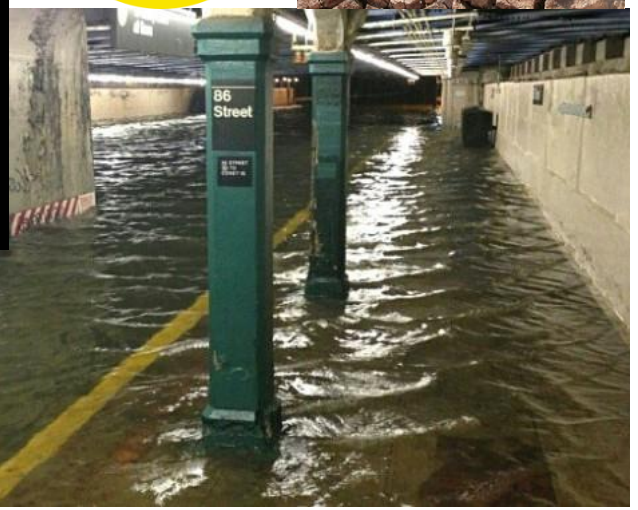
Presentation Content

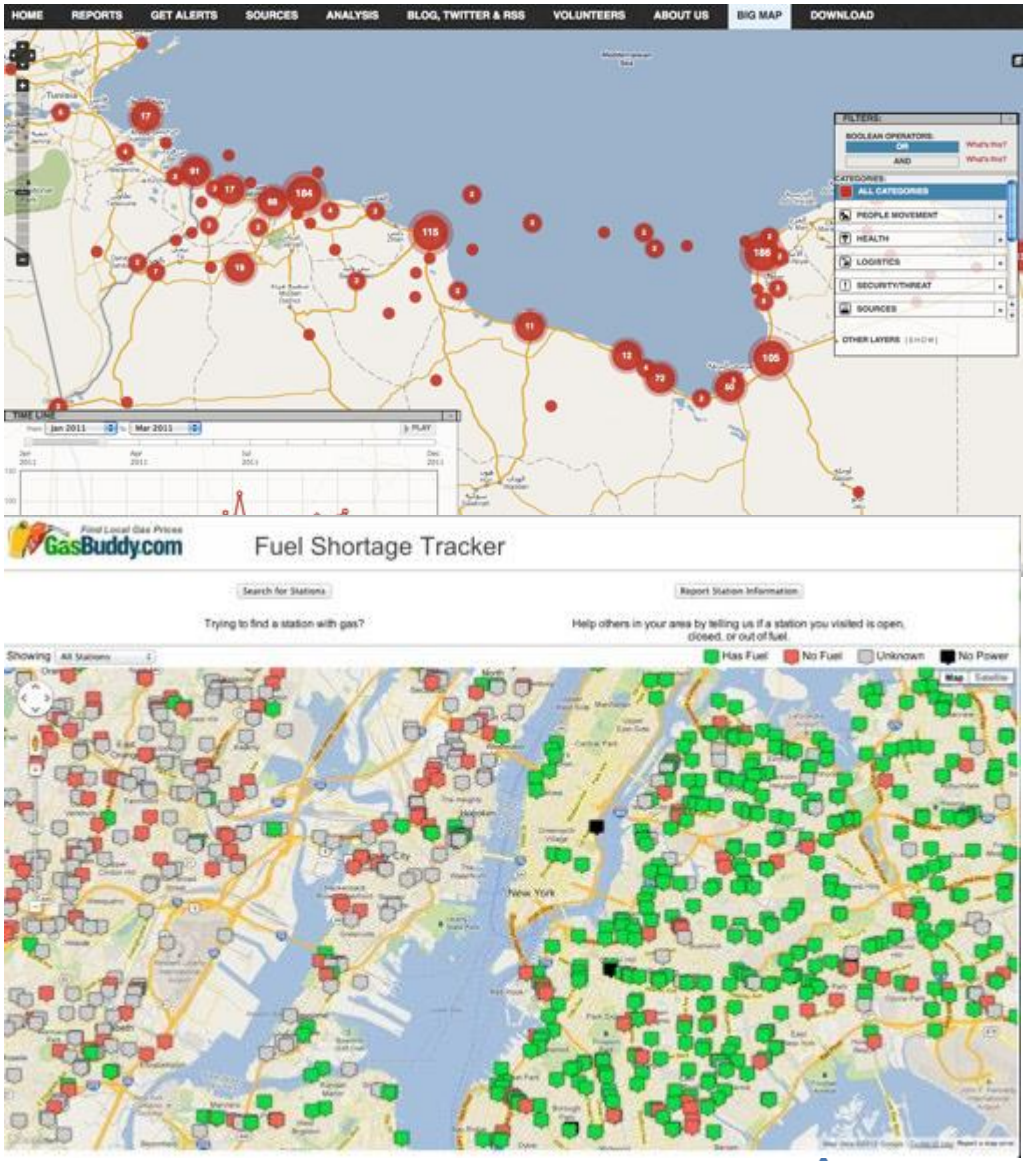
- The Challenge
- The Response
  - The Start of an Interagency Framework for Integrated Modeling & Simulation (ESFLG/MDWG)
  - DHS S&T/FEMA SUMMIT Capability
    - Program Vision and Motivation
    - SUMMIT Architecture and Technology
    - SUMMIT Applications: Exercises and Future Extension to Planning

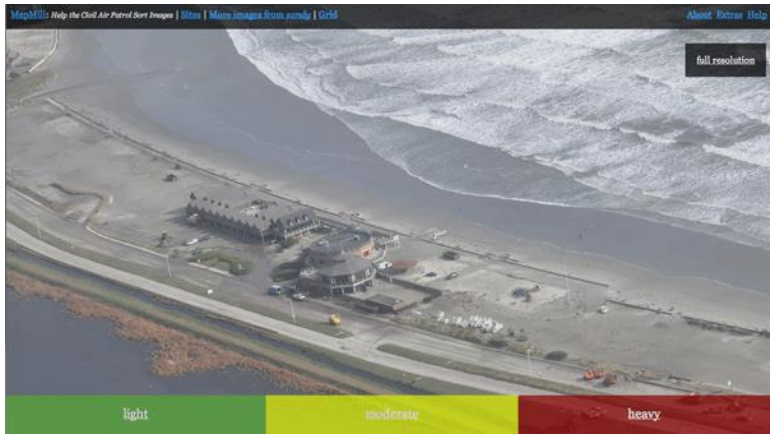
The National Challenge

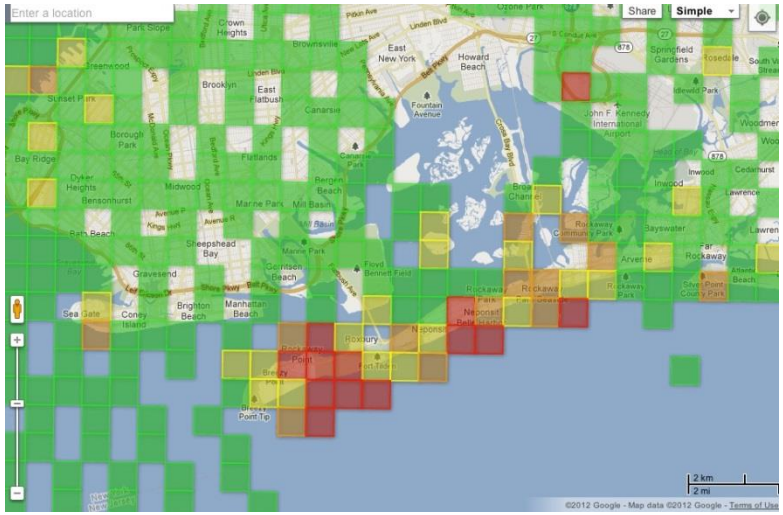
- Diverse events
- Complex, interconnected events
- Average of 337 disasters/yr (2000-2013)

Community Innovation







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The Technical Challenge

- Developing an information framework for risk analysis and planning in preparedness, response, recovery and mitigation efforts.

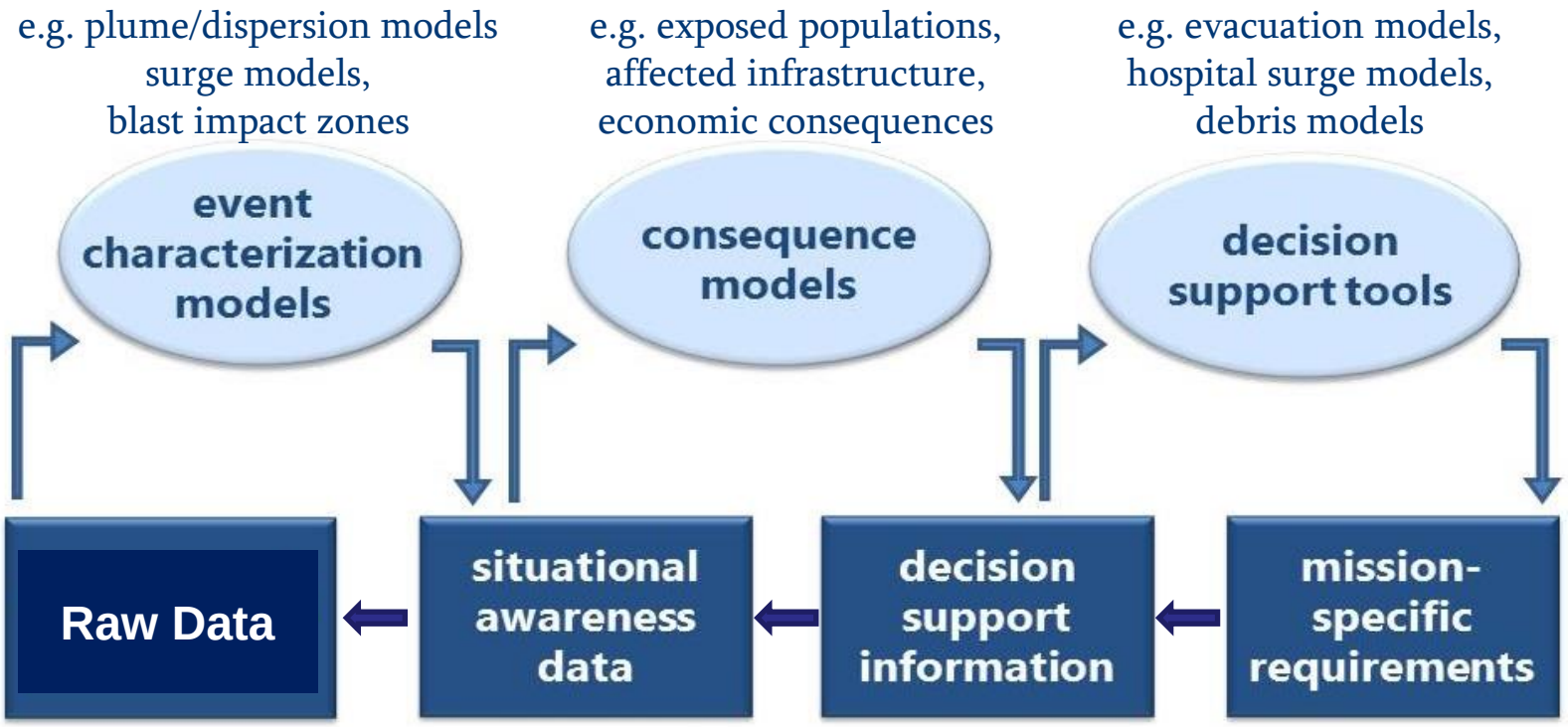
- Transparent, integrated ecosystem where data and models can be link together, with access controls, to drive information creation.

FEMA initiated study to identify and assess the data and modeling resources that are used across the U.S. interagency during emergency management

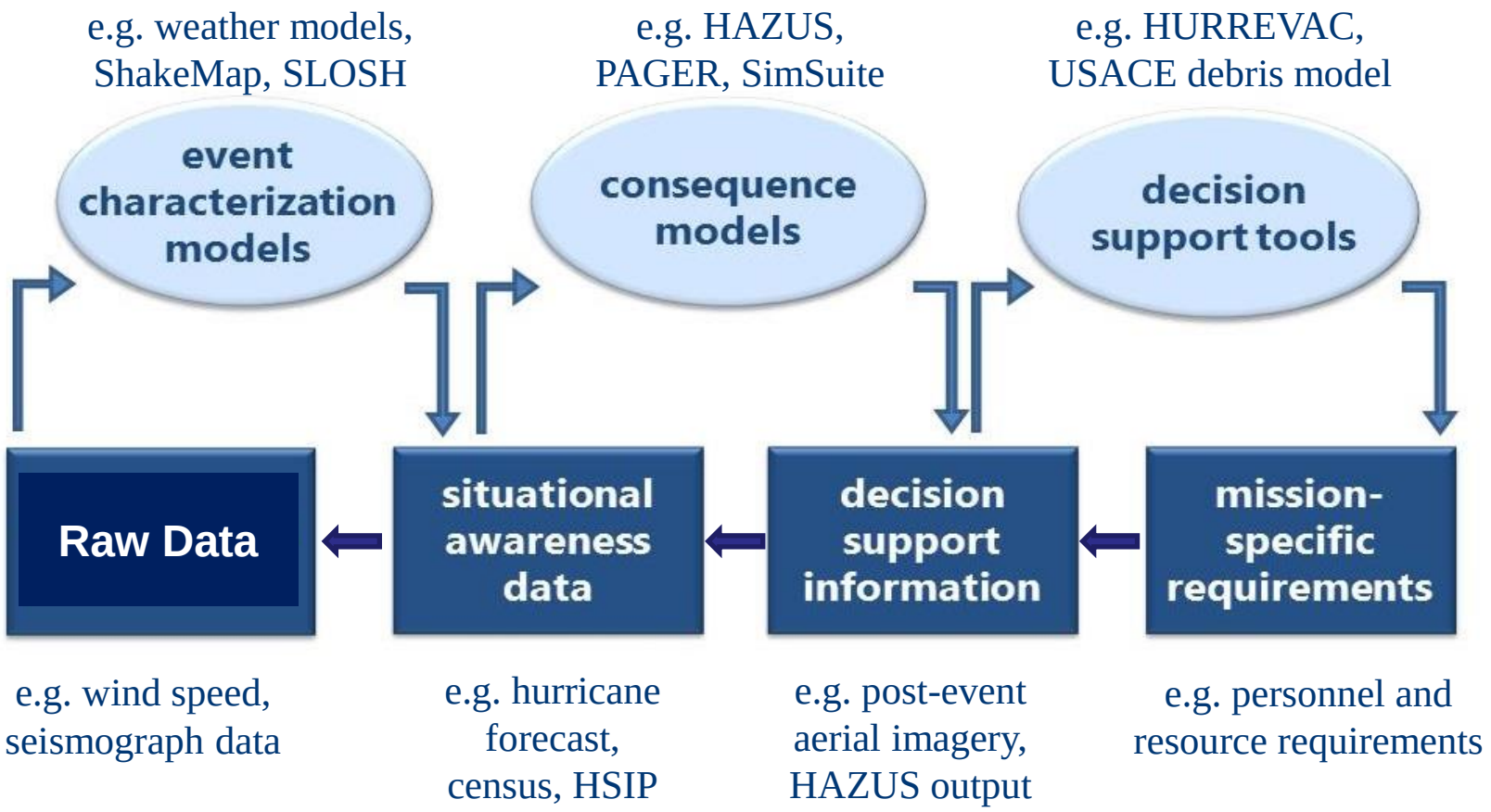
Modeling and Data Working Group (MDWG)

- Determine what information is needed by whom
- Develop an ontology to categorize the information requirements
- Identify and characterize the data and models that produce information relevant to hurricane and earthquake scenarios
- Perform network analysis to define gaps and identify linkages between resources and users/producers
- Build an interactive inventory cataloging the resources

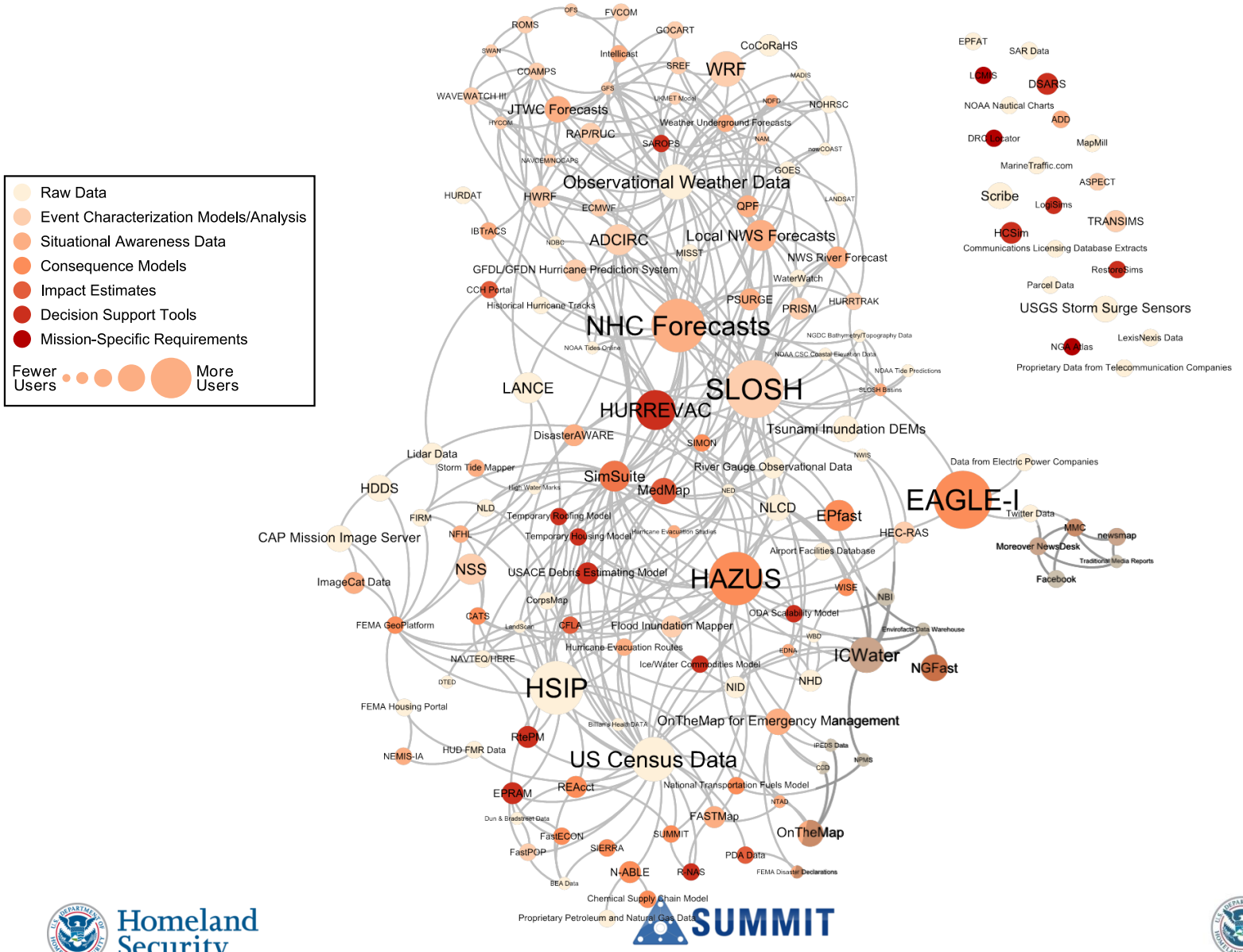
Recommended Framework



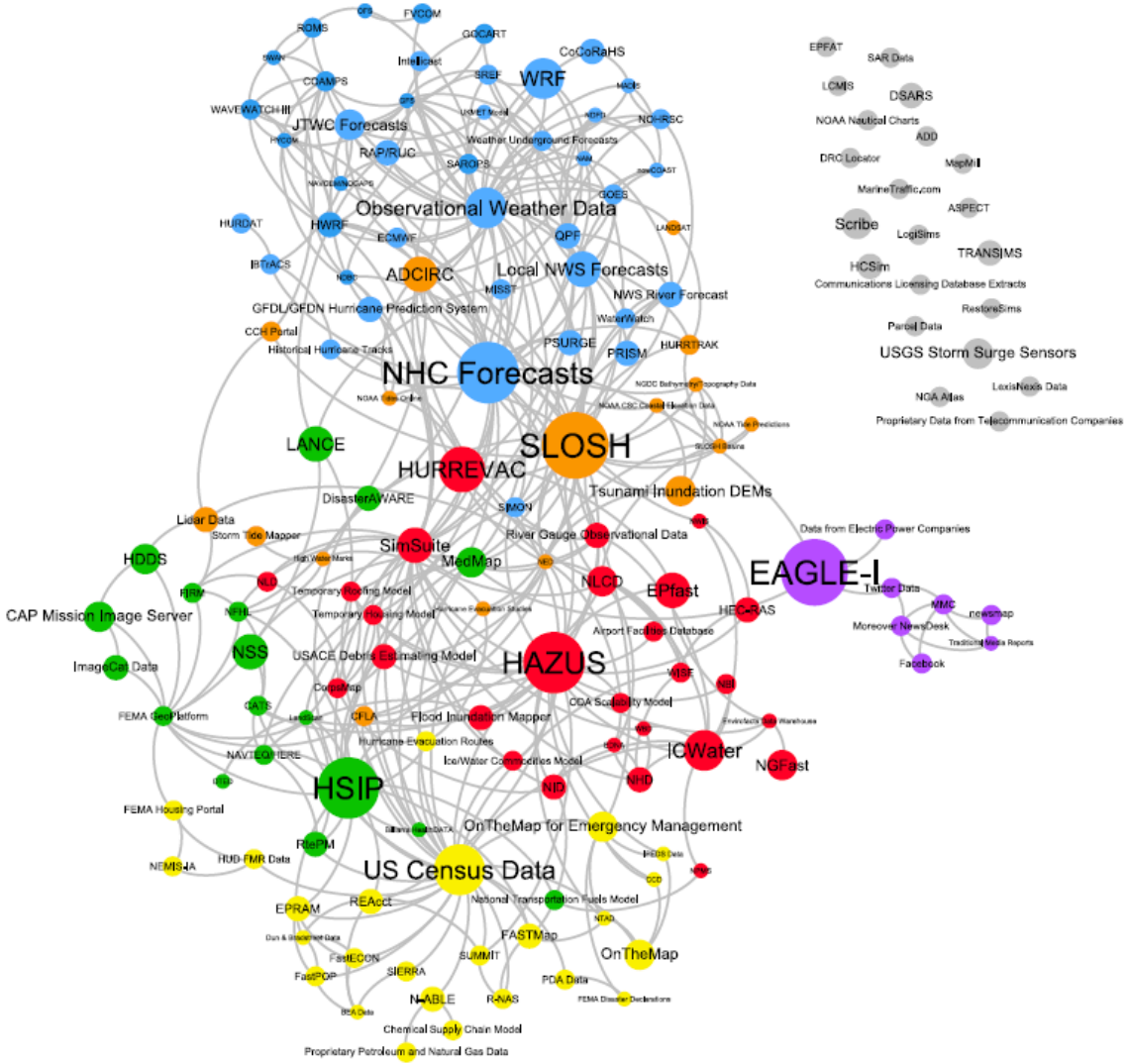
Example of Data Resources



Resource Network – Hurricane

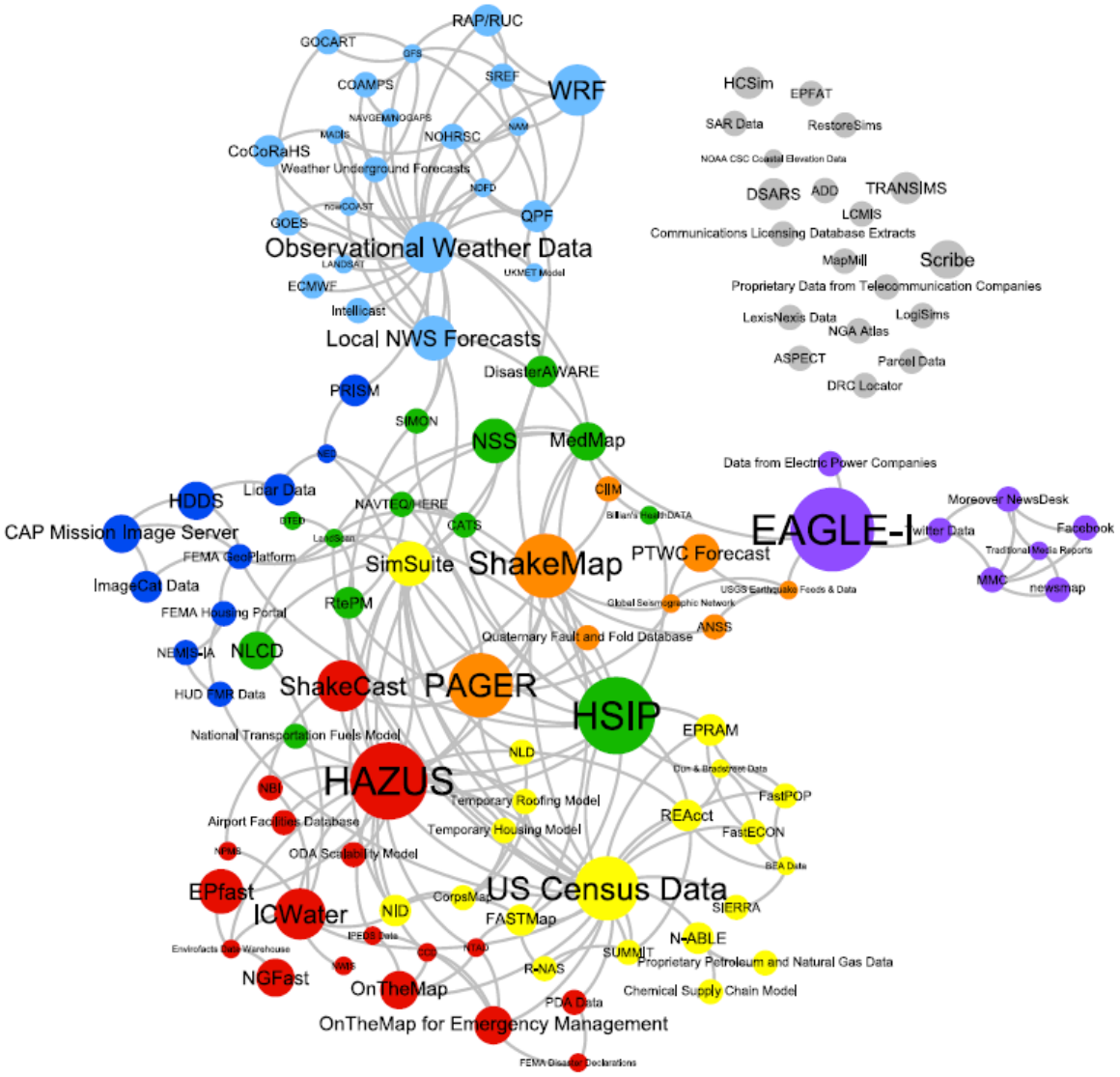


User Network – Hurricane



- Each node represents a resource in the inventory and sized by the number of organizations that use that resource across the federal interagency
- Colors represent different communities.

User Network – Earthquake



- Each node represents a resource in the inventory and sized by the number of organizations that use that resource across the federal interagency
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Integrated Threat and Hazard Analysis Capability using SUMMIT

(Standard Unified Modeling Mapping and Integration Toolkit)

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FEMA National Preparedness Assessment Division
Department of Homeland Security (DHS)
Federal Emergency Management Agency (FEMA)

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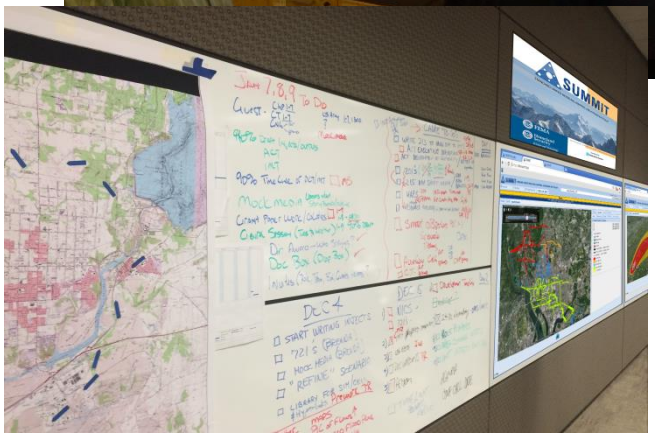
Problem Statement

DHS is not making full, effective use of Modeling and Simulation (M&S) to support Disaster Response Planning and Operations

Project Objective:

Provide USG (FEMA, OHA, NPPD) a **scalable M&S platform** to efficiently produce data for multiple scenarios or archive, share, and reuse any data utilized in plan creation for future planning, comparative analysis or during emergency response operations.



Current Gaps

- **Integration:** currently disparate systems prohibits complex, cascading analysis, sharing, and collaboration
- **Uncertainty:** Planning only done for single scenarios and response does not typically convey uncertainty
- **Reuse:** data from planning not archived and used during response or subsequent planning

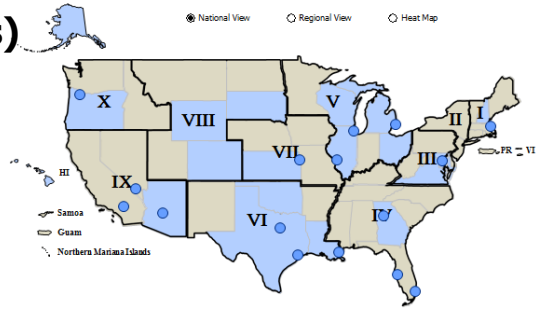
Desired Outcome

- Enhanced national preparedness (THIRA) through robust multi-scenario planning capability
- Dramatically shorten the time to respond to disaster requests for informations

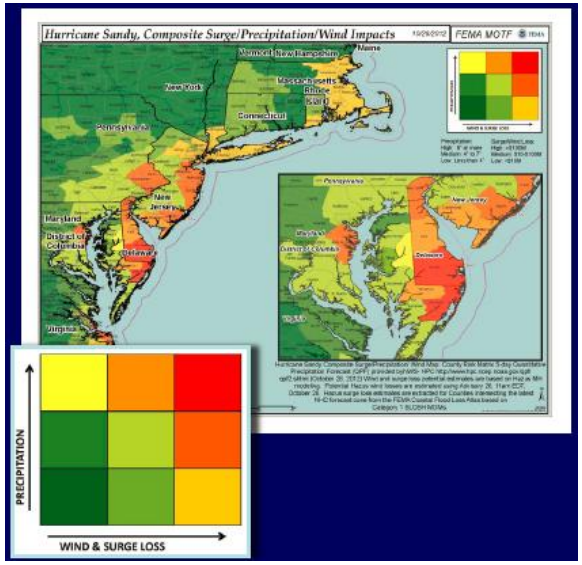
US Planning and Disaster Declarations Modeling & Simulation (M&S) Needs Are Underserved Due to Cost and Capability Constraints

FEMA Threat and Hazard Identification and Risk Assessments (THIRAs)

- Impact: **$1.2B/yr** of FEMA Grant awards depend on THIRAs.
- Integration: 700+ scenarios generated with uncoordinated, disparate tools and data. 96% shared scenario types
- Uncertainty: Plans based on only a single scenario with well defined parameters primarily due to cost and capability constraints.



- Reuse: Data not archived in any usable manner, making "what-if" analysis during an event impossible and requiring new M&S data to be generated for future planning efforts.

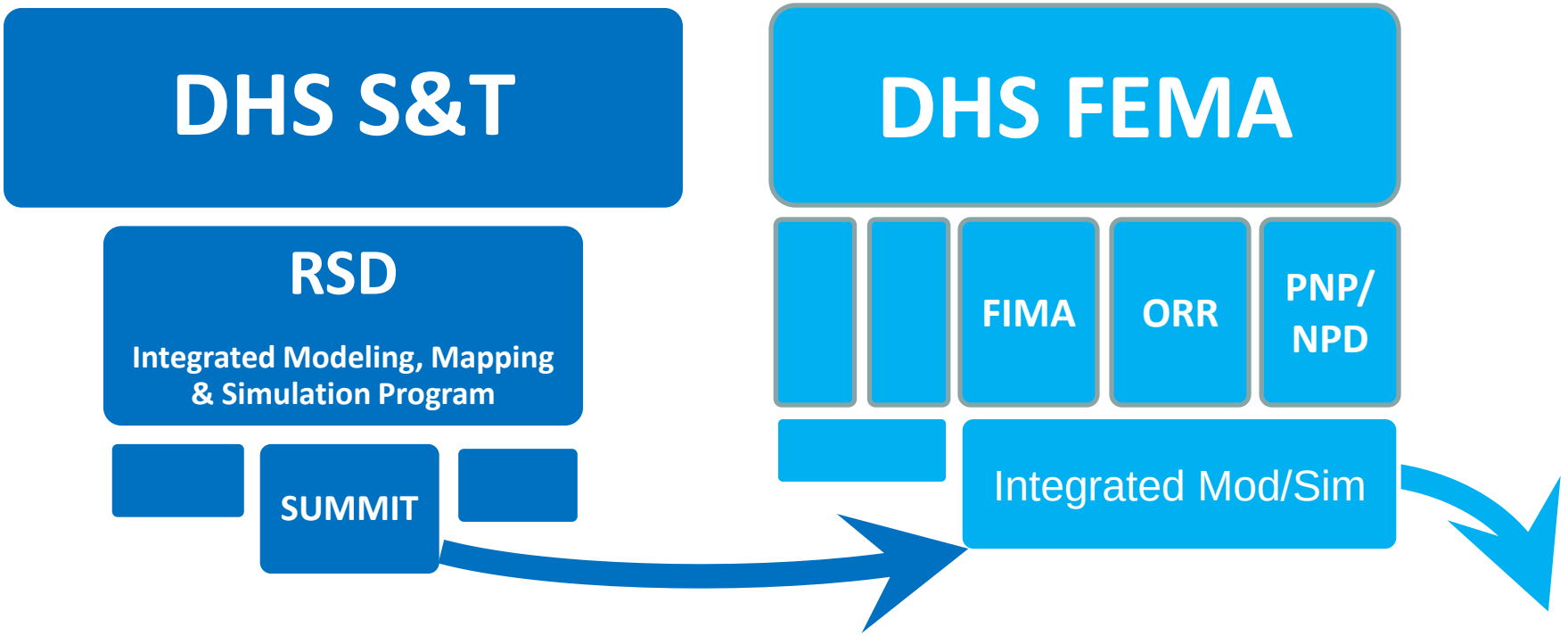


FEMA Modeling Task Force (MOTF)

Operations

- Impact: Disparate tools for RFIs. M&S credited with expediting FEMA Individual Assistance *($4.4M saved in Hurricane Sandy alone*). Resource and capability constraints limited MOTF in 2013 to ~5 of 95 disaster declarations (~5%).
- Integration: emergency operations community primarily rely on tools provided by private and open source community designed for the general public use to create situational awareness and integrate data. Technologies do not accommodate emergency planning and operations processes.
- Uncertainty: M&S for operations do not typically convey uncertainty, have difficulty handling incomplete information, and are not available on the necessary time-scales for effective decision making.

Program Vision for SUMMIT

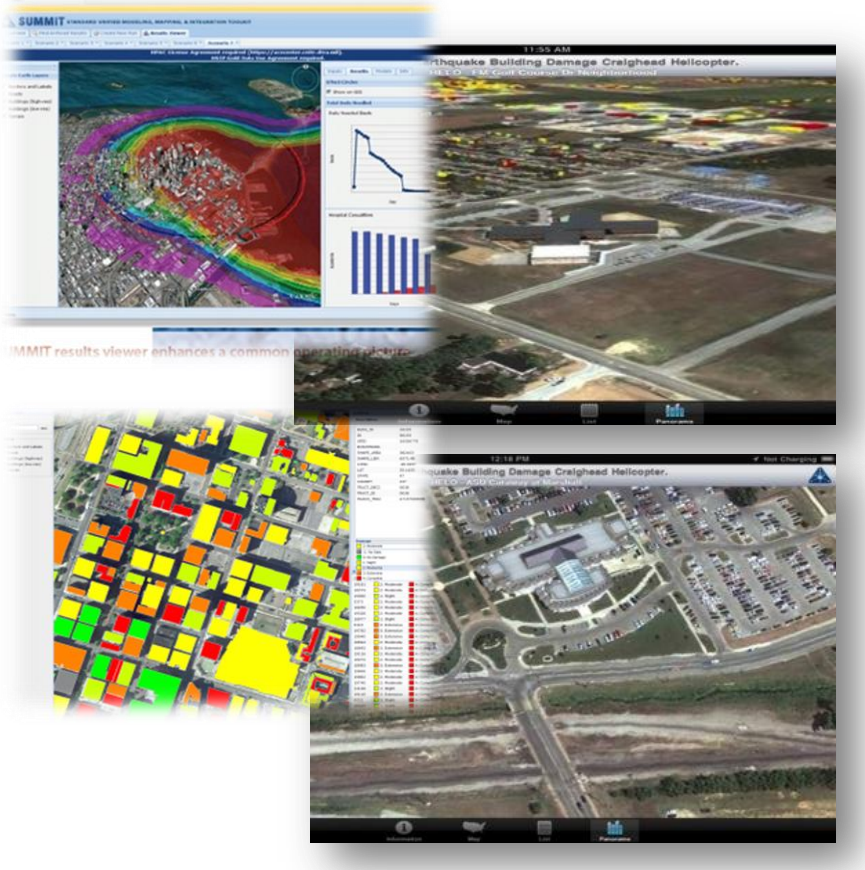


Vision: A capability for linking together "best-in-class" modeling and simulation tools to enable analysts, emergency planners, and incident managers more effectively, economically, and rapidly prepare, analyze, train, and respond to real or potential incidents.

Integrated Modeling and Simulation for Analysts

CURRENT capabilities to support the following scenarios

- Improvised Nuclear Device
- Hurricane
- Tsunami
- Earthquake
- Chemical Release
- Biological Release
- Cyber Attack



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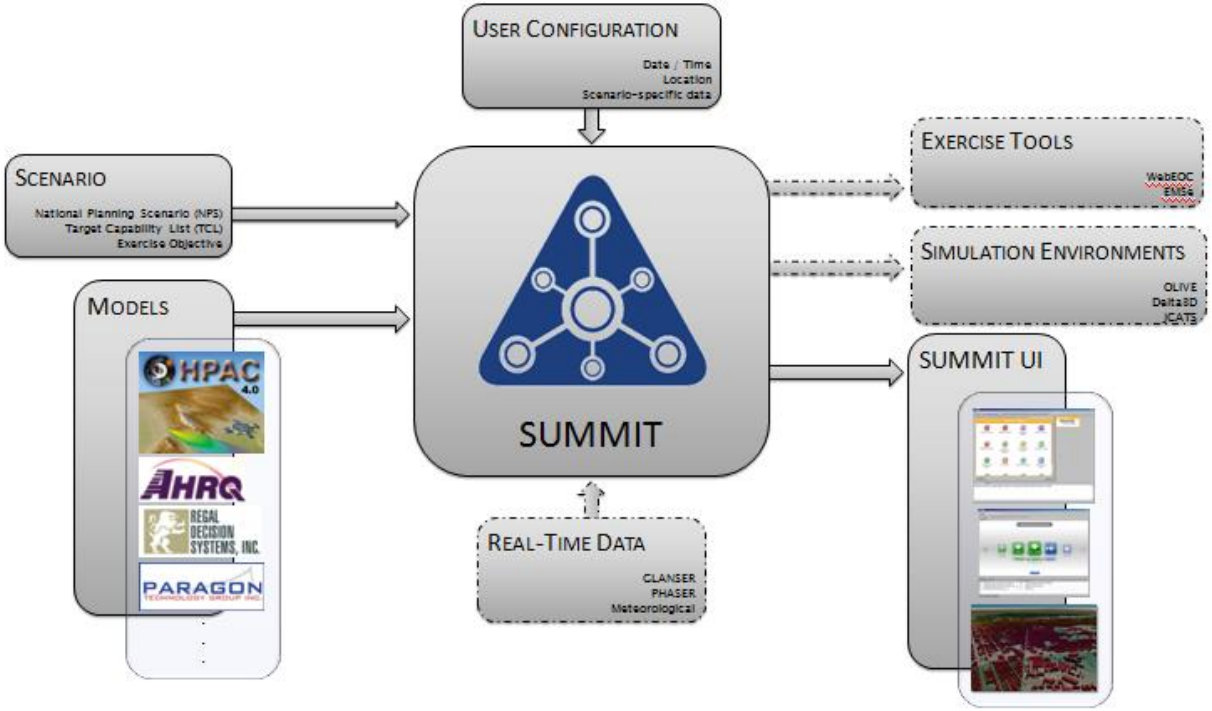
SUMMIT Architecture



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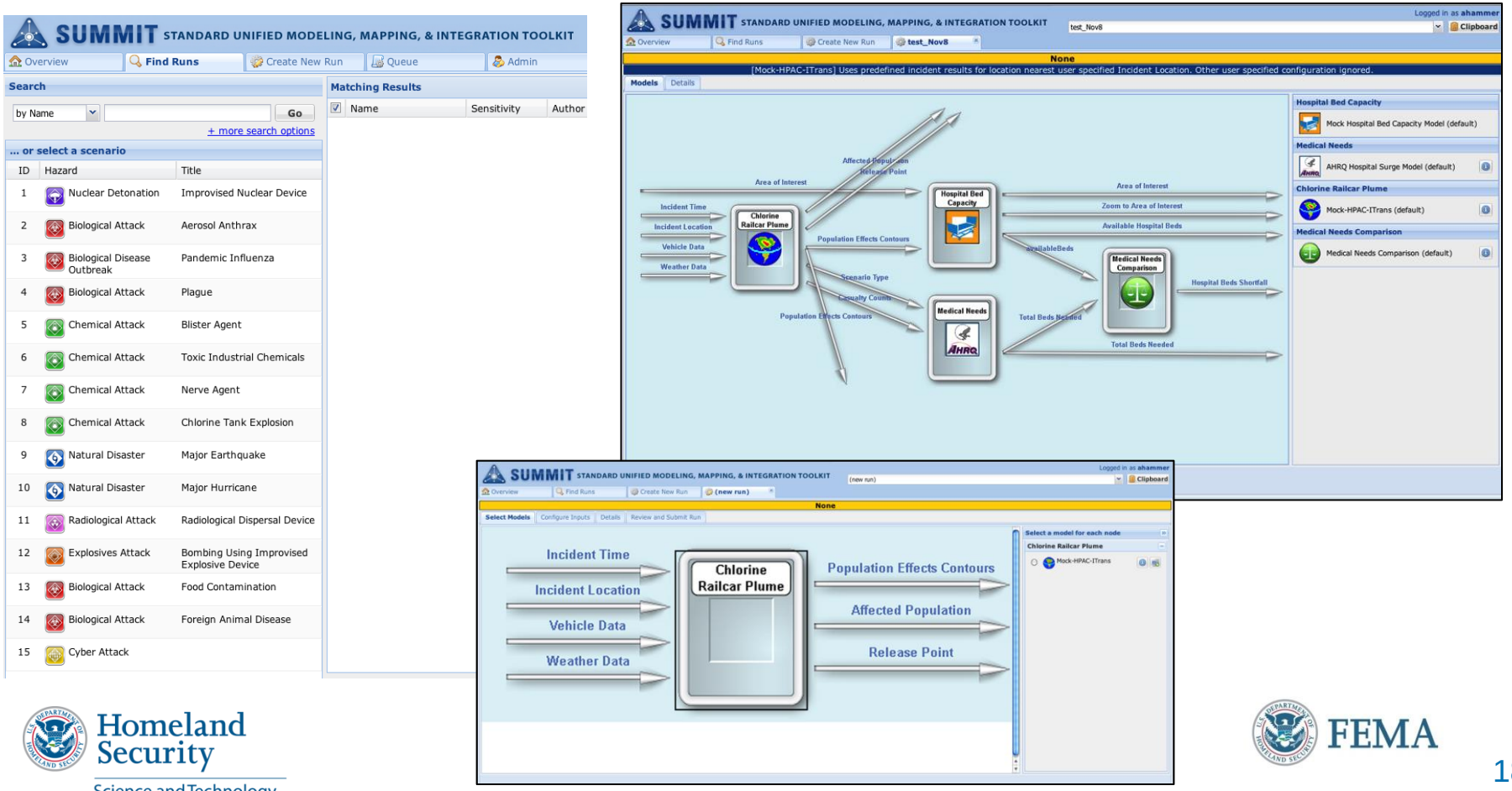
SUMMIT Technology

SUMMIT innovation is new method for model integration

- Extendable repository of Templates, Slots, NIEM datatypes, and Model Wrappers
- User-supplied description and usage meta data
- Slots categorized by Taxonomy (syntax and semantics)



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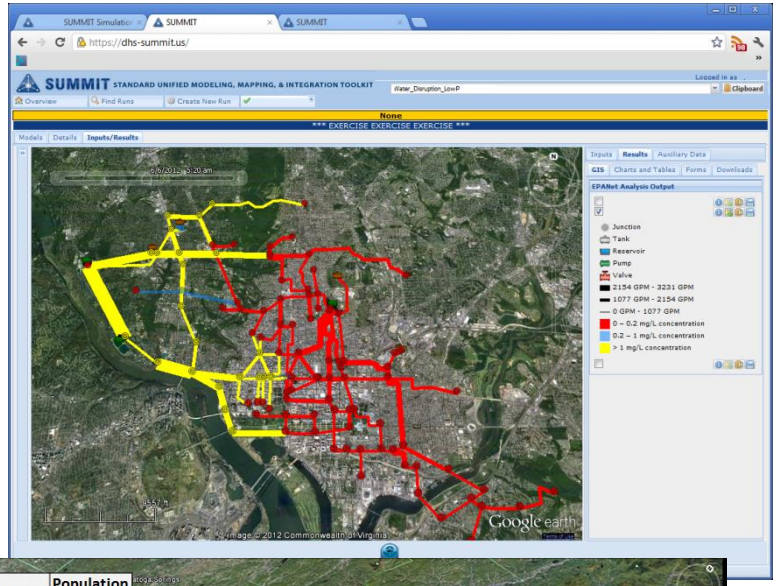
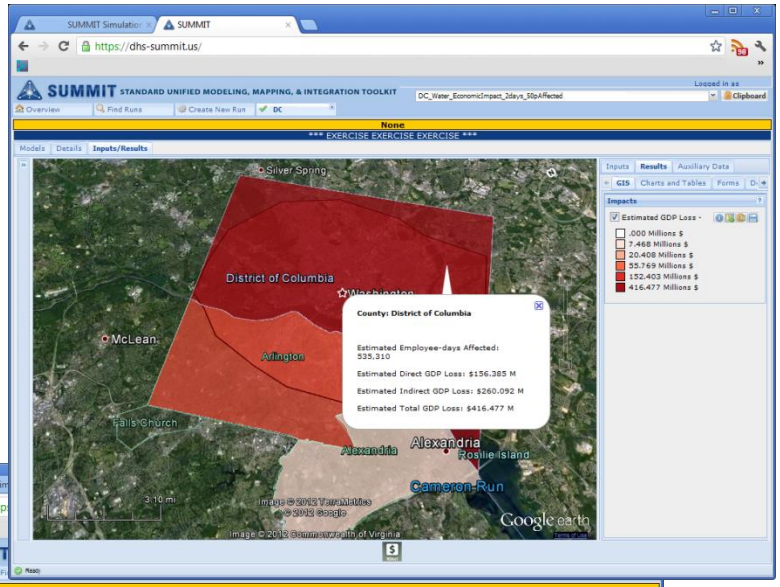
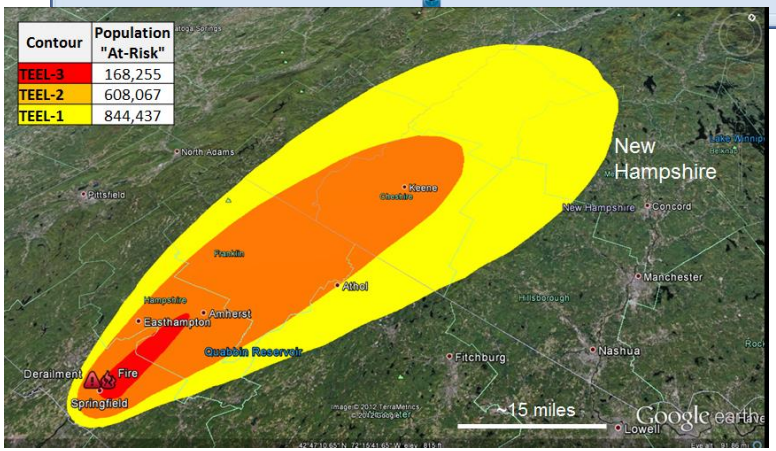
Example SUMMIT Results

Lifeline Disruption

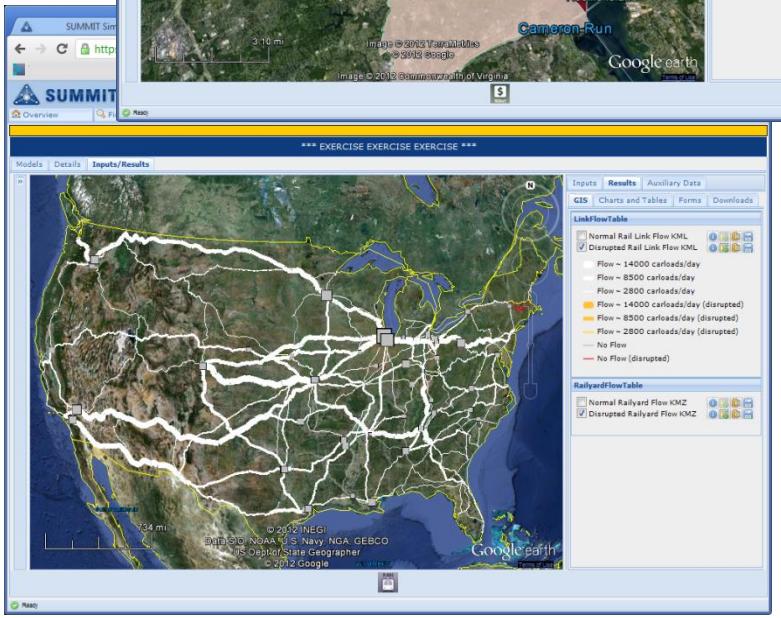


Economic Disruption





Populations at-risk



Logistics Disruption

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Models Currently Available
(additional models constantly being added to SUMMIT ecosystem)

Legend

NPS: National Planning Scenario

I.D.: Infrastructure Damage

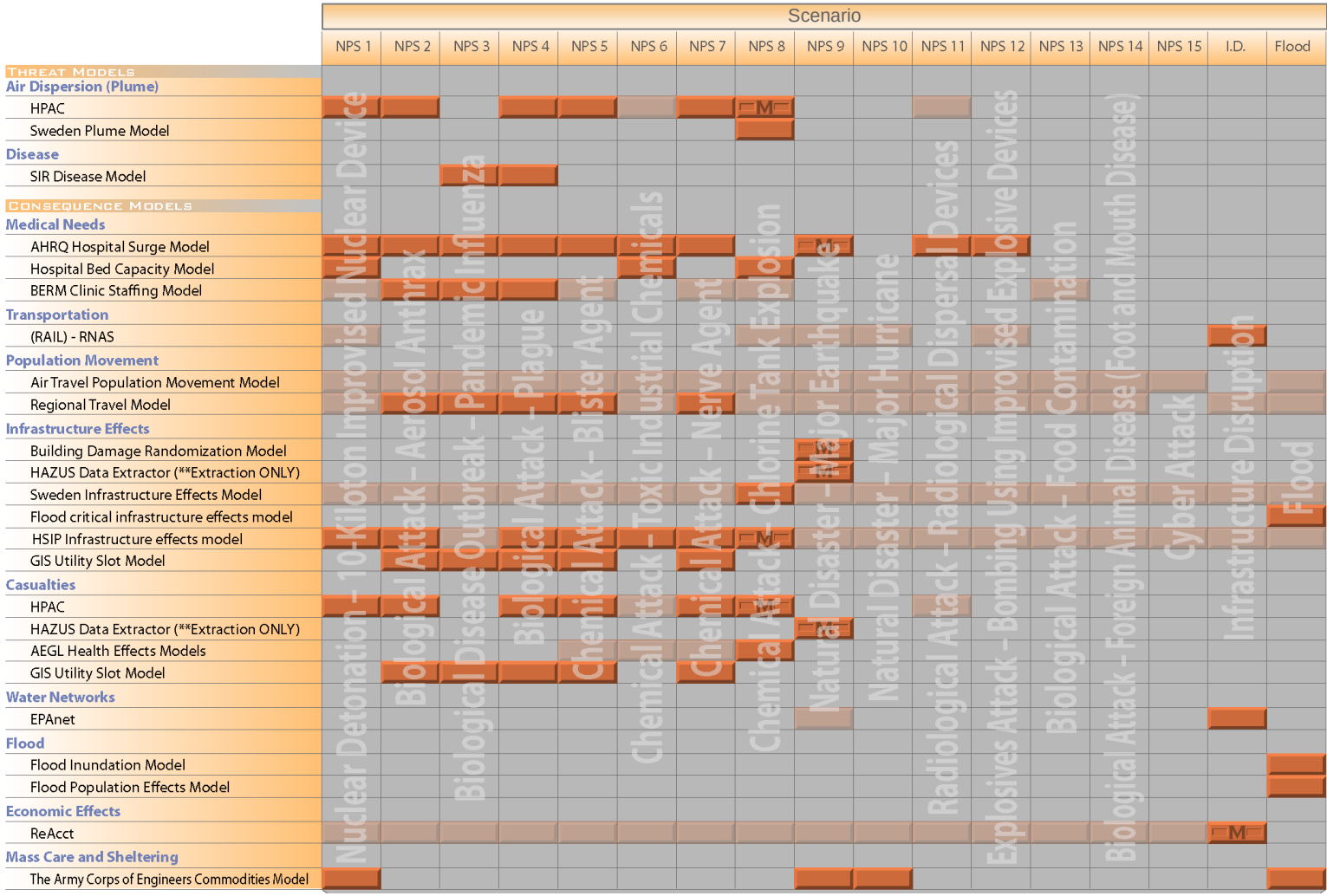
Model available in template to support scenario

Model could be added to template to support scenario

M — Mature model and template used in support of multiple exercises

In progress:

1. United Nations IED
2. US Census model
3. DHS trucking/pallet
4. Imperial College Asteroid
5. NOAA HYSPLIT
6. HotSPOT (RDD)
7. FARSITE wildfire
8. LandScan Population
9. RtePM Evacuation



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SUMMIT SUPPORTED

EXERCISES

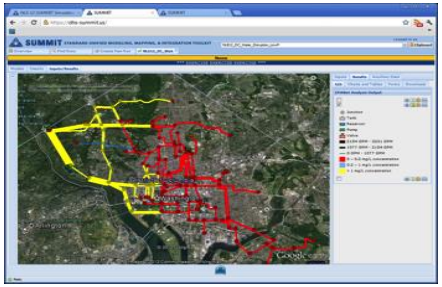
SUMMIT Exercise Support Examples

FEMA Region II Blue Surge (May 2013)

- 3 day functional exercise focusing on the first 72 hours a tsunami in the Caribbean. SUMMIT provided:
  - HAZUS earthquake and flood
  - USACE/DoD commodities
    - Trucks, Ice, PODs, Staff
  - Casualty distribution
  - Infrastructure effects
  - Displaced households

National Level Exercise 2012 (June 2012)

- Cyber-security exercise. SUMMIT provided:
  - Model-based scenario data
  - Capability to view integrated M&S results to enhance situational awareness and common operating picture during exercise conduct.
- Models/data integrated in SUMMIT:
  - Regional Economic Accounting (REAcct)-GDP
  - Railroad Network Analysis System
  - EPAnet – effects of chemical levels in water
  - HPAC – air dispersion model
  - FASTMap - infrastructure effects map



SUMMIT Transition *(in progress)*

- FEMA National Exercise Division
  - *Amazon Cloud System*

- California Exercise Simulation Center
  - *Sacramento, CA*

- Sweden
  - *Swedish National Defense College*

SUMMIT Impact @ CESC*

SUMMIT at the CESC

Certification scenarios: Data on wildfire behavior, population impacts, affected infrastructure, economic disruption

Training Certifications (CICCS)

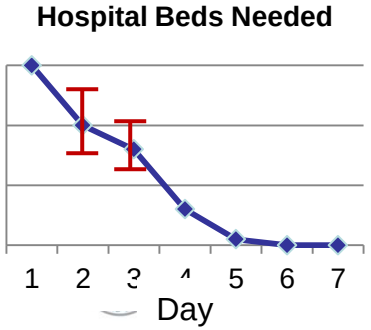
"Performance-based System"

Exercise scenarios and injects: Data on catastrophic incidents (e.g., derailment) and downstream impacts

Incident Command Exercises

Suite of scenarios for robust testing of plans: Requirements data

Plans Validation



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R&D and Value Roadmap for SUMMIT

Q4/FY2014 — **Timeline** — **Q4/FY2015** — *"base capability"*

	Planning Focus			Response Focus		
	SUMMIT Capability →					
	Batch	Model Run Library	Basic Informatics	Live Data Fusion	Data Analytics	Visualization and Uncertainty
SUMMIT R&D Capability	Capability to run hundreds of SUMMIT scenarios automatically by specifying a range of input parameters	Archive library of batch runs that can be queried using the basic informatics described below	Ability to search library of batched SUMMIT results for parameter values (e.g., max/min)	Capability to incorporate real-time data feeds from other tools or sources that are important for response operations. For example, the use of live data for the configuration of models (e.g. inverse plume modeling based on environmental sensor data feeds).	Capability to perform analyses/data manipulation of real-time operational data to support decision-making. Analytics performed on SUMMIT results to provide an initial testable hypothesis of incident scope, scale, impact and resource needs or other decision support via what-if analysis.	Human factor-informed data representation for intuitive interpretation of data and data uncertainty for use by a variety of client types including mobile computing platforms.
Value Add	Planning: Enables user to **analyze the variability and sensitivity** of scenario parameters and response decisions on scenario outcomes in order to develop **robust operational plans**.			Response: Data analytics will build on Basic Informatics, providing users with response guidance and ability to develop robust operational plans. **Live data fusion** will enable the user to replace modeling data with real data over the course of operations, and use best available estimates for decision-making. Visualization will enable the user to **intuitively interpret complex data** and **data uncertainty**, to obtain **situational awareness** and respond more effectively and efficiently.		

Future SUMMIT Application to Emergency Planning

In the future, SUMMIT could be used to develop libraries of modeling runs that provide data to answer key planning questions, incorporating scenario variations and uncertainty.

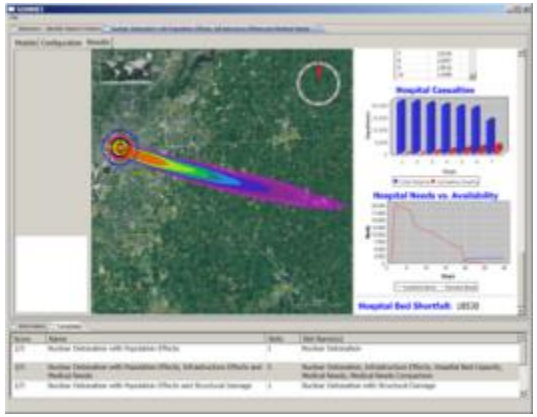
Additional requirements from end-users are needed

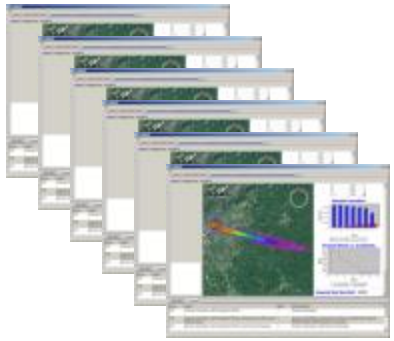
Example

1 SUMMIT run for 1 set of inputs:
- 1 IND detonation location
- Winds W 15mph
- Static population (home locations)…

Thousands of SUMMIT run for varying inputs:
- Multiple detonation locations
- Varying weather conditions by time of year
- Population distributions for home, work…

Planning Guidance (e.g., Medical surge requirement for IND detonation threat)





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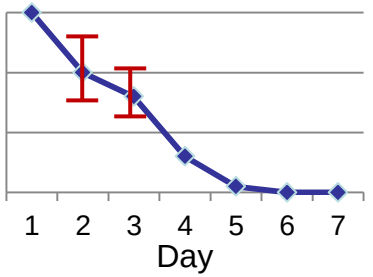

SUMMIT is being advanced to automate this capability

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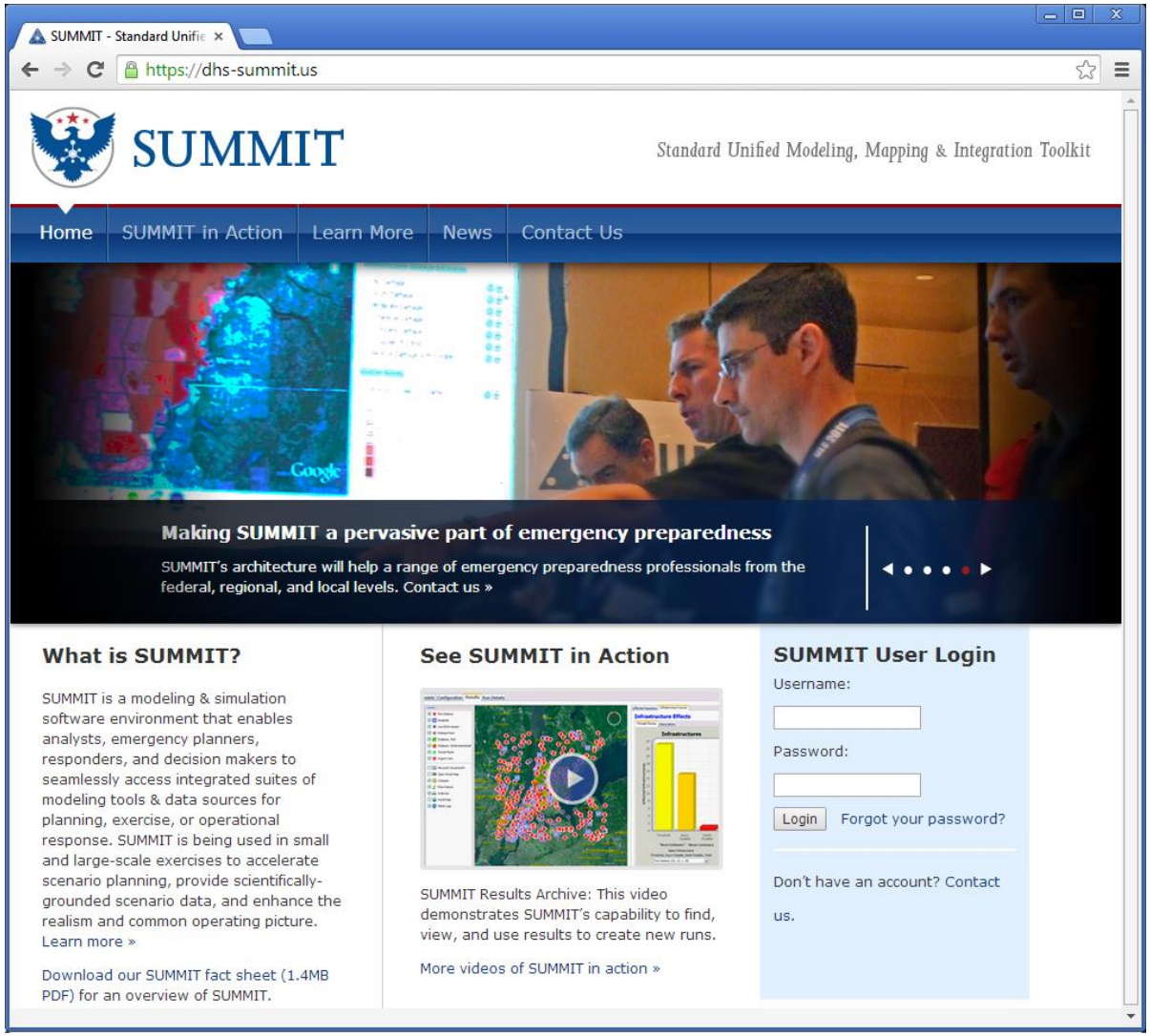
Beta version of SUMMIT available online



Next Generation Response & Recovery

SHERPA

SUMMIT for Homeland Emergency Response & Planning Analysis

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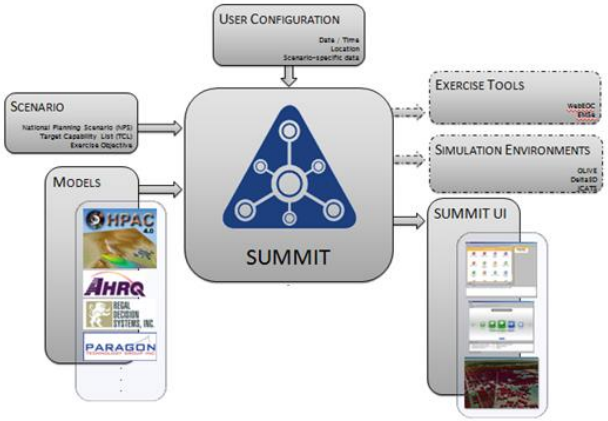
Chase Garwood
Resilient Systems Division
Science and Technology Directorate

Standard Unified Modeling and Mapping Integration Toolkit (SUMMIT)



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Platform technology developed for FEMA National Exercise Division to linking together "best-in-class" modeling and simulation tools to enable analysts, emergency planners, and incident managers more effectively, economically, and rapidly prepare, analyze, and train during exercises.

SUMMIT innovation

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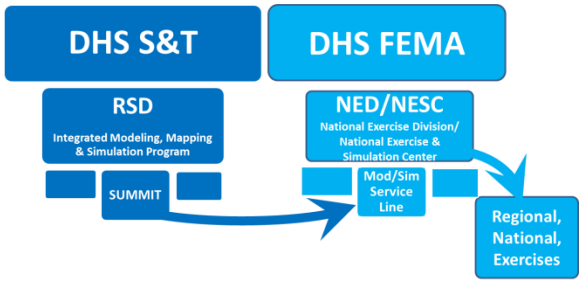
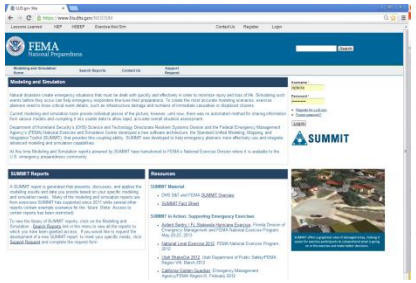




FEMA NED Transition

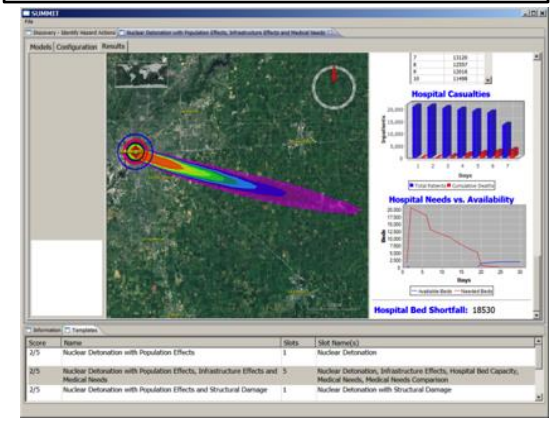
SUMMIT^{R} aligns to Nation and End User Priorities

Division RSD Strategic Plan (2013)	**RSD Thrust 1** – Adaptive Risk Mitigation **RSD Thrust 2** – Agile Disaster Management
Agency FEMA Strategic Plan (2011) S&T Strategic Plan: Goal 1, 3 (2011)	**FEMA Initiative 2** -Build the Nation's Capacity to Stabilize and Recover from a Catastrophic Event **FEMA Initiative 3** - Build Unity of Effort and Common Strategic Understanding Among the Emergency Management Team **S&T #1**. Rapidly develop and deliver knowledge, analyses, and innovative solutions that advance the mission of the Department. **S&T #3**. Strengthen the Homeland Security Enterprise and first responders' capabilities to protect the homeland and respond to disasters.
Department Quadrennial Homeland Security Review (2010)	**HS Core Mission 5:** Ensuring Resilience to Disasters **HS Enterprise Mission:** Maturing and Strengthening the Homeland Security Enterprise
Department/Nation DHS Strategic Plan 2012-16 (2012) National Preparedness Goal (2011)	A secure and resilient nation with the capabilities required across the whole community to prevent, protect against, mitigate, respond to, and recover from the threats and hazards that pose the greatest risk
Nation Presidential Policy Directives PPD-8 (2011) & PPD-21 (2013)	**PPD-8**: ..an integrated, all-of-Nation, capabilities-based approach to preparedness…concrete, measurable, and prioritized objectives to mitigate that risk. **PPD-21 Strategic Imperative #3:** Implement an integration and analysis function to inform planning and operations decisions regarding critical infrastructure.

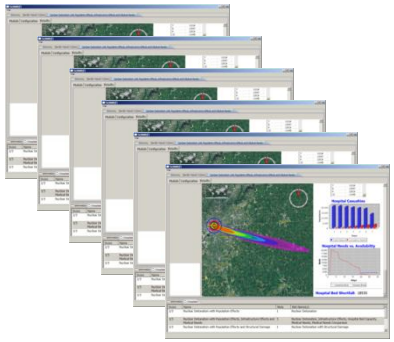
SUMMIT^{R} Approach – Planning

- M&S/data utilized during planning process is archived for use during future planning sessions, assessment protocols or emergency operation activities
- M&S execution augmented through model library availability within standardized integrating architecture
- M&S utilized to determine sensitivity of key planning assumptions to scenario characteristics (e.g., hurricane wind speed correlation to evacuation route)
- M&S utilized to generate results from incomplete data (e.g., vary parameters with incomplete data)
- Archived planning scenarios reused in subsequent planning efforts reducing cost

1 SUMMIT run for 1 set of inputs:
- 1 IND detonation location
- Winds W 15mph
- Static population (home locations), etc.



Thousands of SUMMIT run for varying inputs:
- Multiple detonation locations
- Varying weather conditions by time of year
- Population distributions for home, work, etc.



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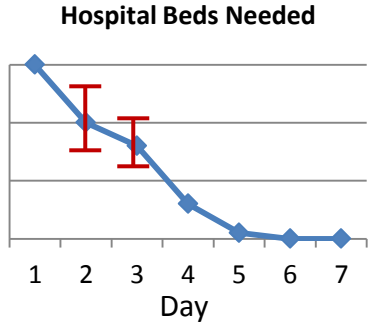
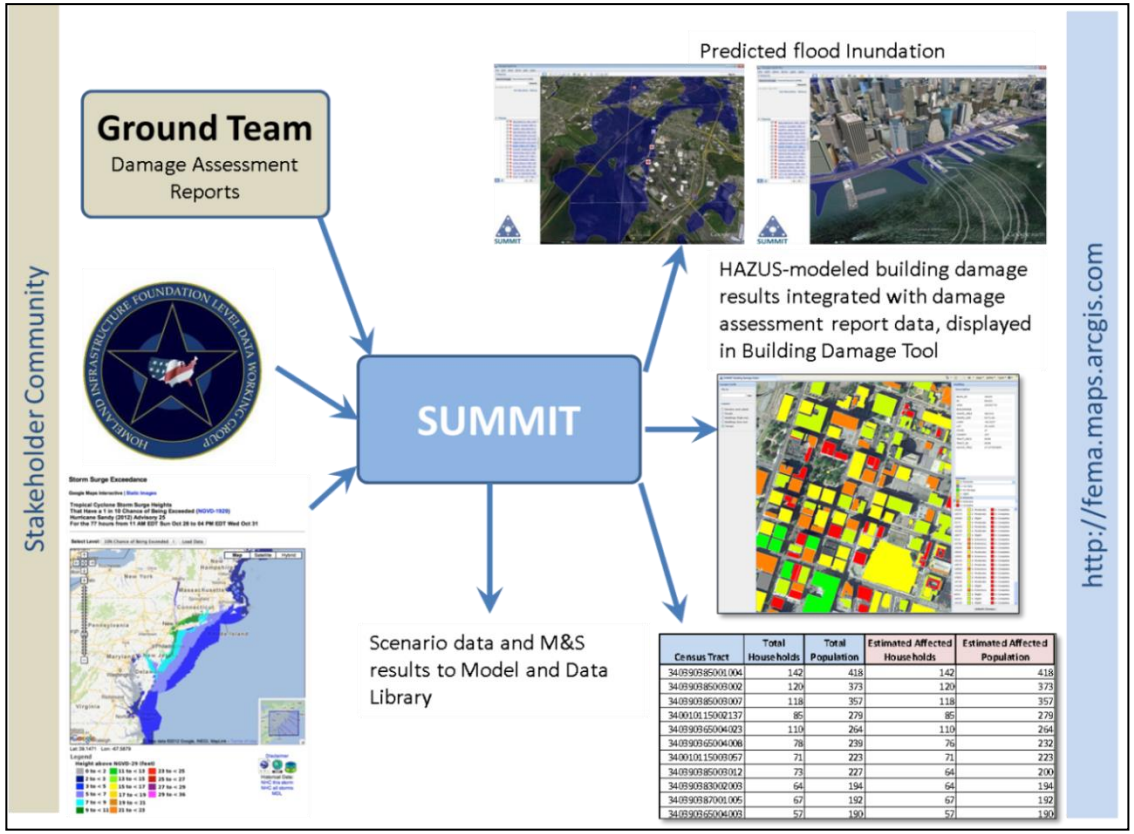
Planning Guidance (e.g., Medical surge requirement for IND detonation threat)



End state: M&S execution library covering scenario and outcome space able to be utilized for all emergency planning activities (e.g., library containing all hurricane tracks on eastern seaboard for past 100 years).

SUMMIT^{R} Approach – Operations



Census Tract	Total Households	Total Population	Estimated Affected Households	Estimated Affected Population
34039085001004	142	418	142	418
34039085003002	120	373	120	373
34039085003007	118	357	118	357
34001011502137	85	279	85	279
34039065004023	110	264	110	264
34039065004008	78	239	76	232
34001011503057	71	223	71	223
34039085003012	73	227	64	200
34039083002003	64	194	64	194
34039087001005	67	192	67	192
34039065004003	57	190	57	190

End state:

M&S data created during planning utilizable during emergency operations to guide incident management and address questions such as "How bad could this get?" and "What are we prepared to handle?"

Current two dominant mechanisms:

1) **Reach-back centers:**
   too expensive for planning, only used during operations

2) **M&S available to community:**
   tools require expertise to operate, which is not generally available during operations

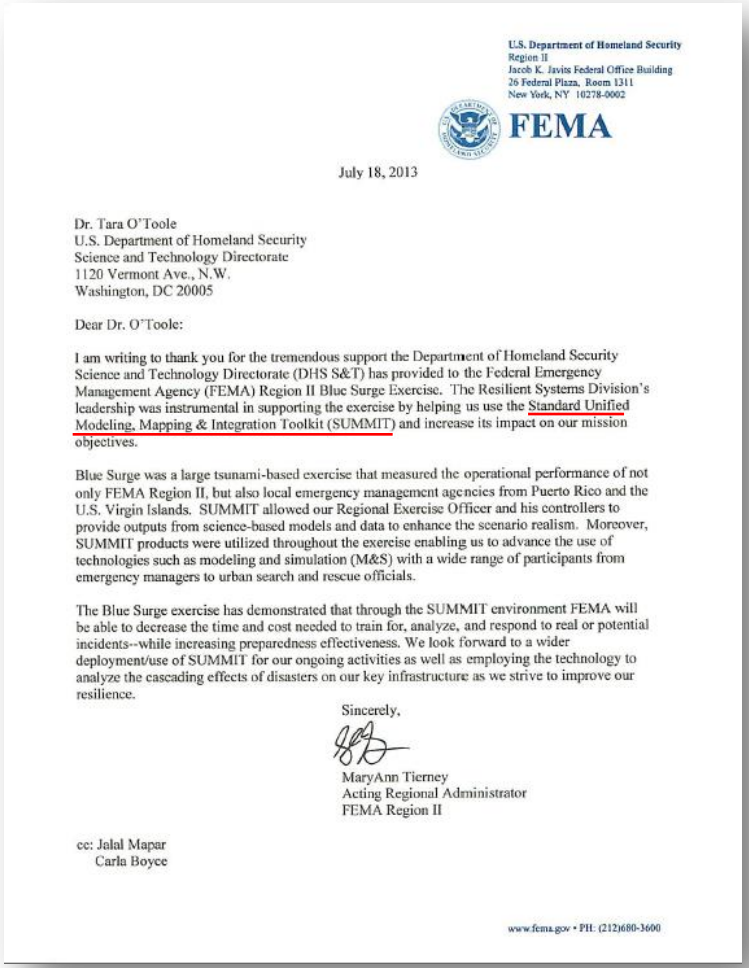
Use M&S to retrieve real-time information and capture complex impact estimates uncertainty given incomplete situation awareness

FEMA adoption of M&S for exercises has increased awareness of need and technology gaps

Current approach does not supports "Train as you fight, fight as you train" philosophy

Strong community support for SUMMIT

FEMA Region 2 Administrator



U.S. Department of Homeland Security
Region II
Jacob K. Javits Federal Office Building
26 Federal Plaza, Room 1311
New York, NY 10278-0002

FEMA

July 18, 2013

Dr. Tara O'Toole
U.S. Department of Homeland Security
Science and Technology Directorate
1120 Vermont Ave., N.W.
Washington, DC 20005

Dear Dr. O'Toole:

I am writing to thank you for the tremendous support the Department of Homeland Security Science and Technology Directorate (DHS S&T) has provided to the Federal Emergency Management Agency (FEMA) Region II Blue Surge Exercise. The Resilient Systems Division's leadership was instrumental in supporting the exercise by helping us use the Standard Unified Modeling, Mapping & Integration Toolkit (SUMMIT) and increase its impact on our mission objectives.

Blue Surge was a large tsunami-based exercise that measured the operational performance of not only FEMA Region II, but also local emergency management agencies from Puerto Rico and the U.S. Virgin Islands. SUMMIT allowed our Regional Exercise Officer and his controllers to provide outputs from science-based models and data to enhance the scenario realism. Moreover, SUMMIT products were utilized throughout the exercise enabling us to advance the use of technologies such as modeling and simulation (M&S) with a wide range of participants from emergency managers to urban search and rescue officials.

The Blue Surge exercise has demonstrated that through the SUMMIT environment FEMA will be able to decrease the time and cost needed to train for, analyze, and respond to real or potential incidents--while increasing preparedness effectiveness. We look forward to a wider deployment/use of SUMMIT for our ongoing activities as well as employing the technology to analyze the cascading effects of disasters on our key infrastructure as we strive to improve our resilience.

Sincerely,

MaryAnn Tierney
Acting Regional Administrator
FEMA Region II

cc: Jalal Mapar
Carla Boyce

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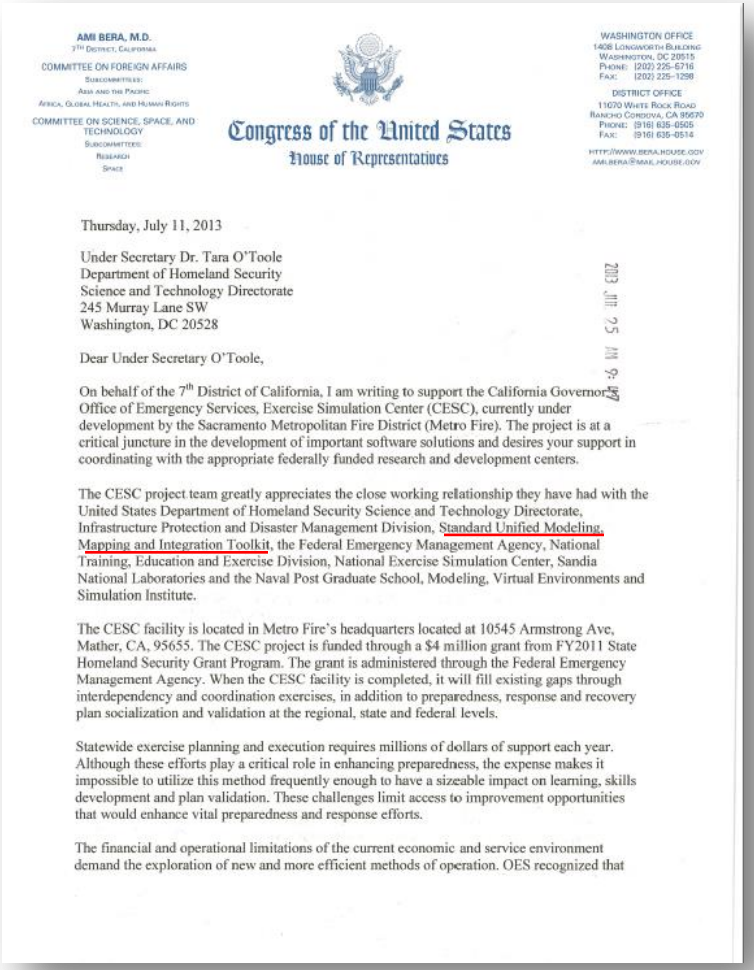
Congressman Bera and California Exercise Simulation Center



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Thursday, July 11, 2013

Under Secretary Dr. Tara O'Toole
Department of Homeland Security
Science and Technology Directorate
245 Murray Lane SW
Washington, DC 20528

Dear Under Secretary O'Toole,

On behalf of the 7th District of California, I am writing to support the California Governor's Office of Emergency Services, Exercise Simulation Center (CESC), currently under development by the Sacramento Metropolitan Fire District (Metro Fire). The project is at a critical juncture in the development of important software solutions and desires your support in coordinating with the appropriate federally funded research and development centers.

The CESC project team greatly appreciates the close working relationship they have had with the United States Department of Homeland Security Science and Technology Directorate, Infrastructure Protection and Disaster Management Division, Standard Unified Modeling, Mapping and Integration Toolkit, the Federal Emergency Management Agency, National Training, Education and Exercise Division, National Exercise Simulation Center, Sandia National Laboratories and the Naval Post Graduate School, Modeling, Virtual Environments and Simulation Institute.

The CESC facility is located in Metro Fire's headquarters located at 10545 Armstrong Ave, Mather, CA, 95655. The CESC project is funded through a $4 million grant from FY2011 State Homeland Security Grant Program. The grant is administered through the Federal Emergency Management Agency. When the CESC facility is completed, it will fill existing gaps through interdependency and coordination exercises, in addition to preparedness, response and recovery plan socialization and validation at the regional, state and federal levels.

Statewide exercise planning and execution requires millions of dollars of support each year. Although these efforts play a critical role in enhancing preparedness, the expense makes it impossible to utilize this method frequently enough to have a sizeable impact on learning, skills development and plan validation. These challenges limit access to improvement opportunities that would enhance vital preparedness and response efforts.

The financial and operational limitations of the current economic and service environment demand the exploration of new and more efficient methods of operation. OES recognized that

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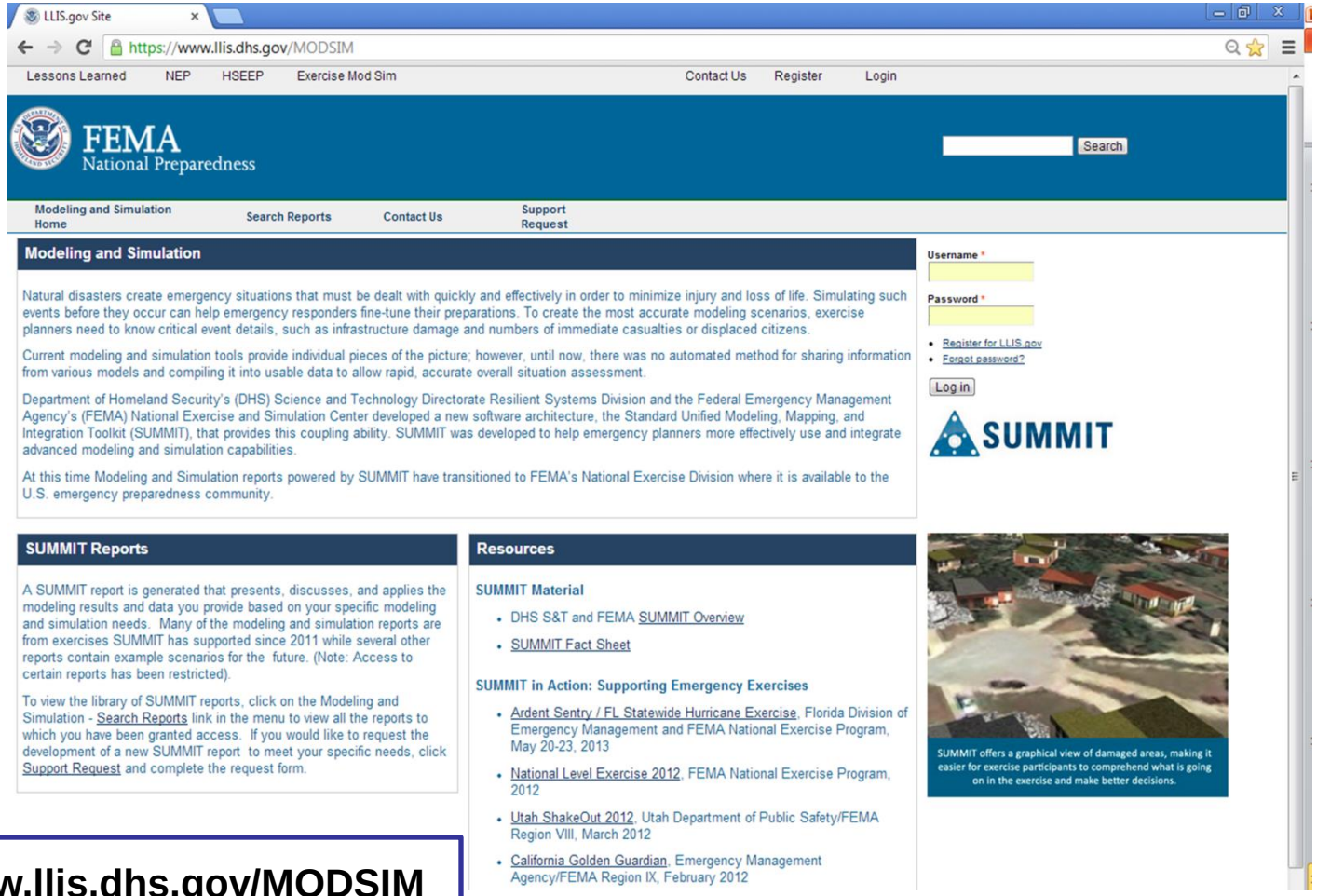
SUMMIT Reporting Capability has Successfully Transitioned from DHS S&T to FEMA's LLIS and HSEEP



https:www.llis.dhs.gov/MODSIM

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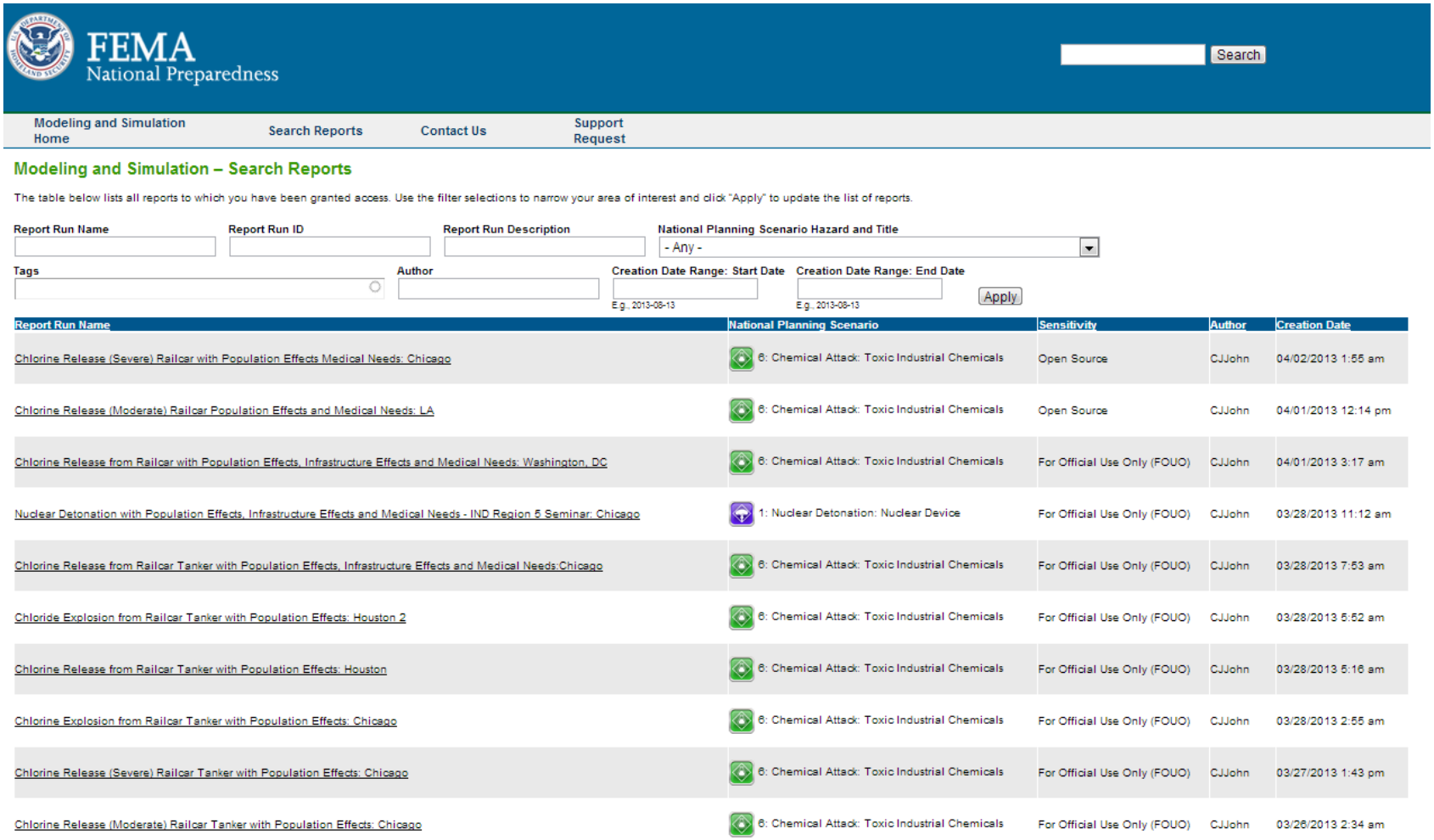
SUMMIT Reports are Searchable by Type and Category



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Tags | Author | Creation Date Range: Start Date (E.g., 2013-08-13) | Creation Date Range: End Date (E.g., 2013-08-13) | Apply

Report Run Name	National Planning Scenario	Sensitivity	Author	Creation Date
Chlorine Release (Severe) Railcar with Population Effects Medical Needs: Chicago	6: Chemical Attack: Toxic Industrial Chemicals	Open Source	CJJohn	04/02/2013 1:55 am
Chlorine Release (Moderate) Railcar Population Effects and Medical Needs: LA	6: Chemical Attack: Toxic Industrial Chemicals	Open Source	CJJohn	04/01/2013 12:14 pm
Chlorine Release from Railcar with Population Effects, Infrastructure Effects and Medical Needs: Washington, DC	6: Chemical Attack: Toxic Industrial Chemicals	For Official Use Only (FOUO)	CJJohn	04/01/2013 3:17 am
Nuclear Detonation with Population Effects, Infrastructure Effects and Medical Needs - IND Region 5 Seminar: Chicago	1: Nuclear Detonation: Nuclear Device	For Official Use Only (FOUO)	CJJohn	03/28/2013 11:12 am
Chlorine Release from Railcar Tanker with Population Effects, Infrastructure Effects and Medical Needs:Chicago	6: Chemical Attack: Toxic Industrial Chemicals	For Official Use Only (FOUO)	CJJohn	03/28/2013 7:53 am
Chloride Explosion from Railcar Tanker with Population Effects: Houston 2	6: Chemical Attack: Toxic Industrial Chemicals	For Official Use Only (FOUO)	CJJohn	03/28/2013 5:52 am
Chlorine Release from Railcar Tanker with Population Effects: Houston	6: Chemical Attack: Toxic Industrial Chemicals	For Official Use Only (FOUO)	CJJohn	03/28/2013 5:16 am
Chlorine Explosion from Railcar Tanker with Population Effects: Chicago	6: Chemical Attack: Toxic Industrial Chemicals	For Official Use Only (FOUO)	CJJohn	03/28/2013 2:55 am
Chlorine Release (Severe) Railcar Tanker with Population Effects: Chicago	6: Chemical Attack: Toxic Industrial Chemicals	For Official Use Only (FOUO)	CJJohn	03/27/2013 1:43 pm
Chlorine Release (Moderate) Railcar Tanker with Population Effects: Chicago	6: Chemical Attack: Toxic Industrial Chemicals	For Official Use Only (FOUO)	CJJohn	03/26/2013 2:34 am

SUMMIT M&S Report Page

SUMMIT's M&S report feature downloadable data including:

- Analysis notes
- Model(s) parameters
- Excel/CSV results data
- GIS layers (Google Earth and ESRI Shapefiles)
- Result Images
- PDF summary
- Raw data formats

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