# Sandia National Laboratories and the National Infrastructure Simulation and Analysis Center

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NISAC

Los Alamos

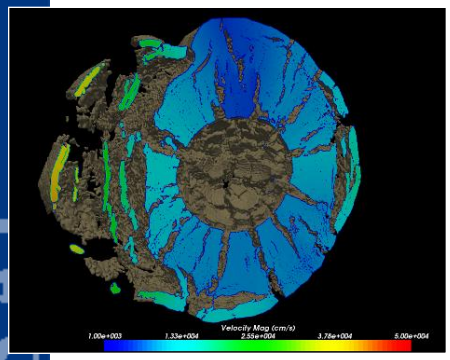
Sandia National Laboratories

# Sandia National Laboratories – *a Strategic National Security Engineering Laboratory*

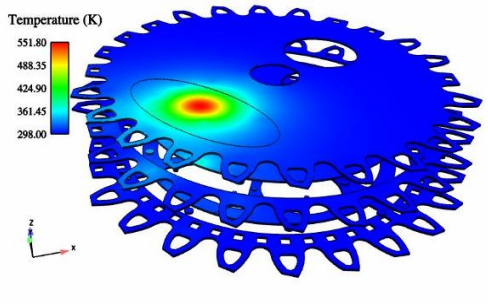
Sandia is also a federally funded research and development center (FFRDC) owned by the Department of Energy

## Key Mission Areas

- Nuclear Weapon
- Defense Systems & Assessments
- Energy, Resources, & Nonproliferation
- Homeland Security and Defense



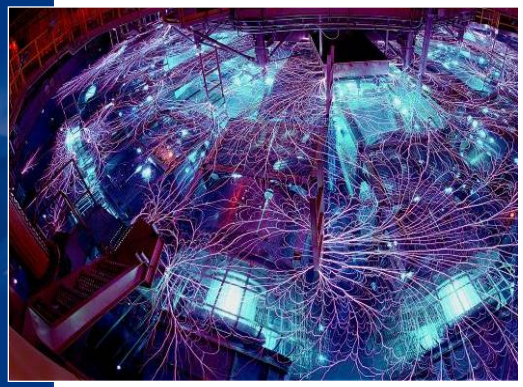

Computational and Information Sciences



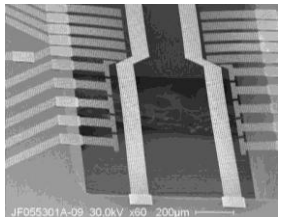

Engineering Sciences

## Key Science Foundations include:

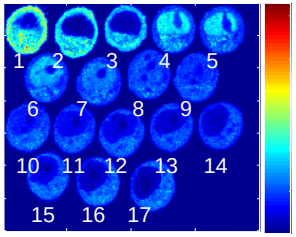
- Computation, computers, and math (advanced Modeling & Simulation and analytics)
- Critical infrastructure and interdependencies analysis



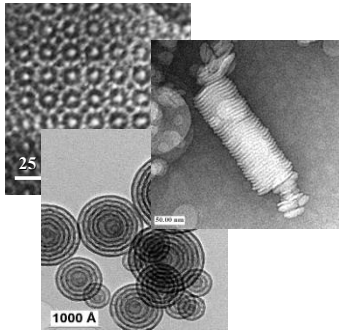
Pulsed Power



Microelectronics / Photonics




Bioscience




Materials Science and Technology

**http://www.sandia.gov**

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# National Infrastructure Simulation and Analysis Center (NISAC)

Established in 2000, NISAC was incorporated into the USA Patriot Act of 2001 and became part of DHS upon its inception in May 2003.

Congress mandated that NISAC serve as a "***source of national expertise to address critical infrastructure protection***" research and analysis.

Infrastructures are the systems that provide the things we take for granted.


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**http://www.sandia.gov/nisac**

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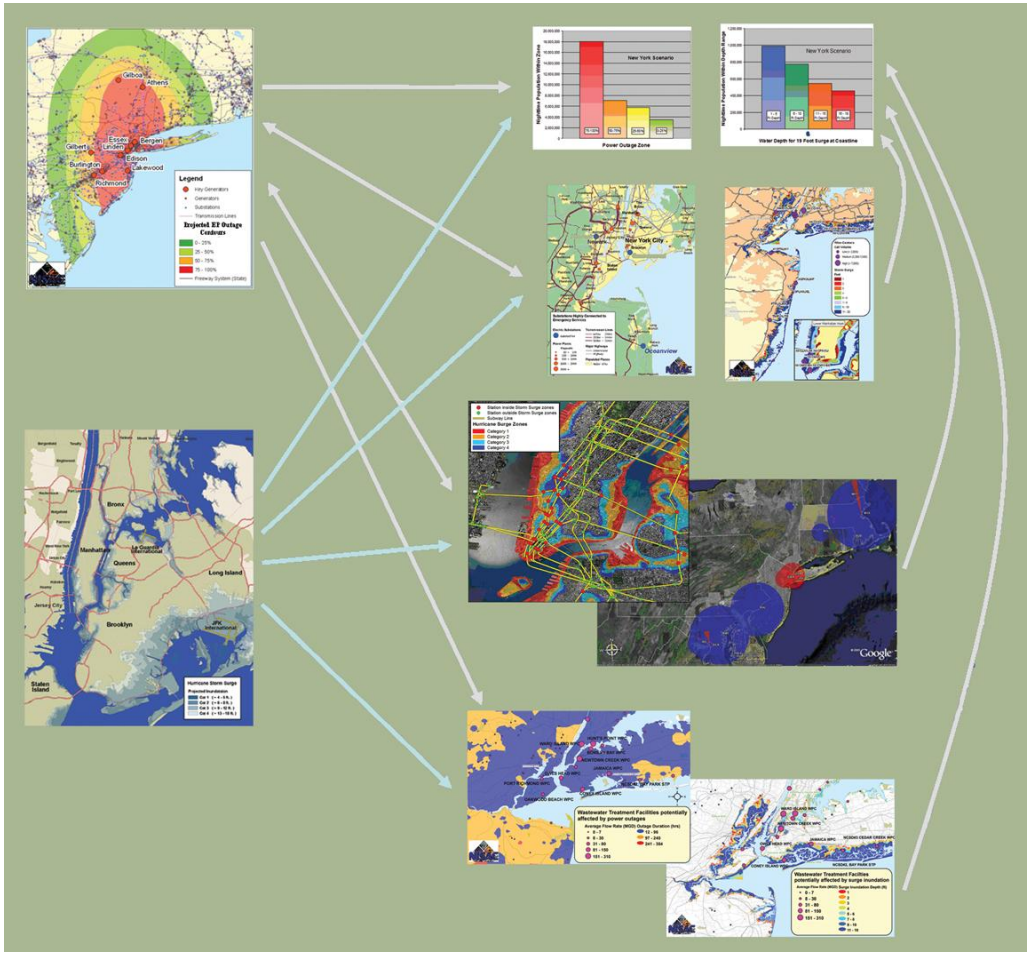
# A Challenging if not Daunting Task

- Each individual infrastructure is complicated
- Interdependencies are extensive and poorly studied
- Infrastructure is largely privately owned, and data is difficult to acquire
- No single approach to analysis or simulation will address all of the issues

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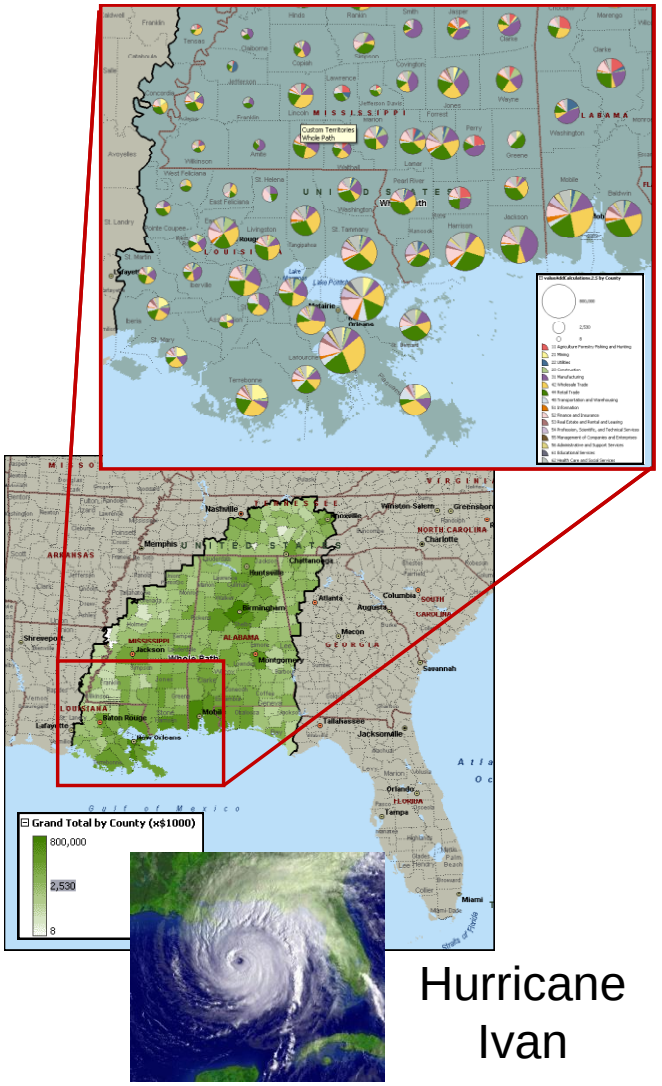
# Example Natural Disaster Analysis: Hurricanes

## Analyses:

- Damage areas, severity, duration, restoration maps
- Projected economic damage
  - Sectors, dollars
  - Direct, indirect, insured, uninsured
  - Economic restoration costs
- Affected population
- Affected critical infrastructures
- Propagating supply chain effects

## Focus of research:

- **Comprehensive evaluation of Threats**
- **Design of Robust Mitigation**
- **Evolving Resilience**




Hurricane Ivan

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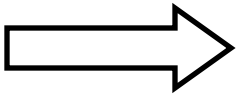
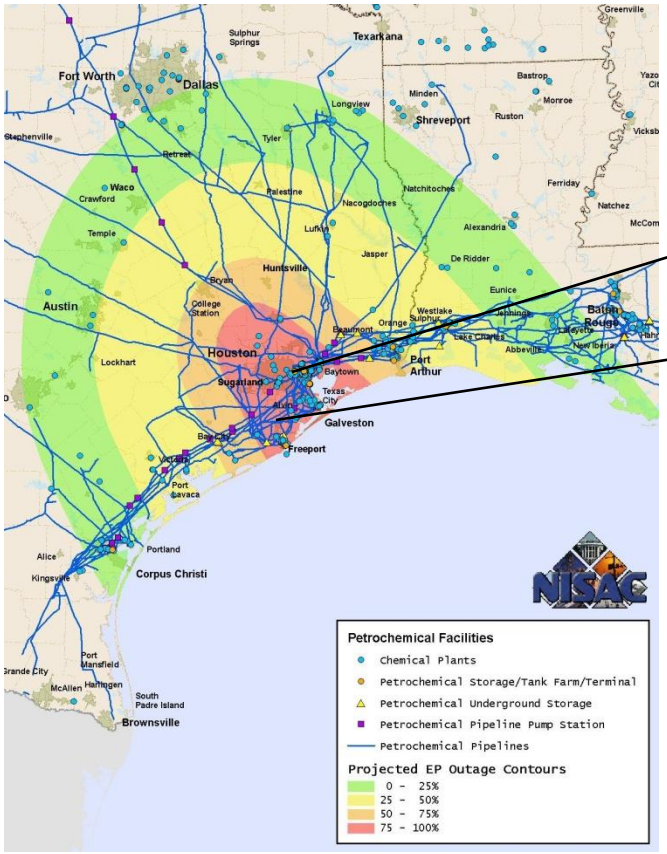
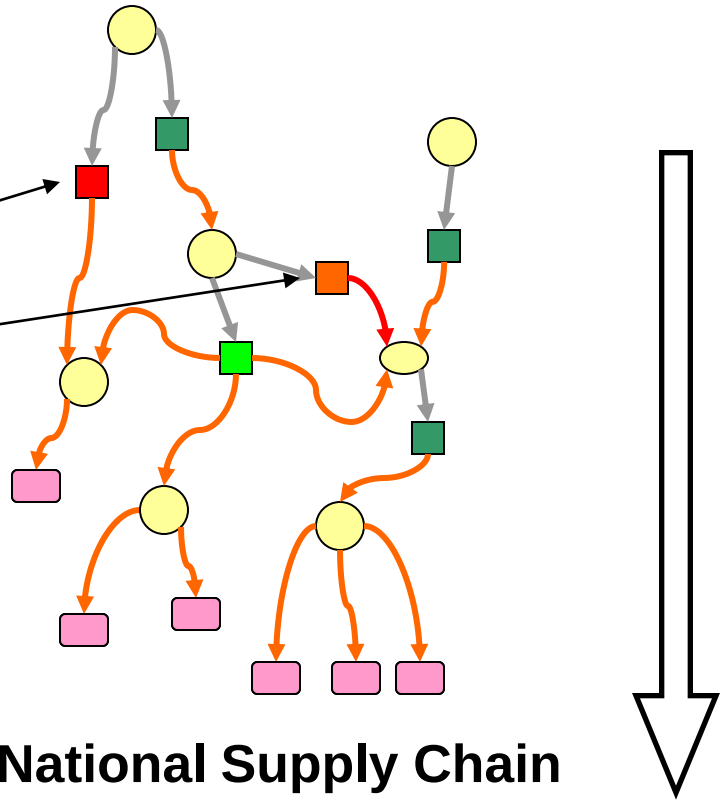
# Application: Industrial Disruptions

***Disrupted Facilities***



***Reduced Production Capacity***



**National Supply Chain**

***Diminished Product Availability***

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# NISAC Applications

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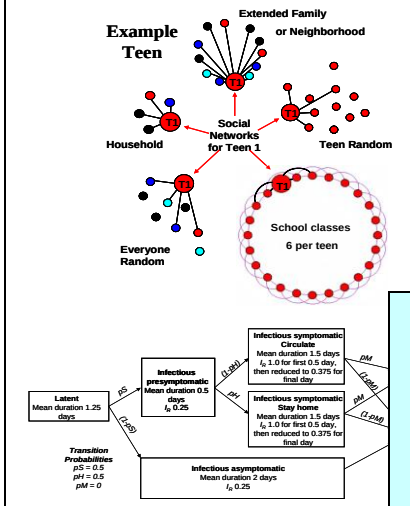
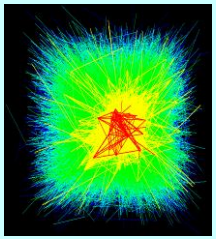
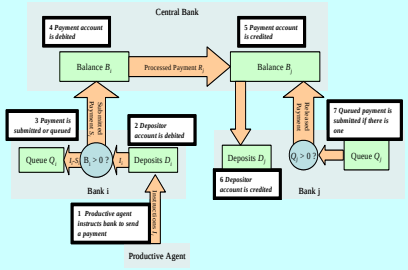
## Infectious Disease Spread

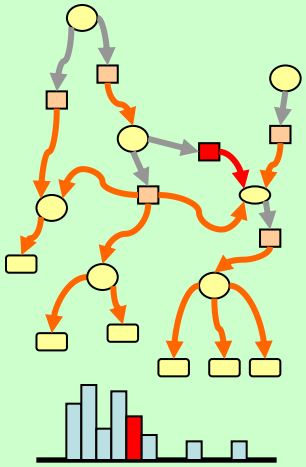



## Banking Interactions



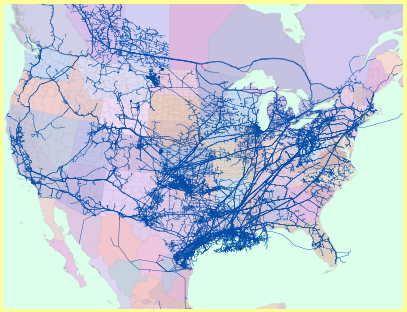


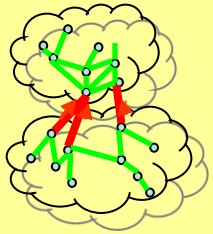

## Petrochemical Interdependencies



Capacity

## Natural Gas Transmission





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# 2003: Advanced Methods and Techniques Investigations (AMTI)

## Critical Infrastructures:

- Are ***Complex*****:** composed of many parts whose interaction via local rules yields ***emergent structure* (*networks*) *and behavior* (*cascades*)** at larger scales
- ***Grow and adapt*** in response to local-to-global ***policy***
- ***Contain people***
- Are interdependent "***systems of systems***"

Critical infrastructures are -

**Complex Adaptive Systems of Systems: CASoS**