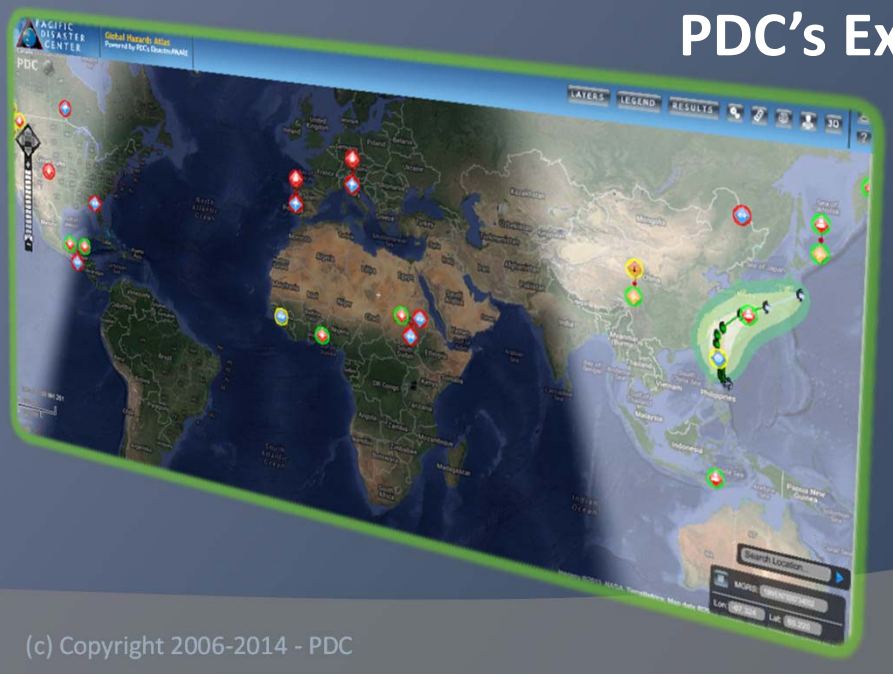
PACIFIC DISASTER CENTER

Fostering Disaster-Resilient Communities through Information, Science, Technology and Exchange

DisasterAWARE

APPLYING SCIENCE AND TECHNOLOGY FOR POST-DISASTER RECOVERY:

PDC's Experiences in the US and Asia-Pacific



NCDR
2014 International Training Workshop:
Post-disaster Recovery
27-31 September 2014
Taipei, Taiwan

Chris Chiesa
Deputy Executive Director
Pacific Disaster Center

University of Hawaii: Managing Partner

Presentation Overview

- **Brief Introduction to Pacific Disater Center (PDC)**
- **Thoughts on Disaster Recovery**
- **PDC Experiences in Asia and US**
- **Resources**

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An Introduction to the Pacific Disaster Center (PDC)

PDC Overview

Asia Pacific:
- 38% of World's Disasters
- 80% of World's Casualties

- Vision: Safer & More Secure World
  - More resilient, sustainable communities, safer nations, and a more secure world through reducing disaster impacts
- Goal: Disaster Resiliency
  - Foster disaster-resilient communities through information, science, technology, and exchange
- Mission: Reduce Disaster Risks
  - Provide applied information research and evidence-base analysis supporting development of more effective disaster risk reduction (DRR) policies and practices; and applications and information products supporting Humanitarian Assistance and Disaster Relief (HA/DR) operators and practitioners in the Asia Pacific region and beyond.
- History: Two Decades
  - Initial Operational Capability (IOC) – October 1995
  - University of Hawaii as Managing Partner – December 2006

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What we do: Bridging Communities…

S & T Community		Decision Makers
Peer Review	Audience	The Public
Low	Comfort with uncertainty	High
Complex	Vocabulary	Simple
Technical Groups	Associations	Very Public

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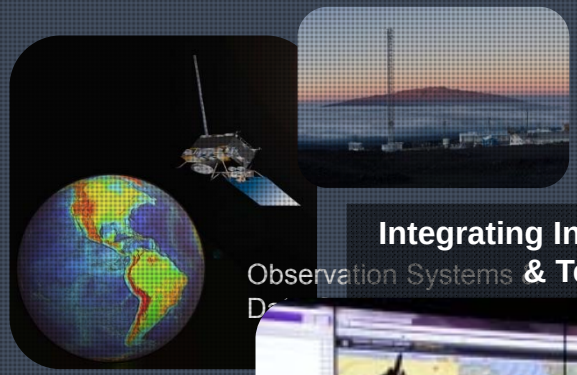
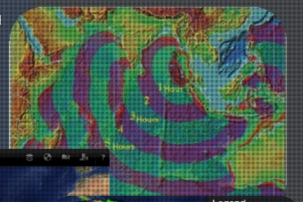
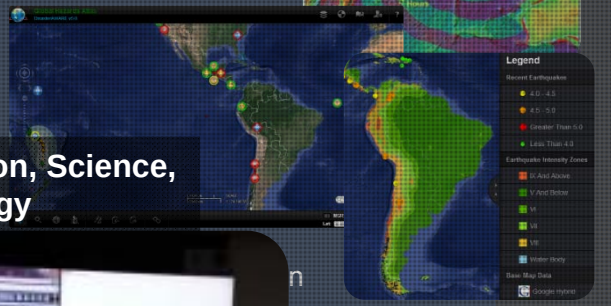
How we do it: Integrate and Apply..

- Applied Science & Technology
- Capability Building
- Evidence-Based Information Products
  - Policy & Decision Makers
  - Disaster Managers
  - Planners
  - Humanitarian Assist. Missions

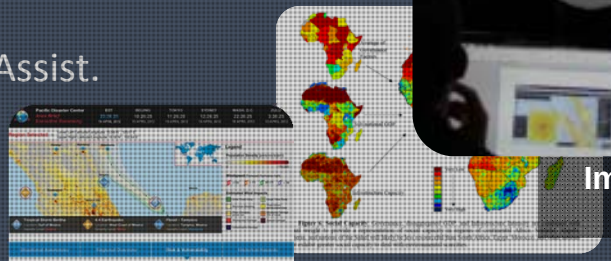


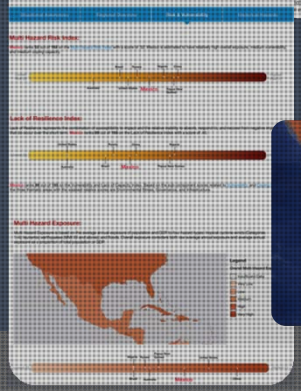




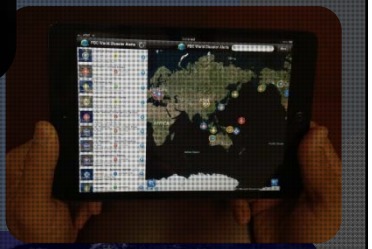
Observation Systems &
Da

Integrating Information, Science, & Technology





Improve Decision-support Capabilities



Advanced Applications, Models, Risk & Vulnerability Assessments

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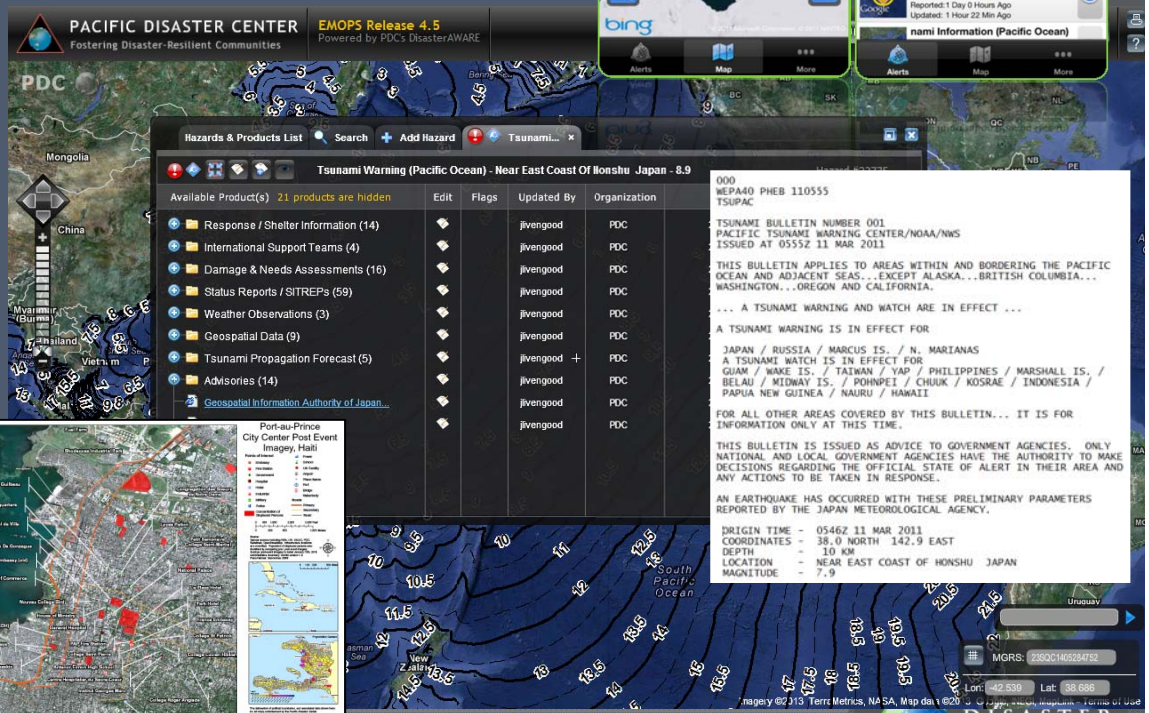
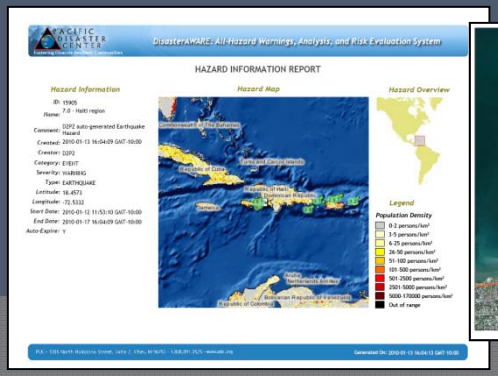
DisasterAWARE: Resources for Hazard Monitoring and Early Warning in Asia-Pacific & Beyond

- Disaster Alert (mobile)
- Atlas and EMOPS (web)
- Regional EWS/DSS Deployments
  - Thailand
  - Vietnam
  - Indonesia
  - ASEAN





Disaster Recovery

Recovery is a Complex Process and Involves Many Stakeholders

- Many components
  - Physical (infrastructure, housing, etc.)
  - Economic (jobs, livelihoods, GPD)
  - Environmental (lost habitat, lost processes)
  - Cultural
  - Psychological/Emotional
- Many Aspects
  - Planning (pre-disaster)
  - Communications, Organization, Financing
  - Community & Private-sector Engagement

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Measuring Recovery Progress

- What does it mean to "recover" from a disaster?
- How long does it take to reach (full?) "recovery?"
- How do you measure/monitor this?

- Good databases of disaster impacts; Less so for disaster recovery ….

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PDC Supporting Disaster Recovery

Indian Ocean Tsunami (12/26/04)

- December 26, 2004
- Magnitude 9.0 EQ
- Damage: More than $USD 10B
- Deaths: More than 200,000
- Injuries: More than 500,000
- Impacted: 5 million people were estimated to have lost homes/shelter
- Traveled over 3000 miles (5000 km), Impacting people in 11 Countries

Indian Ocean Tsunami Recovery Monitoring

Description

- Use space-based technologies to monitor the recovery status and progress of communities impacted by the December 2004 Indian Ocean Tsunami.

Scope

- Select & monitor a set of representative sites
  - Range of pre-impact conditions / land uses
    - urban, agricultural, coastal fishing, etc.
  - Range of impacts intensities / severities
  - Distribution of countries

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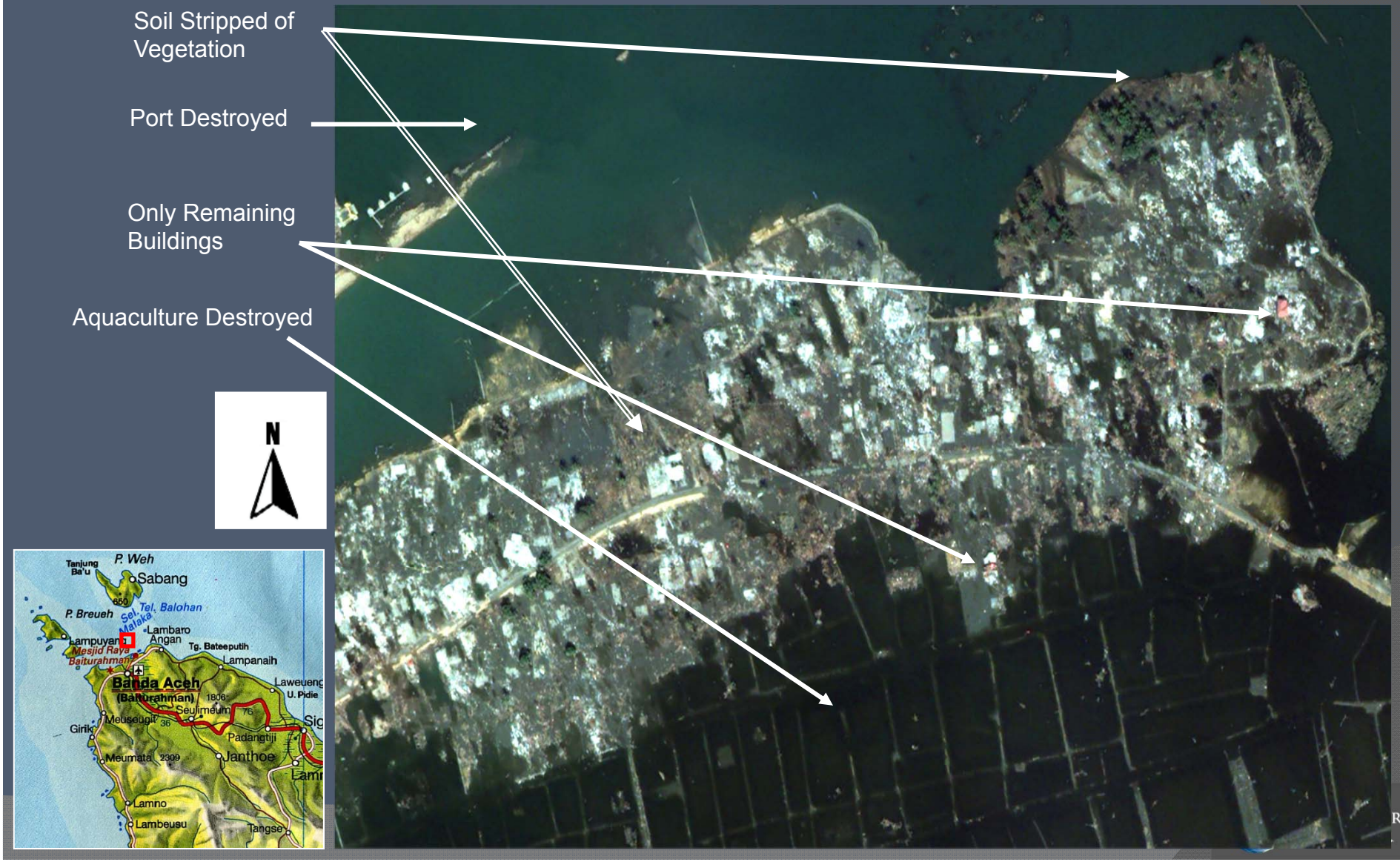
Banda Aceh, Indonesia: Pre-event June 29, 2005

(QuickBird; Pan-sharpened)

Banda Aceh, Indonesia: Post-event Dec 28, 2004

(QuickBird; Pan-sharpened)



Banda Aceh, Indonesia: Recovery June 29, 2005

(IKONOS; Pan-sharpened)

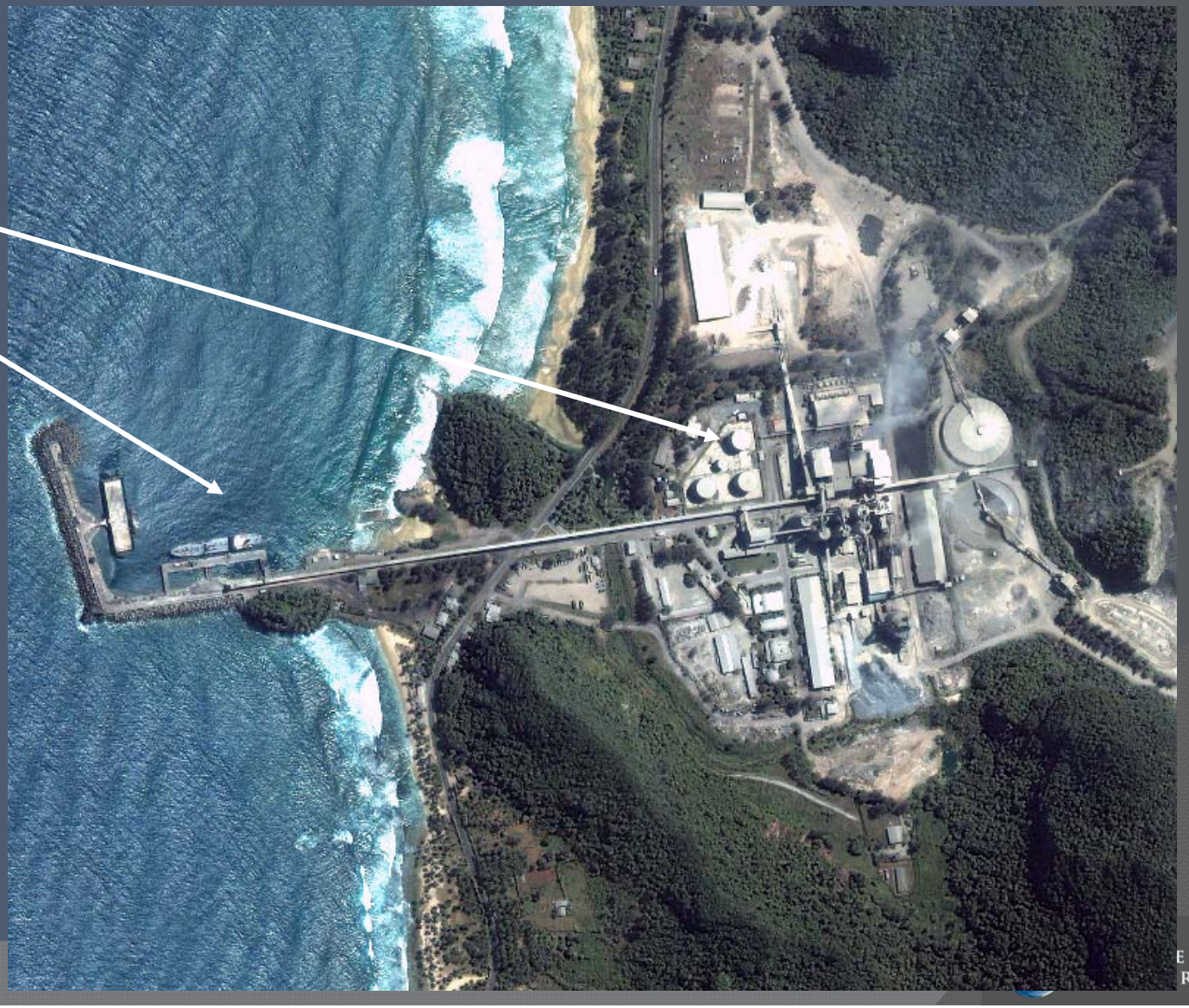
Vegetation Returning to Stripped Areas

Port and Aquaculture Remain Destroyed

Some New Buildings Constructed, many with Blue Roofs

Girik, Indonesia : Pre-event June 23, 2004

(QuickBird; Pan-sharpened)



Girik, Indonesia: Post-event December 28, 2004

(QuickBird; Pan-sharpened)

Soil Stripped of Vegetation

Facilities Heavily Damaged, including Displaced Tank Farm

Damaged Dock w/ Sunken Vessels

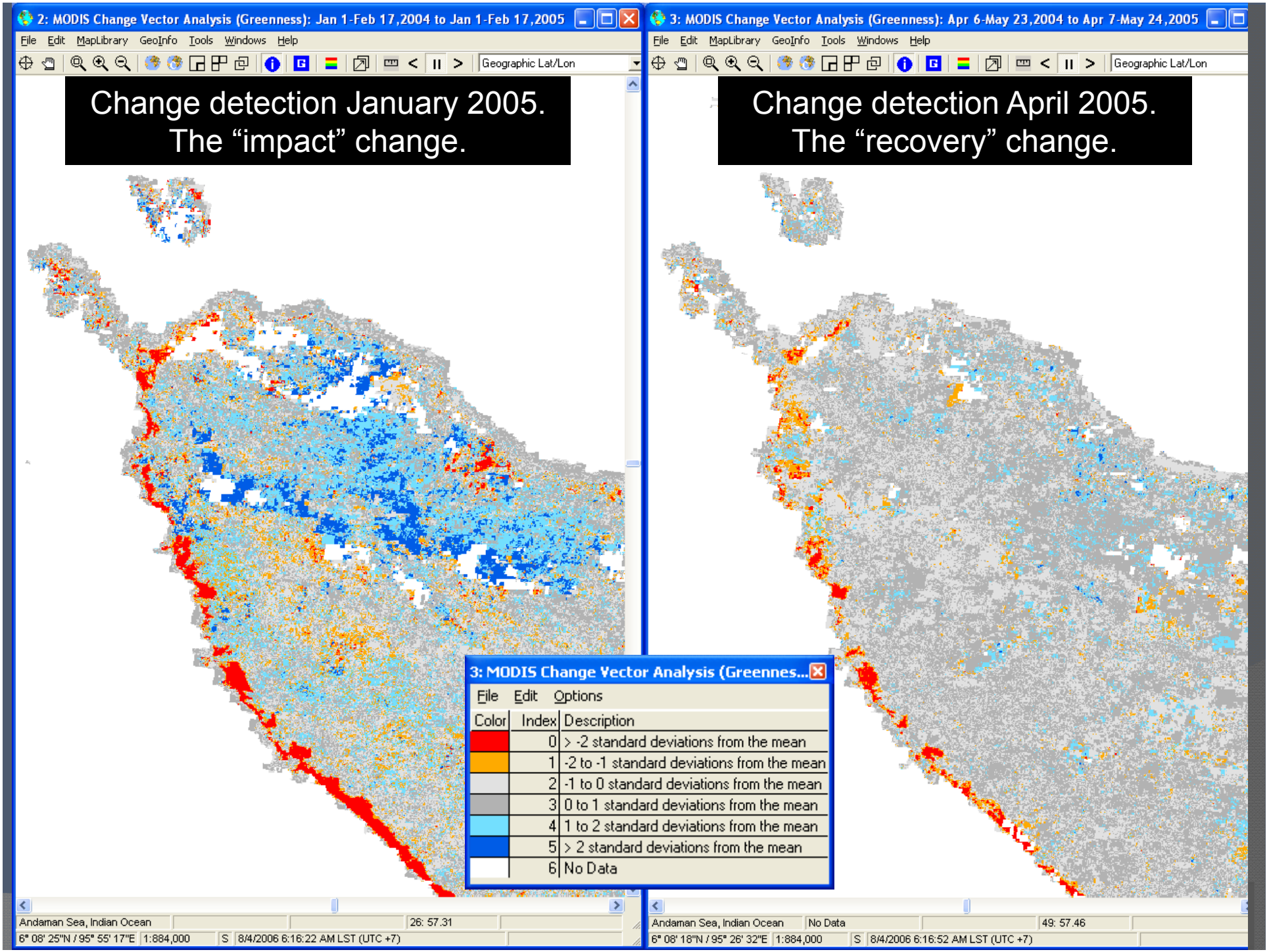
Girik, Indonesia : Recovery June 29, 2005

(IKONOS; Pan-sharpened)

Vegetation beginning To grow in Formerly Stripped Areas

Newly Constructed Facility Fence

Debris Removal and Storage Evident


2: MODIS Change Vector Analysis (Greenness): Jan 1-Feb 17,2004 to Jan 1-Feb 17,2005
File Edit MapLibrary GeoInfo Tools Windows Help
Geographic Lat/Lon
Change detection January 2005.
The “impact” change.
3: MODIS Change Vector Analysis (Greennes...
File Edit Options
Color Index Description
0 > -2 standard deviations from the mean
1 -2 to -1 standard deviations from the mean
2 -1 to 0 standard deviations from the mean
3 0 to 1 standard deviations from the mean
4 1 to 2 standard deviations from the mean
5 > 2 standard deviations from the mean
6 No Data
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3: MODIS Change Vector Analysis (Greenness): Apr 6-May 23,2004 to Apr 7-May 24,2005
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Geographic Lat/Lon
Change detection April 2005.
The “recovery” change.
Andaman Sea, Indian Ocean
No Data
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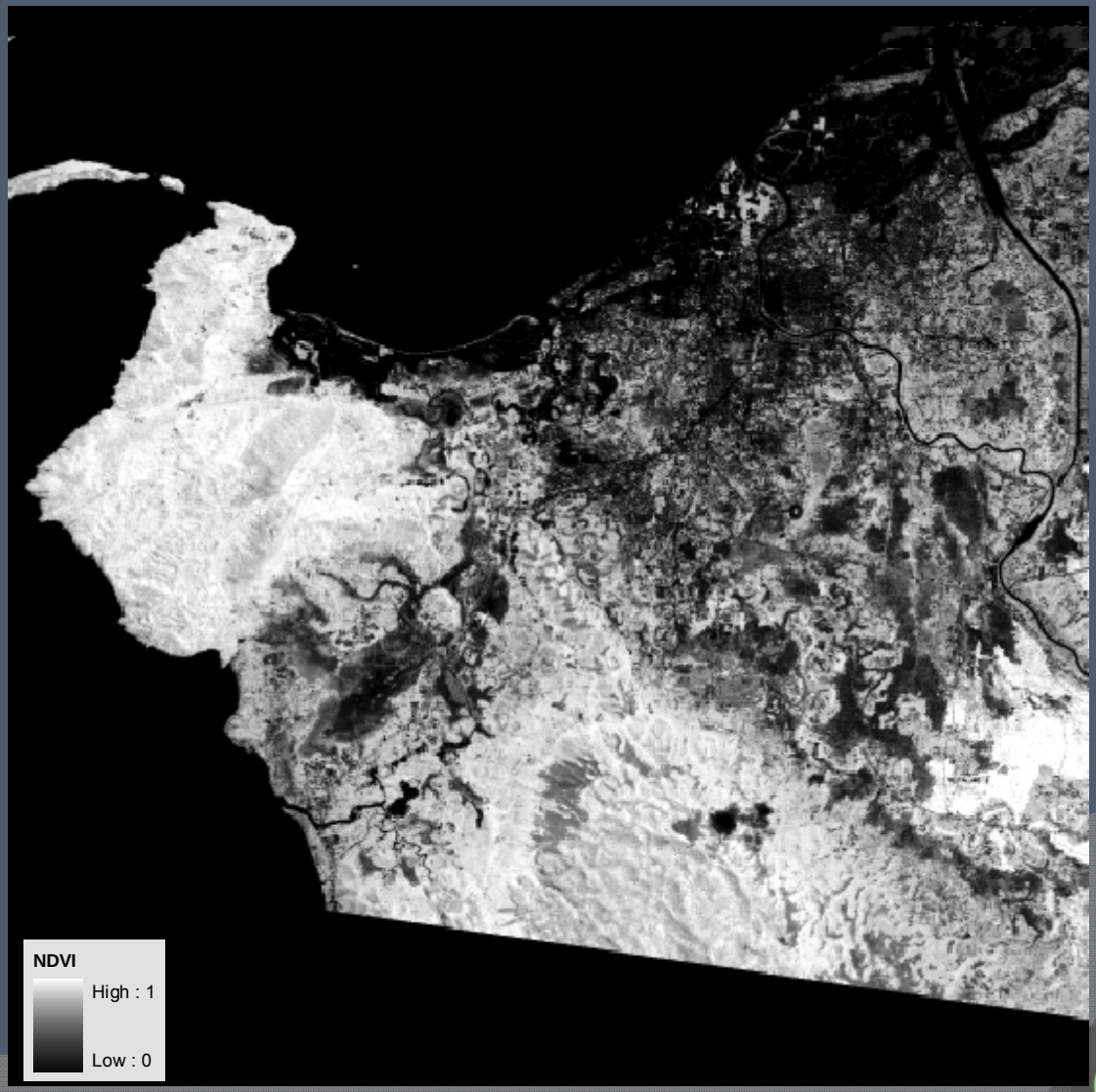
m1

Vegetation Index (NDVI) Time Series

6 Months After Tsunami



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m1

NDVI VALUES

NDVI images were made from radiance data (the raw image pixel value is Digital Number but I converted them to radiance) This is done for normalization, when two types of imagery or the same type but different acquisition date images are used it is better to calibrate the data before doing any change detection.

NDVI = NIR - VISIBLE/NIR + VISIBLE (used to show or measure green vegetation (amount and also the state = if it is healthy or not) also used in models that try to quantify green biomass and leaf area in forests

Because we were interested in loss of vegetation. pixels with negative values of NDVI were recoded to a Zero Value (some Non vegetated areas have higher NIR reflectance than VIS reflectance, that is why you get a neg value)

Red Square = next slides extent

This slide just shows the NDVI for the three different times

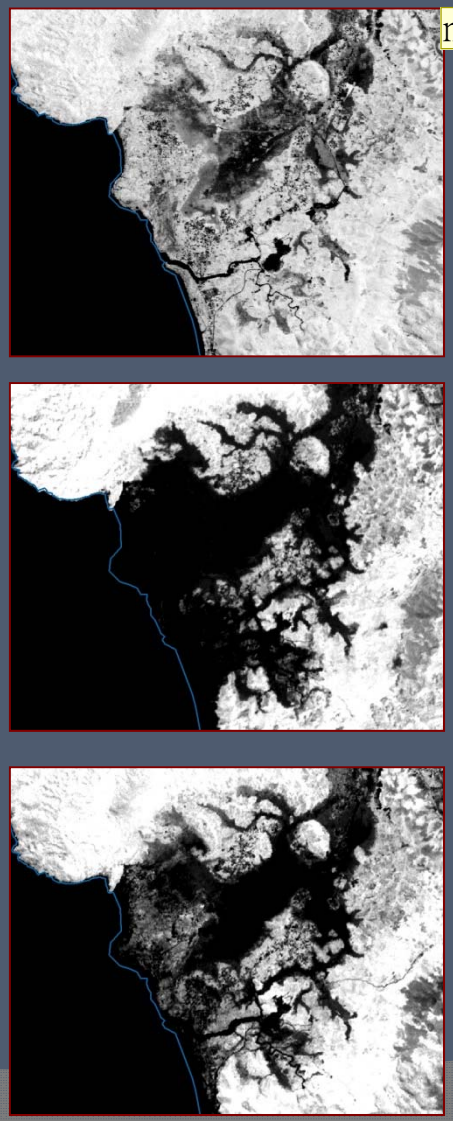
mnieves, 2006/8/4

Change Detection

Pre-Tsunami

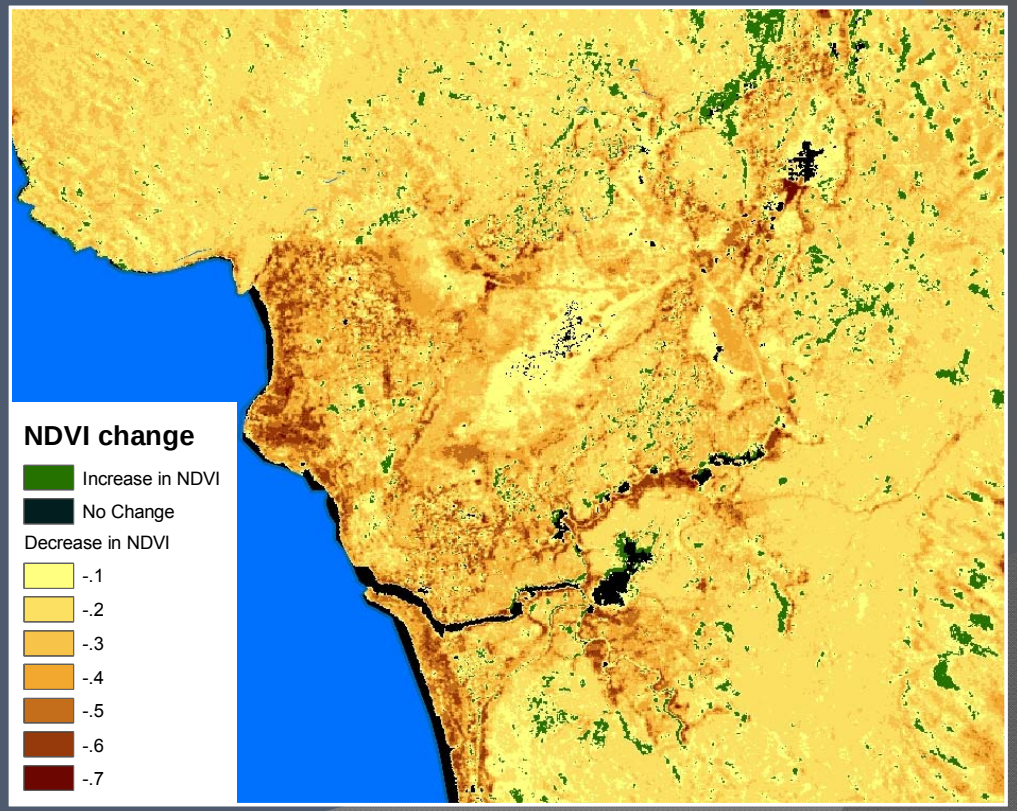
Immediately After Tsunami

6 Months After Tsunami



NDVI change between Pre-tsunami image and 6 months after the tsunami

NDVI change immediately after the tsunami



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m2

Change detection ran in ENVI. Again here we wanted to see loss in vegetation, that is why there is only one class for increase in vegetation the rest represent loss in NDVI.

Small changes in NDVI might be due to other things not related to tsunami. For example some areas don't line up very good (hills for example), different acquisition time, different sensors and small changes in vegetation due to weather for example), sensor noise (satellites errors), atmosphere also affects the signal specially in the NIR band. However darker areas represent tsunami damage for sure

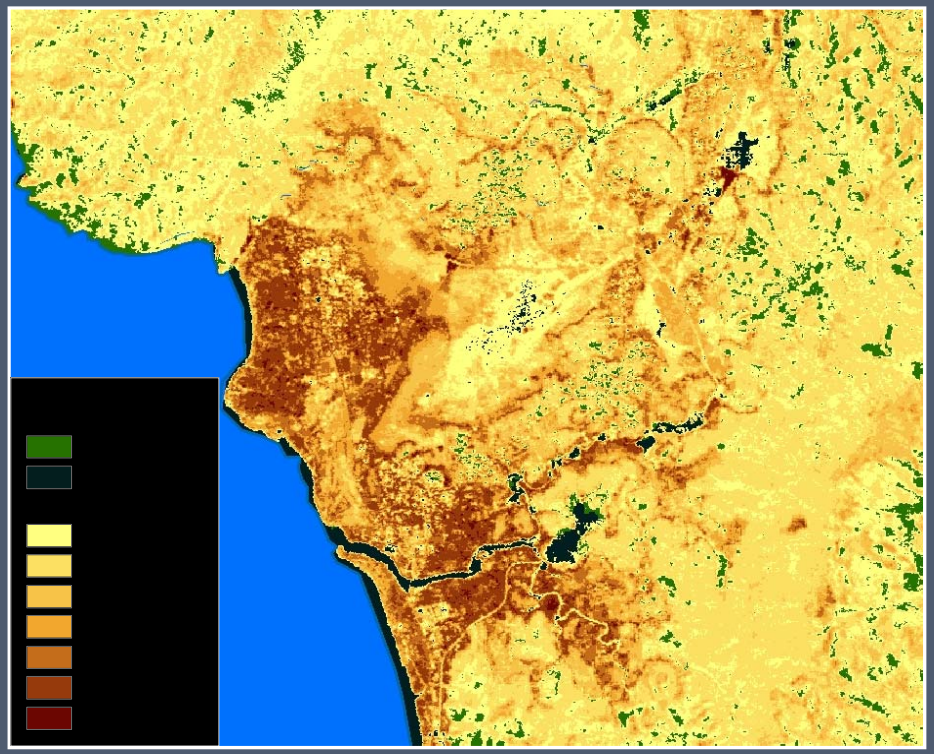
The import thing is that you can see the change in NDVI and for the AOI most of the changes are due to the tsunami and you see that from the second change detection when the vegetation comes back. (the pattern also follows the tsumani affected area)

mnieves, 2006/8/4

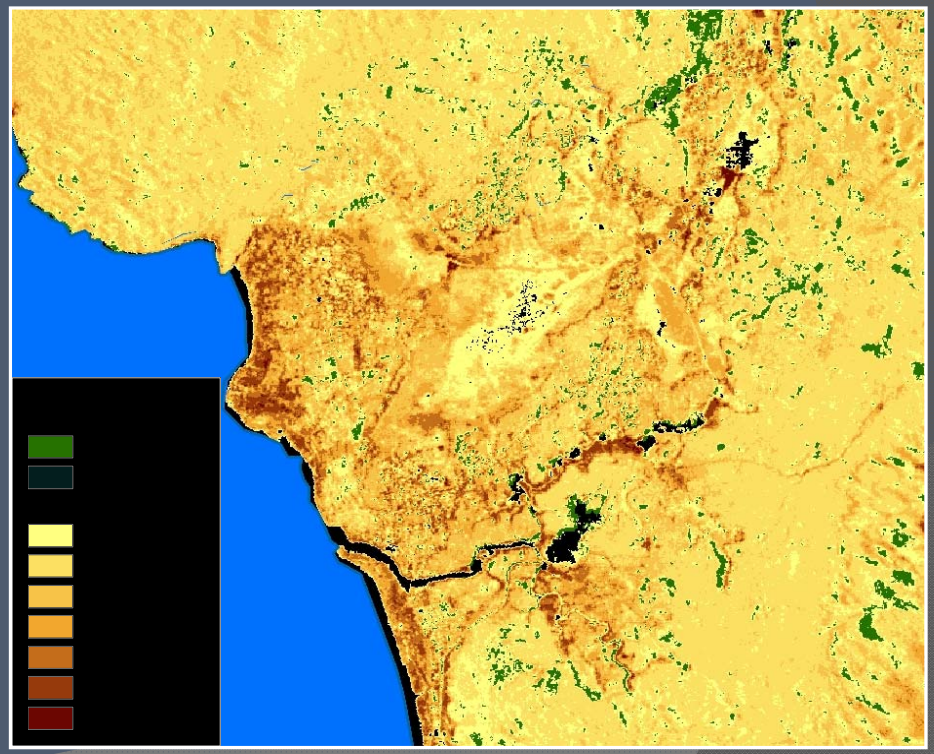
m3

Change Detection

Pre Tsunami - Immediately After



Pre Tsunami – 6 Months After



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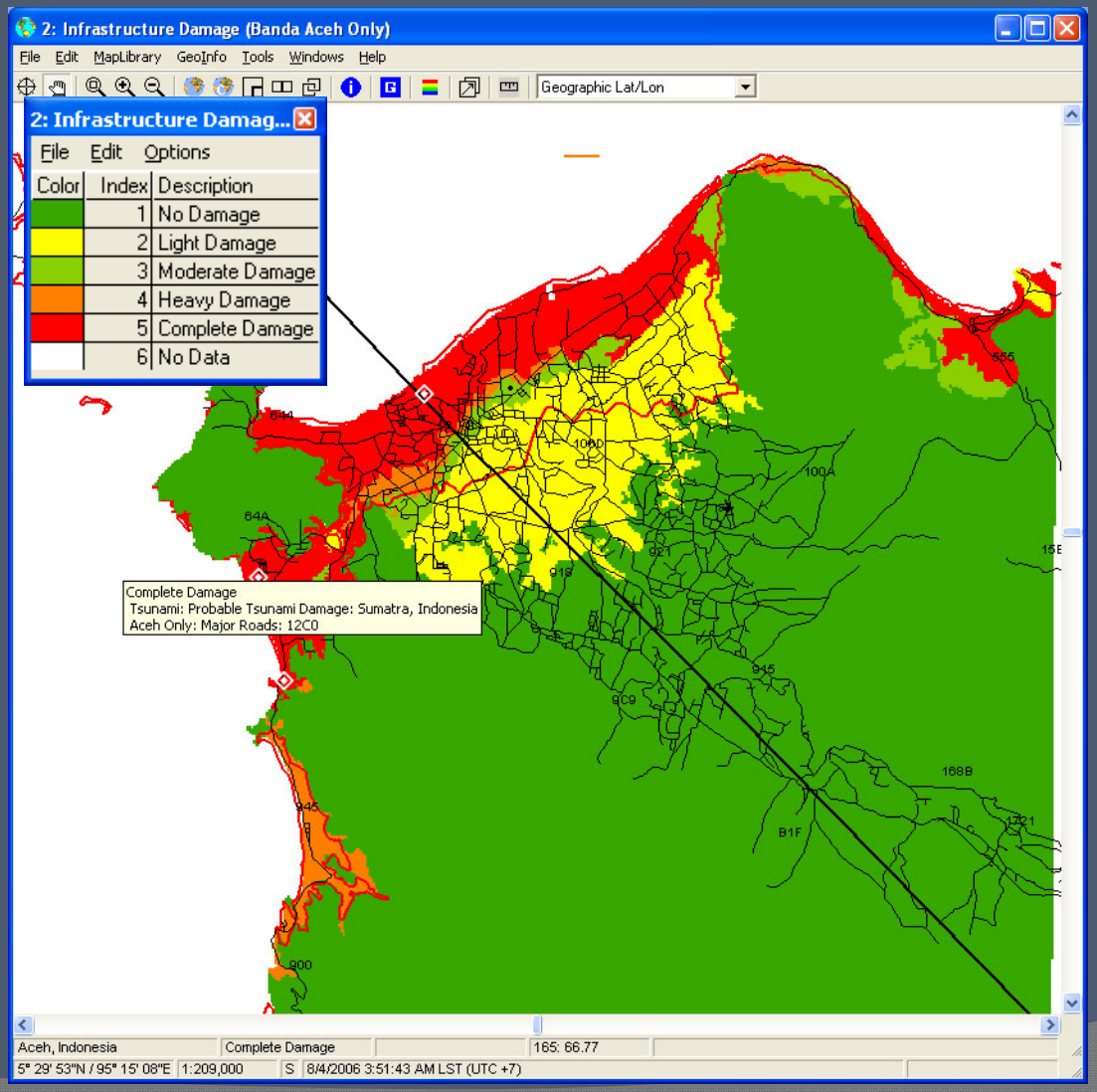
m3 This one shows the difference and how vegetation is coming back (less darker areas)
mnieves, 2006/8/4

IDSI



Infrastructure Damage Severity Index (IDSI)

- Developed by PDC
- Documents relative damage in affected areas
- Prepared through manual interpretation of high-resolution (~1m) satellite imagery

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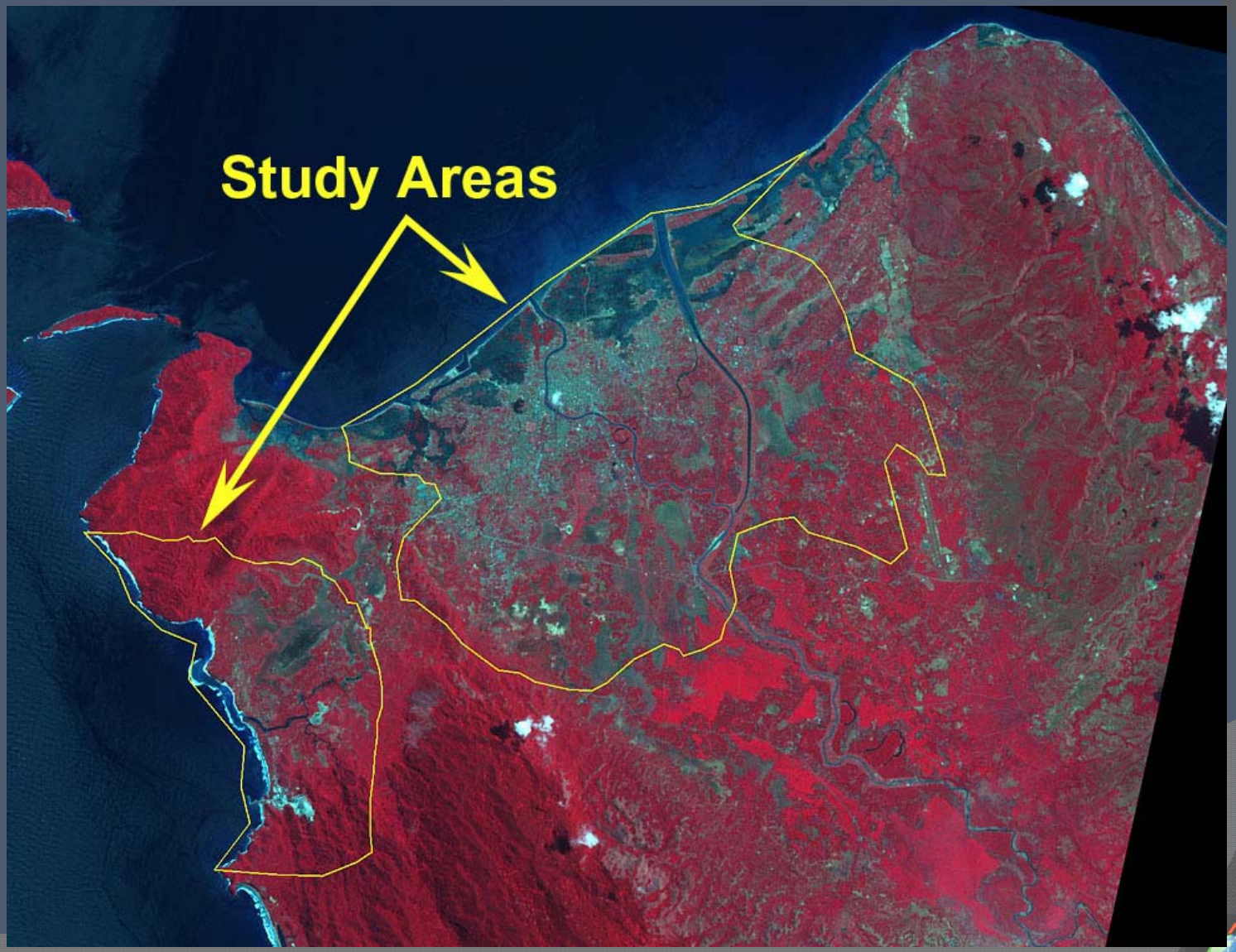
Quantification of Lost/Recovering Infrastructure



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Quantification of Lost/Recovering Infrastructure

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Quantification of Lost/Recovering Infrastructure

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Quantification of Lost/Recovering Infrastructure

Roads: At Pre-Event (T0), Immediately After (T1), 6 Months Later (T2)

Recovery Monitoring Site	(T0) Baseline Km of Roads Present	(T1) Remaining Km of Roads & % Change from T0	(T2) Total Km of Roads & % Change from T0
Banda Aceh, Indonesia	56.62 Km	28.24 Km	34.70 Km
	100 %	49.01 %	60.22 %

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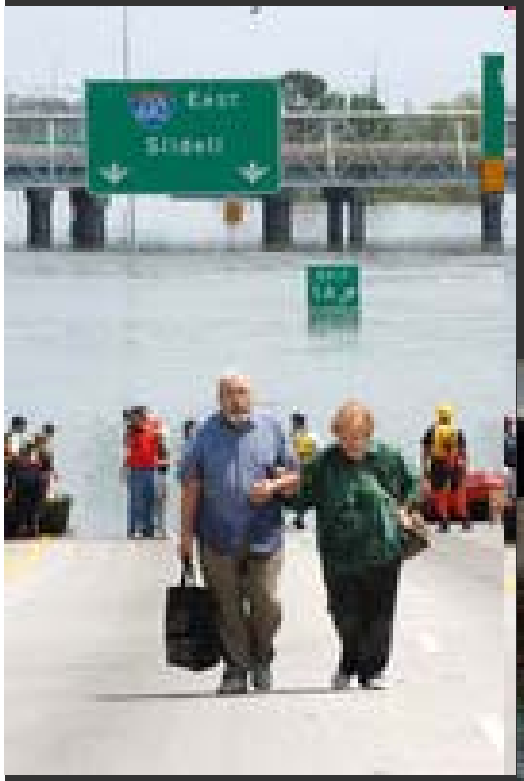
Hurricane Katrina

- August 23, 2005
- **Damage**: $81 billion total; $40.6 billion in insured losses
- **Deaths:** 1,833
  - LA: 1,577, MS: 238, FL: 14, GA: 2, AL: 2
- **Storm Surge**
  - Mississippi: 17-28 ft
  - Louisiana: 5-15ft
  - Alabama: 8-15ft
- **Evacuees**: 1.2 million people

Mississippi

New Orleans, Louisiana



Social Vulnerability and Hazards

- What makes people and places vulnerable to environmental threats from natural, technological, and human-induced hazards?
- Development of methods and metrics for analyzing societal vulnerability and resilience to environmental hazards and extreme events
- Characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard

Social Vulnerability and Hazards

Special Needs Populations

- Difficult to identify (infirm, transient) let alone measure; invariably left out of recovery efforts; often invisible in communities

Age (Elderly and Children)

- Affect mobility out of harm's way; need special care; more susceptible to harm

Socioeconomic Status (Rich, Poor)

- Ability to absorb losses and recover (insurance, social safety nets), but more material goods to lose

Race and Ethnicity (Non-white, Non-Anglo)

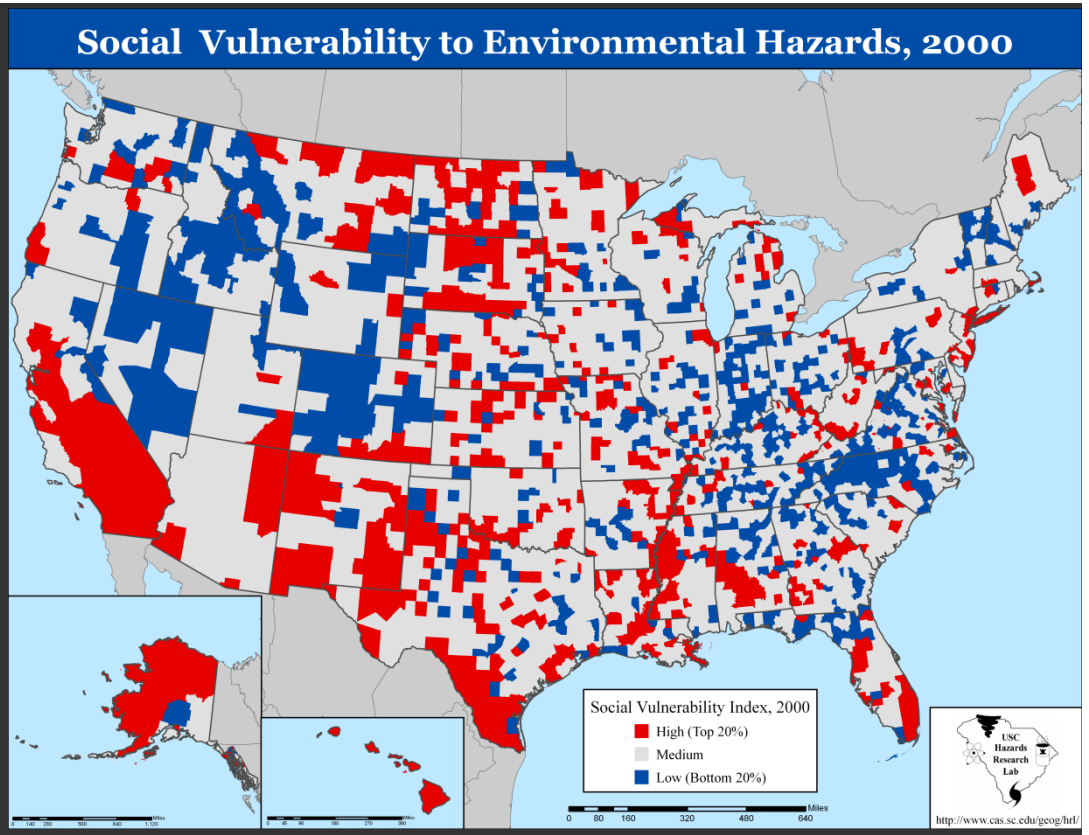
- Impose language and cultural barriers; affect access to post-disaster recovery funding; tend to occupy high hazard zones

Gender (Women)

- gender-specific employment, lower wages, care-giving role

Social Vulnerability Index (SoVI)

- Relative Index
- County Level
- United States
- Decade - 2000
- Data Reduction
- 42 Socioeconomic Variables



- www.sovius.org

Cutter, S.L., B.J. Boruff, and W.L. Shirley. 2003. "Social Vulnerability to Environmental Hazards." *Social Sciences Quarterly*. 84(2): 242-261.

Cutter, S. L. and C. Finch. 2008. "Temporal and Spatial Changes in Social Vulnerability to Natural Hazards," *Proceedings of the National Academy of Sciences .*

SoVI

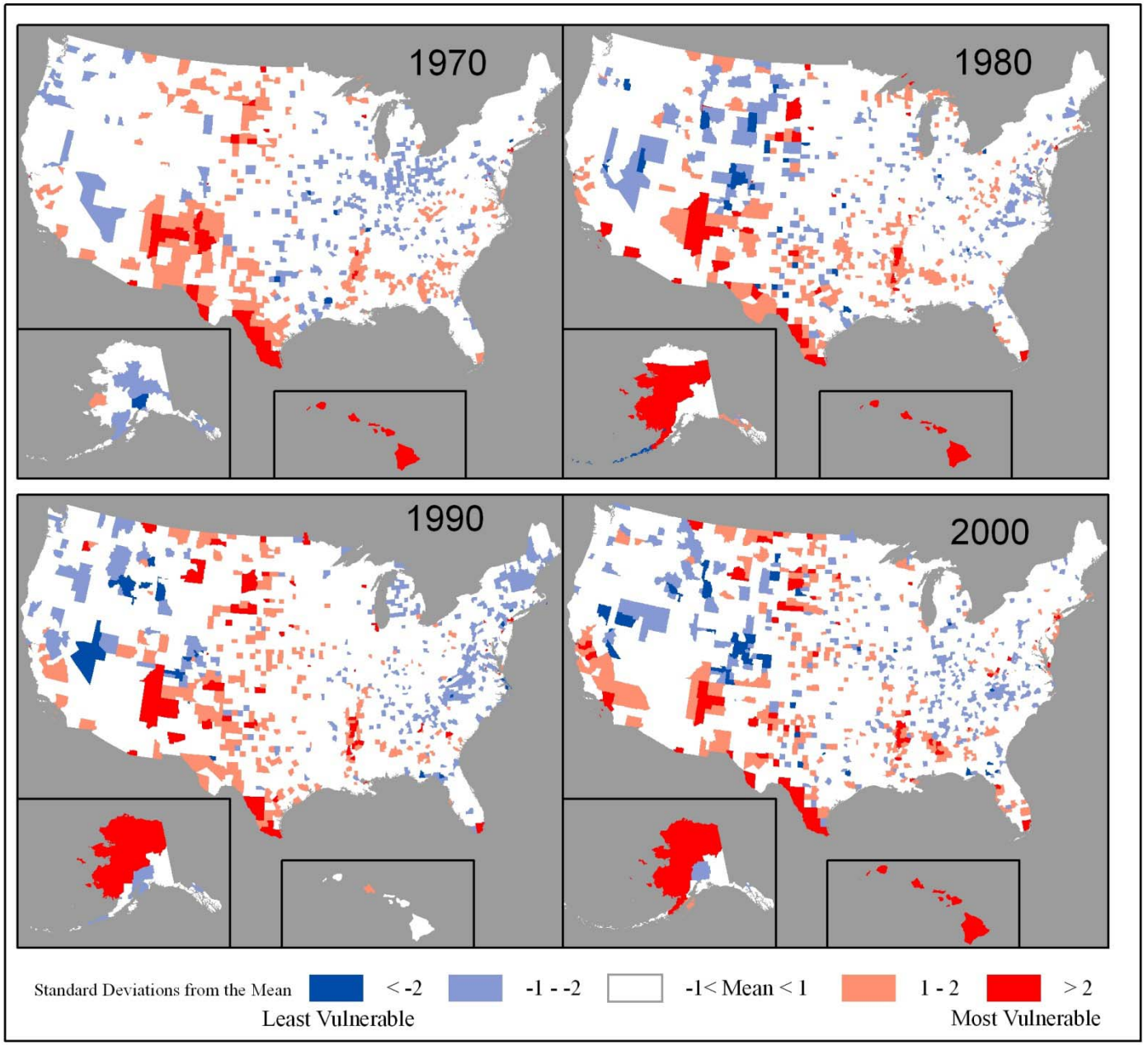
- Socioeconomic Status (Income, Political Power, Prestige)
- Gender
- Race and Ethnicity
- Age
- Commercial and Industrial Development
- Employment Loss
- Rural/Urban
- Residential Property
- Infrastructure and Lifelines
- Renters
- Occupation
- Family Structure
- Education
- Population Growth
- Health Status
- Medical Services
- Social Dependence
- Special-needs Population

Cutter, S.L., B.J. Boruff, and W.L. Shirley. 2003. “Social Vulnerability to Environmental Hazards.” *Social Sciences Quarterly*. 84(2): 242-261.

Social Vulnerability Index (SoVI)

- Identify Vulnerable Populations
- Replicate Methodology for Different Time Periods
- Assess Spatial Patterns and Changes
- Highlight Temporal Trends
- Project Future Vulnerability
- Scale Methodology for Different Levels of Geography

Spatial and Temporal Analysis



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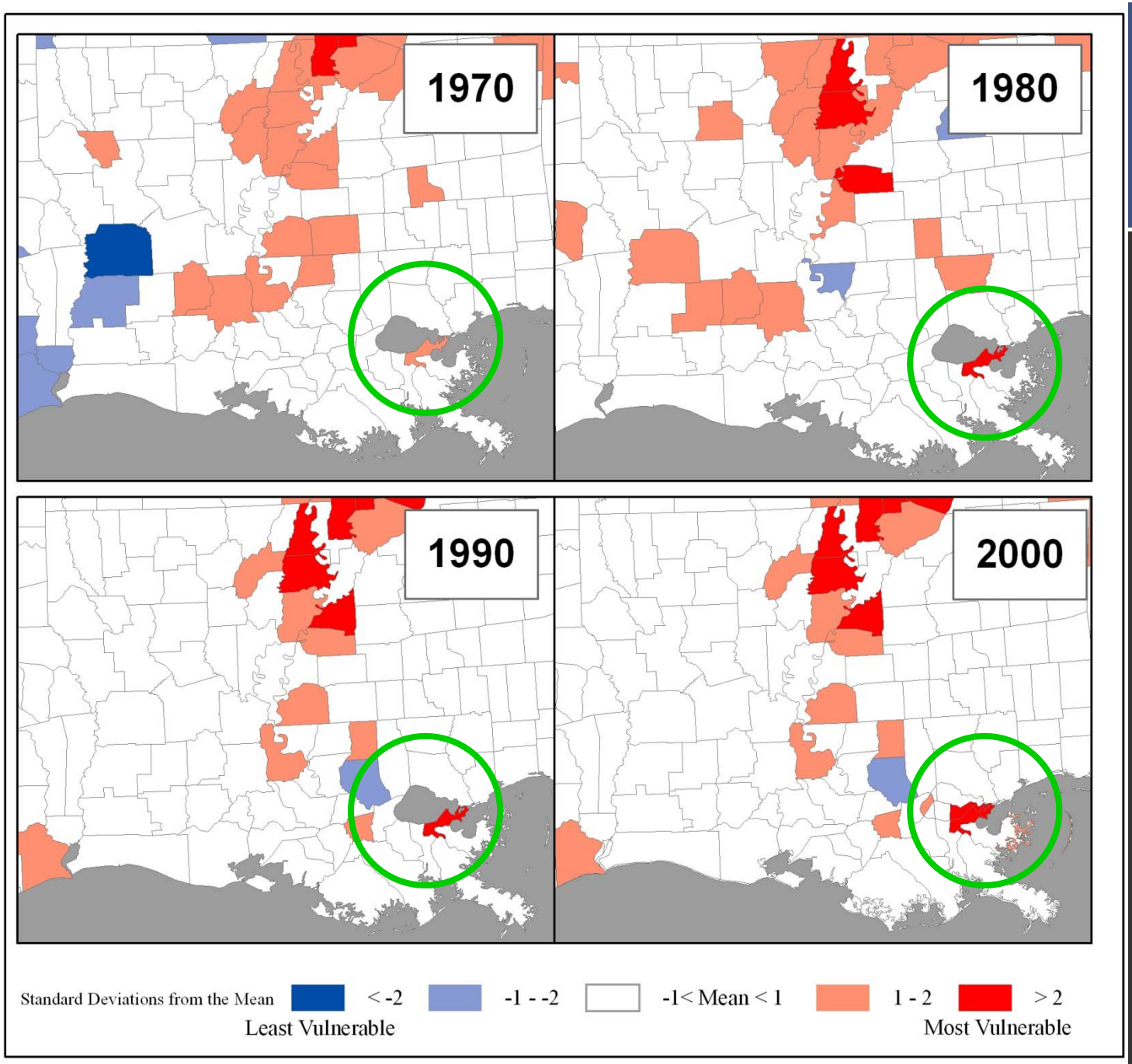
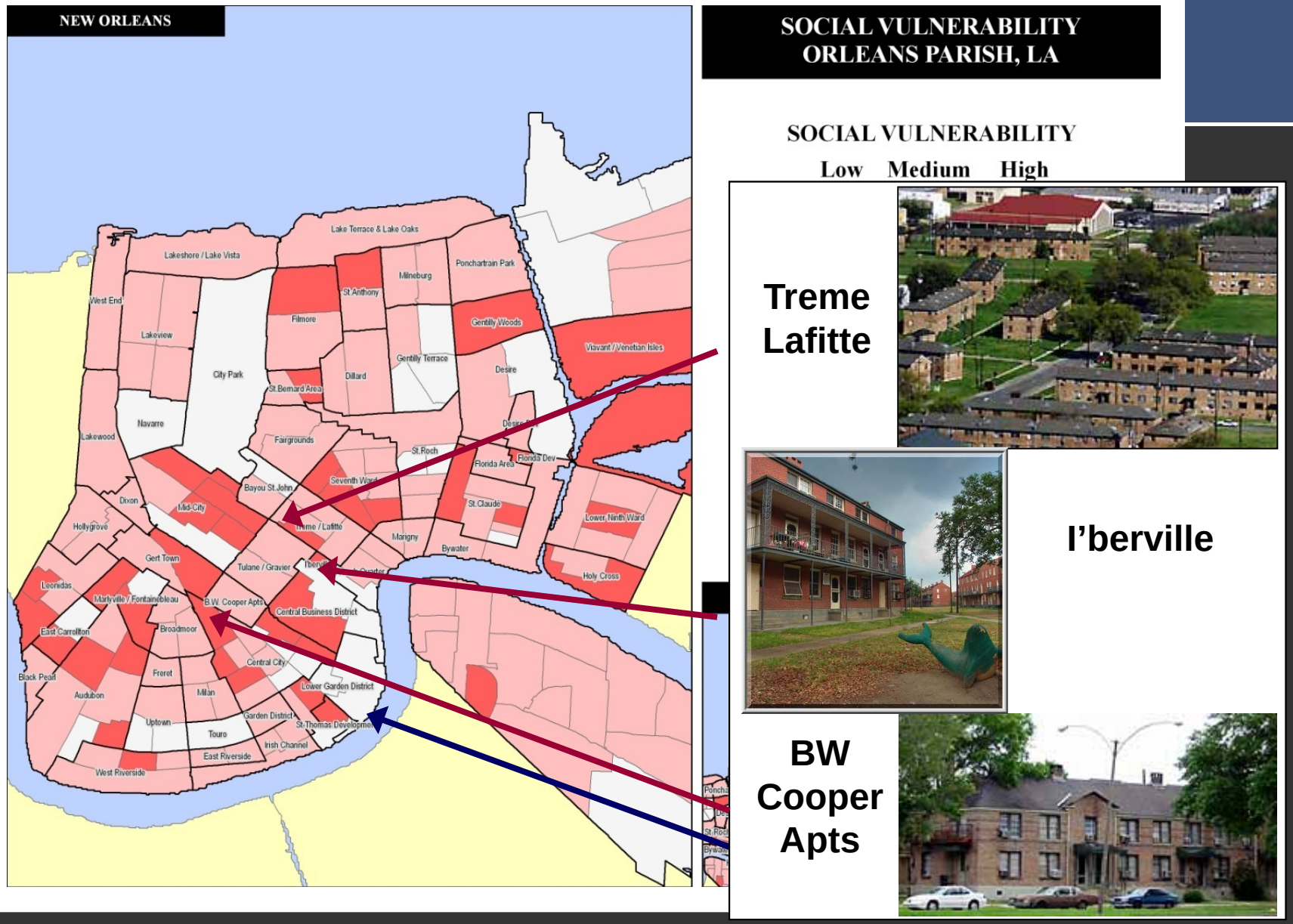
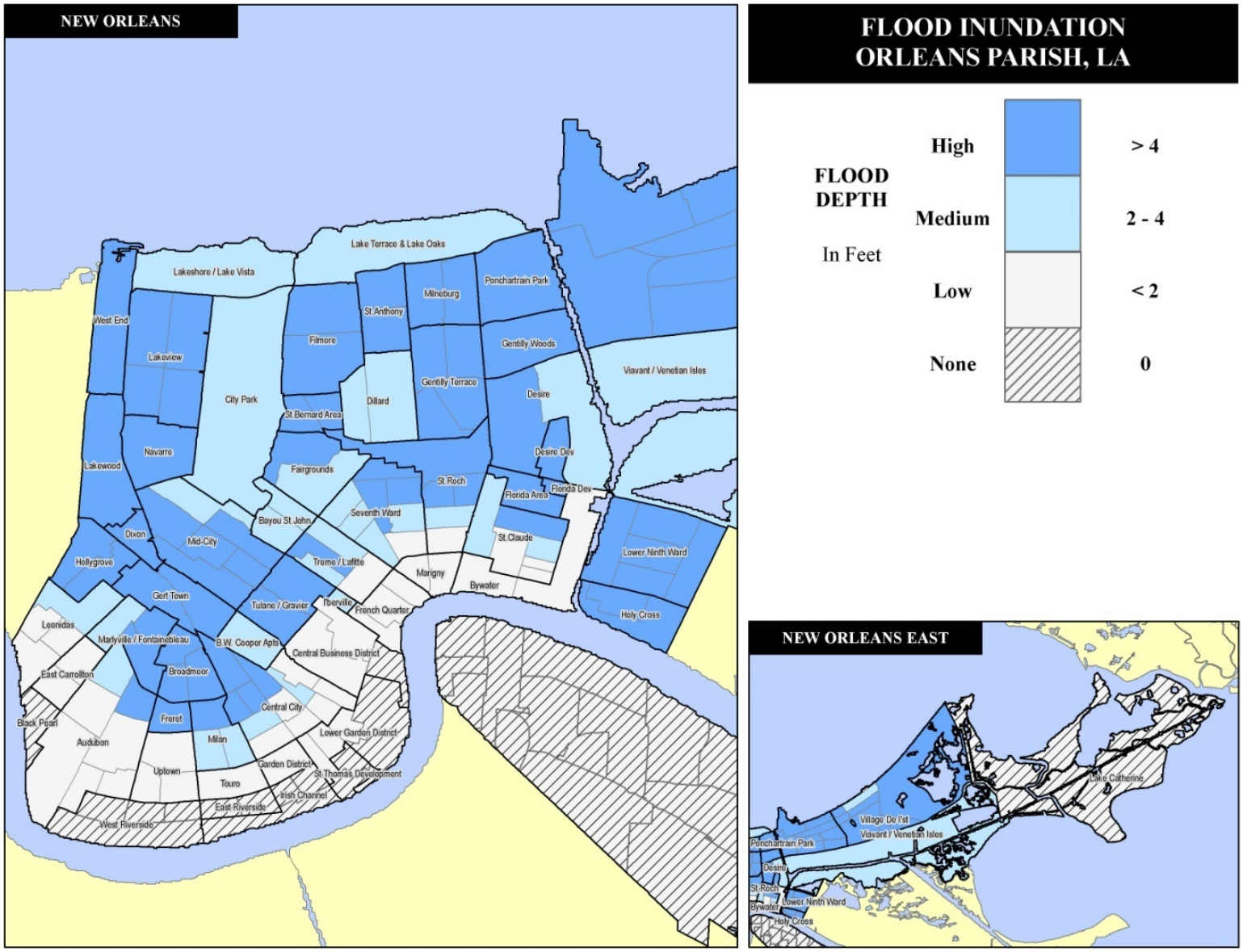

1970
1980
1990
2000
Standard Deviations from the Mean
< -2
-1 - -2
-1< Mean < 1
1 - 2
> 2
Least Vulnerable
Most Vulnerable

Neighborhood Disparities: Social Vulnerability



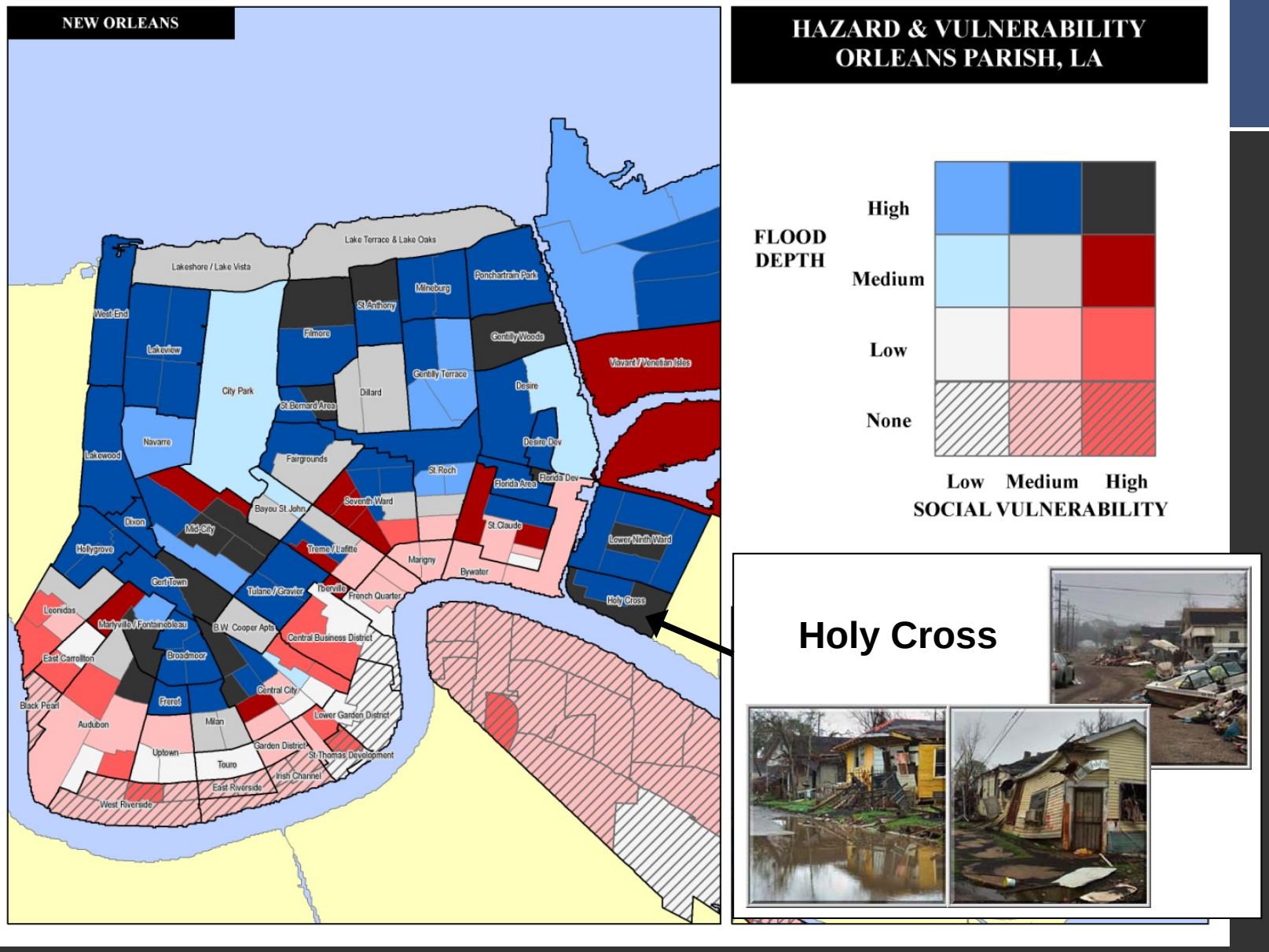
Finch, C., C.T. Emrich, and S.L. Cutter, 2010. "Disaster disparities and differential recovery in New Orleans," *Population and Environment*, DOI 10.1007/s11111-009-0099-8.

Neighborhood Disparities: Flood Inundation



Finch, C., C.T. Emrich, and S.L. Cutter, 2010. “Disaster disparities and differential recovery in New Orleans,” *Population and Environment*, DOI 10.1007/s11111-009-0099-8.

Neighborhood Disparities: Uneven Impact



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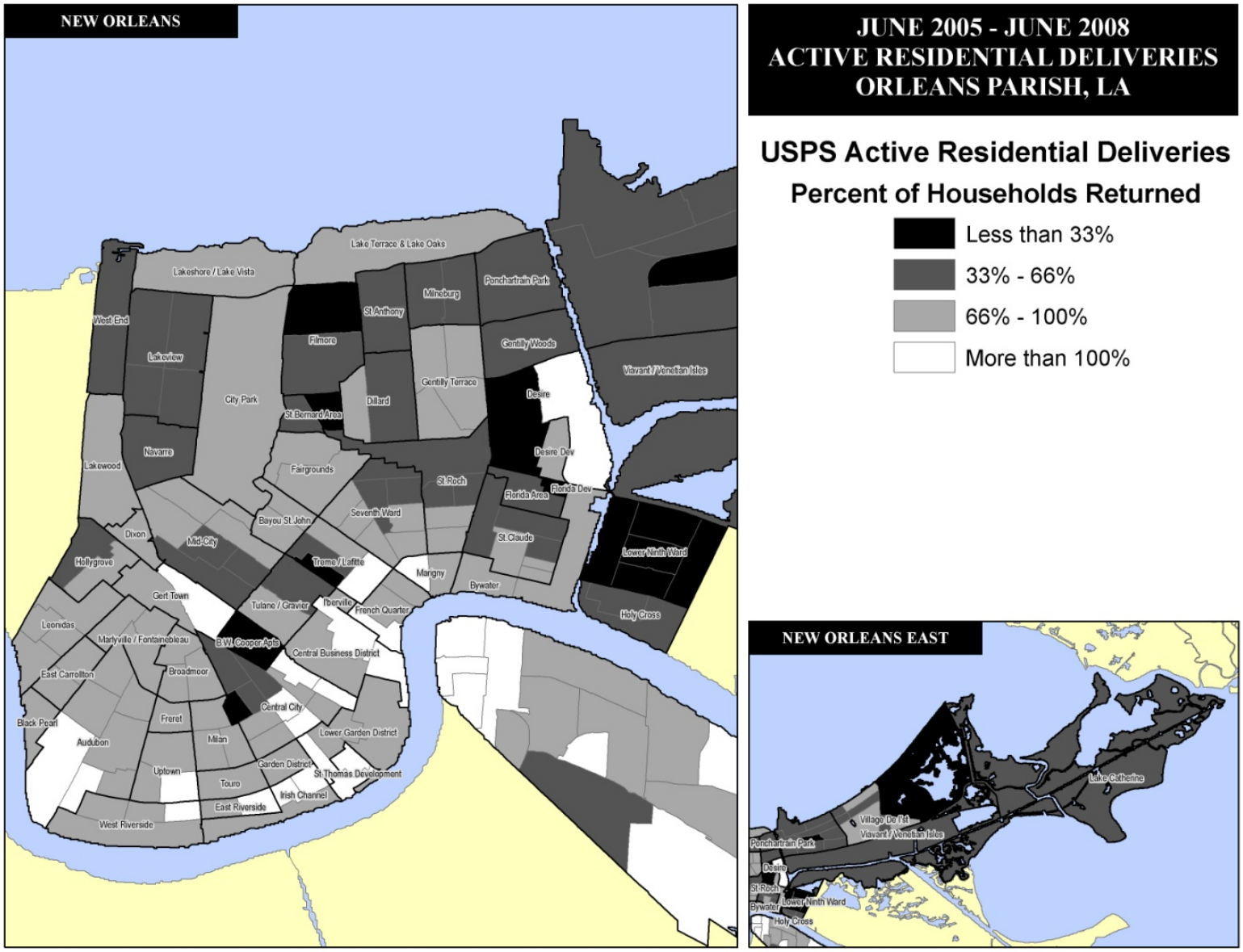
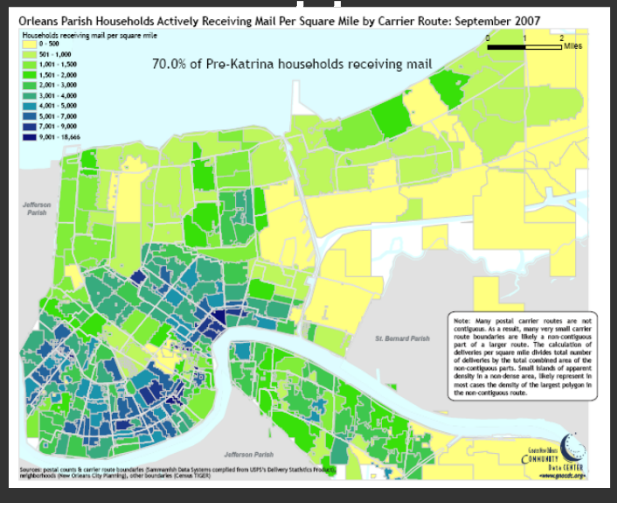
Neighborhood Disparities: Uneven Recovery



Finch, C., C.T. Emrich, and S.L. Cutter, 2010. “Disaster disparities and differential recovery in New Orleans,” *Population and Environment*, DOI 10.1007/s11111-009-0099-8.

Lessons Learned

- Disproportionate impacts based on pre-existing vulnerabilities means uneven recovery
- Measurement of recovery in relation to pre-existing vulnerabilities
- Need to consider the spatial inequities in risk and vulnerability in any risk reduction decision



Resources for Disaster Managers

DisasterAWARE

- DisasterAWARE (**A**ll-hazard **W**arning, **A**nalysis and **R**isk **E**valuation)
  - An integrated **platform** providing situational awareness, decision support, and information exchange capabilities to disaster management decision makers.
- DisasterAWARE provides an interoperable platform that incorporates international "best practice" methodologies and technologies for data acquisition, hazard modeling, risk and vulnerability assessment, mapping, visualization, and communications.

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DisasterAWARE Applications

Disaster Alert

- Mobile applications for iOS and Android devices
- Real-Time Hazard Reporting
- Search: Disaster Alert (iTunes/Google Play)

Atlas

- Publicly accessible application
- Real-Time Hazard Reporting
- Basedata and Observations
- http://atlas.pdc.org/atlas/

EMOPS

- Used by State / Local / Foreign Disaster Practitioners
- Enhanced content and response operations
- Authorized users can add hazards & products
- http://emops.pdc.org/emops/

Custom

- Custom applications
- Agency or region specific platform
- Customized content and response operations
- Examples: VinAWARE, InAWARE, DMRS, etc…

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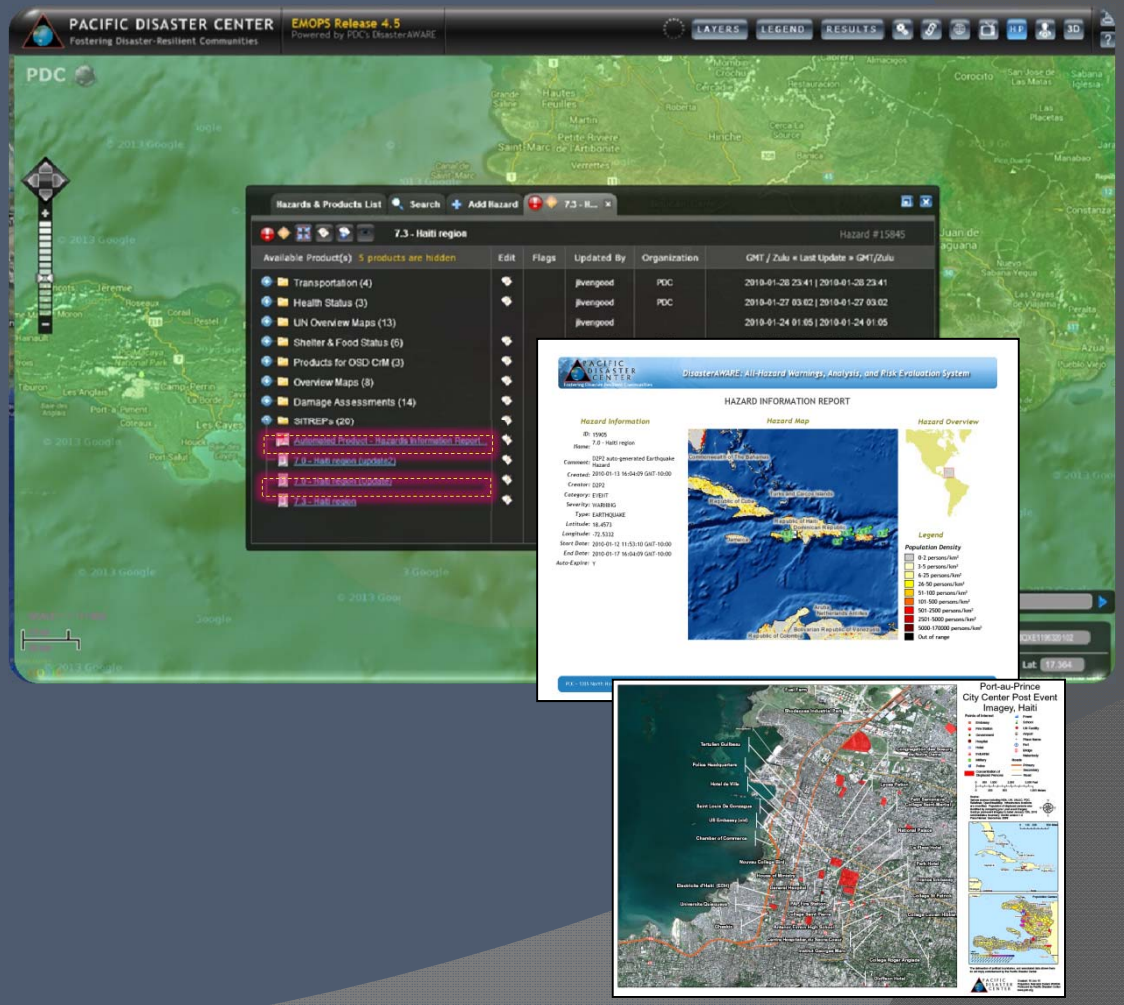
DisasterAWARE for Decision Makers

***EMOPS** is used by civil and military authorities around the world to support disaster response and humanitarian assistance actions*

"EMOPS"

- Integrated Multi-hazard Monitoring
- Disaster Early Warning
- Automated / Integrated Modeling
- Exposure (Risk) Maps & Historical Hazard Data
- Intra-Agency Info Sharing
  - User Added Situation Reports
  - Damage Products, …



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Global Hazard Info Network (GHIN)

http://www.pdc.org/ghin

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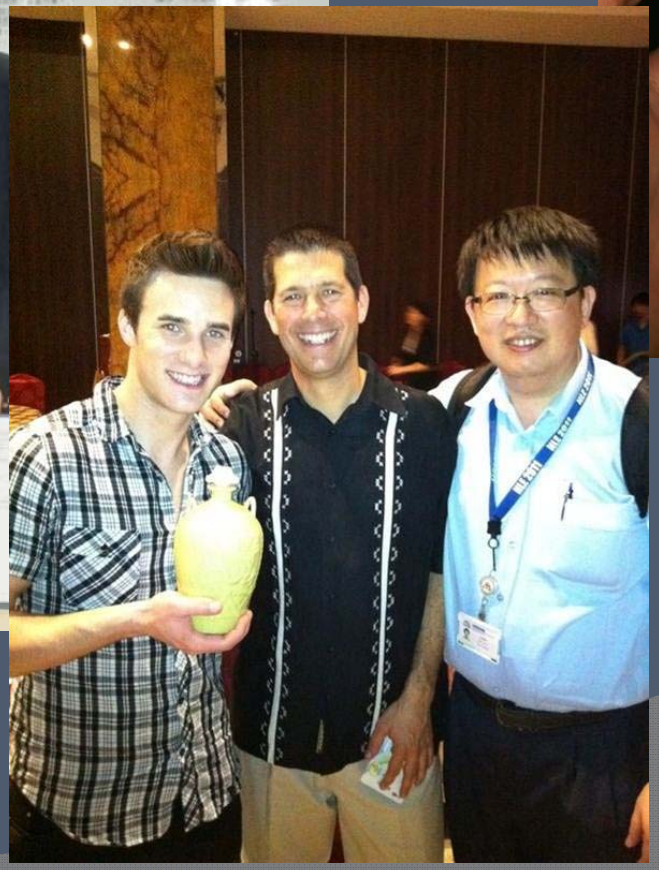
PDC-NCDR – A long-lasting Relationship!



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PACIFIC DISASTER CENTER

Fostering Disaster-Resilient Communities

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