# Transitioning Research Capabilities into Decision Support and Emergency Management Applications

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# Introduction

- Satellite remote sensing and numerical modeling (atmosphere and ocean) offer wide variety of capabilities for decision support related to emergency management
- A major challenge is transitioning such capabilities developed in a research environment to users operating in a decision support environment
- Web based technologies and mobile devices is an effective platform to transition research capabilities to end users

# Outline

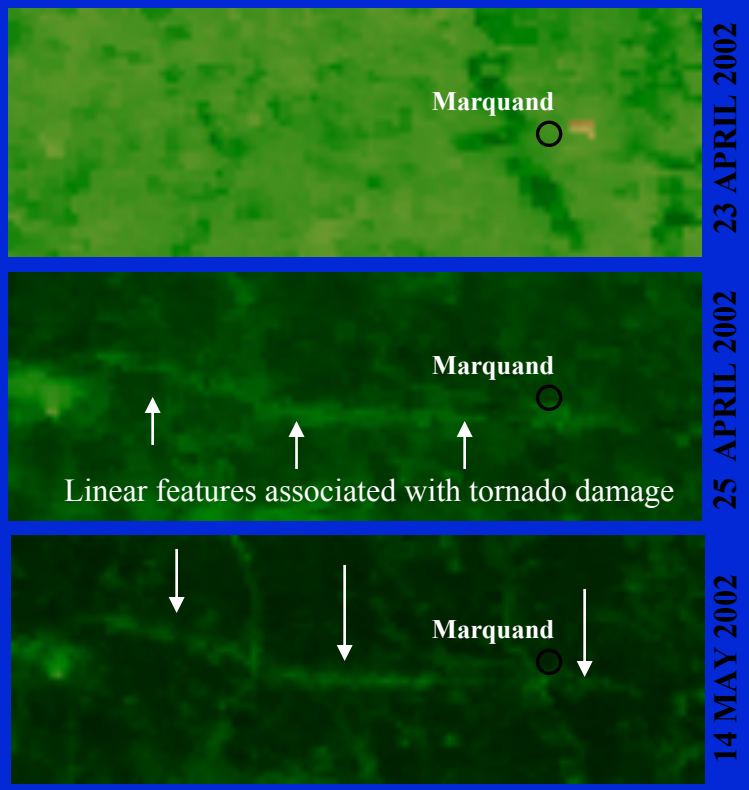
- Examples of research results with potential decision support applications
- Transitioning of these capabilities
- What are some of the capabilities that are relevant in the context of the oil spill? How can we transition these capabilities to an interdisciplinary research community and for decision support?

# Tornado damage

- Damage events that occur in populated areas resources are often available for a through assessment
- Resources are often not available for extensive surveys when the damage occur in sparsely populated regions
- Satellite imagery could be utilized for this purpose

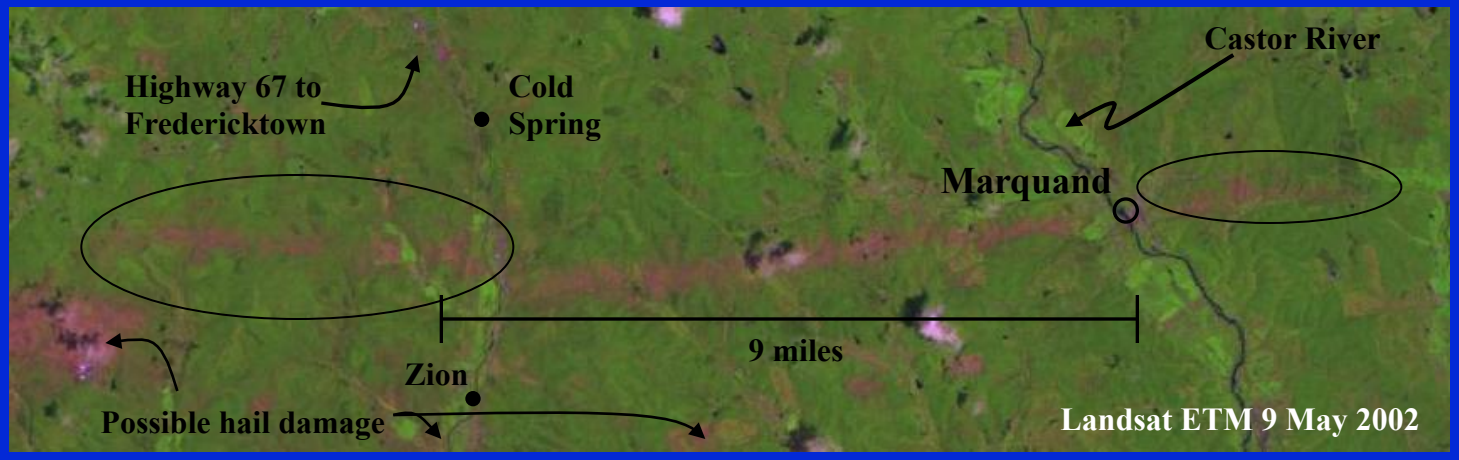
# Tornado damage

MODIS NDVI



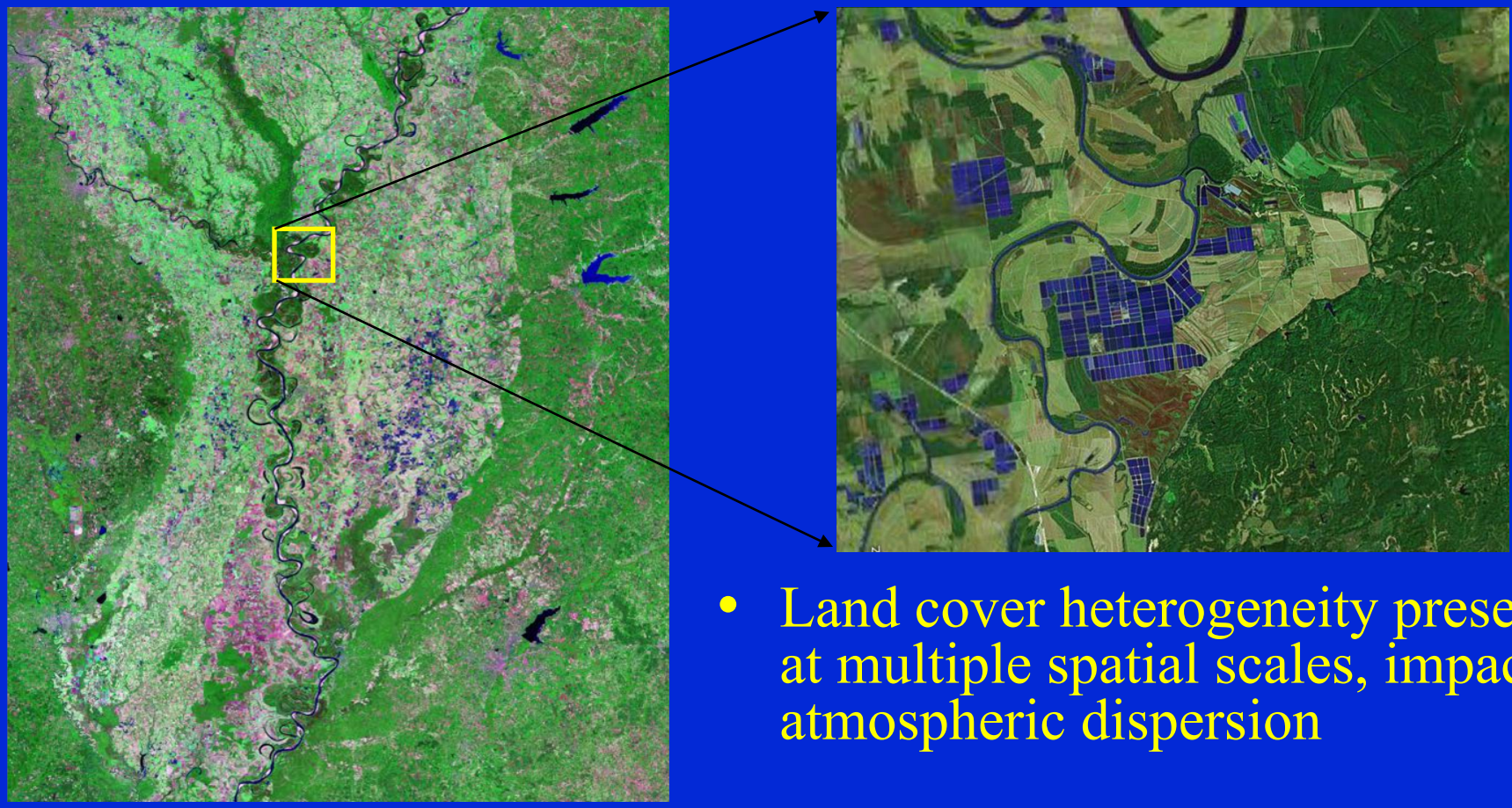

- Satellite data analysis found damage that was not identified by the ground survey

Jedlovec, Nair and Hanes, 2006




Landsat

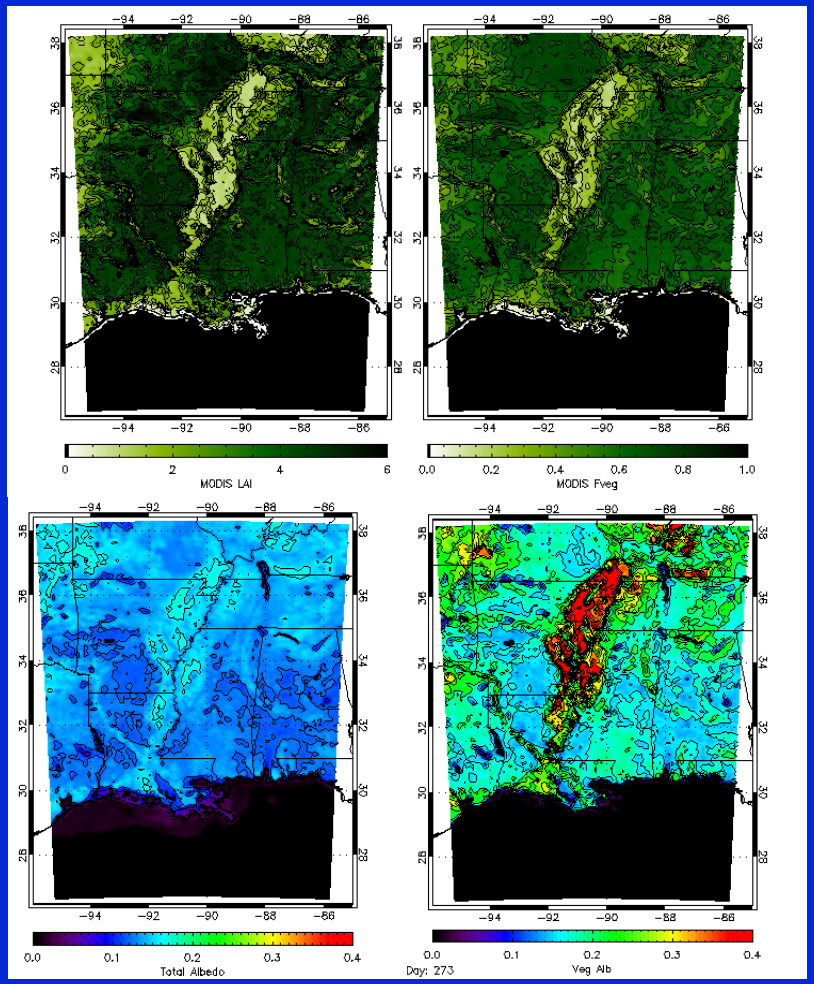
# Atmospheric Dispersion



- Land cover heterogeneity present at multiple spatial scales, impacts atmospheric dispersion

- During the Bhopal tragedy in India, circulation patterns induced by surrounding lakes transported Methyl Isocyanate (MIC), urban areas
- Nocturnal inversion confined MIC close to the surface

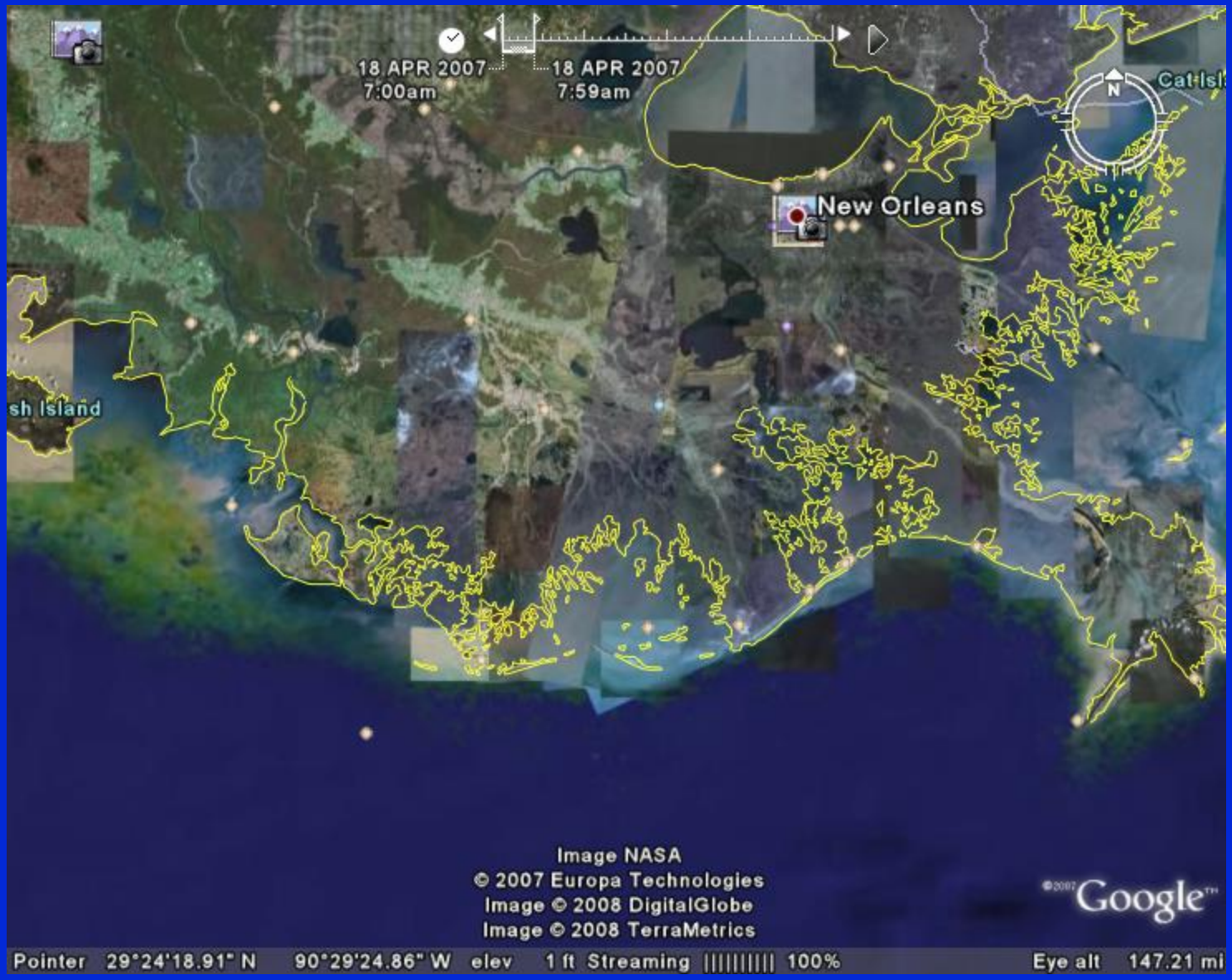
# Atmospheric Dispersion



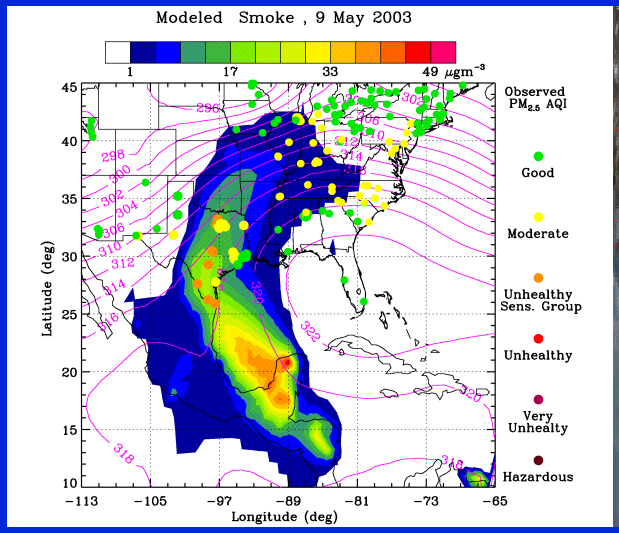

- Nocturnal patterns substantially impacted by land surface heterogeneity
- Land surface heterogeneity can better represented in numerical models through the use of satellite remote sensing data

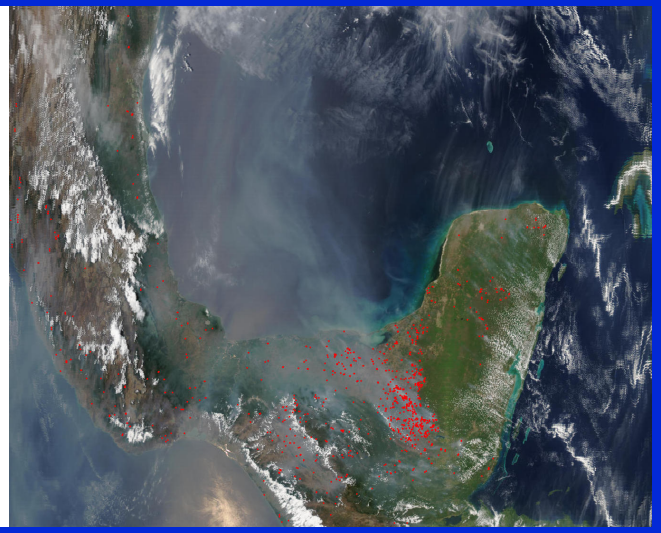
Wu, Nair, Pielke Sr., McNider, Christopher and Anantharaj,2009

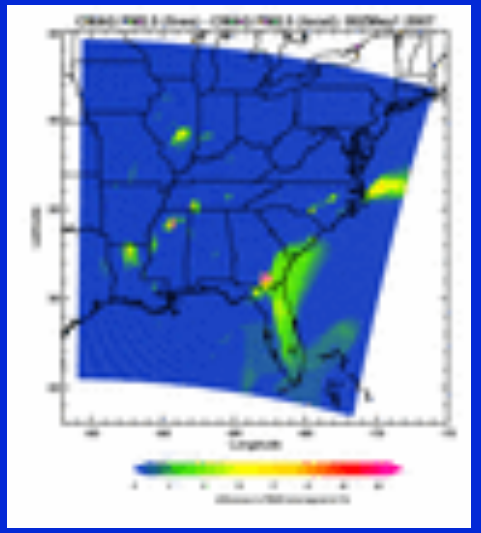
# Impact of land surface heterogeneity



# Satellite remote sensing and numerical modeling of smoke transport

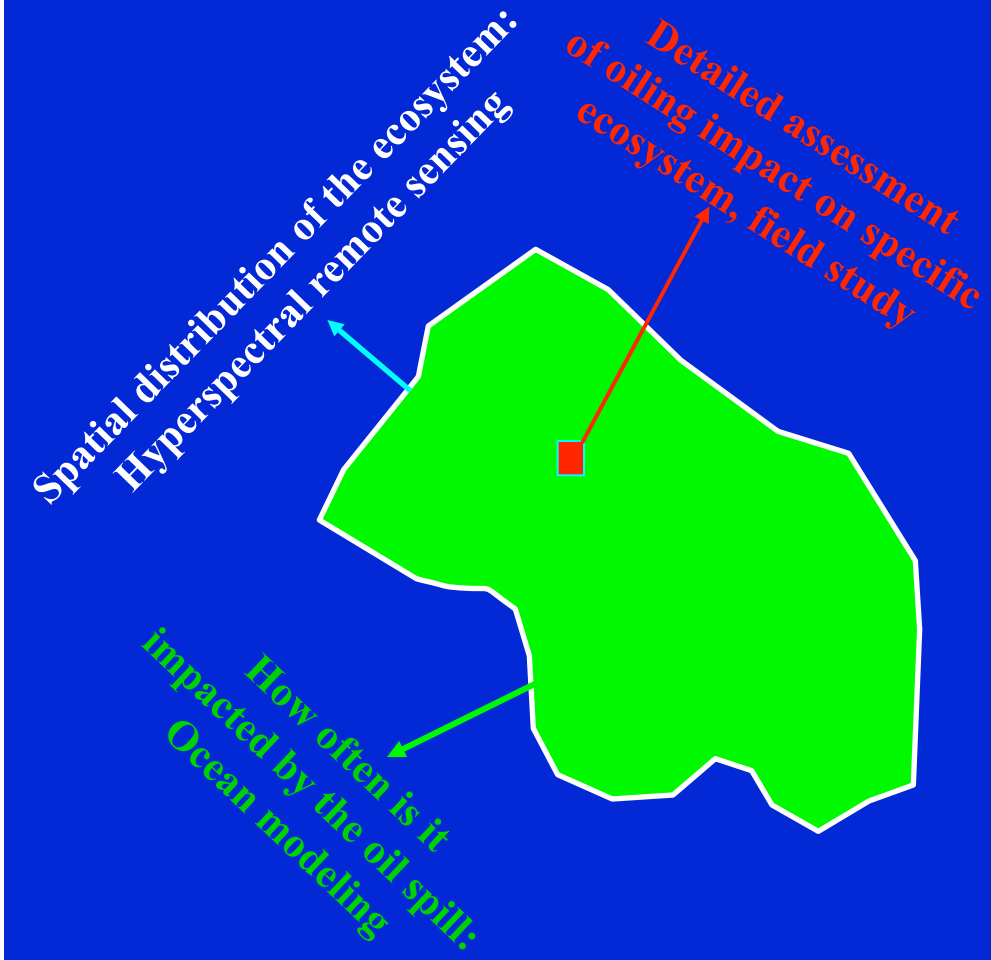




Wang et al. 2006, Christopher et al., 2009

# Potential application of remote sensing and numerical modeling for the Oil Spill impact assessment

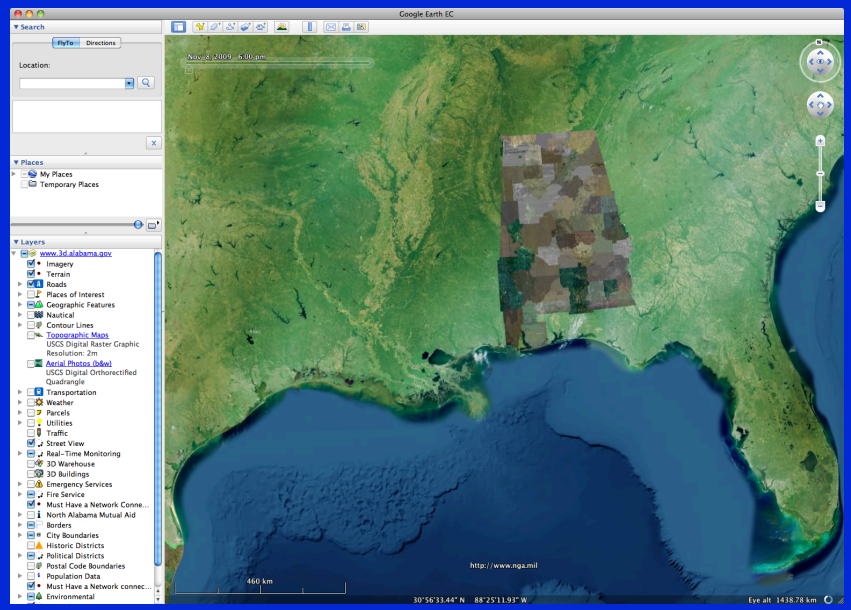



- Use of hyperspectral remote sensing data for classification of ecosystems impacted by oil spill (salt marshes, sea grass)
- In combination with lagrangian ocean trajectory models, remote sensing could be utilized to upscale small scale point assessments derived from detailed field studies

# Interactions between research and emergency management community

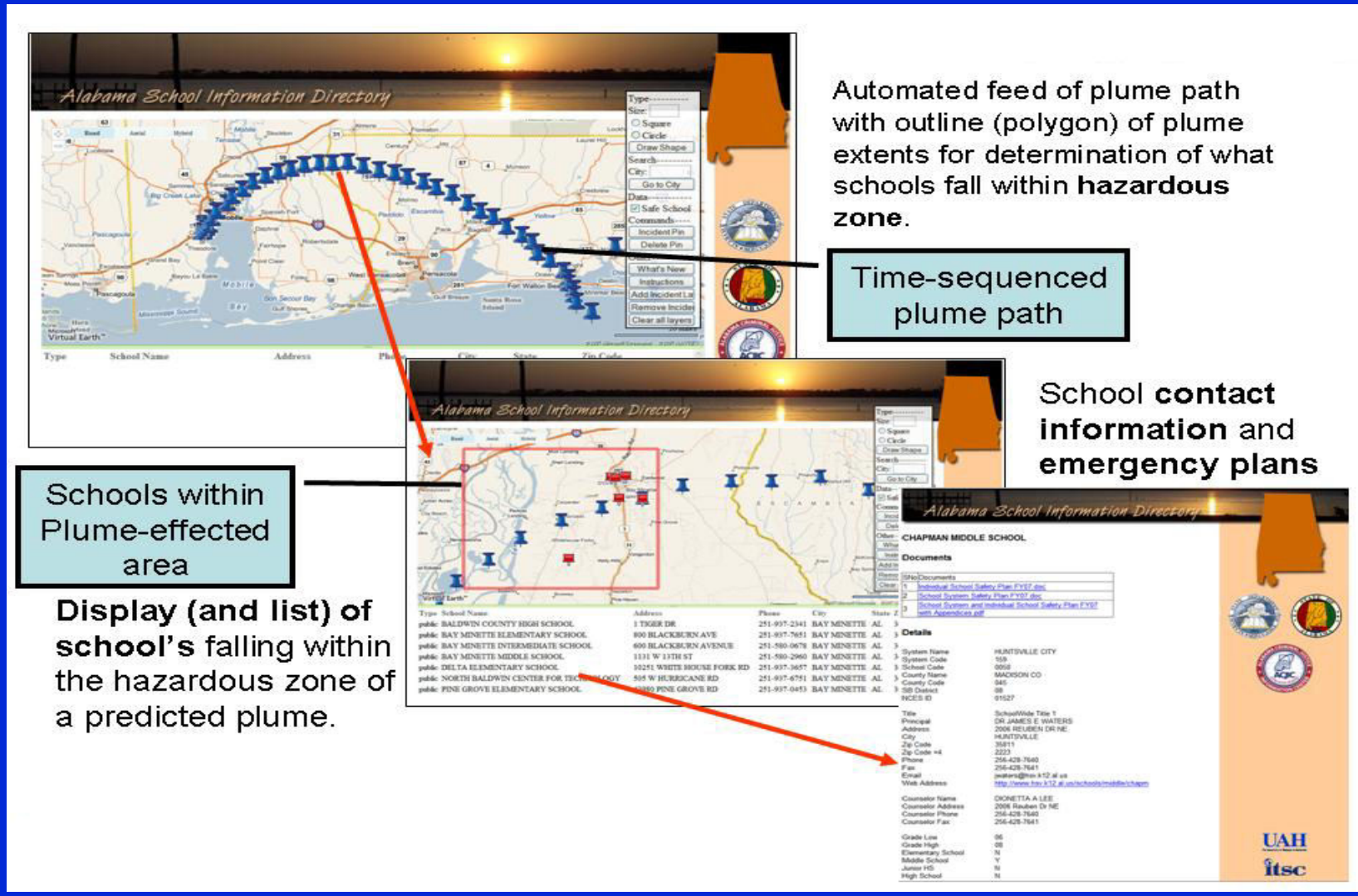
- Remote sensing data sets developed in a research environment is also useful for those involved in oil spill emergency management response
- Data generated during the emergency management response is also useful for researchers
- What is an efficient way to promote interactions?

# Transition of research to decision support framework

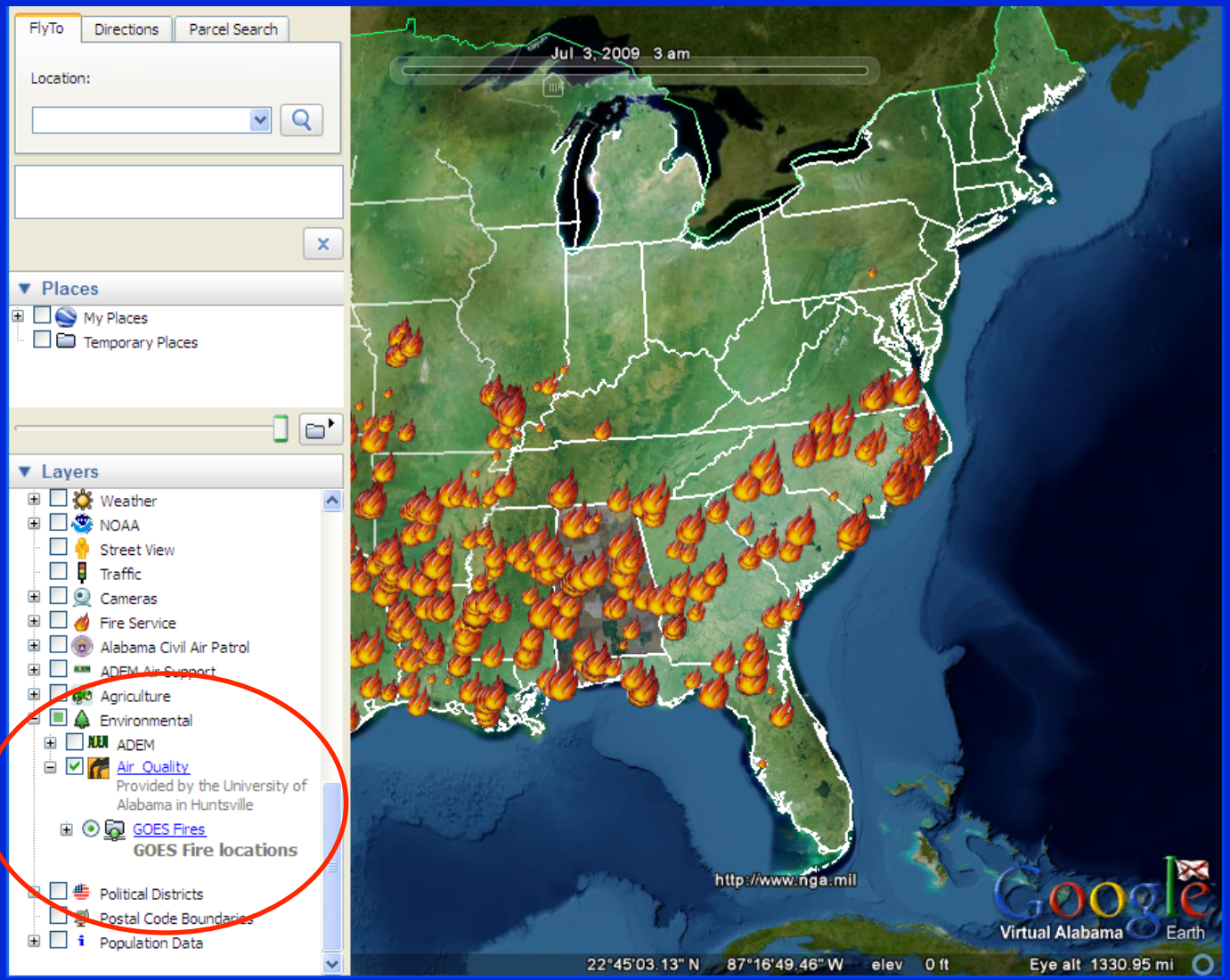



- Virtual Alabama (VA): Developed by Alabama Department of Homeland Security
- Leverages existing state asset imagery and infrastructure data into a web-based decision support tool
- VA has over 1800 online users and incorporates variety of information from state and federal agencies

# An example: Interfacing of dispersion model with safe school initiative



# An example: Fire, nutrient deposition products in VA



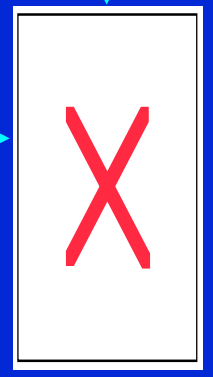
# Architecture for an integrated system: Research and Decision support

Base Layer: Geophysical datasets- Spatial maps, time series-Research input

- Satellite derived Oil spill maps
- Satellite derived vegetation indices
- Satellite derived chlorophyll
- Satellite derived SST
- Satellite derived solar insolation
- Satellite derived ecosystem maps
- Meteorology, rainfall, temperature

User Layer: Data-Research/emergency management

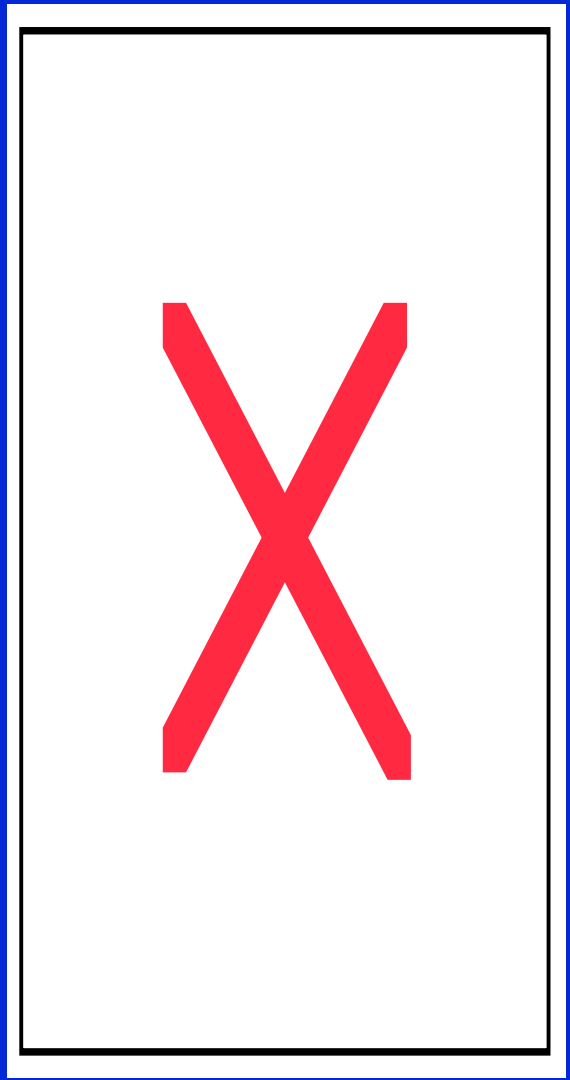
- Aircraft monitoring of vegetation
- Physical and chemical characterization
- Coastal Ecosystem oil and dispersant impact
- Satellite derived Oil spill maps



User Layer: Analysis tools: All

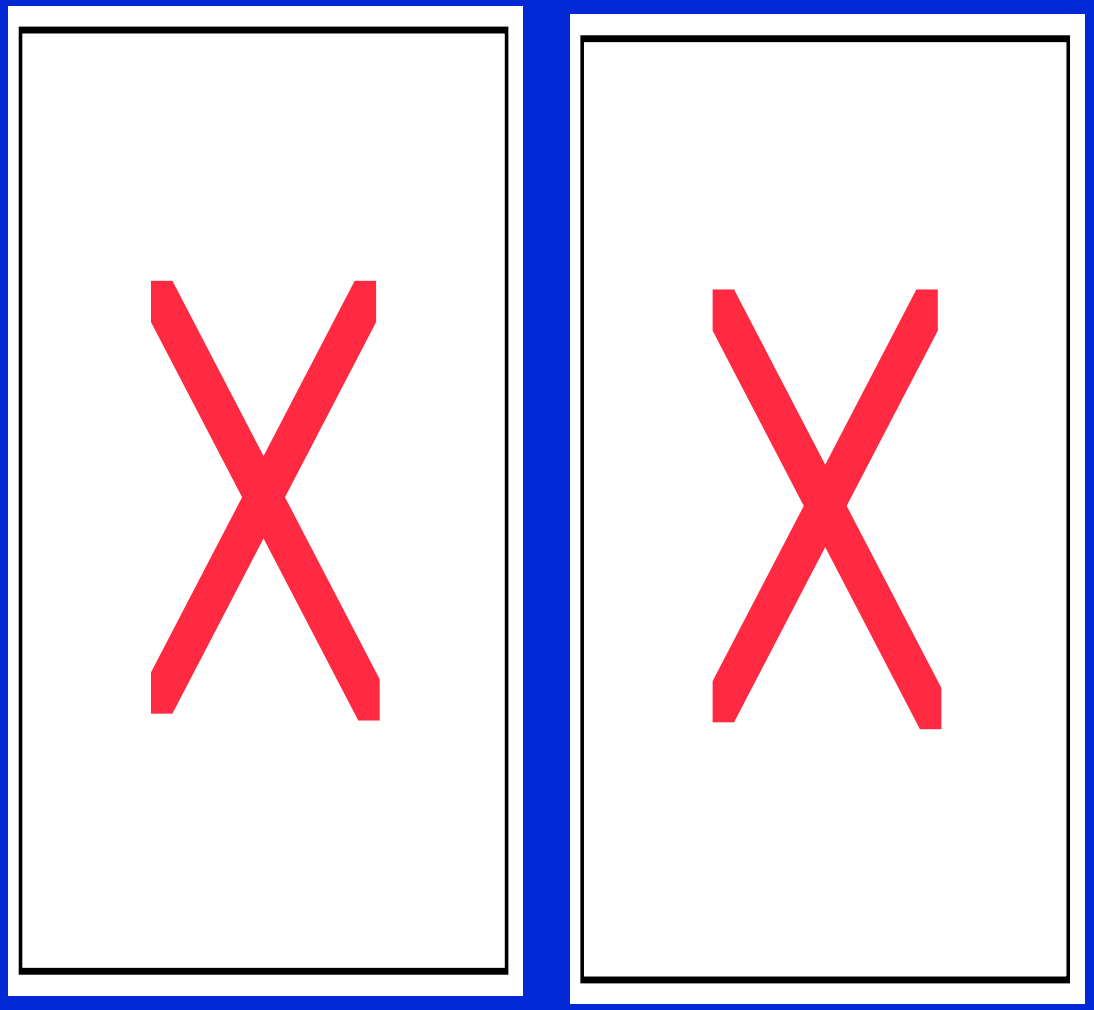
- Time series analysis
- Ecological Modeling
- Lagrangian models

# Integrated system



- Customized applications on mobile devices (iPhone/iPad) will allow emergency field researchers/ management personnel to access research products (ecosystem maps/forecast etc)
- Utilization of geolocation capabilities of mobile devices will allow the utilization of data layers to locate specific ecosystem types/ other features of interest

# Integrated system



- Mobile devices will allow users to feed back information to the integrated system: for example, tar ball sightings etc which could be of use to researchers
- The integrated system will play a dual role, supporting rapid transitions of research capabilities for decision and emergency management support, while providing feedback for research

# Conclusions

- Web based technologies that integrate information from state and federal agencies provide an effective base for transitioning research capabilities into operations
- Contextual information that exist with such systems allow effective utilization of research capabilities in an emergency management and decision support setting
- Incorporation of mobile devices allow effective utilization of the research capabilities in the field

# Conclusions

- Mobile devices also allow for emergency management personnel and decision makers to provide feedback to the system which could be utilized for research

- Interactive feature of the mobile devices also allow new methods for utilization of research capabilities, for example generation of classifiers by unskilled personnel in emergency management situations to identify features of interest in satellite imagery, inverse modeling etc.

- Such technologies are currently being developed at ESSC and ITSC, University of Alabama in Huntsville