

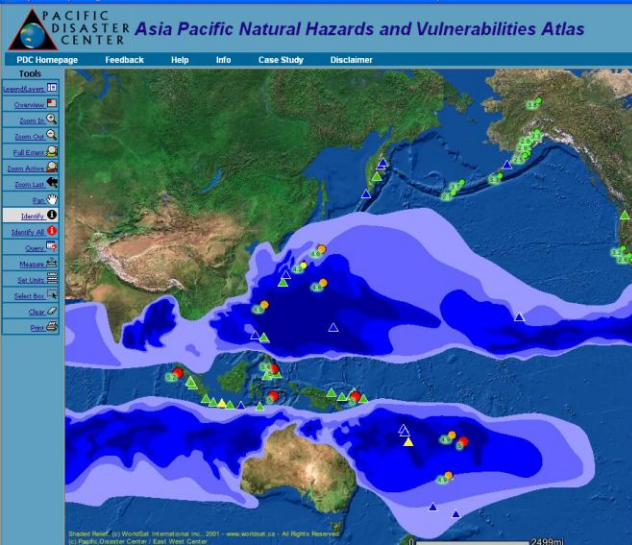
The International Training Symposium for  
Typhoon and Flood Disaster Reduction  
Taipei, Taiwan  
5 – 9 May 2008



*Fostering Disaster-Resilient Communities*

# ***Geospatial Technologies in Support of Disaster Risk Reduction in the Asia Pacific***

http://www.pdc.org Asia Pacific Natural Hazards and Vulnerabilities Atlas - Microsoft Internet Explorer



**Mr. Todd Bosse**  
**Sr. Geospatial Information Analyst**  
**Pacific Disaster Center**

**[tbosse@pdc.org](mailto:tbosse@pdc.org)**

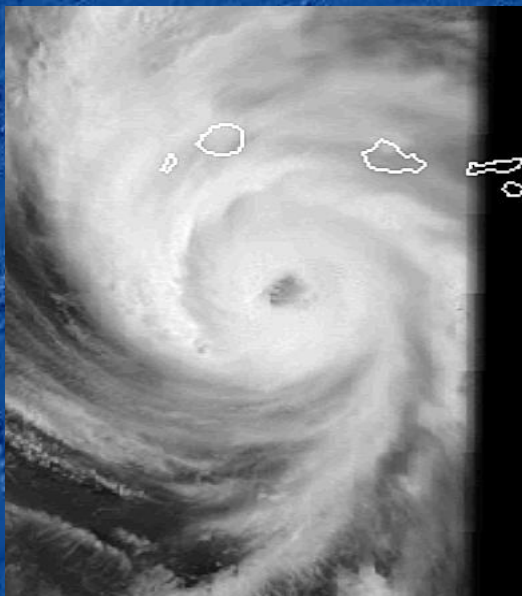
(c) Copyright 2007 - PDC

# Presentation Outline

- Overview of Pacific Disaster Center
- Risk Reduction / Emergency Preparedness
  - Risk Assessment
  - Risk Communication
- PDC CBDRM Experiences in SE Asia
  - Phu Tho Province (Vietnam)

# PDC Concept

**PDC Originated  
In the Aftermath of  
Hurricane Iniki - 1992**



# Facilities in the State of Hawaii

**Federal  
Support Office**  
Ft. Shafter

**State of Hawaii  
Support Office**  
Hawaii SCD,  
Diamond Head



**Pacific Disaster  
Center**  
Maui Research &  
Technology Park,  
Maui





# PDC's Role Is...

- A center created to establish **access** to new and more effective **information resources** supporting all levels of emergency management.
- An **information resource** and **technology applications** center providing products and services to the **emergency management** agencies and organizations in the Pacific.
- A **public-private partnership**, enabling the PDC to enter into contractual agreements and develop **externally funded** projects.
- **University of Hawaii** is the Managing Partner.

# Our Center

- Applied Science & Technology
- Information Products Supporting:
  - Policy & Decision Makers
  - Disaster Managers
  - Humanitarian Assistance

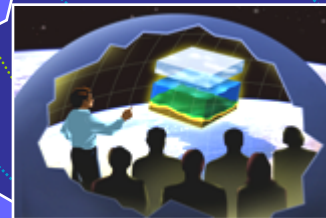


Observation Systems  
/Data

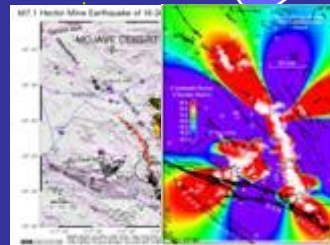


GIS, Visualization and  
Display Systems

**Integrating  
Information, Science,  
Technology**



**Improve  
Decision-  
Support  
Capabilities**

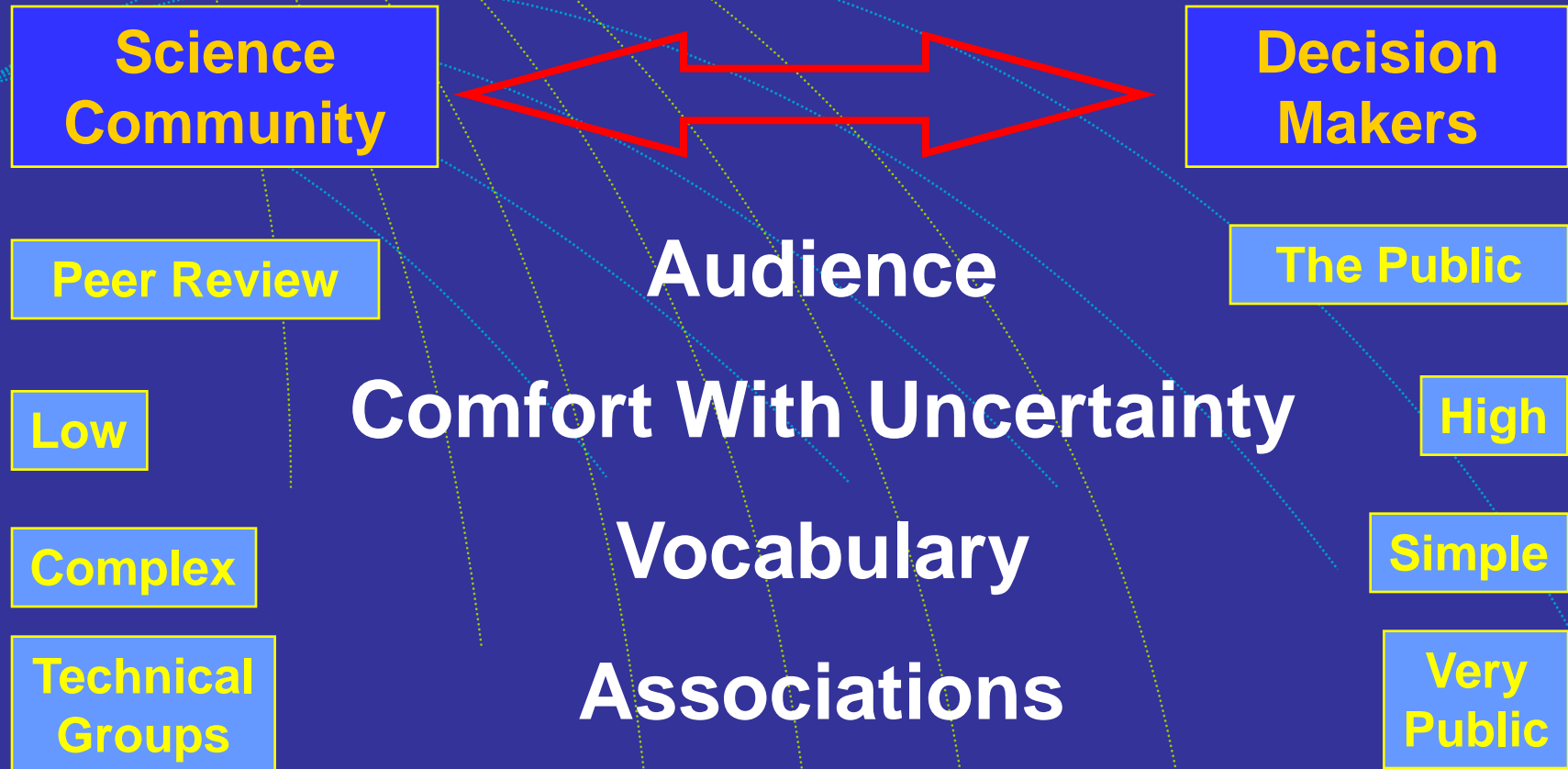


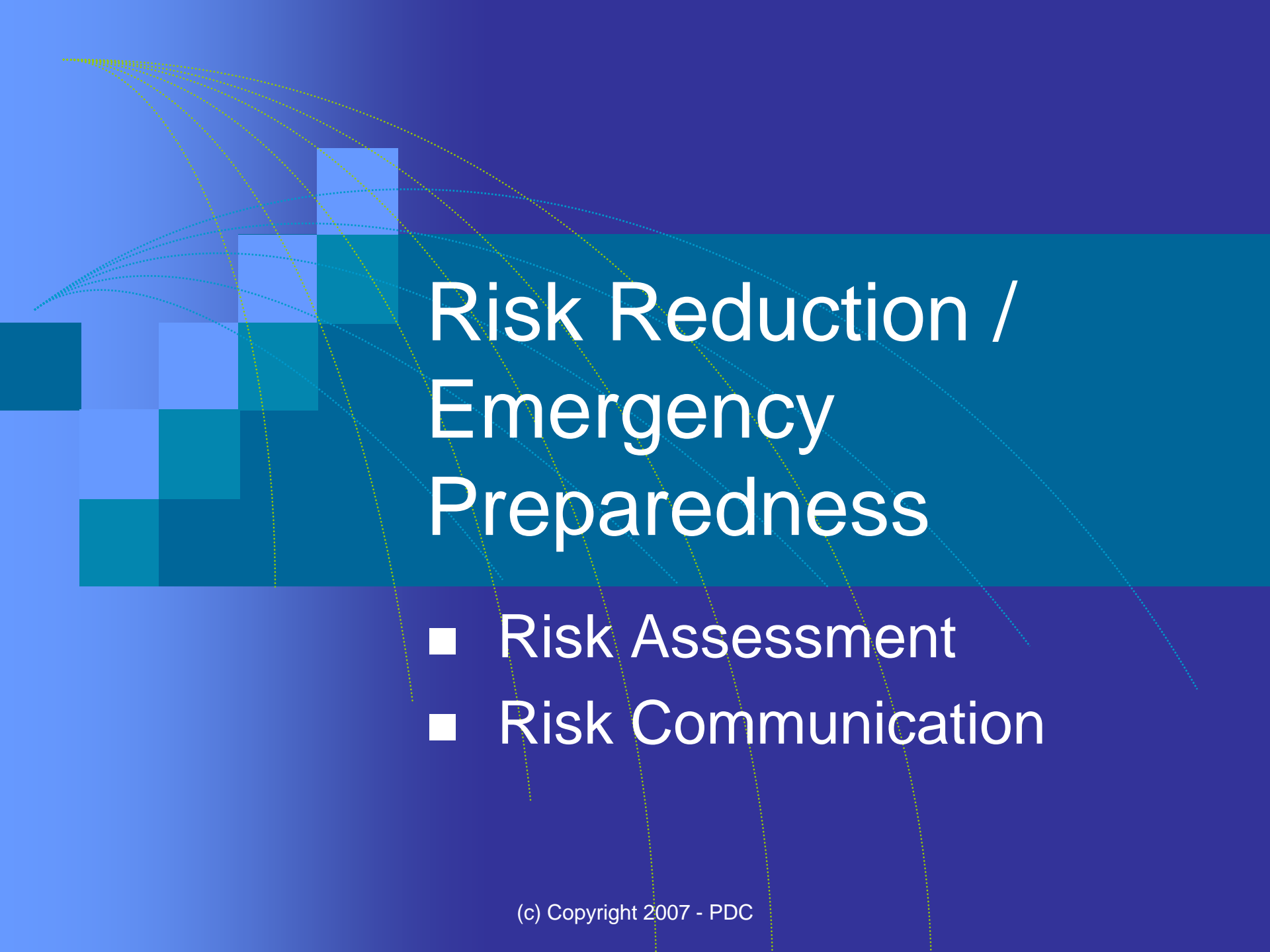
Advanced Applications,  
Algorithms, Models



Communication Systems  
and Networks

# Building a Bridge





# Risk Reduction / Emergency Preparedness

- Risk Assessment
- Risk Communication



# GIS Links Maps and Databases

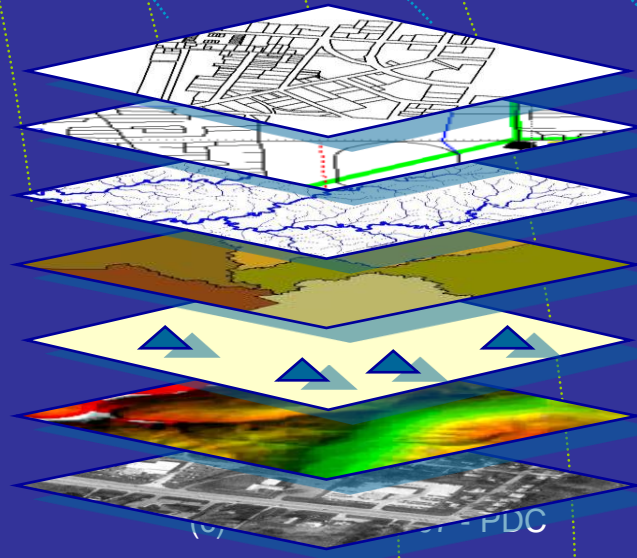


Map

GIS

Attributes of Hospitals					
NAME	ADDRESS	CITY	NUMBER OF BEDS	SHAPE_FID*	Shape*
KONA COMMUNITY HOSPITAL	79-1019 HALUKAPIA STREET	KEALAKEKUA	75	1	Point
KOHALA HOSPITAL	54-389 HOSPITAL ROAD	KOHALA	26	2	Point
KAU HOSPITAL	1 KAMANI STREET	PAHALA	21	3	Point
HAWAIIA HEALTH CENTER INC	45-565 FLUMERIA ROAD/P.O BOX 509	HONOKAA	0	4	Point
HILLO MEDICAL CENTER	11190 WAAJUNIE AVENUE	HILO	274	5	Point
KAHI MOHOLA	91-2301 FORT WEAVER ROAD	EWING BEACH	88	6	Point
KAISER FOUNDATION HOSPITAL	3288 MOANALUA ROAD	HONOLULU	198	7	Point
KAPOLANI MED CTR FOR WOMEN	11919 PUNAHOU STREET	HONOLULU	276	8	Point
REHAB HOSPITAL OF THE PACIFIC	226 NORTH KUAKINI STREET	HONOLULU	86	9	Point
KUAKINI MEDICAL CENTER	347 NORTH KUAKINI STREET	HONOLULU	189	10	Point
LEAHU HOSPITAL	3675 KILAUEA AVENUE	HONOLULU	132	11	Point
QUEEN'S MEDICAL CENTER	1301 PUNCHBOWL STREET	HONOLULU	496	12	Point
ST FRANCIS MEDICAL CENTER	2230 ULUKA STREET	HONOLULU	221	13	Point
SHRINERS HOSPS FOR CHILDREN	1310 PUNAHOU STREET	HONOLULU	40	14	Point
STRAUB CLINIC AND HOSPITAL	888 SOUTH KING STREET	HONOLULU	139	15	Point
TRIPLER ARMY MEDICAL CENTER	1 JARRETT WHITE ROAD	HONOLULU	354	16	Point
KAWAII HOSPITAL	56-117 PAULALEA	KAWAII	24	17	Point
CASTLE MEDICAL CENTER	640 ULUKAHU STREET	KAILUA	150	18	Point
HAWAII STATE HOSPITAL	45-710 KEAHALA ROAD	KANEHOE	167	19	Point
WAIHAWA GENERAL HOSPITAL	128 LEHUA STREET	WAIHAWA	162	20	Point
KAPOLANI MED CTR AT PALI Momi	58-1075 MOANALUA ROAD	AEAE	75	21	Point
ST FRANCIS MEDICAL CENTER-WEST	91-2141 FORT WEAVER ROAD	EWING BEACH	67	22	Point

Database



Land Use  
Transportation  
Surface Waters  
Boundaries  
Critical Facilities  
Elevation  
Aerial Imagery

# Risk Reduction Framework

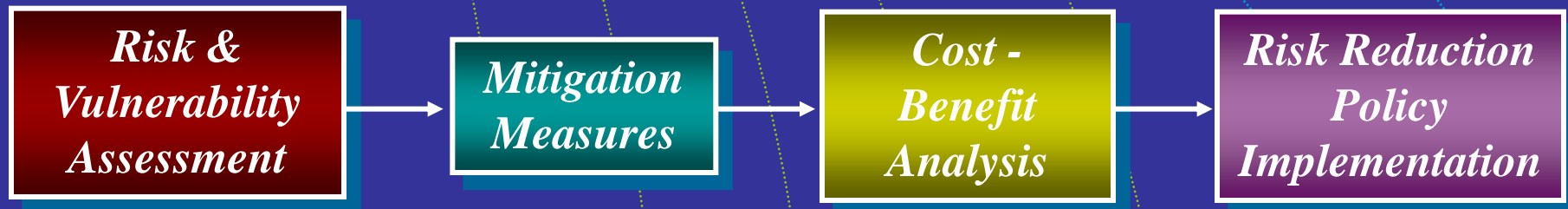
*The goal: To manage risk, reduce vulnerability, and promote sustainable and resilient communities.*

*~ Establish the Risk Management Context ~*

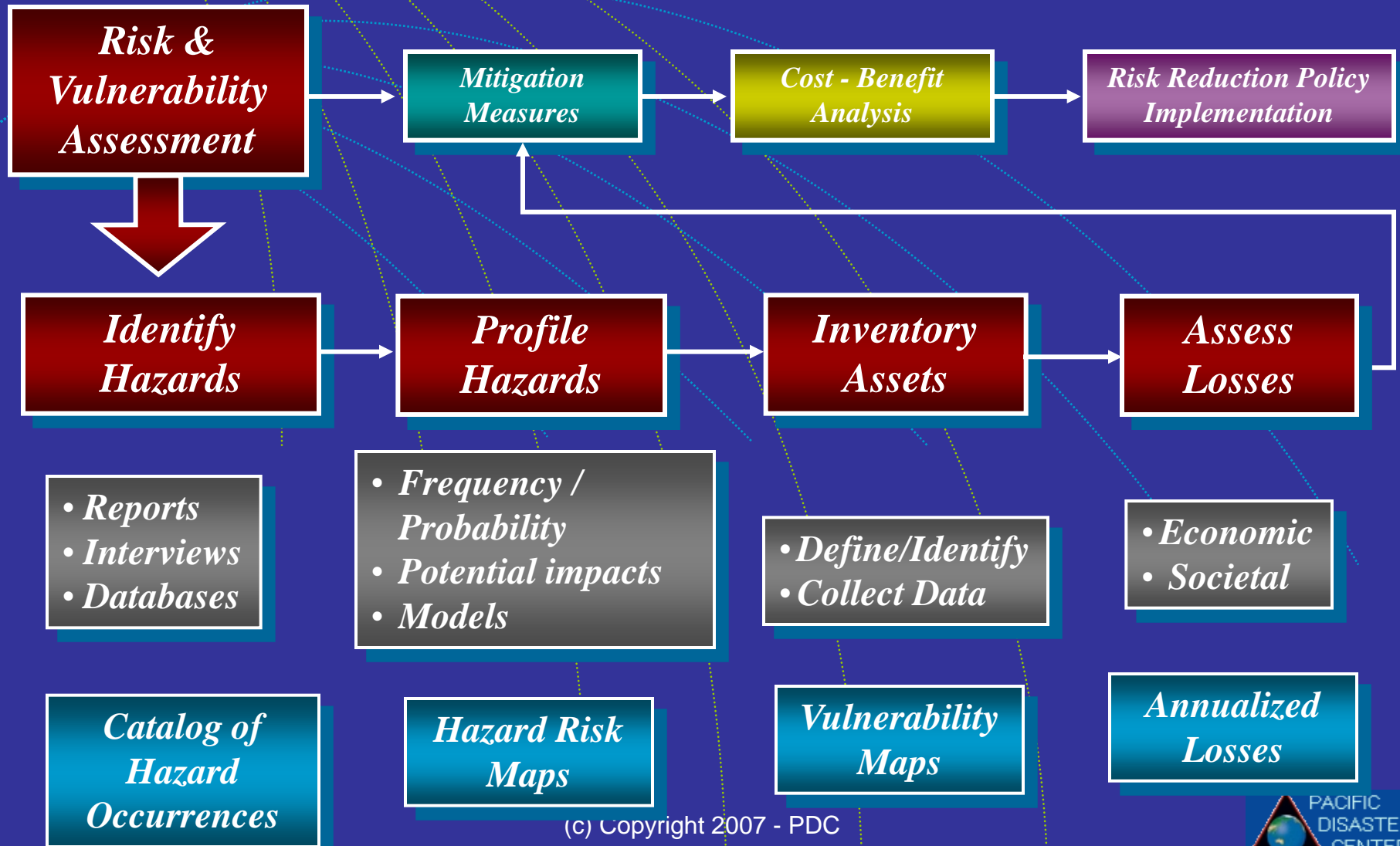
*Advocate whole-of government participation.*

*Identify national/municipal/community development priorities.*

*Develop strategic and organizational objectives that promote risk reduction.*



# RVA Process



# Identify the Hazards

- Research the hazards

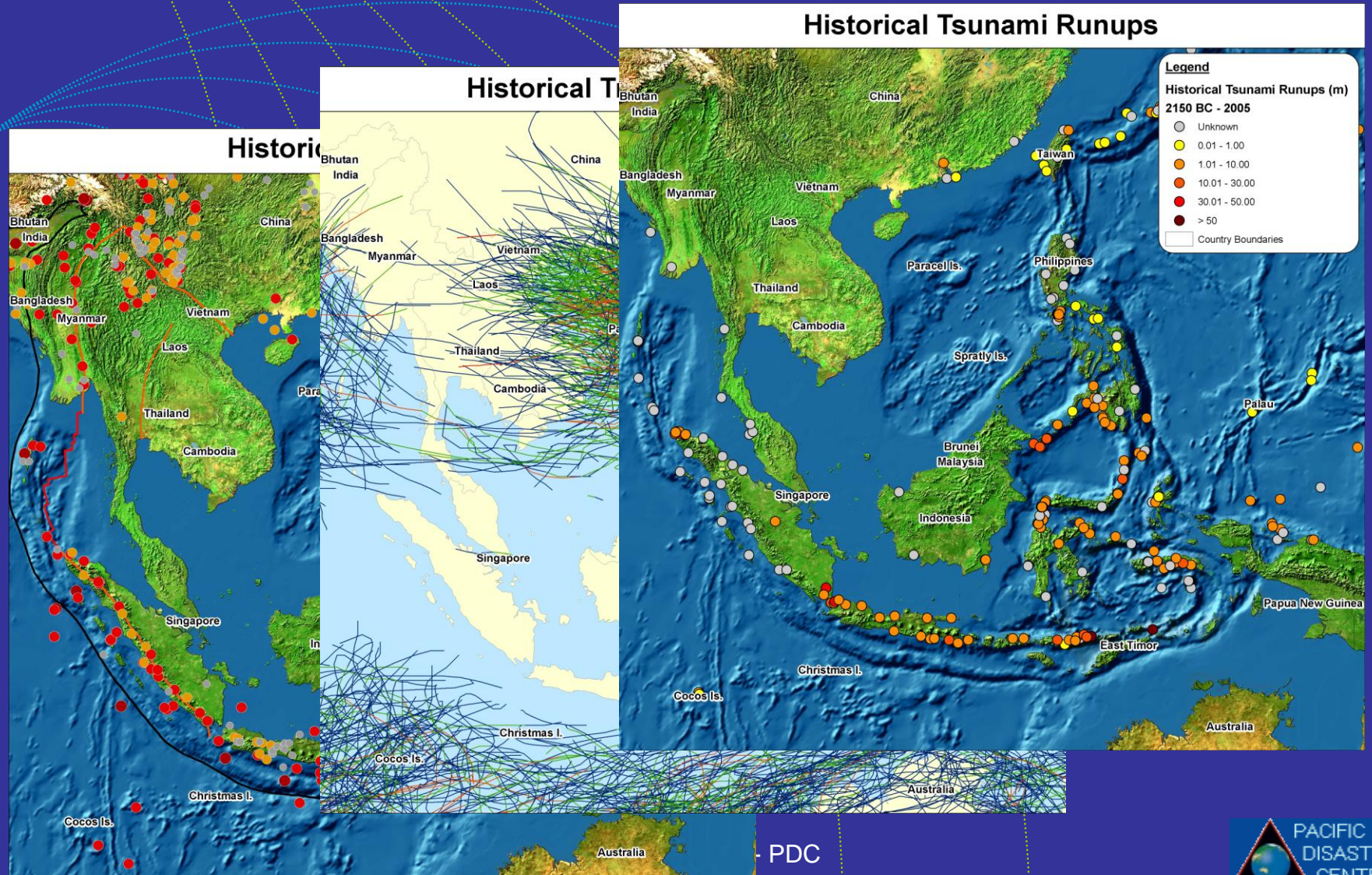
- ☐ Historical accounts, duration, location, severity or magnitude, property damage, loss of life, cost of recovery.

- Access data and information sources

- ☐ Hazard mitigation plans, regional reports and studies, Internet resources, local newspapers, personal interviews with government agency representatives, professional experts, GIS user groups, and residents.



# Identify the Hazards



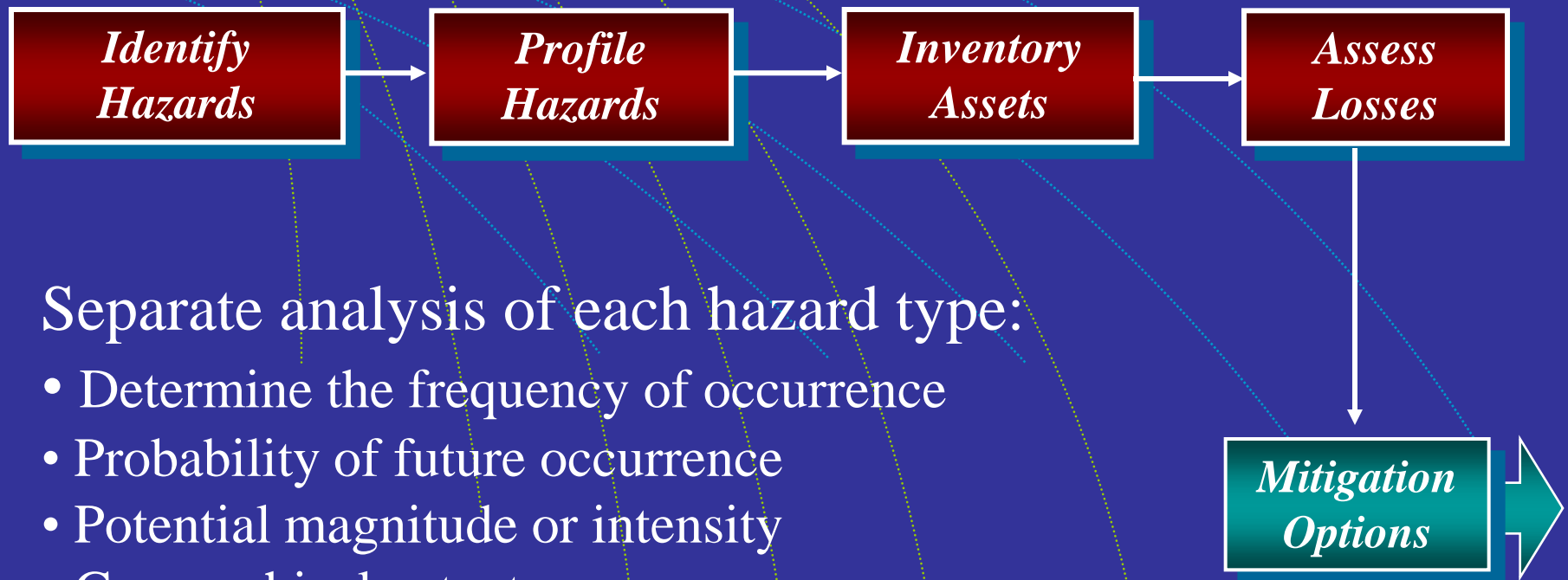


# Identify the Hazards

## *Catalog of Hazard Occurrences*

Event Name or Type	Date and Duration	Severity (Category)	Geographical Extent	Deaths / Injuries	Estimated Losses (\$)
Un-named hurricane	January 29-30, 1966	Category 2 100+ mph gusts	Throughout Tutuila	90/0	4.3 million
Hurricane Tusi	January 16-20, 1987	Category 3, Max sustained winds 110 mph, gusts to 120mph	Manu'a Islands	0/0	5 - 10 million
Hurricane Ofu	February 2-4, 1990	Category 2, Max sustained winds 90 mph, gusts to 100mph, 20+ inches of rain, high surf, storm surge, 10+ landslides	Islands of Tutuila, Aunu'u, Ofu, Olesega, Ta'u, and Swains	10/0	10 million (PPG); Public losses 28,761,983 (FEMA); Damage to roads 4,400,000 (FEMA); \$200,000 (ReIns:Swiss)
Hurricane Val	December 6-10, 1991	Category 3, Max sustained winds of 100 mph, gusts to 123 mph, high surf, storm surge, 20+ inches of rain	Tutuila and Manu'a Islands	15/0	13 million (PPG); Public losses 80,473,533 (FEMA); 50-80 million overall damage to seaport, 11 million to seaport infrastructure (AS Dir. Port Authority); \$167,700 (ReIns:Swiss)

# Profile the Hazards



# Profile the Hazards

## Example Data

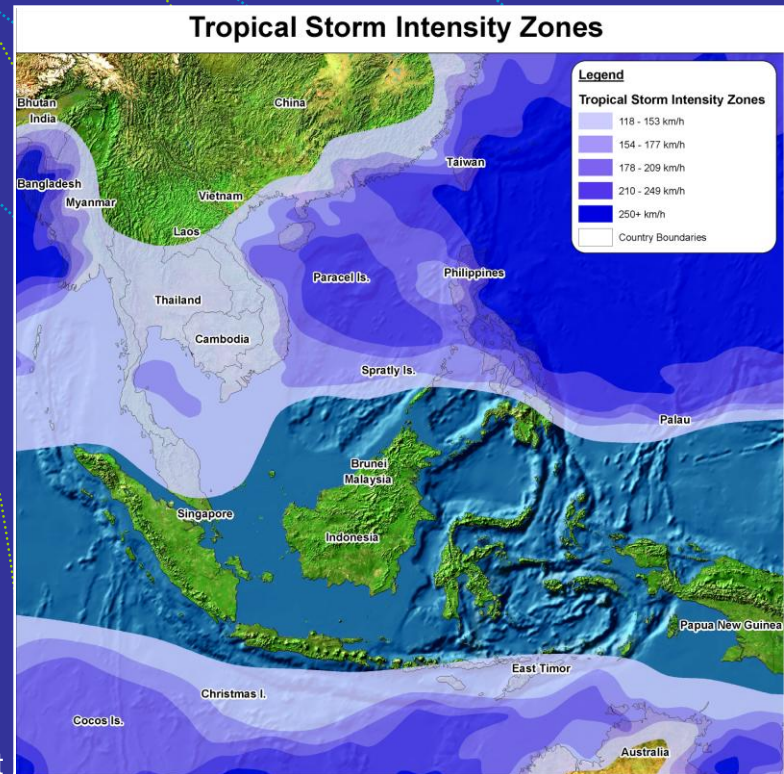
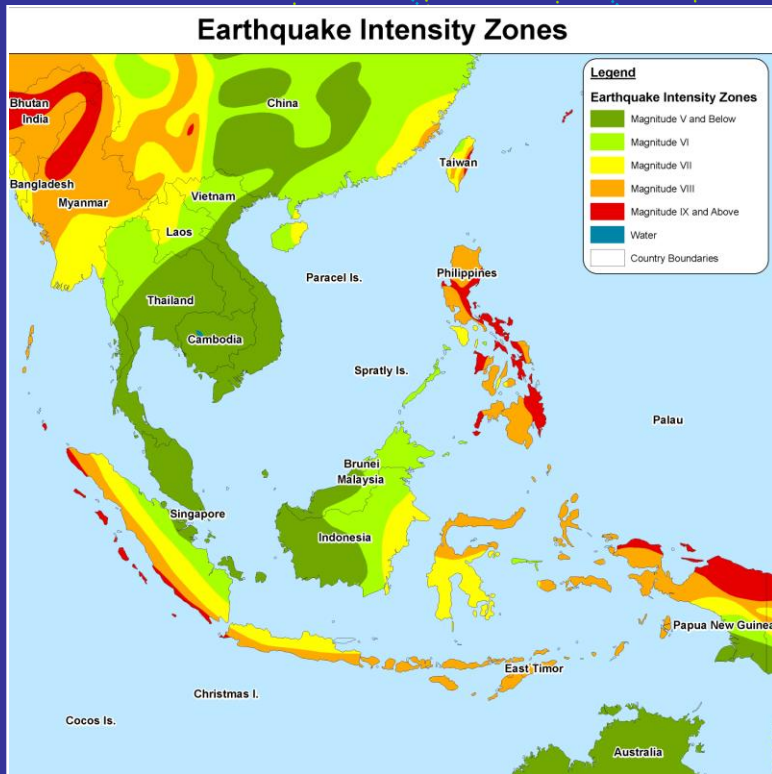
Hazard Type	Potential Impacts	Count	Time Period (years)	Frequency (% chance per year)	Probability of Occurrence	Estimation of Accumulated Losses (\$)
Earthquakes	<ul style="list-style-type: none"> <li>Damage to infrastructure and buildings</li> <li>Injuries, loss of life</li> </ul>	1	450	0.2%	Low	
Floods	<ul style="list-style-type: none"> <li>Damage to roads, homes, businesses</li> <li>Loss of access to emergency services</li> <li>Inundation of urban and low-lying areas</li> <li>Erosion</li> <li>Landslides</li> <li>Power failures</li> </ul>	4	36	11%	High	\$9,525,000
Landslides	<ul style="list-style-type: none"> <li>Injuries, loss of life</li> <li>Loss of access to emergency services</li> <li>Property loss</li> <li>Blocked or damaged roads, buildings</li> <li>Liquefaction of fill soil types.</li> <li>Amplified ground shaking of unconsolidated soils.</li> </ul>	5	24	20.8%	High	
Tropical Cyclones (including storm surge)	<ul style="list-style-type: none"> <li>Flooding rainfall</li> <li>High wind damage to infrastructure and buildings</li> <li>High surf, storm surge, coastal erosion</li> </ul>	8	32	25%	High	\$105,000,000
Tsunamis	<ul style="list-style-type: none"> <li>Inundation of low-lying areas</li> <li>Injuries, loss of life</li> <li>Damage to buildings and infrastructure</li> <li>Coastal erosion</li> </ul>	2-3	50	4% to 6%	Medium	

# Profile the Hazards:

## GIS in the Hazard Analysis

- Visualization of Hazard Risk Areas
  - GIS used to identify and map hazard risk areas.
  - Determine vulnerability to jurisdictions, critical facilities, and structures.

### *Hazard Risk Maps*



# Inventory Assets



## Inventory Assets

- What is important to community
- What is at risk? Vulnerable?
  - Facilities, infrastructure, business, populations
- Collect additional data.
  - Visualize in GIS



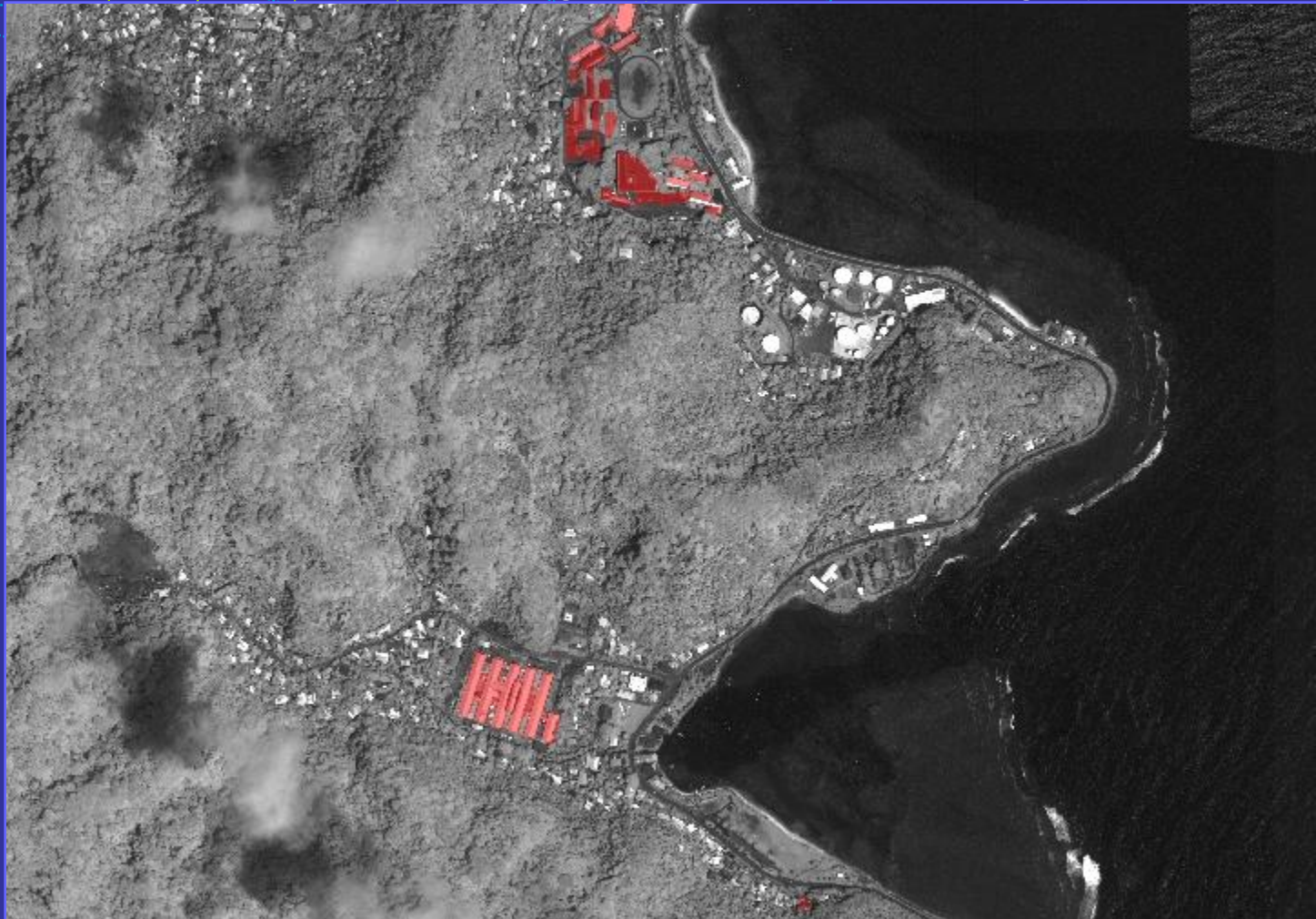
## Example of Critical Facilities Data Collection

[illegible]

# Inventory Assets

## GIS Data Collection/Processing

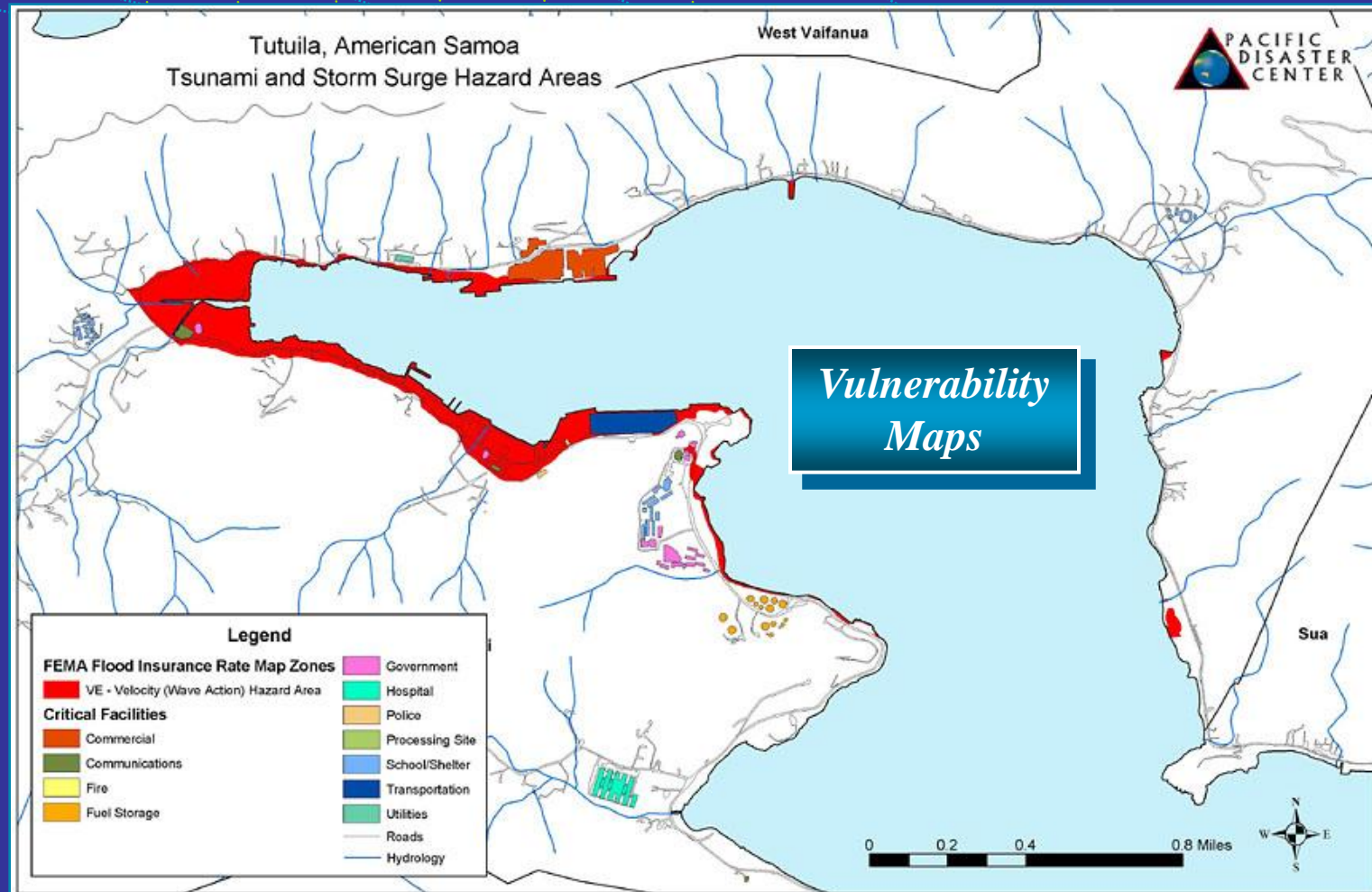
Critical Facilities as processed from CAD data, and  
verified against the Ikonos Imagery



# Vulnerability Maps

## Tsunami & Storm Surge Hazard

Velocity Wave Hazard (VE) Zones displayed in context with  
Critical Facilities and basic infrastructure

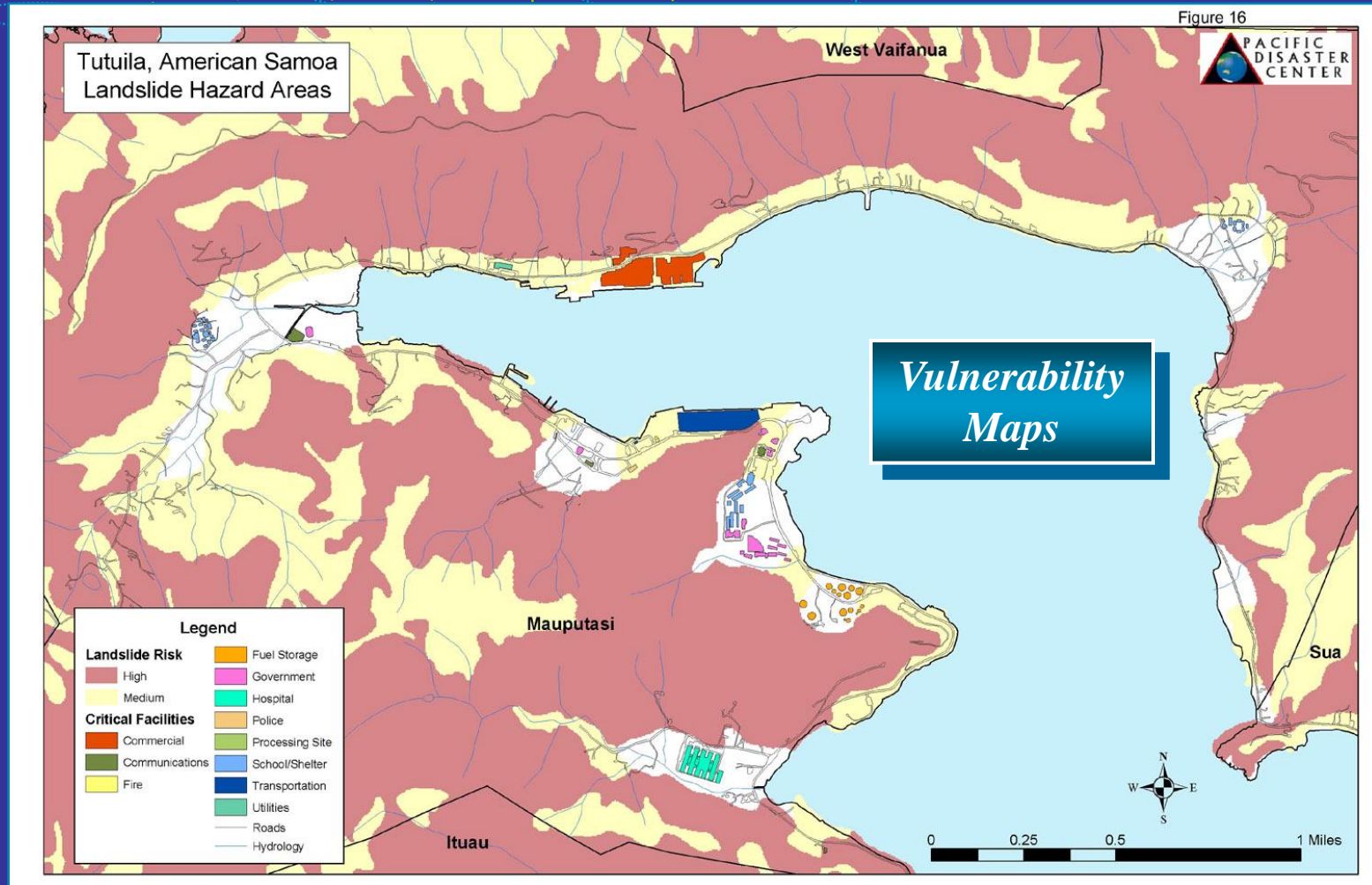




# Vulnerability Maps

## Landslide Hazard

Landslide Hazard displayed in context with Critical Facilities and basic infrastructure



# Summarize Vulnerability of Critical Facilities to Each Hazard



County	Village	Facility Name	Number of Buildings	Function	Earthquake	Flood	Landslide	Storm Surge / Tsunami
Maoputasi	Fagatogo	American Samoa Telecom.	1	Communications	Medium	Low	Low	High
Maoputasi	Utulei	Dept of Ed.	1	Government	Medium	Low	Medium	High
Maoputasi	Fagatogo	High Court	1	Government	Medium	Low	Low	High
Maoputasi	Fagatogo	Inter-island Ferry Terminal	1	Transportation	Medium	Low	Medium	High
Maoputasi	Fagatogo	DPS Fire Division	2	Fire	Medium	Low	Medium	High
Maoputasi	Fagatogo	Container Dock	1	Transportation	Medium	Low	High	High
Maoputasi	Pago Pago	District Court	1	Government	Medium	Low	Low	High
Maoputasi	Satala	Star Kist Samoa Co.	2	Commercial	Medium	Medium	Medium	High



# Assess Losses

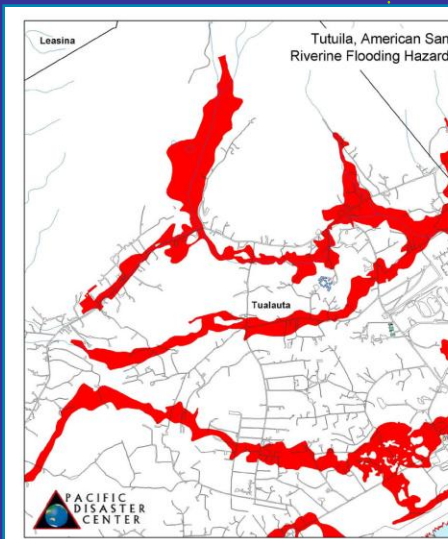
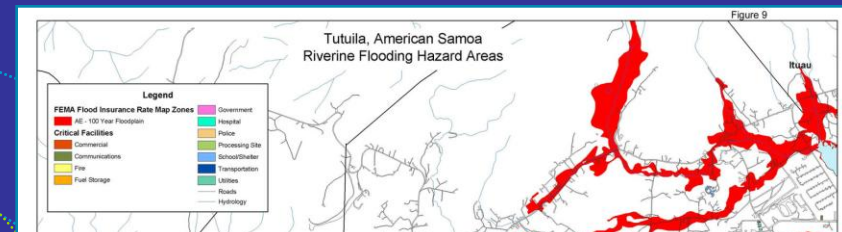
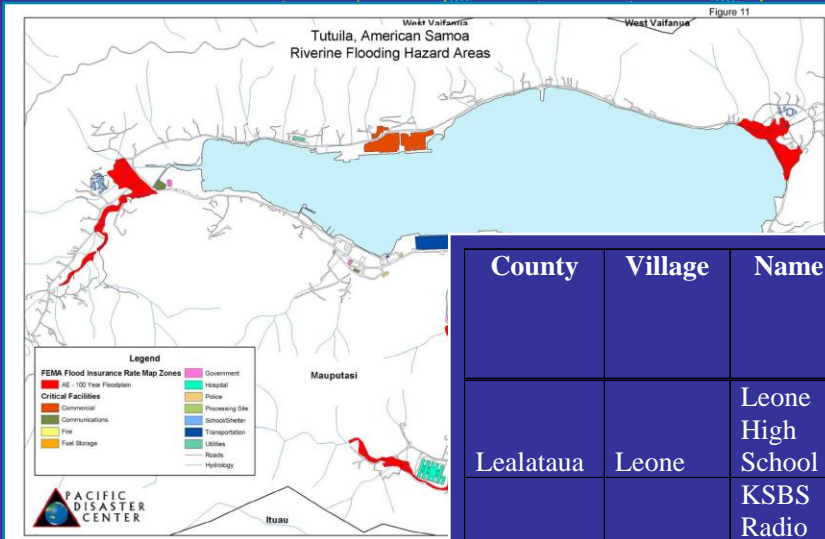


## Assess Losses

- What are potential losses?
  - Facilities, infrastructure, business, populations
- Estimate annualized losses
  - How much can you afford to lose?

# Loss Estimation for Critical Facilities

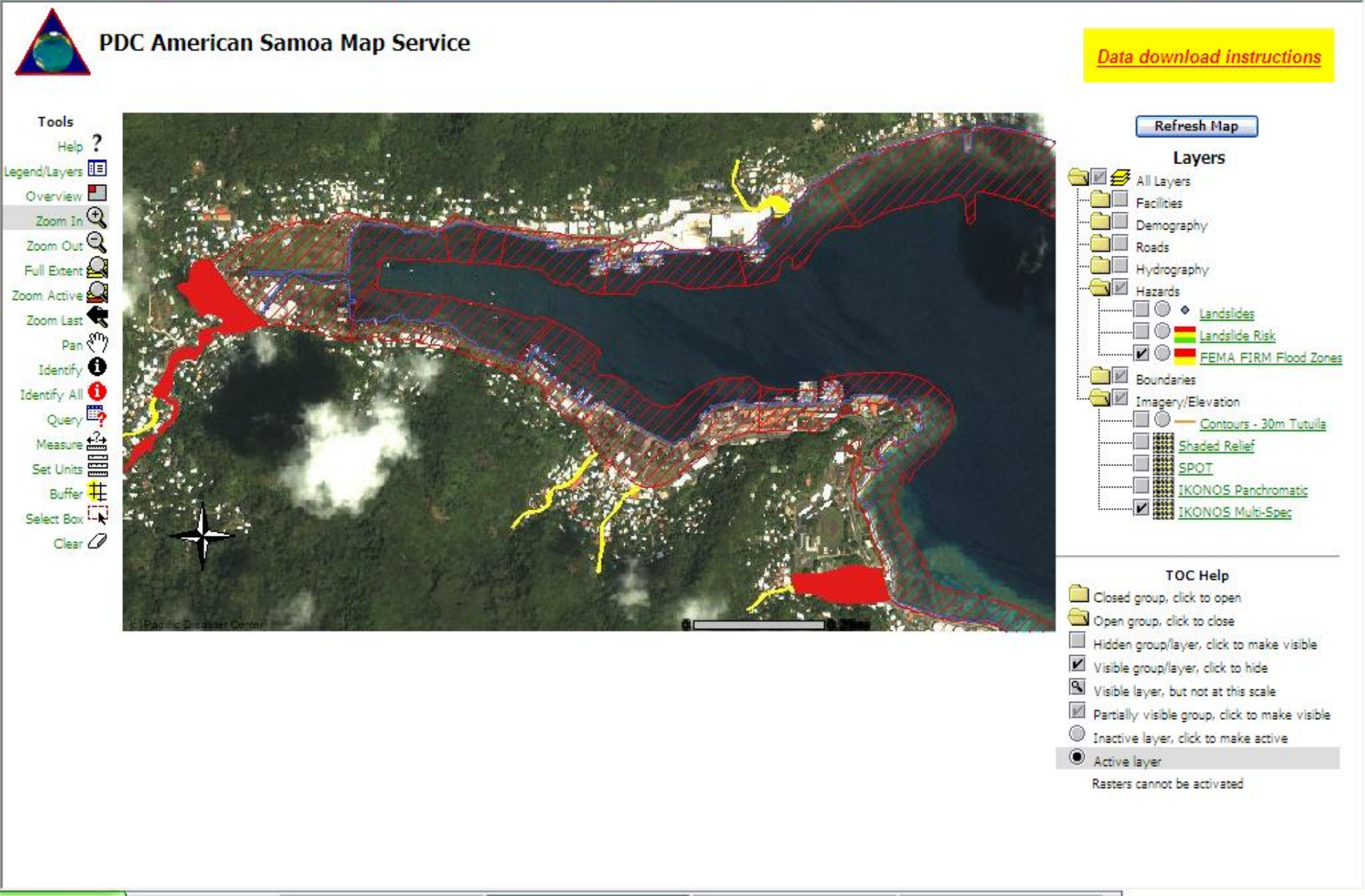
## Tutuila, American Samoa



County	Village	Name	Function	Number of Employees	Estimated Replacement Cost (\$)	Critical Facilities Ownership	Approx. Value Contents (\$)	1 <sup>st</sup> -Floor Flood Elevation (feet)
Lealataua	Leone	Leone High School	School/Shelter		\$1,960,000	Gov't.	\$1,960,000	53
Maoputasi	Fagaalu	KSBS Radio Station	Communications	10	\$384,000	Private	\$384,000	15
Maoputasi	Fagaalu	LBJ Tropical Medical	Hospital	500	\$18,836,193	Gov't.	\$28,254,289	17
Maoputasi	Fagatogo	ASG Gov't Bldgs.	Government		\$14,000,000	Gov't.	\$14,000,000	12.5
Maoputasi	Fagatogo	DPS Central Station	Police	230	\$770,414	Gov't.	\$1,155,621	8
Maoputasi	Fagatogo	DPS Fire Division	Fire	25	\$150,000	Gov't.	\$225,000	6
Tualauta	Tafuna	PPG Intl. Airport	Transportation	77	\$69,080,080	Gov't.	\$69,080,080	15.5

An abstract graphic on a blue background. On the left, there is a grid of squares in various shades of blue and teal. From the top-left corner, several thin, curved lines in yellow and light blue arc across the upper half of the image. The title 'Risk Communication' is written in white, sans-serif font in the center-right area.

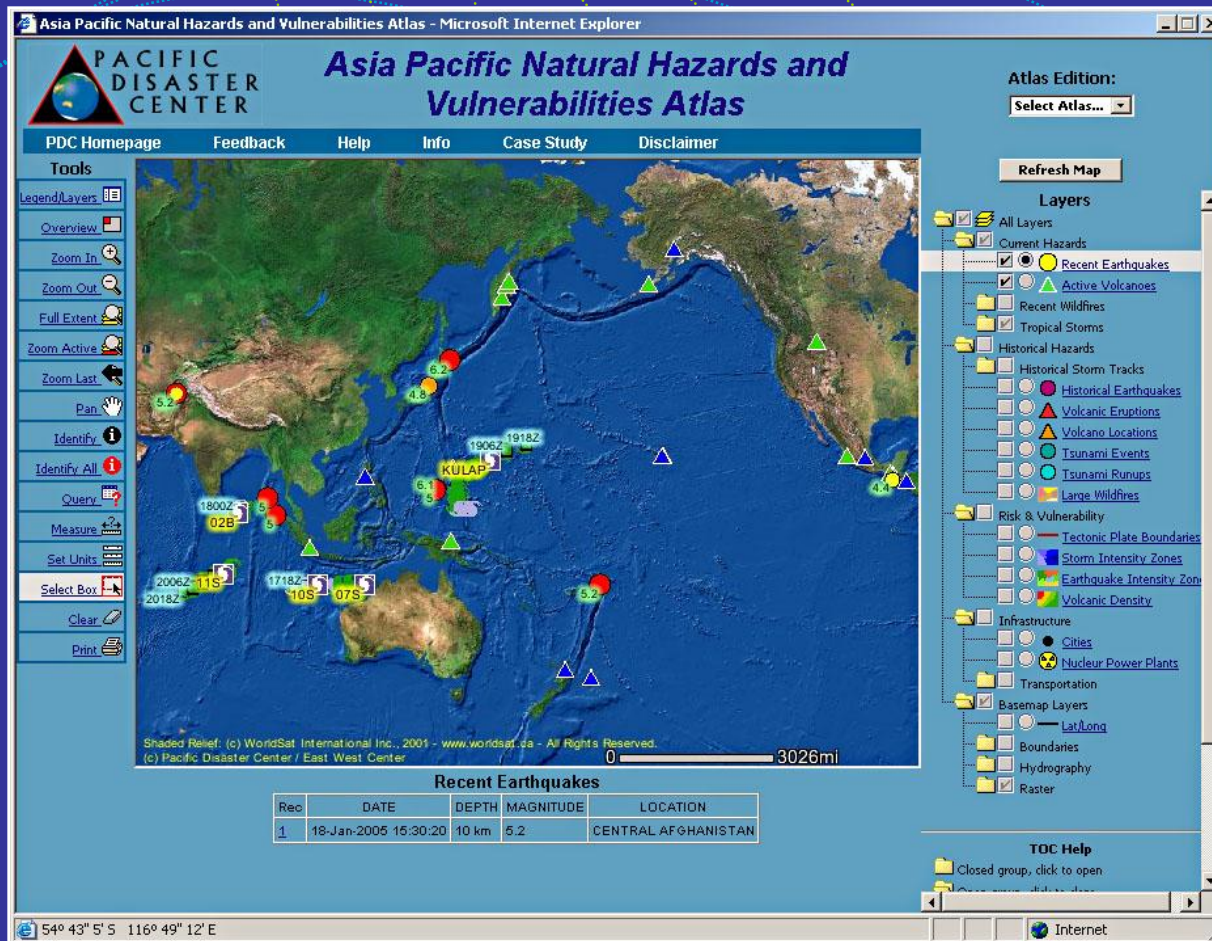
# Risk Communication





# Asia Pacific Natural Hazards Atlas

*Web-based, Geospatial Information Application Supporting Regional Hazard and Vulnerability Assessments*



## Natural Hazards

- Tropical Storms
- Wildfires
- Earthquakes
- Tsunamis
- Volcanoes
- Floods

## Risk Exposure

- People
- Infrastructure

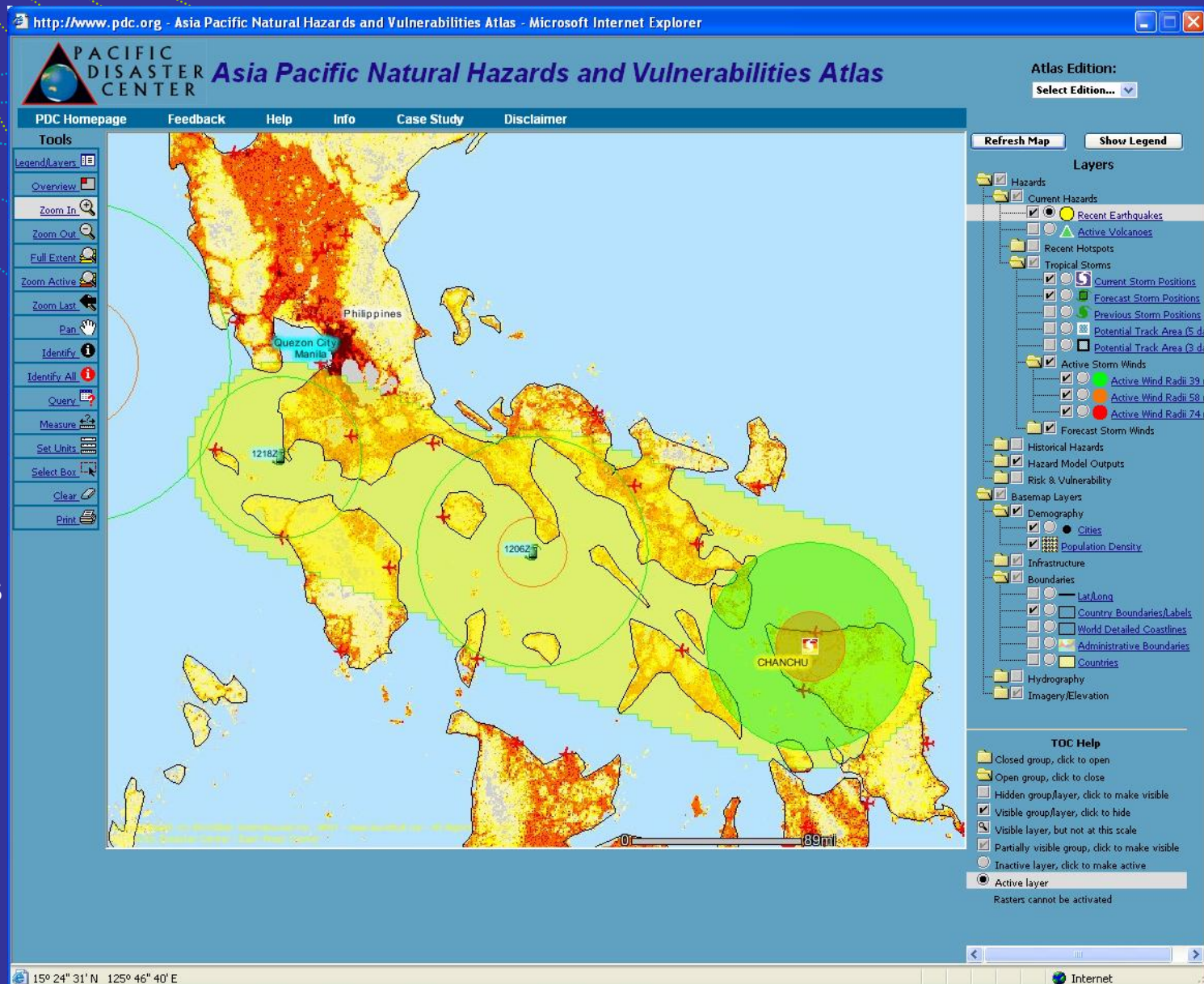
<http://atlas.pdc.org>




# Simplify, Integrate, Understand Risk ...

May 11, 2006

- Simplify
- Integrate ...
- Intensity Zones (EQ & Storms)
- Infrastructure
- Danger Zones
- Population at Risk





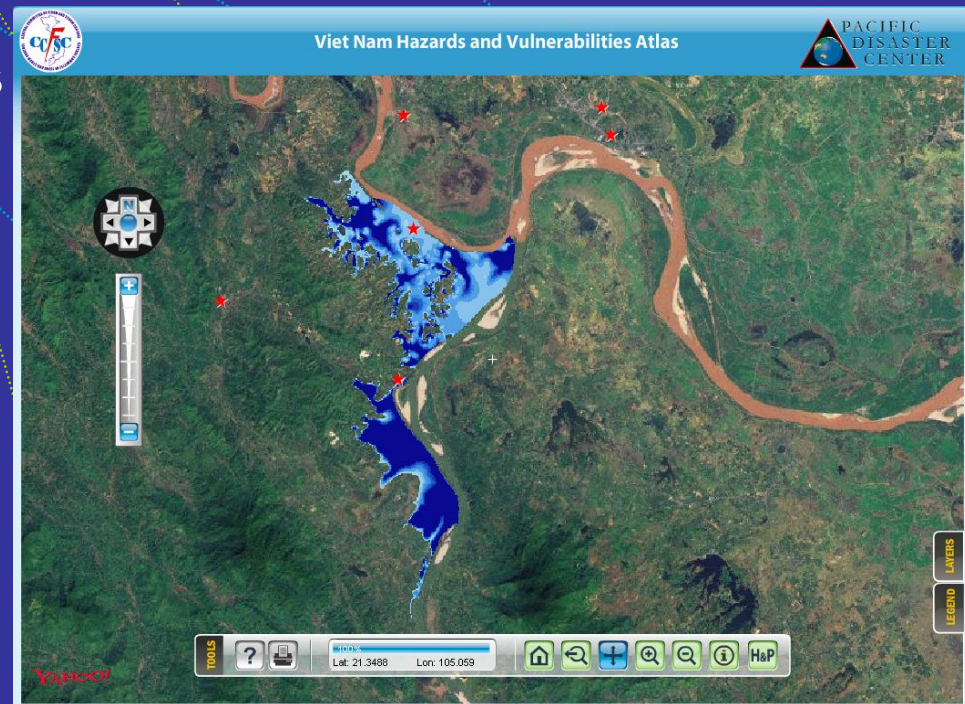
# Community-based Risk Reduction / Emergency Preparedness Case Study

Phu Tho Province (Viet Nam)

# Phu Tho Province Flood Inundation

Purpose: To better understand potential inundation areas and resulting impacts of flooding.

- Scenario: hypothetical breaching of dykes along Black & Red rivers
- Reduce impacts to lives and property
- Allow Disaster Management officials to refine mitigation options and evaluate preparedness plans, including warning systems and evacuation procedures
- Modeled using the DHI MIKE 21 Flood model



# Vietnam Atlas Data

## Data Characterized by Location

### Dyke Management Center, Vietnam

- Facilities
- Dyke system works
- Transportation
- Boundaries
- MIKE Flood Model
- Topo Maps



User

### Pacific Disaster Center, Hawaii

- Active Hazards (D)
- TRMM (D)
- DFO (D)
- Hydro-Met (D)
- Hazards & Products

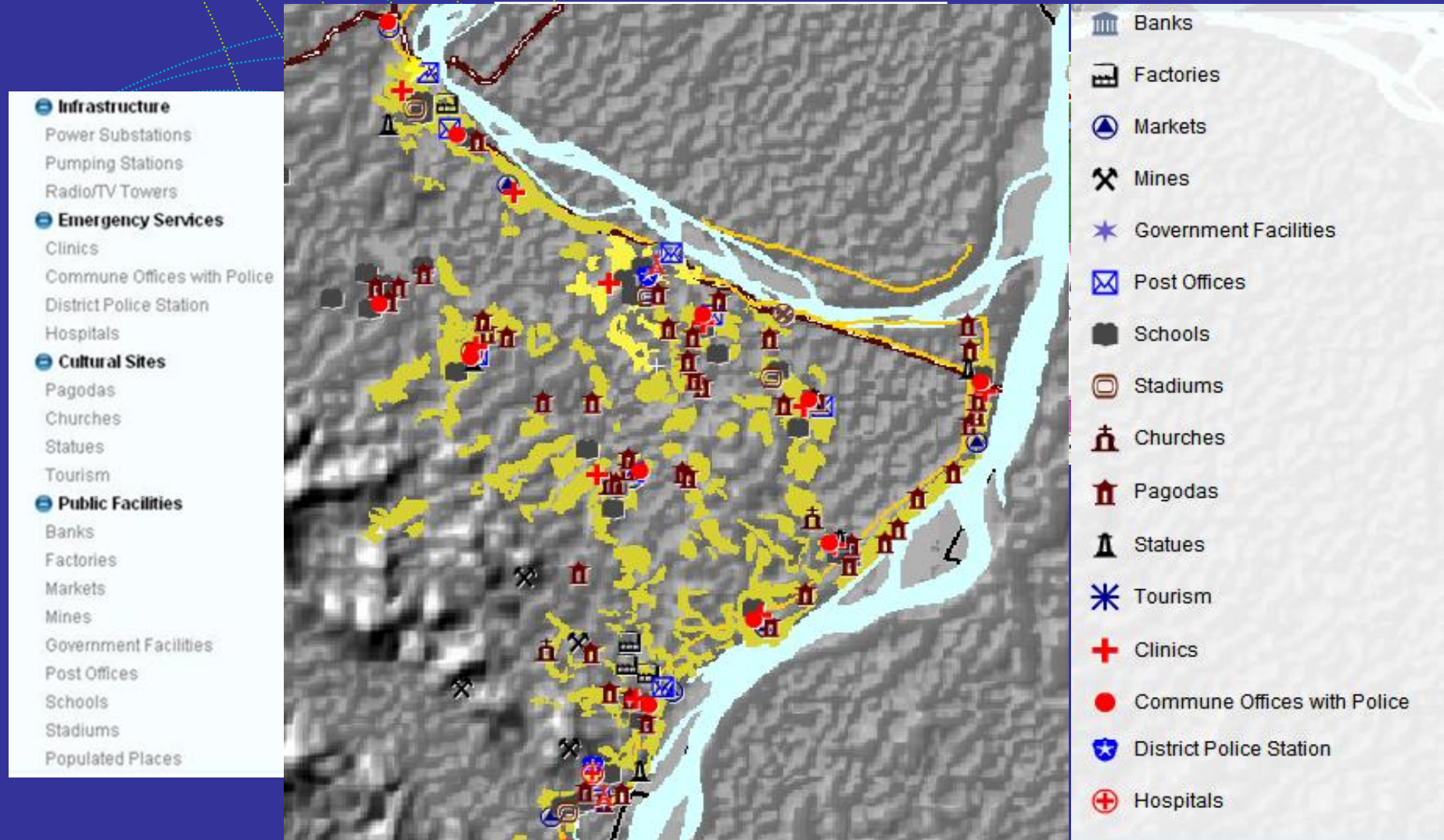
### Internet Image Services

- Yahoo!
- Microsoft
- Google

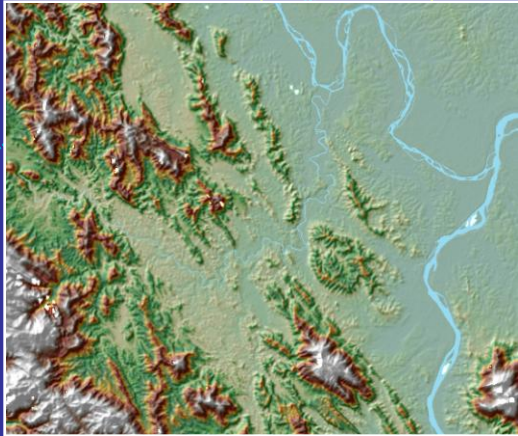
**D = Dynamic /  
Near Real-Time**



# Key Infrastructure Data Collection



# Run Flood Model



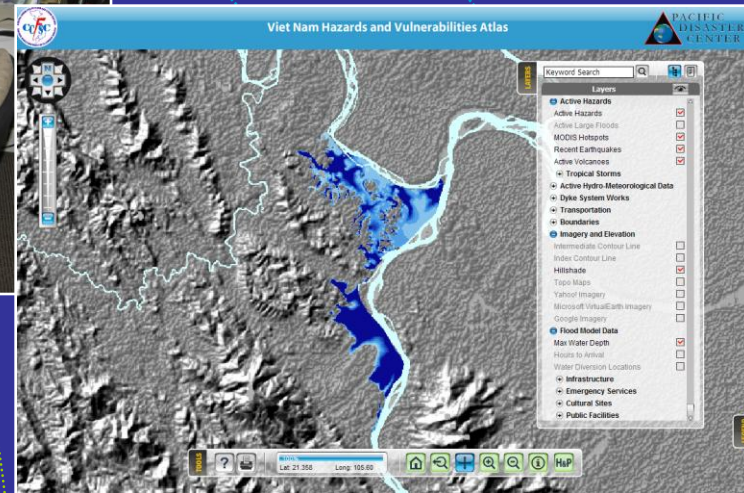
**Elevation Data: 20-Meter created by PDC**

Dyke #1	Model Assumptions
River:	Black River
Dyke Height:	5 meters
Rate Discharge:	300 cubic meters/second
Estimated Breach Size:	80 meters

**Model Input Parameters**



**Modeling Analyst**



**Graphical Output**



# Consequence Assessment



## Viet Nam Dyke Breach Assessment Report

### 1 Purpose

The purpose of this case study is to better understand the inundation and resulting impacts from hypothetical breaching of dykes along the Black and Red Rivers in northern Viet Nam. These scenarios approximate plans by D even larger impacts to lives and flooding conditions. Impact analysis mitigation options and evaluate procedures. The scenario was infrastructure and asset data collected by the Disaster Management Committee.

### 2 Background

Water Diversion Location
Thuong Nong
Thach Dong
Dong Luan

### 3 Consequence Analysis

#### 3.1 Scenario Parameters

Dyke #1
River:
Height:
Rate Discharge:
Estimated Breach Size:

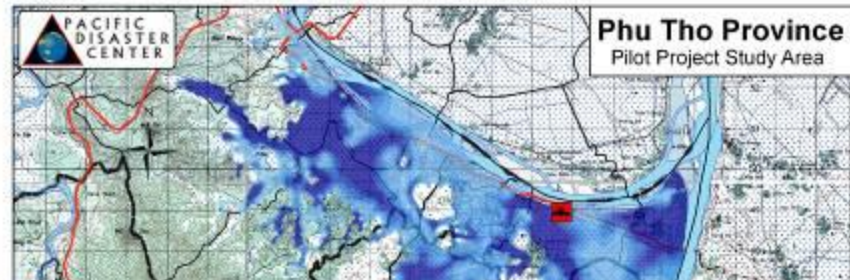
Dyke #3	Model Assumptions
River:	Black River
Height:	5 meters
Rate Discharge:	550 cubic meters/second
Estimated Breach Size:	137 meters

Dyke #4	Model Assumptions
River:	Red River
Height:	5 meters
Rate Discharge:	300 cubic meters/second
Estimated Breach Size:	55.5 meters

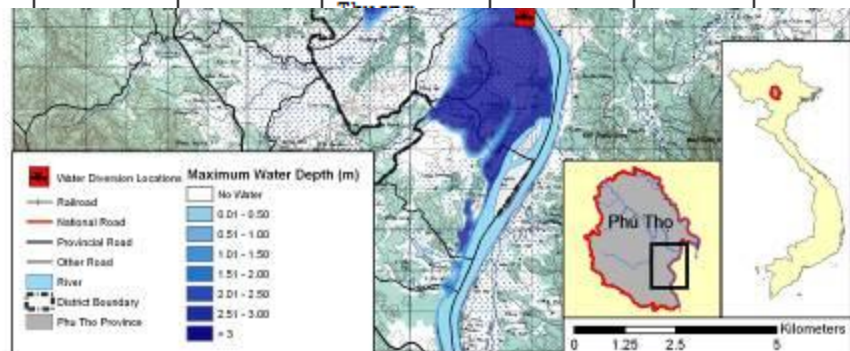
Hypothetical Scenario

Vietnam Dyke Breach Scenario

11/3/2007



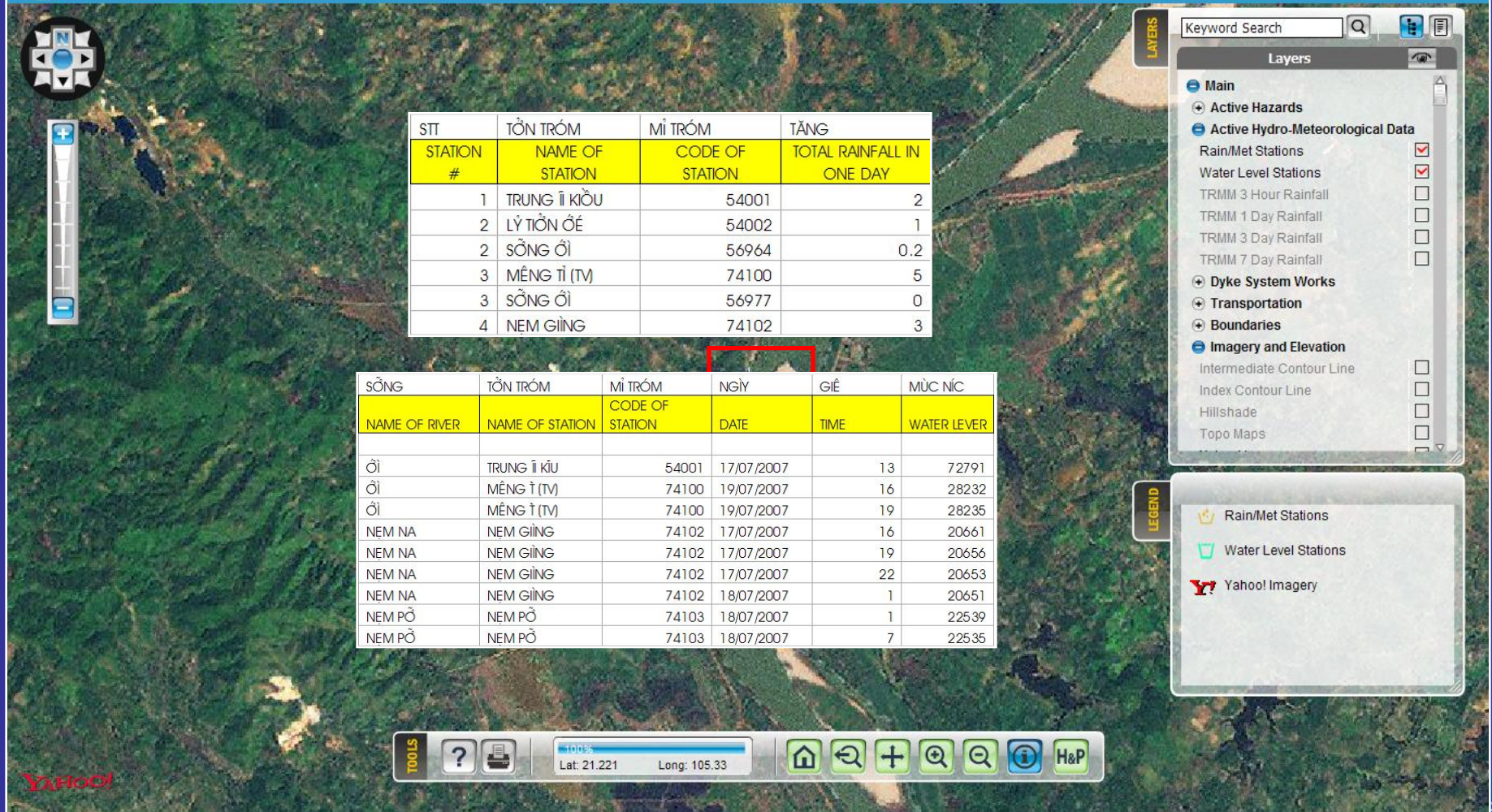
Infrastructure Type	Commune	Distance to Nearest Breach Location (km) *	Time to First Arrival (hours)	Name of Nearest Breach Location	Maximum Water Depth (m)	Latitude	Longitude
Pumping Station	X. DỄU D-NG	0.87	2.57	Thuong Nong	3.44	21.2476	105.3134
School	X. DỄU D-NG	2.11	8.98	Thuong Nong	1.02	21.2453	105.3008
School	X. DỄU D-NG	1.90	8.34	Thuong Nong	1.00	21.2415	105.3031
Clinic	X. DỄ NẾU	5.79	46.20	Thuong Nong	0.11	21.2425	105.2653
Commune Office with Police	X. DỄ NẾU	5.89	42.35	Thuong Nong	0.54	21.2409	105.2644
Post Office	X. DỄ NẾU	5.78	42.99	Thuong Nong	1.83	21.2413	105.2655



# Real-Time Hydro/Met Data

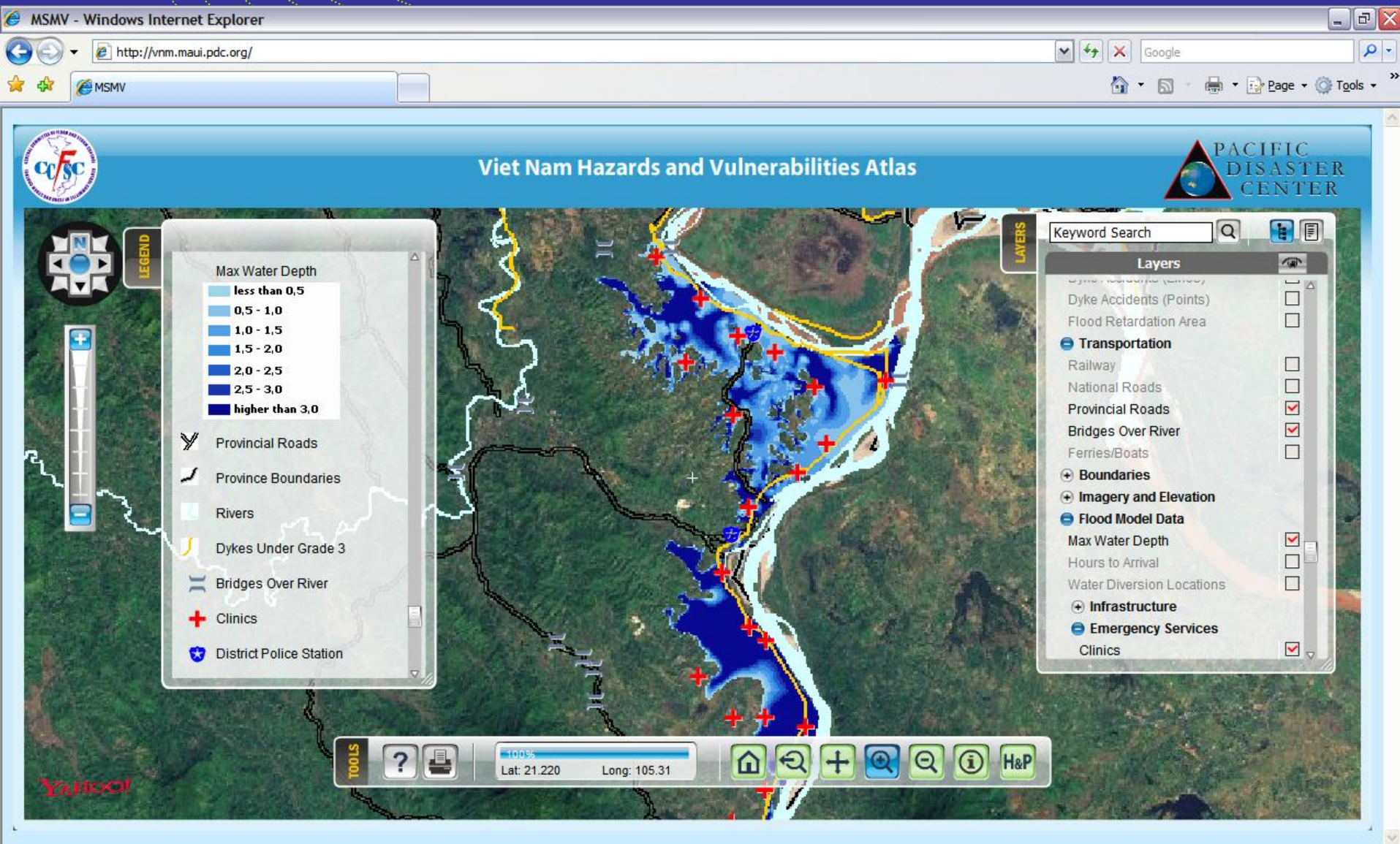


Viet Nam Hazards and Vulnerabilities Atlas





# Viet Nam Hazards Atlas



# Contact Information:

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Visit AP Hazards Atlas at:

<http://atlas.pdc.org>