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GIScience and Disaster Management: Research Prospects and Challenges

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Roadmap

- Disaster Management Cycle
- Disaster Recovery & Mitigation
  - National Trends
  - Need for Integrative Science
- Disaster Preparedness & Response
  - New York & New Orleans
  - GIS as Integrative Framework
- Potential Roles for Universities?
  - Strengths
  - Disaster Preparation
  - Disaster Response
- Final Thoughts

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Disaster Management Cycle

Risk Equation

Risk = Probable Loss (lives & dollars) =

Hazard × Exposure × Fragility

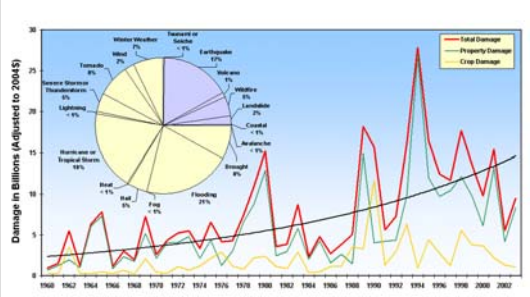
Faulting, shaking, landsliding, liquifaction

Extent & density of built environment

Structural fragility

Original Slide Courtesy of Tom Jordan

Increasing cost of natural disasters



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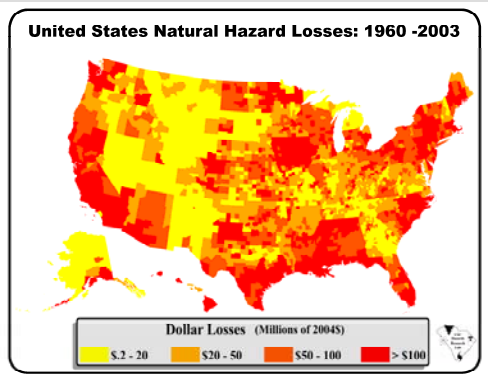

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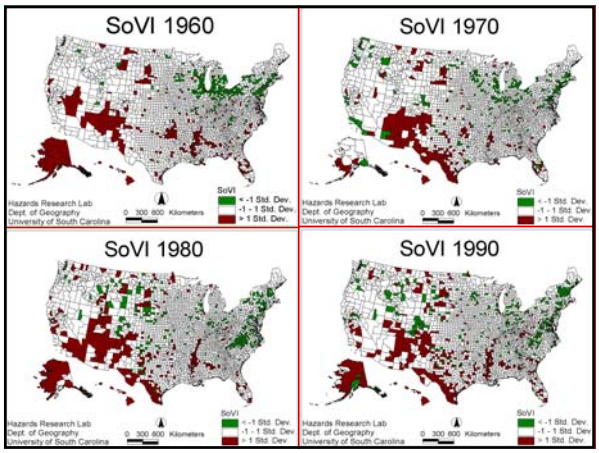

USC Hazards Research Lab

Key Scientific Issues

What makes people and places vulnerable to environmental threats from natural, technological, and human-induced hazards?

--Understand the circumstances that place people and localities at risk (susceptibility, resistance)

--Understand the circumstances that enhance or reduce the ability to respond to environmental threats (resilience, adaptation)

Goal: Provide scientific basis for disaster and hazard reduction policies

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Disaster Response

On the night of 9/11/01 the Center for Advanced Research of Spatial Information (CARSI) at Hunter College began making maps of the World Trade Center Site from the

NYC digital base-map (**NYCMap**)

Having the only remaining copy of the **NYCMap**, Professor Sean C. Ahearn and his staff at CARSI brought three of their computers down to the temporary command center on the morning of 12 September, 2001 and set up the kernel that would become a 24/7 mapping and data center established at Pier 97 and serving the EOC with geospatial information and analysis.

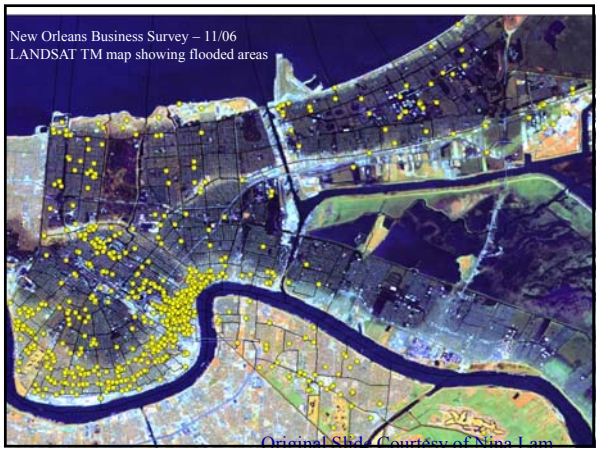
Original Slide Courtesy of Sean Ahearn

FDNY – Ground Zero

- Challenge – **Replace cumbersome manual process for collecting and cataloging evidence at WTC "Ground Zero"**
- Solution – **Ruggedized handheld computers with LinksPoint's GPS and barcoding software**
- Benefit – **LinksPoint solution cut evidence acquisition time from 5-10 minutes to <1 minute – reducing firefighter exposure to hazardous conditions and improving data accuracy and usability**

LINKSPOINT Data to the Point

Original Slide Courtesy of Sean Ahearn



Original Slide Courtesy of Nina Lam

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Universities

- Special places …
- They have domain knowledge and technical expertise
- They have cadres of faculty and trained students who could respond to an emergency
- They have the local knowledge and relationships required to build and assemble regional datasets for emergency response
- They have the technical infrastructure to support innovation and back up key database assets, modeling protocols, etc., etc.

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Disaster Preparation

- Develop protocols for collecting / sharing geospatial data between counties, utilities, etc. and FEMA's response teams at JFO during event
- Organize, assemble, identify gaps, and fill in geospatial foundation data required during event for specific regions and hazards on an annual basis
- Conduct geospatial R&D to advance the data models, analysis and scenarios used to anticipate and manage emergency response
- Organize workshops to train disaster managers and first responders in real-time, on-the-ground decision support using geospatial technologies

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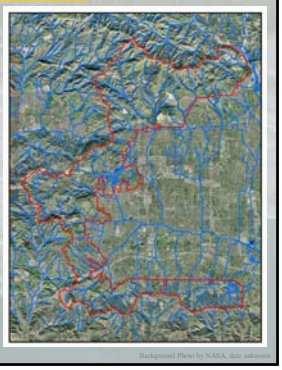
Stream Networks

- NHD Stream Network
- The original has been upgraded:
  - Missing stream links added
  - Duplicate streams removed
  - Attributes corrected
  - Man-made drains such as pipes and canals removed
- Utilized Nature Conservancy scripts with digital vector stream network generated by ANUDEM, LA County Storm drains, and 1:24K USGS topographic maps



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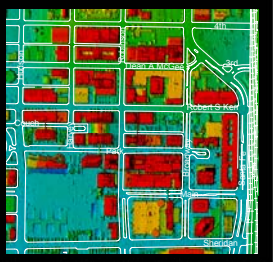
LiDAR Data for Building Heights -Oklahoma City



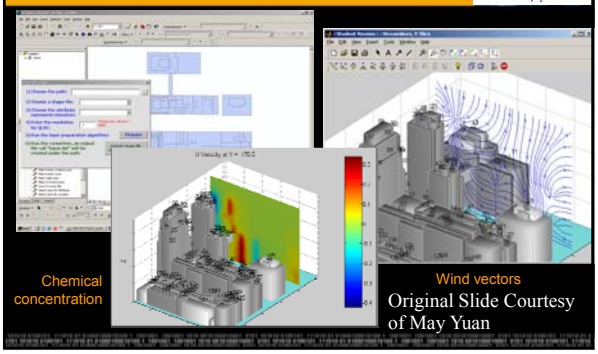
Original Slide Courtesy of May Yuan

GIS geographically contextualizes LiDAR data

Use GIS to build 3D digital city with building dimensions and occupancy information

Original Slide Courtesy of May Yuan

Integrate GIS 3D City and Numerical Models to Simulate Dispersion Scenarios



Chemical concentration

Wind vectors

Original Slide Courtesy of May Yuan

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Disaster Response

- Deploy geospatial technologies and pre-compiled geospatial data "bundles" to provide fundamental support for rescue, assessment, logistics, and recovery
- Mobilize university experts from around the country to provide R&D expertise that exceeds operational capabilities of FEMA JFO staff
- This is a different kind of science with different expectations, deliverables, etc.
  - Southern California Growth Visioning Example

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Final Thoughts

- Need to build several prototype systems to …
  - Show how federal, state, and local geospatial datasets can be integrated and used to support disaster preparedness and management across the nation
  - Demonstrate what types of programs and resources would be required in the future to turn science into practice
- These prototypes would need to accommodate regional diversity – the differences between the hazards themselves and the places they occur – to advance the value of geospatial assets across the entire hazard management cycle

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