Applications of Hazus-MH for Emergency Management

December 16, 2010





What is Hazus-MH?

Free ArcGIS extension

Facilitates a risk-based approach to mitigation

Identifies and visually displays hazards and vulnerabilities

Calculates scientifically-defensible damages, economic losses, and mitigation benefits





How does Hazus-MH Support Emergency Management?

IDENTIFY vulnerable areas

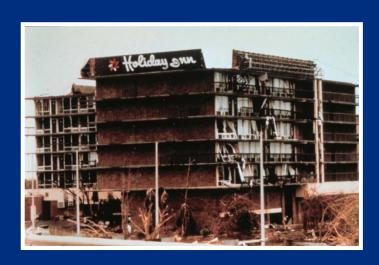
ASSESS level of readiness and preparedness to deal with a disaster before disaster occurs

ESTIMATE potential losses from specific hazard events

DECIDE on how to allocate resources for most effective and efficient response and recovery

PRIORITIZE mitigation measures that need to be implemented to reduce future losses (what if)







How Hazus-MH Estimates Losses



Produces maps, tables, and reports

Analyzes social and economic impacts

Considers what is at risk

Identifies hazard

Analyzes physical landscape

Damage/Loss Functions

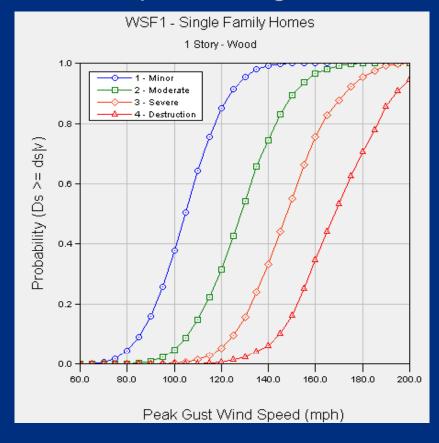
Assess damage and losses based on hazard conditions

Example - Hurricane model has 4,818 unique building

categories

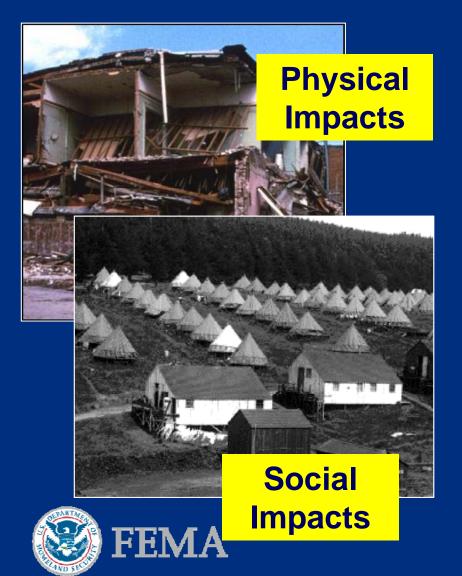
 45 damage/Loss functions for each building model

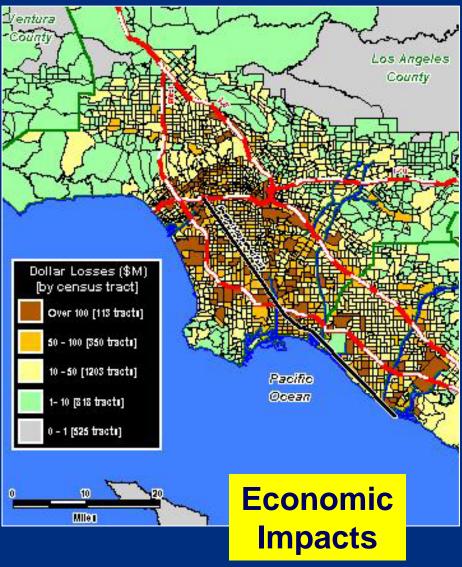
 Total of 216,810 unique damage/loss curves





Hazus-MH Output

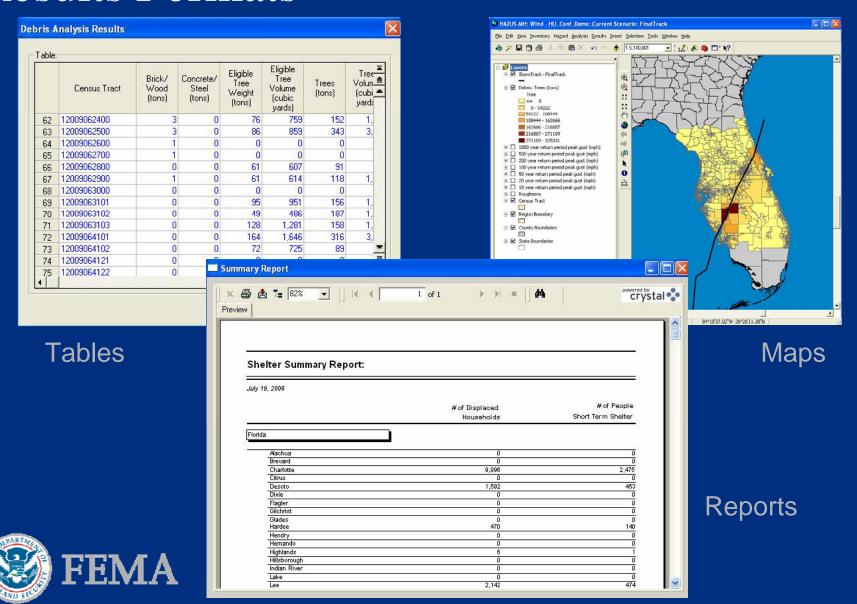




Hazus-MH Output

	Earthquake Ground Shaking Ground Failure	Flood Frequency Depth Discharge Velocity	Hurricane Wind Pressure Missile Rain			
Direct Damage						
General Building Stock	√	\checkmark	√			
Essential Facilities	√	✓	✓			
High Potential Loss Facilities	√					
Transportation Systems	√	\checkmark				
Utility Systems	\checkmark	\checkmark				
◯ Induced Damage						
Fire Following	✓					
Hazardous Materials Release						
Debris Generation	✓	\checkmark	✓			
Direct Losses						
Cost of Repair	✓	✓	√			
Income Loss	✓	✓	✓			
Crop Damage		\checkmark				
Casualties	\checkmark	Generic Output				
Shelter Needs	\checkmark	\checkmark	✓			
Indirect Losses						
Supply Shortages	✓	√				
Sales Decline	✓	✓				
Opportunity Costs	✓	✓				
Economic Loss	✓	✓				

Results Formats



Supported Hazards



Hurricanes



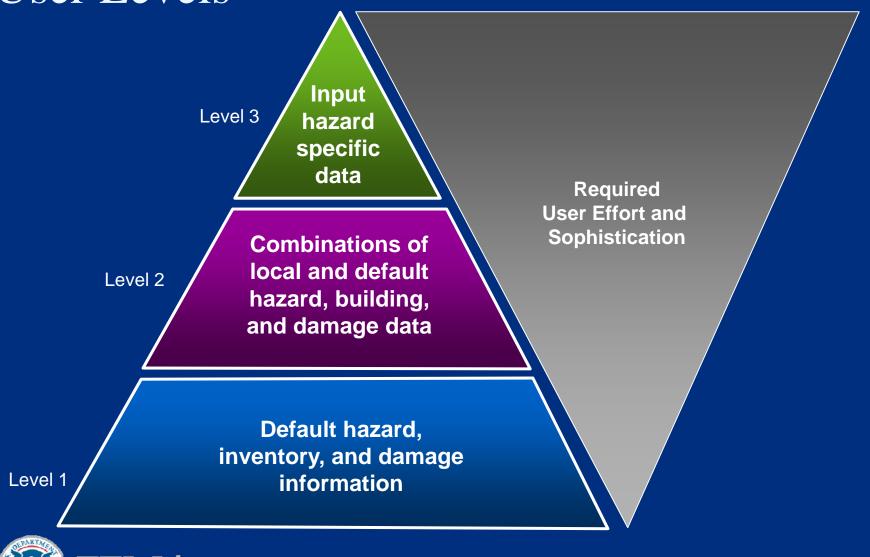
Riverine and Coastal Floods



Earthquakes



User Levels





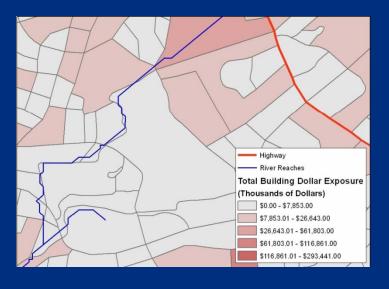
Inventory Components

Aggregate Inventory

- Demographics
- General Building Stock broken down by type (how constructed) and occupancy (how used)

Site-Specific Inventory

Hazard Specific Inventory (both aggregate and site specific)



Aggregate

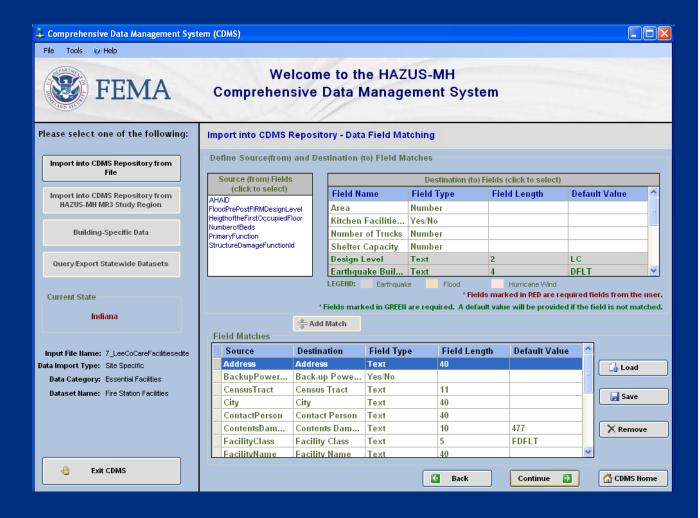


Site Specific

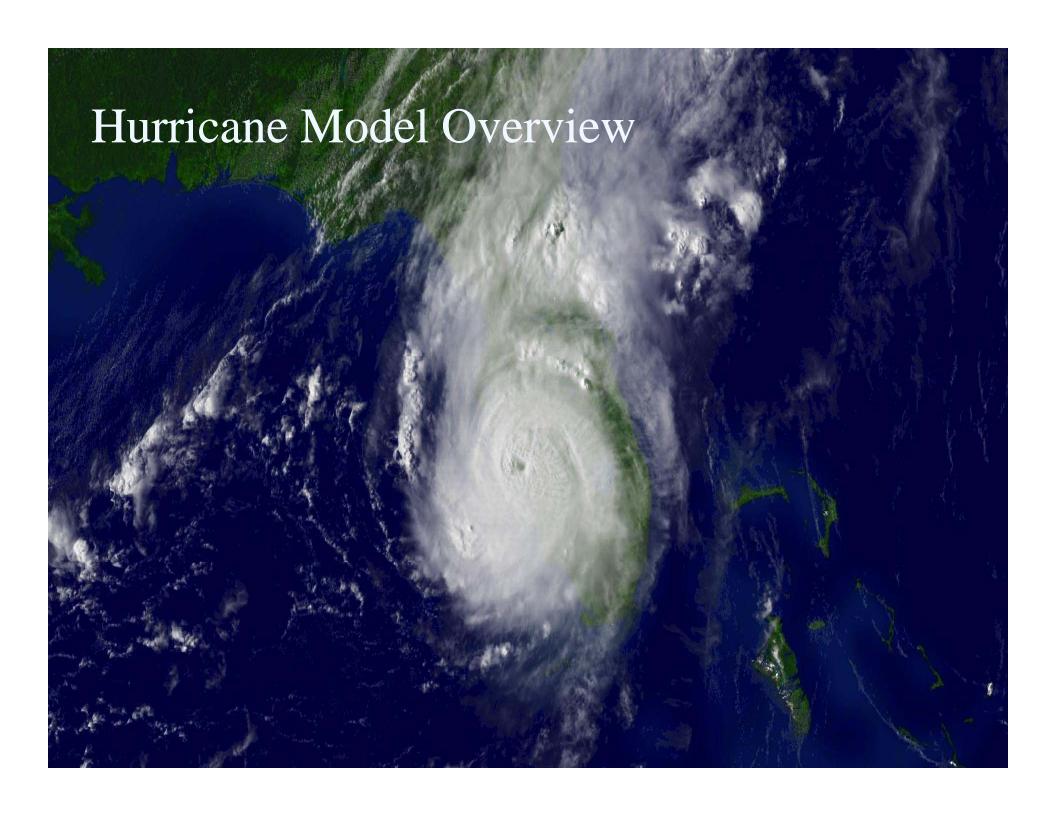


Integrating Local Data

Comprehensive Data
Management
System

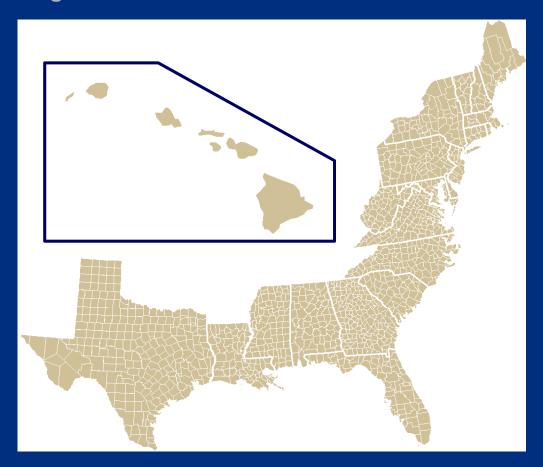






Supported States

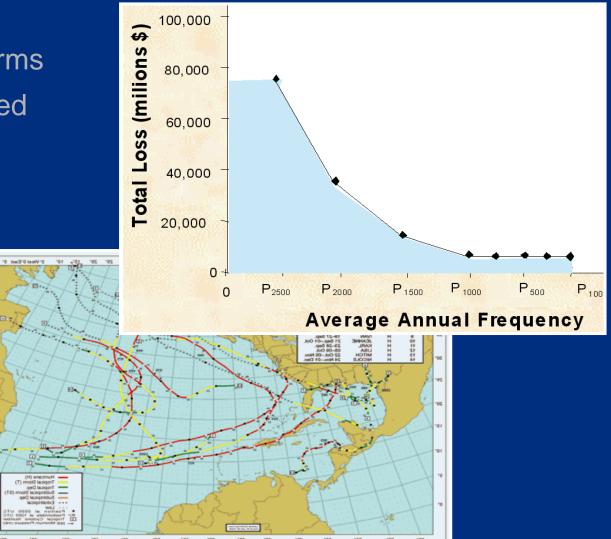
Model includes 22 gulf and east coast states as well as Hawaii





Scenario Options

- Individual storms
 - User-defined
 - Historical
- Probabilistic

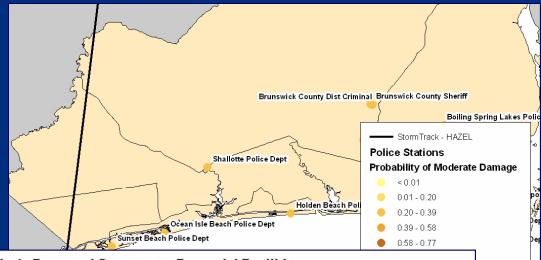




Direct Physical Damage

Essential Facilities

- Loss of Use (Days)
- Damage State Probability



Facilities

Table 4: Expected Damage to Essential Facilities

			# Facilities	
Classification	Total	Probability of at Least Moderate	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
Fire Stations	11	5	0	0
Hospitals	2	1	0	0
Police Stations	17	7	0	0
Schools	24	4	0	0



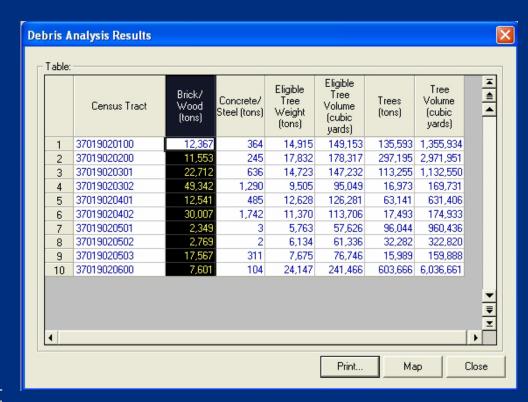
Debris

Building Debris

- Wood and Masonry
- Steel and Concrete

Tree Blowdown

- Tree Debris
- Eligible Tree Debris
 - Building density, length of roads, and census block shapes
 - Trees downed in close proximity to streets, highways, or buildings make up the great majority of trees brought to the curb for collection and disposal

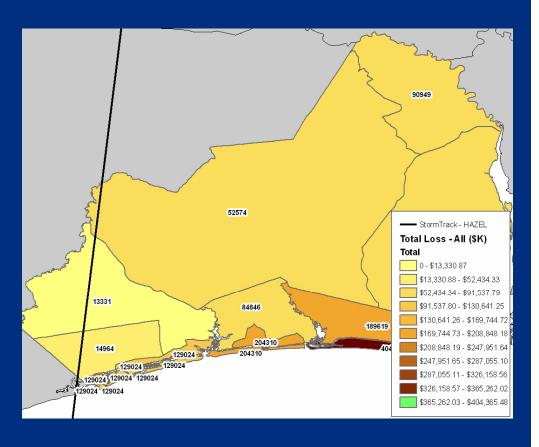




Direct Economic Losses

General Building Stock Loss

- Building Losses
 - Structural
 - Non-structural
 - Content
 - Business Inventory
- Business Interruption Losses
 - Wage
 - Income
 - Rental & Relocation
 - Proprietor



Economic Losses from a Hazus-MH Simulated Hurricane Scenario



Direct Social Losses

Shelter

- Number of Displaced Households
- Temporary Housing Requirements
- Based on Demographic Considerations [Ethnicity, Income, Age, Ownership]



Shelter Camp during the 1906 San Francisco Earthquake





Scenario Options

Return Period

Discharge Value

Flood Information Tool Input

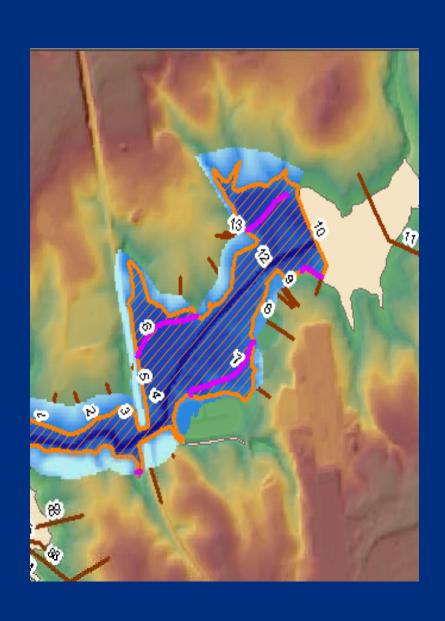
Quick Look

Enhanced Quick Look

User Provided Depth Grid

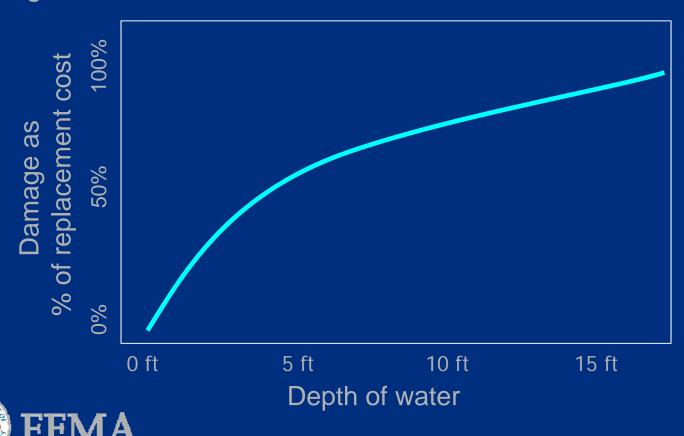
HEC-RAS





Depth-Damage Curves

Damage to buildings and infrastructure is estimated using depthdamage curves



Results

General Building Stock Results

- By Amount of Damage
 - occupancy, building type (sq. ft.)
 - by count
- By Dollar Losses
 - full and depreciated replacement value
 - building, content, and inventory losses
 - costs of relocation, wage, income, and rental losses
 - direct employee output losses and employment loss (days)





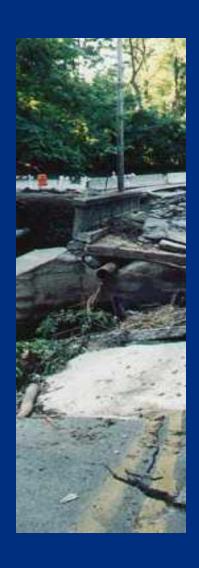
Results

Essential facilities

- Building and content losses
- Functionality assessment (yes/no)
- Restoration time to 100% functionality

Lifeline losses (for selected components)

- Losses to structures and equipment
- Functionality assessment (yes/no)





Results

Vehicle Losses

Agriculture Losses

Shelter Requirements

Indirect Economic Losses

 Income and employment impact with and without aid by market sector





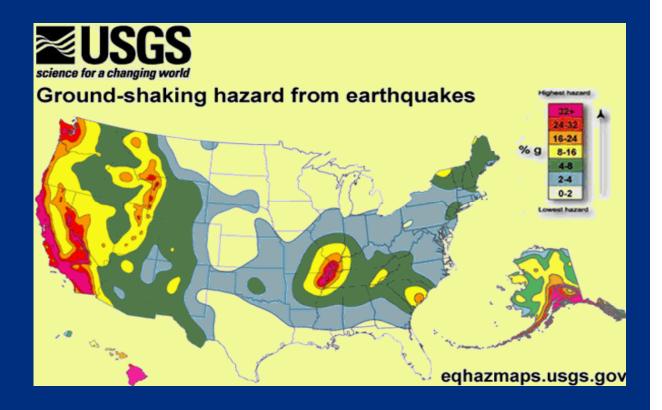


Scenario Options

User defined events

Historic events

Probabilistic events



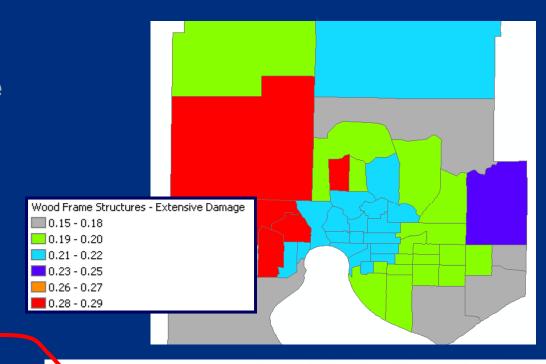


Direct Physical Damage

Structural and nonstructural damage estimates for buildings

Damage state probability counts and losses

Technical Manual chapter 5 describes the conditions that exist at each damage state by building type



Chapter 5. Direct Physical Damage - General Building Stock

Wood, Light Frame (W1):

Slight Structural Damage: Small plaster or gypsum-board cracks at corners of door and window openings and wall-ceiling intersections; small cracks in masonry chimneys and masonry veneer.

Moderate Structural Damage: Large plaster or gypsum-board cracks at corners of door and window openings; small diagonal cracks across shear wall panels exhibited by small cracks in stucco and gypsum wall panels; large cracks in brick chimneys; toppling of tall masonry chimneys.



Direct Physical Damage

Essential Facilities

- Restoration Time to 100% Functionality
- Damage State Probability
- Damage states are described in chapters 5 and 6 of Technical Manual

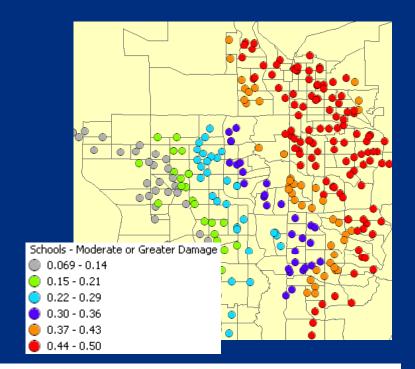


Table 6: Expected Damage to Essential Facilities

		# Facilities				
Classification	Total	At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1		
Hospitals	1	1	1	0		
Schools	51	51	51	0		
E O Cs	1	1	1	0		
PoliceStations	22	22	22	0		
FireStations	10	10	10	0		



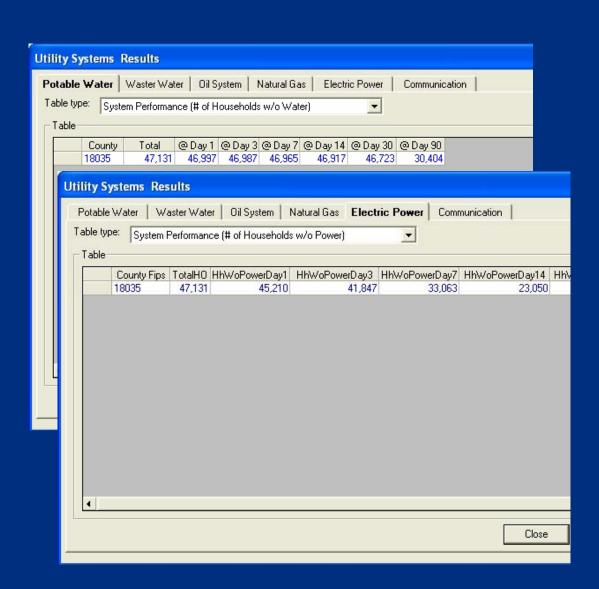
U tility Damage

Pipeline and Facility Damages, Losses, and Functionality for Potable Water, Waste Water, Oil Systems and Natural Gas.

Functionality at 1, 3, 7, 14, 30 and 90 days

Number of households without Potable Water and Electricity





Transportation Damage

Highway, Railway, Light Rail

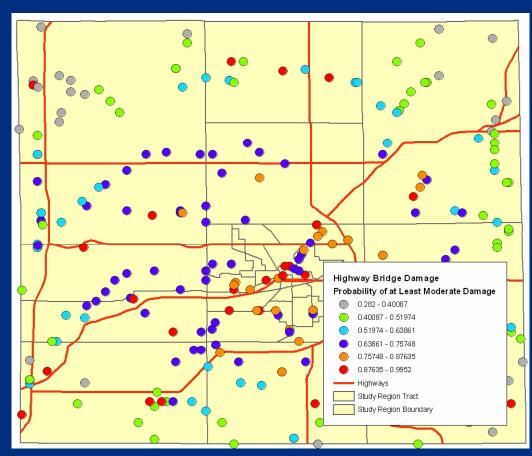
 Bridge, Segment and Tunnel Losses,
 Damages and Functionality

Bus, Port, and Ferry

Facility Damage, Loss, and Functionality

Airport

Runway and Facility Damage, Loss and Functionality





Induced Physical Damage

Fire Following

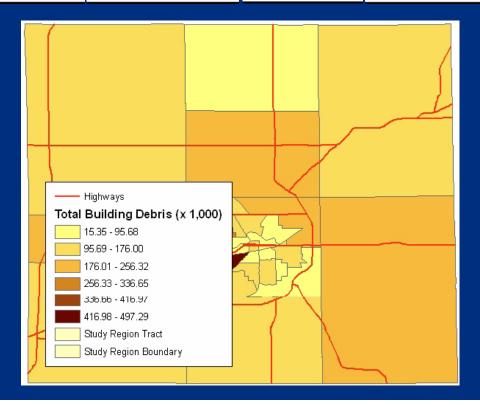
- Number of Ignitions
- Extent of Burned Areas

Debris Generation

- Wood and Masonry
- Steel and Concrete

	FEMA
NO SECUL	T TITALY

	Value Exposed (thous. \$)	Population Exposed	Number of Ignitions
Indiana Delaware	8,675	100	13
Total	8,675	100	13
Region Total	8,675	100	13



Direct Economic Losses

Building Losses (GBS)

- Structural
- Non-structural
- Content
- Business Inventory

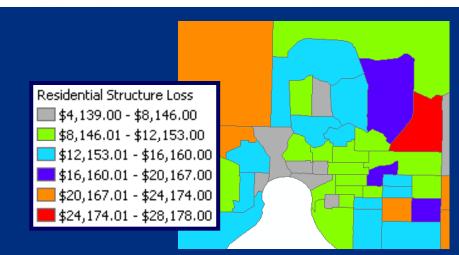
Business Interruption

- Wage
- Income
- Rental & Relocation
- Proprietor

Lifelines

Direct Cost of Repair

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Lo	ses						
	Wage	0.00	1.67	38.65	2.03	1.59	43.94
	Capital-Related	0.00	0.71	31.50	1.26	0.55	34.01
	Rental	9.48	10.63	20.46	0.66	0.76	42.00
	Relocation	1.11	0.26	1.51	0.02	0.28	3.18
	Subtotal	10.59	13.27	92.12	3.97	3.18	123.13
Capital Sto	ock Loses						
	Structural	51.09	18.50	36.39	6.88	8.35	121.21
	Non_Structural	236.70	112.16	135.12	31.84	25.49	541.31
	Content	106.07	39.54	97.18	26.25	18.64	287.66
	Inventory	0.00	0.00	2.02	7.60	0.58	10.20
	Subtotal	393.86	170.20	270.70	72.55	53.06	960.37
	Total	404.45	183.47	362.82	76.53	56.24	1,083.50





Social Losses - Casualties

By severity level

By time of day (2 am, 2 pm, 5 pm)

Severity 1 - No Hospitalizations

Severity 2 – Hospitalization

Severity 3 – Life Threatening

Severity 4 - Fatality

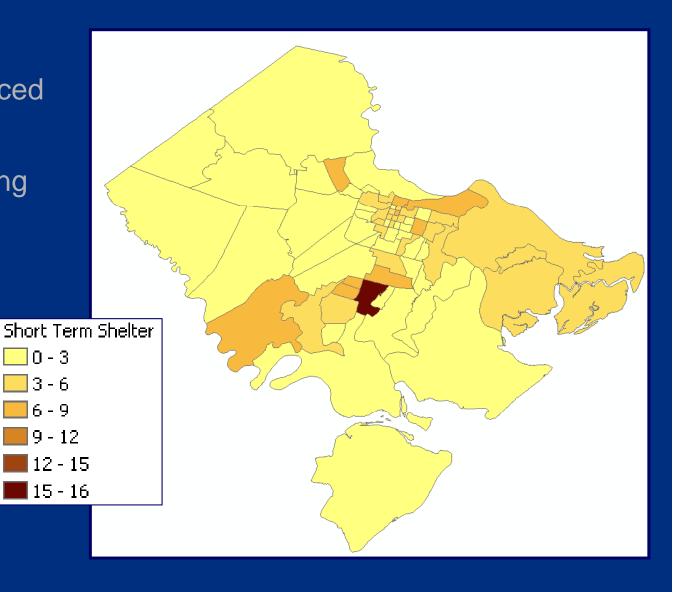
	_	Injury Severity Level				
	Population	Severity 1	Severity 2	Severity 3	Severity 4	
Indiana						
Vanderburgh						
Commuting		54	87	128	26	
Commercial		2,765	862	137	262	
Educational		149	48	8	15	
Hote Is		13	4	1	1	
Industria I		280	88	14	27	
Other-Residential		661	196	28	51	
Single Family		1,581	447	60	105	



Social Losses - Shelter

Number of Displaced Households

Temporary Housing Requirements





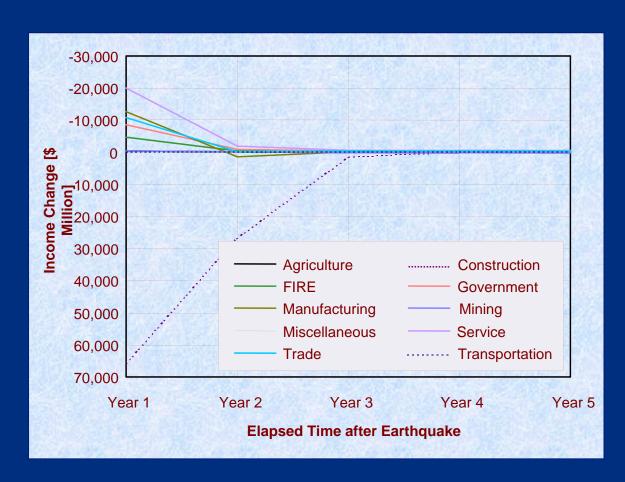
Indirect Economic Losses

Modeling of 10 Economic Sectors

IMPLAN Data

Income Changes vs. Time

Employment Changes vs. Time





What is CDMS?

CDMS is a tool developed by FEMA to support integration of locally developed inventory data into the Hazus-MH loss estimation process.

Primary functions

- Support transfer of data into and out of the master state databases
- Provide validation of user supplied data
- Allow users to query and export inventory information



User Groups

Latest news

User feedback

User group contacts



About FEMA HAZUS HAZUS.org Contact HAZUS.org HAZUS.org Web Pages Resources HAZUS.org Affiliates

► HAZUS User Groups
 ► Donate to HAZUS.org
 ► HAZUS.org Bookstore
 ► HAZUS Training & Technical Assistance
 ► HAZUS.org Special Interest Groups
 ► Register at HAZUS.org

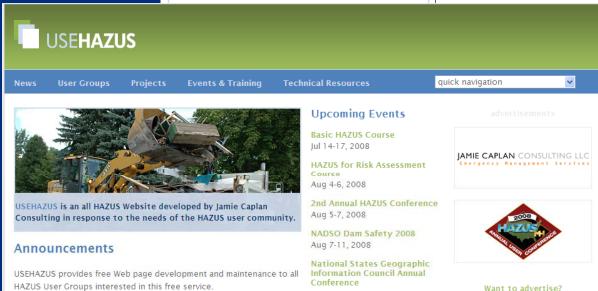


2008 HAZUS User Conference

From Data Collection to Decision Making Aug 5-7, 2008, San Diego, CA

> enda, **⊁<u>click here...</u> :h Howser at**

.com





Training

Classroom Courses

- ArcGIS for Emergency Managers
- Basic Hazus-MH
- Hazus-MH for Floods
- Hazus-MH for Earthquakes
- Hazus-MH for Hurricanes
- Using Hazus for Risk Assessment
- Comprehensive Data Management for Hazus-MH
- Hazus for Floodplain Managers
- Using Hazus for Disaster Operations
- http://www.fema.gov/plan/prevent/hazus/hz_trngconf.shtm

Virtual Courses

Seven courses now available on the ESRI Virtual Campus

http://www.fema.gov/plan/prevent/hazus/hz_virtualtraining.shtm

Become a HAZUS-MH expert!

HAZUS Trained Professional Track: Provides a foundation of basic HAZUS-MH skills plus focused instruction on at least one hazard.

- E190 Introduction to ArcGIS (prior GIS experience may substitute)
- E313 Basic HAZUS MH
- E317 Comprehensive Data Management
- Minimum of ONE of the following: E170 HAZUS-MH for Hurricanes; E172 HAZUS-MH for Floods; or E174 HAZUS-MH for Earthquakes



HAZUS Practitioner Track: Expands upon the HAZUS Trained Professional track by incorporating specialized instruction in topic specific areas.

- E190 Introduction to ArcGIS (prior GIS experience may substitute)
- E313 Basic HAZUS-MH
- E296 Application of HAZUS-MH for Mitigation Planning
- E179 Application of HAZUS-MH for Disaster Operations
- E317 Comprehensive Data Management
- Minimum of ONE of the following: E170 HAZUS-MH for Hurricanes; E172 HAZUS-MH for Floods; or E174 HAZUS-MH for Earthquakes

Professionals and Practitioners will receive a certificate, lapel pin, and a listing on FEMA's website upon completion of their respective curriculum track.





Thanks for your attention! http://www.fema.gov/plan/prevent/hazus/



