

The Use of Integrated Modeling and Simulation at FEMA for Emergency Preparedness Exercises

IEEE HST Conference

November 17, 2011

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**Homeland
Security**





Outline

- **IMMS Program**
- **FEMA NESC and SUMMIT**
- **SUMMIT Software Architecture**
- **Support of NESC Business Process**
- **NESC Pilot**
 - **Objectives**
 - **Training**
 - **Pilot Example**
- **Exercise Support Through the NESC**
- **Conclusion and Future Work**



IMMS Program

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

Central technological component of IMMS: the Standard Unified Modeling and Mapping Integration Toolkit (SUMMIT), which connects users such as emergency planners and exercise developers with modeling resources in an easy-to-use format.



SUMMIT

STANDARD UNIFIED MODELING, MAPPING, & INTEGRATION TOOLKIT

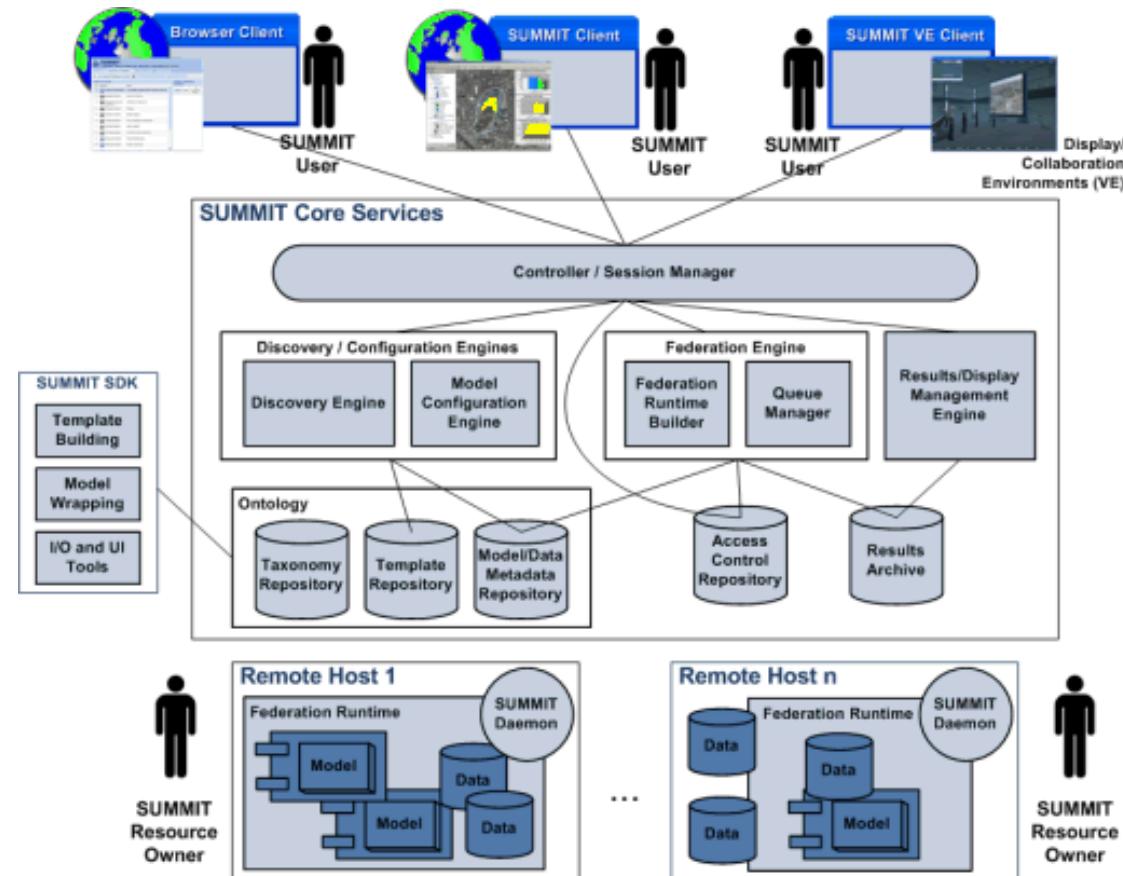


FEMA NESc and SUMMIT

- **Congressionally-mandated state-of-the art training and exercise facility within FEMA headquarters.**
- **Designed to be a scalable, flexible simulation center to accommodate a wide range of services.**
- **Supports the all-hazards preparedness and response mission.**
- **SUMMIT provides NESc with scientifically-based models for exercise planners to:**
 - **Create ground truth data**
 - **Develop exercise injects**
 - **Enhance scenario development**

SUMMIT Software Architecture

- **Distributed system**
- **Multiple clients**
- **Remote hosting of SUMMIT-compliant models**
- **SDK tools**
 - **Template creation**
 - **Model wrapping**





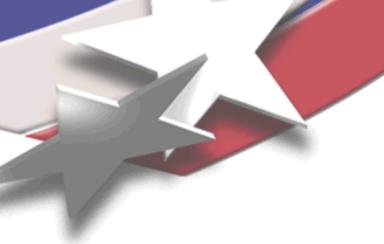
SUMMIT Software Architecture

- **Modeler Support Components – SDK**
 - Software Development Kit (SDK) is a collection of tools allowing content to be added to SUMMIT.
 - Assists scenario designers in the creation of new simulation templates.
 - Assists model owners in the wrapping and integration of new SUMMIT-compliant models to a SUMMIT system.

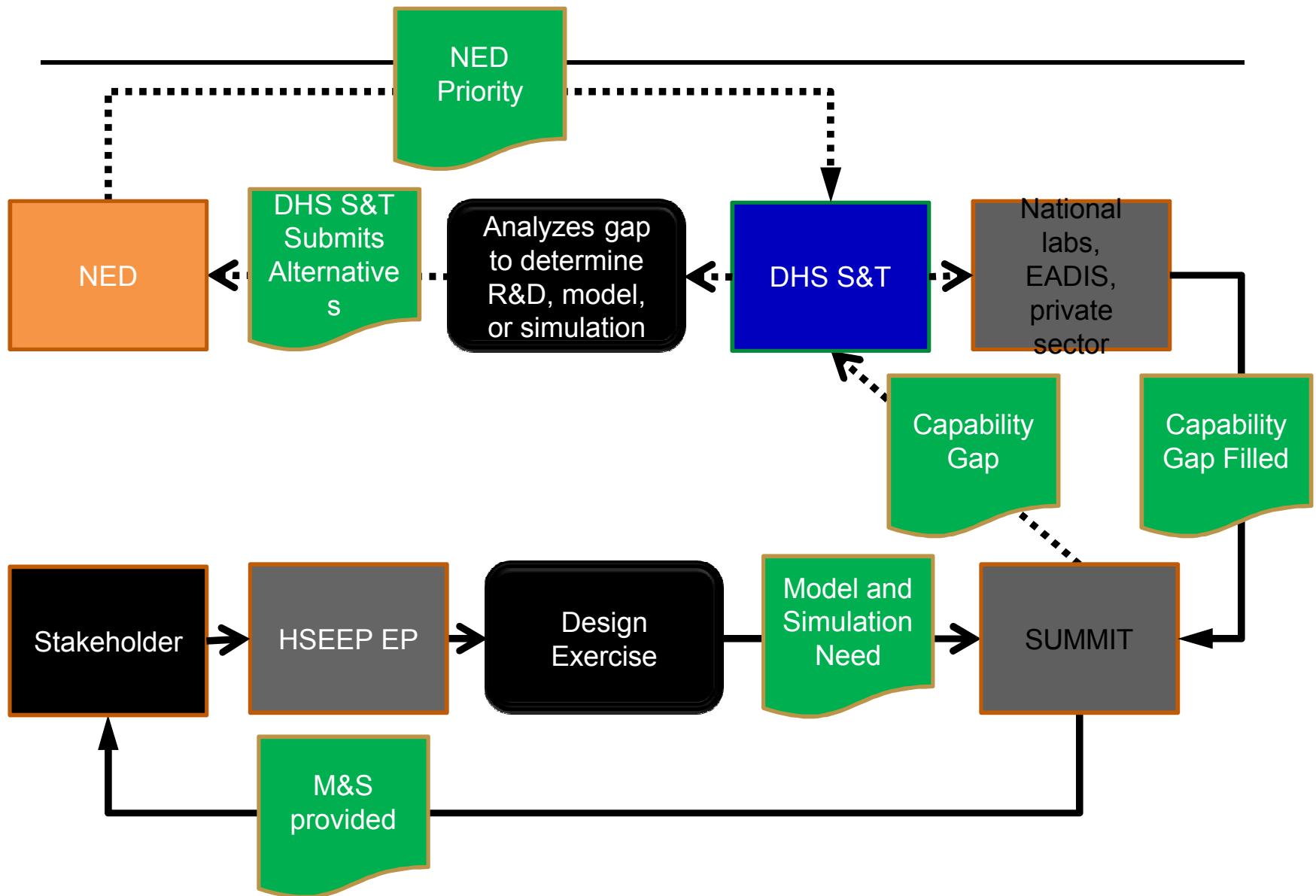


SUMMIT Software Architecture

- **Mission Support Description**
 - **Includes adding new templates and models.**
 - Scenario designers create new templates
 - Moderator can identify gaps prior to system addition
 - If a gap is identified, FEMA or DHS S&T can locate a model or contract software developers to create a new model that can be used in the system
 - New model will be wrapped and reviewed and included in SUMMIT



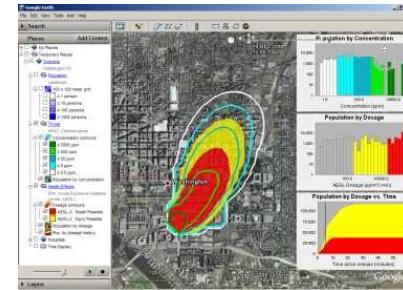
NESC Business Process



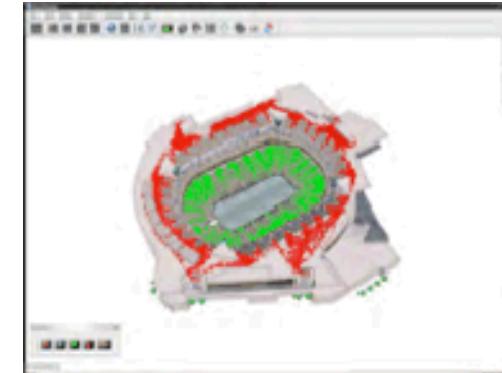


NESC Pilot: Objectives

- **Objectives of the NESC Pilot:**
 - Install, test, evaluate and refine SUMMIT capability in the NESC
 - Build understanding of how SUMMIT fits into NESC concept of operations
 - Increase the proficiency of NESC/NED users to apply SUMMIT capabilities in the exercise design process



HPAC visualized in Google Earth



REGAL'S Evacuation Planning Tool

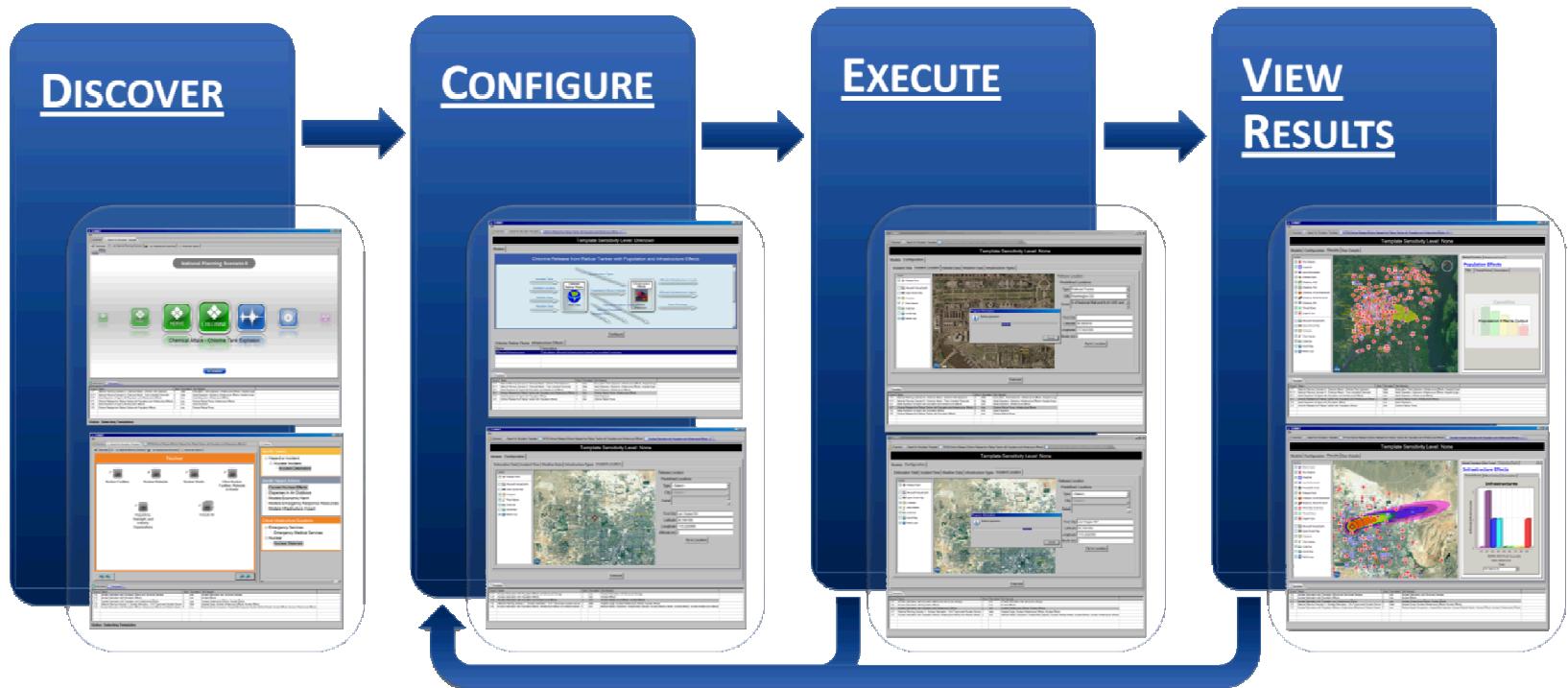


NESC Pilot: Training

- Installation conducted at NESC – users verified basic operational capability of SUMMIT client.
- Training provided to FEMA NED.
 - Singular system capable of running cascading effects of multiple models
 - Allowed users to access multiple models on a singular platform

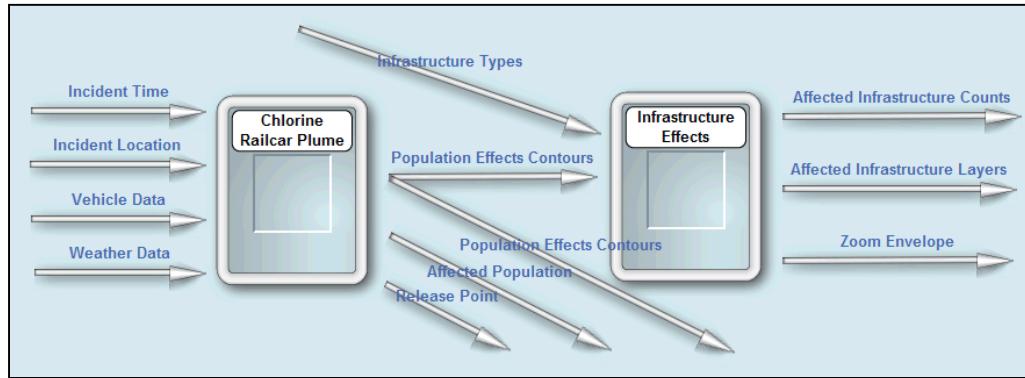


NESC Pilot: System Operational Process





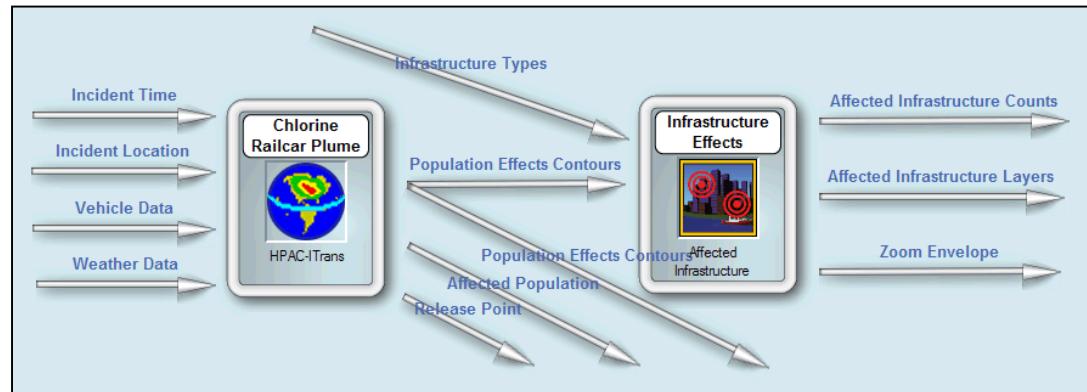
NESC Pilot: SUMMIT Template



Generic pattern for linking together models and data.

Each “slot” includes type and format of data inputs and outputs.

Model and data owners will use the SUMMIT Software Development Kit to wrap their tools so they fit within a “slot.” (a software engineering effort).

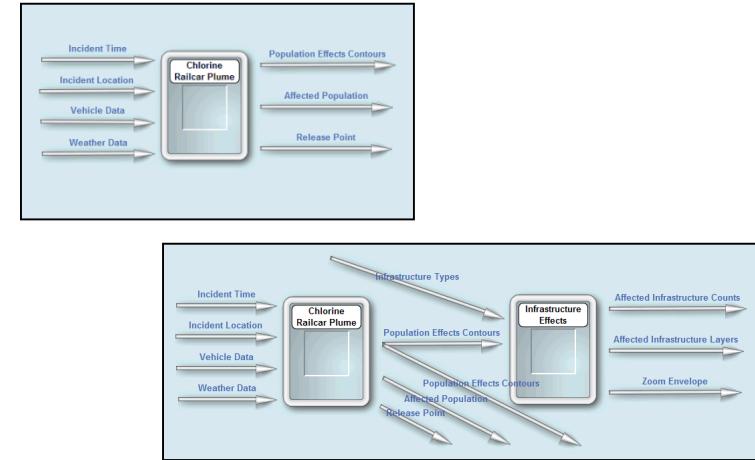
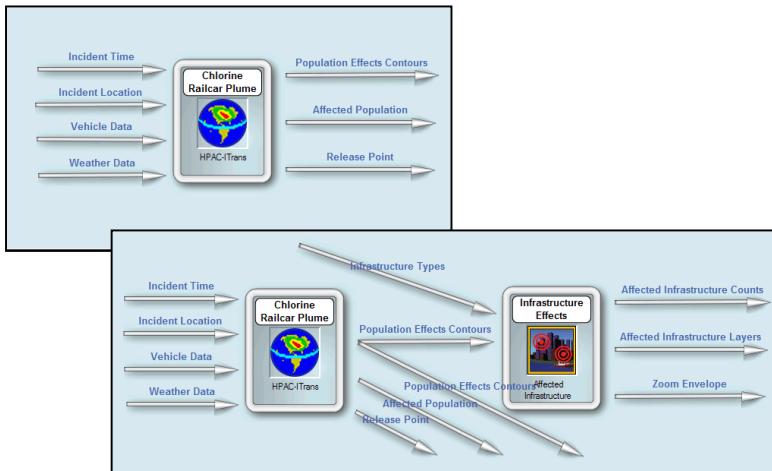




NESC Pilot: Discover

The SUMMIT Discovery engine walks users through a number of questions related to exercise or analysis objectives and scenario preferences, and uses those answers to discover relevant simulation templates.

Multiple templates may be relevant.



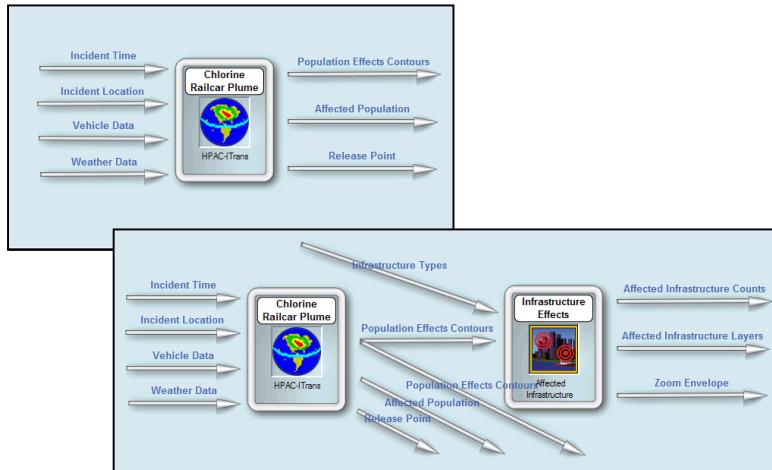
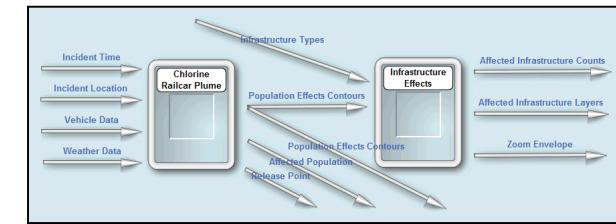
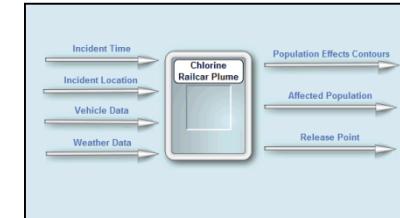
The Discovery engine also finds models and data that may fit into the template slots.



NESC Pilot: Discover

The SUMMIT Discovery engine allows the user to discover relevant simulation templates based on criteria such as National Planning Scenario, Target Capability, or Outcome.

Multiple templates may be relevant.



The Discovery engine also finds models and data that may fit into the template slots.

NESC Pilot: Discover Templates & Models

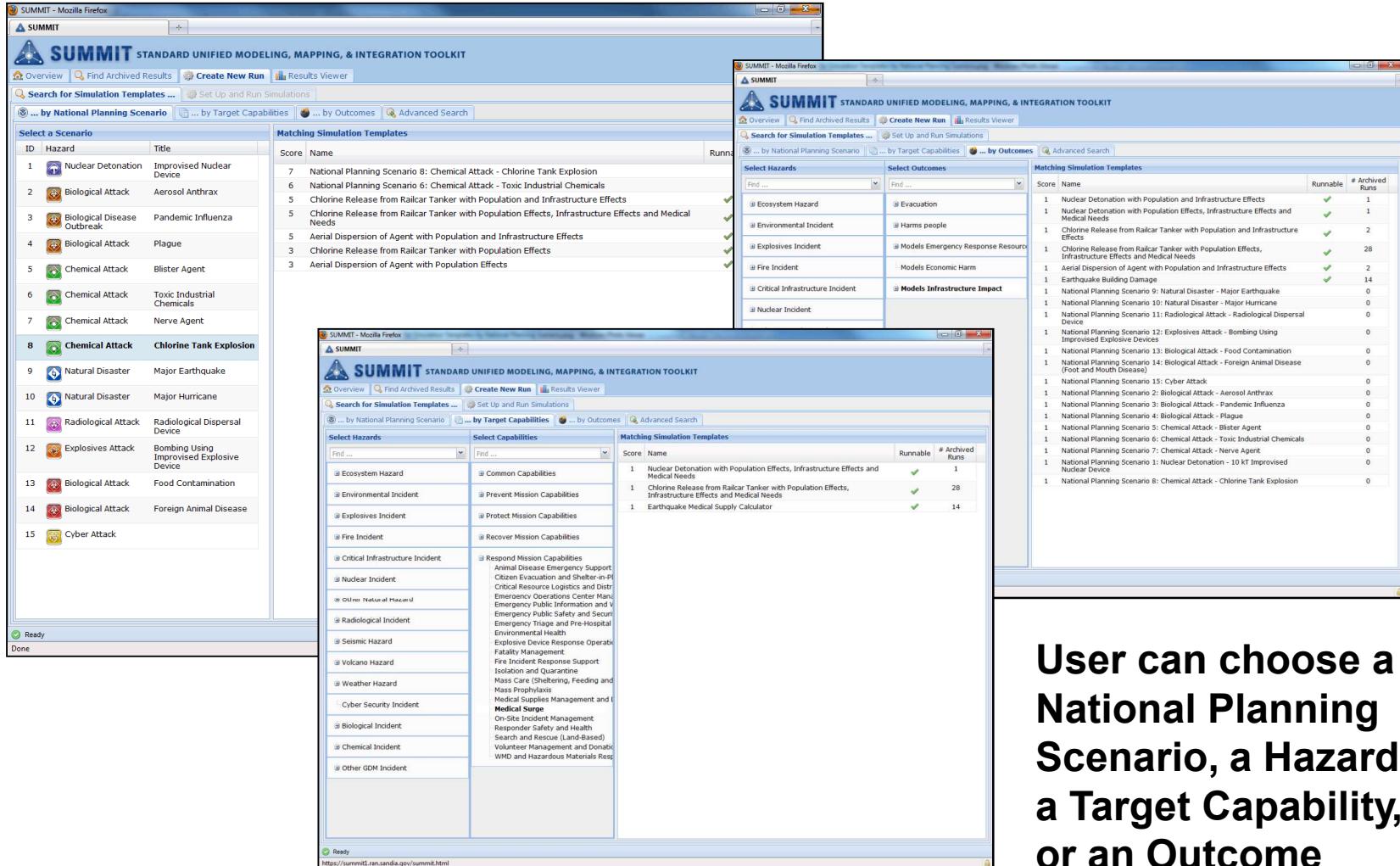
The screenshot displays the NESC Pilot software interface, specifically the 'Discovery' and 'Identify Hazard' modules. The interface is divided into several windows:

- Top Left Window:** Shows a grid of hazard categories: Chemical, Biological, Radiological, Nuclear, Explosives, Critical Infrastructure, Cyber Security, Ecosystem, Environmental, and Fire incidents. A large blue arrow points from this window to the 'Identify Hazard' window.
- Top Right Window:** Shows the 'Identify Hazard' interface with a tree view: Hazard or Incident > Nuclear Incident. A sub-tree 'Nuclear Detonation' is expanded. A blue arrow points from this window to the 'Identify Hazard Actions' window.
- Bottom Left Window:** Shows a detailed view of the 'Nuclear' category, listing Nuclear Facilities, Nuclear Materials, Nuclear Waste, Other Nuclear Facilities/Materials/Waste, and Regulatory Oversight/Industry Organizations. An 'Include All' button is present.
- Bottom Right Window:** Shows the 'Identify Hazard Actions' interface. It lists actions for 'Causes Nuclear Effects', 'Disperses in Air Outdoors', 'Models Economic Harm', 'Models Emergency Response Resources', and 'Models Infrastructure Impact'. Each action has radio buttons for 'Include', 'Exclude', and 'No preference'.
- Bottom Center Window:** Shows a table of scenario templates. The table has columns for 'Score', 'Name', 'Sets', 'Runnable', and 'Set Name(s)'. Examples include '1/4 Nuclear Detonation with Population Effects and Structural Damage' (Score 1, Sets 1, Runnable true, Set Name(s) Nuclear Effects), '1/5 Nuclear Detonation with Population Effects' (Score 1, Sets 1, Runnable true, Set Name(s) Nuclear Effects), '1/7 Nuclear Detonation with Population and Infrastructure Effects' (Score 2, Sets 2, Runnable true, Set Name(s) Nuclear Infrastructure Effects, Nuclear Effects), '1/8 National Planning Scenario: Nuclear Detonation - 10x1 Impressed Nuclear Device' (Score 3, Sets 3, Runnable false, Set Name(s) Hospital Surge, Nuclear Infrastructure Effects, Nuclear Effects), and '1/9 Nuclear Detonation with Population Effects, Infrastructure Effects and Medical Needs' (Score 5, Sets 5, Runnable true, Set Name(s) Medical Needs Companion, Hospital Bed Capacity, Nuclear Medical Needs, Nuclear Effects, Nuclear Infrastructure Effects).

User chooses a hazard or exercise objective...

and sets scenario scope (e.g., critical infrastructure, economic, population effects).

NESC Pilot: Discover Templates & Models



The image displays three separate windows of the SUMMIT (Standard Unified Modeling, Mapping, & Integration Toolkit) software, illustrating the search and selection capabilities for various scenarios, hazards, and outcomes.

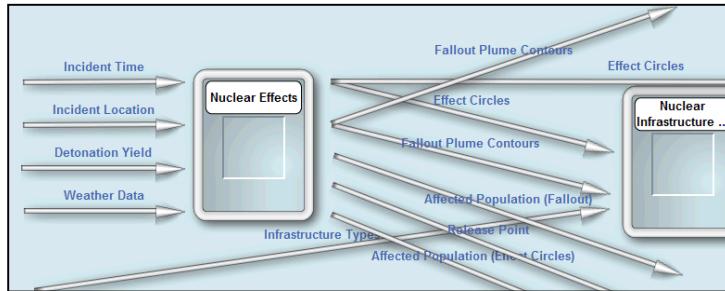
- Left Window (Select a Scenario):** Shows a list of scenarios categorized by hazard type (e.g., Nuclear Detonation, Biological Attack, Chemical Attack) and title. The list includes:
 - 1 Nuclear Detonation Improvised Nuclear Device
 - 2 Biological Attack Aerosol Anthrax
 - 3 Biological Disease Outbreak Pandemic Influenza
 - 4 Biological Attack Plague
 - 5 Chemical Attack Blister Agent
 - 6 Chemical Attack Toxic Industrial Chemicals
 - 7 Chemical Attack Nerve Agent
 - 8 Chemical Attack Chlorine Tank Explosion
 - 9 Natural Disaster Major Earthquake
 - 10 Natural Disaster Major Hurricane
 - 11 Radiological Attack Radiological Dispersal Device
 - 12 Explosives Attack Bombing Using Improvised Explosive Device
 - 13 Biological Attack Food Contamination
 - 14 Biological Attack Foreign Animal Disease
 - 15 Cyber Attack
- Middle Window (Matching Simulation Templates):** Shows a search interface for "Matching Simulation Templates". It includes dropdown menus for "Select Hazards" and "Select Outcomes", and a table of results:

Score	Name	Runnable	# Archived Runs
7	National Planning Scenario 8: Chemical Attack - Chlorine Tank Explosion	✓	1
6	National Planning Scenario 6: Chemical Attack - Toxic Industrial Chemicals	✓	1
5	Chlorine Release from Railcar Tanker with Population and Infrastructure Effects	✓	2
5	Chlorine Release from Railcar Tanker with Population Effects, Infrastructure Effects and Medical Needs	✓	28
5	Aerial Dispersion of Agent with Population and Infrastructure Effects	✓	2
3	Chlorine Release from Railcar Tanker with Population Effects	✓	1
3	Aerial Dispersion of Agent with Population Effects	✓	1
- Right Window (Matching Simulation Templates):** Shows a search interface for "Matching Simulation Templates". It includes dropdown menus for "Select Hazards" and "Select Outcomes", and a table of results:

Score	Name	Runnable	# Archived Runs
1	Nuclear Detonation with Population and Infrastructure Effects	✓	1
1	Nuclear Detonation with Population Effects, Infrastructure Effects and Medical Needs	✓	1
1	Chlorine Release from Railcar Tanker with Population Effects, Infrastructure Effects and Medical Needs	✓	2
1	Chlorine Release from Railcar Tanker with Population Effects	✓	28
1	Aerial Dispersion of Agent with Population and Infrastructure Effects	✓	2
1	Earthquake Building Damage	✓	14
1	National Planning Scenario 9: Natural Disaster - Major Earthquake	✓	0
1	National Planning Scenario 10: Natural Disaster - Major Hurricane	✓	0
1	National Planning Scenario 11: Radiological Attack - Radiological Dispersal Device	✓	0
1	National Planning Scenario 12: Explosives Attack - Bombing Using Improvised Explosive Device	✓	0
1	National Planning Scenario 13: Biological Attack - Food Contamination	✓	0
1	National Planning Scenario 14: Biological Attack - Foreign Animal Disease (Foot and Mouth Disease)	✓	0
1	National Planning Scenario 15: Cyber Attack	✓	0
1	National Planning Scenario 2: Biological Attack - Aerosol Anthrax	✓	0
1	National Planning Scenario 3: Biological Attack - Pandemic Influenza	✓	0
1	National Planning Scenario 4: Biological Attack - Plague	✓	0
1	National Planning Scenario 5: Chemical Attack - Blister Agent	✓	0
1	National Planning Scenario 6: Chemical Attack - Toxic Industrial Chemicals	✓	0
1	National Planning Scenario 7: Chemical Attack - Nerve Agent	✓	0
1	National Planning Scenario 1: Nuclear Detonation - 10 kT Improvised Nuclear Device	✓	0
1	National Planning Scenario 8: Chemical Attack - Chlorine Tank Explosion	✓	0

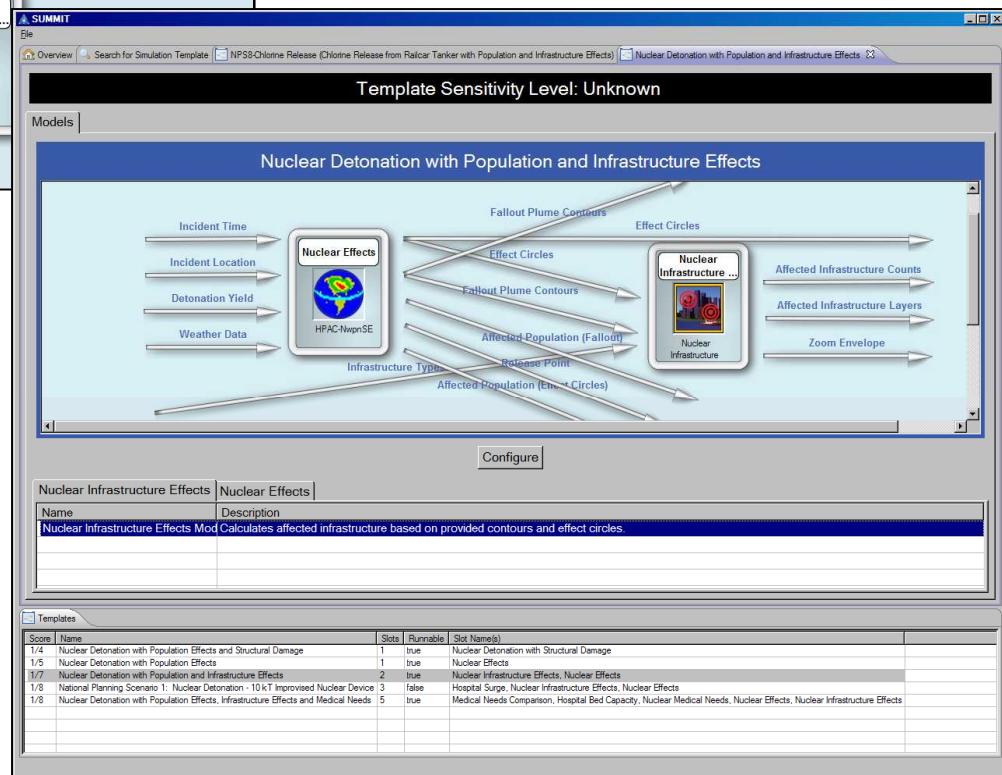
User can choose a National Planning Scenario, a Hazard, a Target Capability, or an Outcome

NESC Pilot: Select Templates & Models

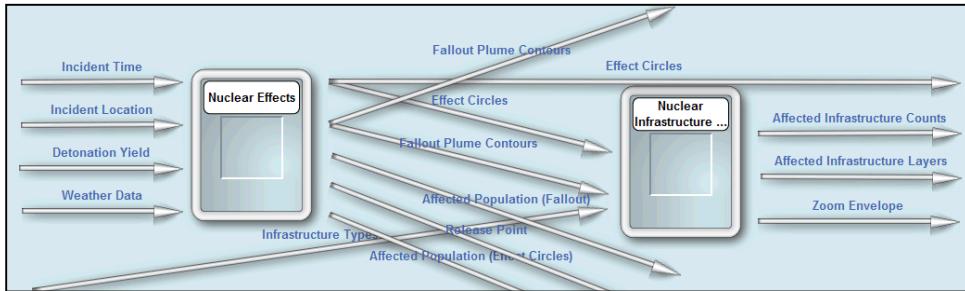


SUMMIT identifies and ranks relevant simulation templates based on the selected objectives, hazard and other scenario parameters.

Metadata is provided for models that are not SUMMIT-compliant.

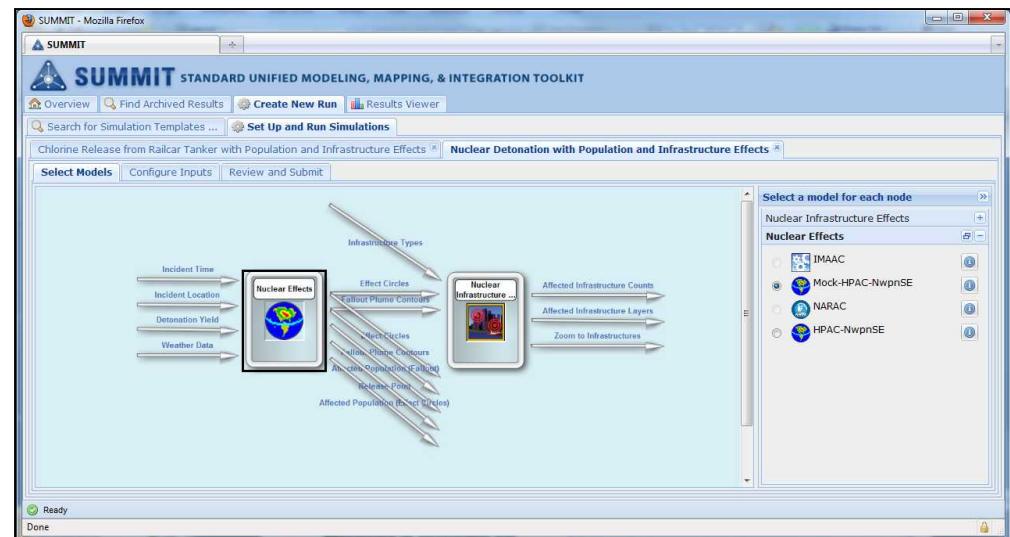


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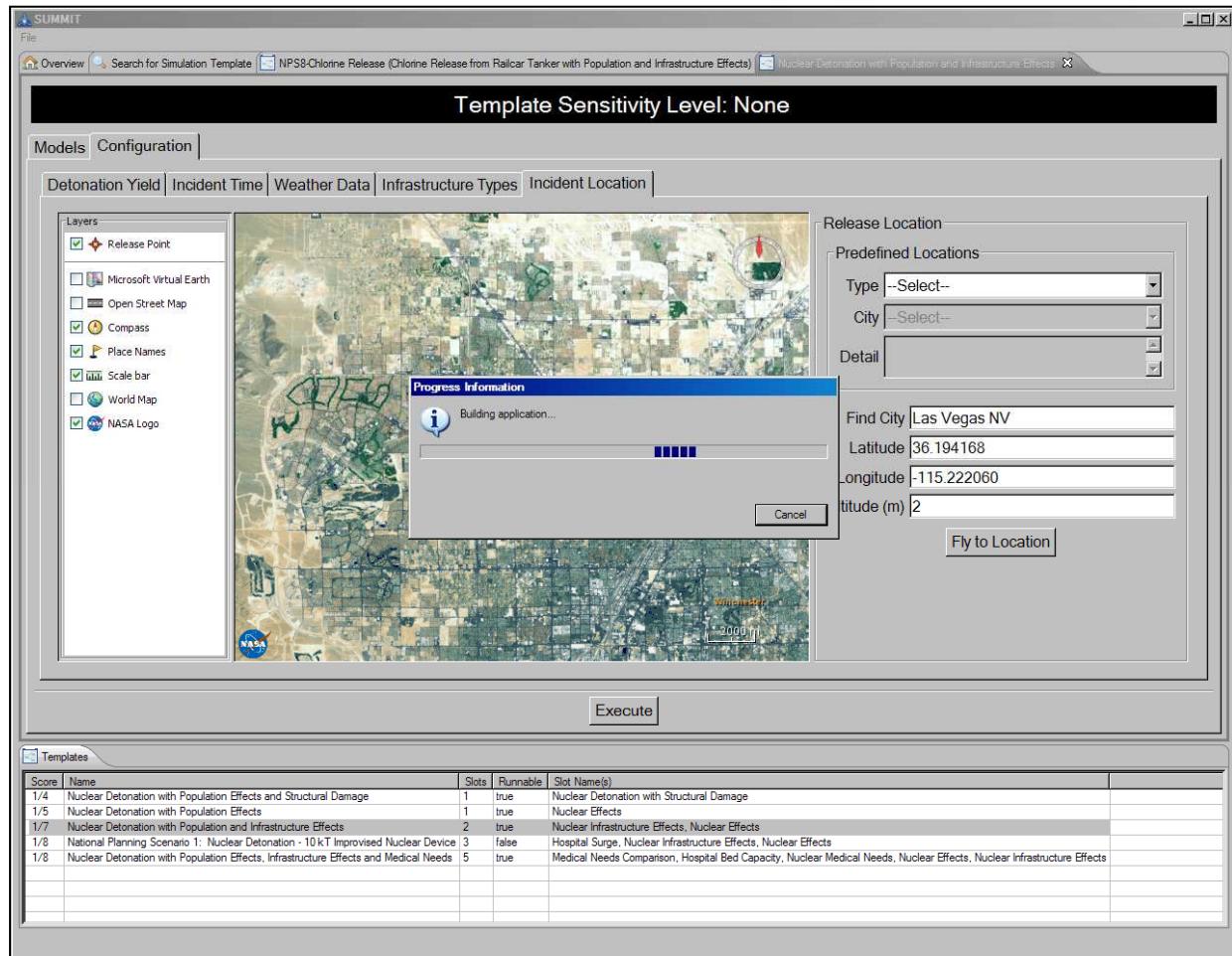
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NESC Pilot: Configure & Execute

If SUMMIT-compliant models are chosen, the user can configure the models (e.g., specify the scenario location, date/time, threat characteristics, etc.).

The system automatically links the models and seamlessly executes them.

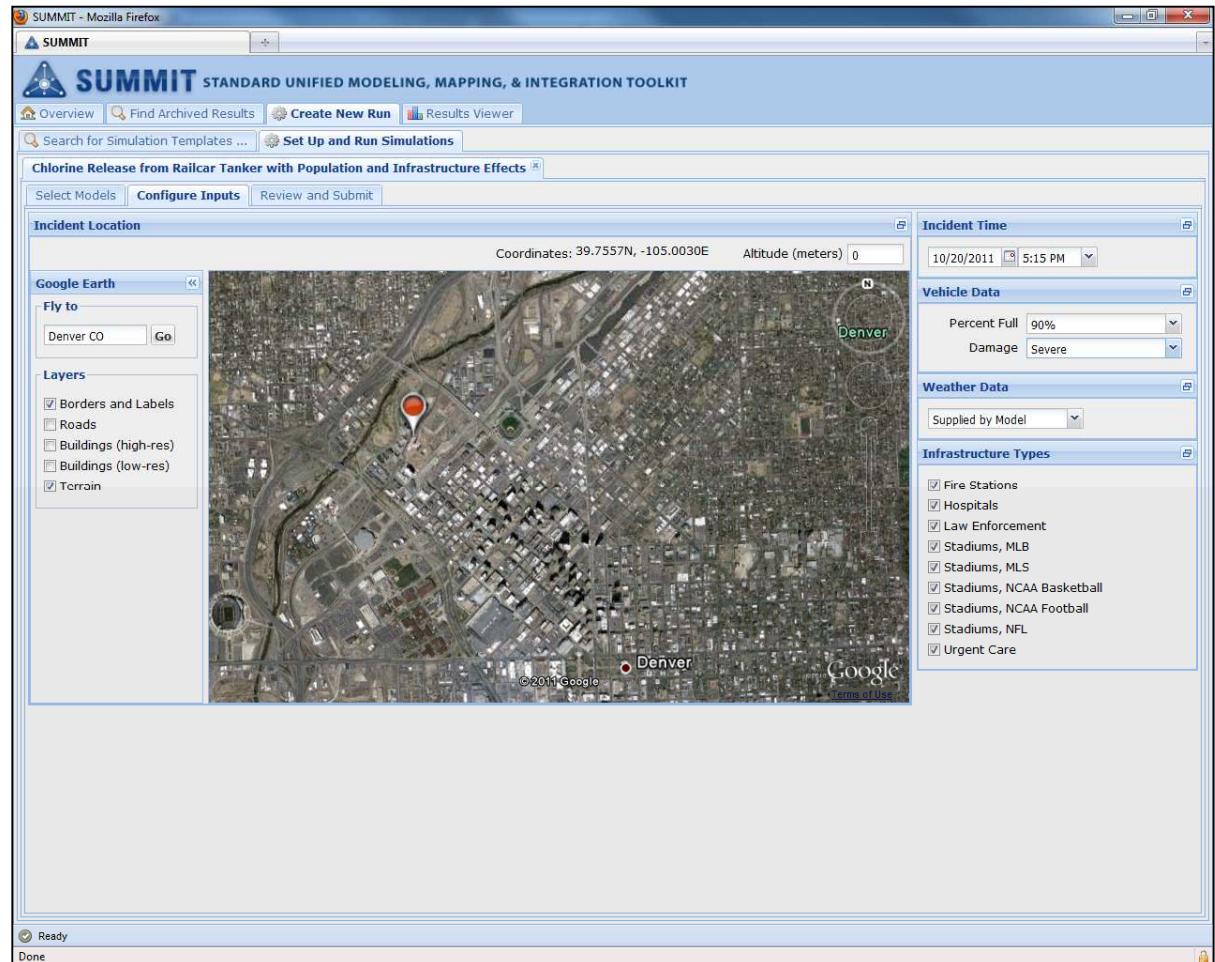




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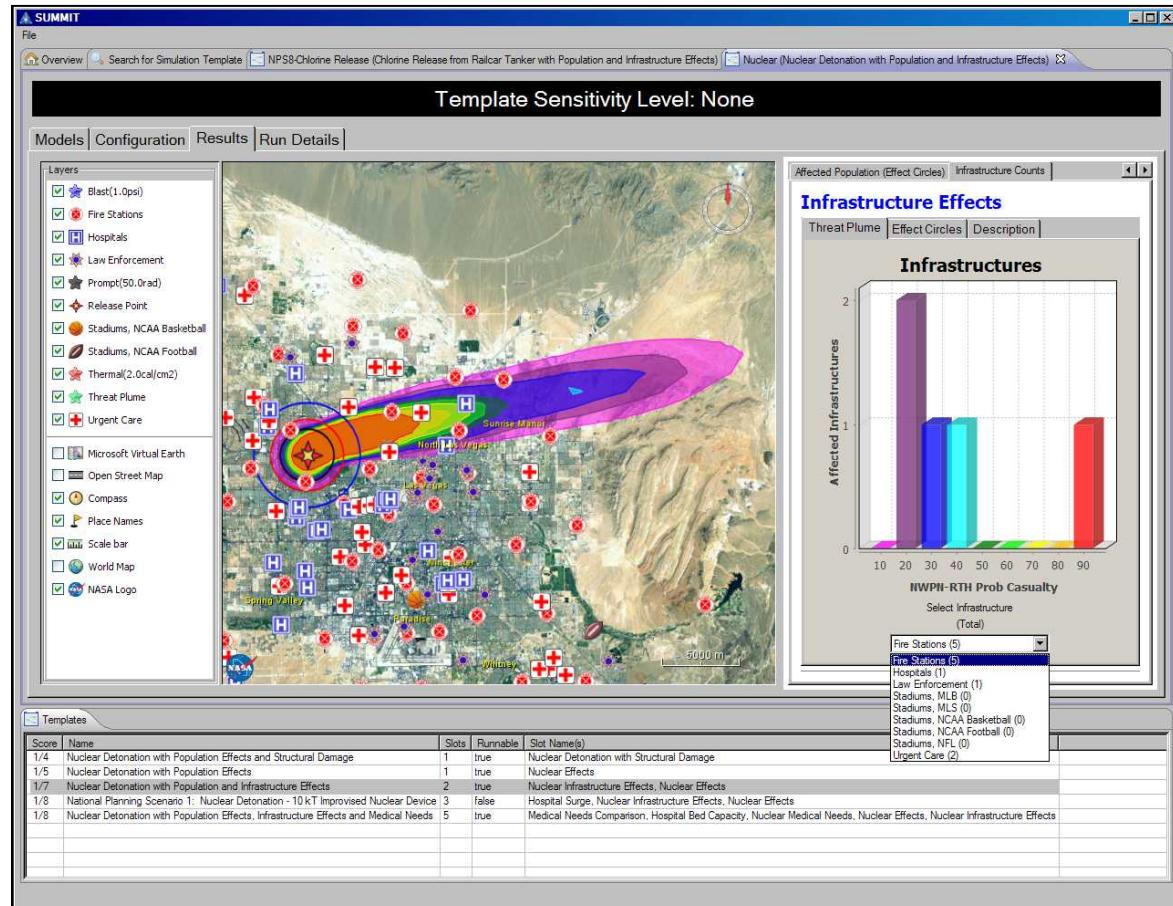


NESC Pilot: Results

**SUMMIT Simulation
Templates also
support result
integration.**

**Output from
multiple models can
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GIS systems or
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visualization tools.**

**Configuration
parameters and
results are archived
and can be easily
accessed and rerun.**

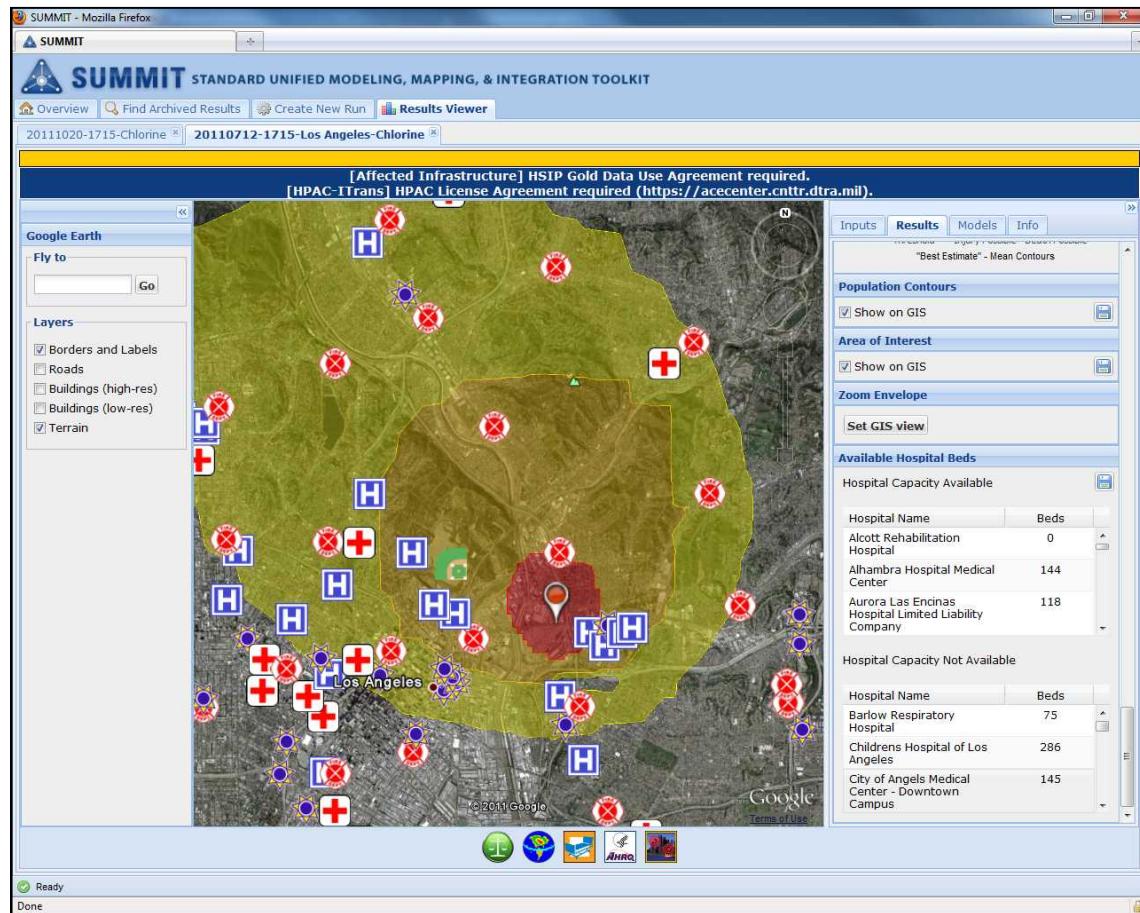


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Exercise Support Through the NES

- Transition the use of M&S to the larger exercise community
- FEMA Regional Exercise Support Program
- Types of Support
 - Development of scenarios
 - Ground truth data
 - Considerations for response to a cascade of modeling outputs
- Used in exercise design through template configuration
- Used in exercise conduct to support injects to prompt and challenge participant actions



Conclusions and Future Work

- Full SUMMIT transition underway
- Exercises support
 - NLE 2010, 2011, 2012
 - U.S./Sweden 2011
 - Utah Shakeout 2012
 - Evergreen 2010
 - WAARP



To Learn More

- Visit dhs-summit.us
- “Integrated Modeling, Mapping, and Simulation (IMMS) Framework for Planning Exercises”, T. Plantenga, E. Friedman-Hill, (I/ITSEC), Nov 2010.
- “Simulation Templates in the SUMMIT System”, E. Friedman-Hill, T. Plantenga, and H. Ammerlahn, in *2010 SISO Spring Interoperability Workshop, Apr 2010*. To be reprinted in *M&S Journal* (www.dod-msiac.org).

Simulation Support for Emergency Preparedness & Response

SUMMIT is a software toolkit that enables analysts, emergency planners, responders, and decision makers to seamlessly access integrated suites of modeling tools & data sources for planning, exercises, or operational response.

The SUMMIT Early Adopter Program is currently underway.

