



LSU HURRICANE CENTER

Hurricane Engineering and Multidisciplinary Research and Education Challenges

**National Science Board
Hurricane Science and Engineering Meeting
April 18, 2006**

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American Association for Wind Engineering
American Society of Civil Engineers
Wind Hazard Reduction Coalition



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Why are we having this meeting?

- Charley, Francis, Ivan, Jeanne, KATRINA, Rita, Wilma



Why are we having this meeting?

- **In Just 15 months (Aug 2004-Oct 2005)**
 - **Over 2000* lives lost**
 - **Hundreds of Billions of \$ Damage**
 - **Much of Gulf of Mexico Coast from East Texas to Florida damaged or destroyed**
 - **Hundreds of thousands of homes damaged or destroyed**
 - **Cities wiped off the map**



Why are we having this meeting?

- **Loss of Life**
 - Occurred primarily in buildings
- **Massive Destruction of the Built Environment**
 - **Significant national impacts**
 - Response and reconstruction costs
 - Construction materials shortages
 - Insurance and reinsurance markets
 - etc



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The Problem is Hurricane Interactions with the Built Environment



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The destruction of our built environment is first and foremost an Engineering Problem

Solution requires strong collaborations with physical, environmental, and social sciences



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National Program for Wind Hazard Impact Reduction

- **National Windstorm Impact Reduction Act of 2004**
- **This program lays out part of the solution –**
 - **includes responsibilities by NSF, NOAA, FEMA, and NIST**



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Primary Hurricane Threats

**Storm surge flooding
and waves**

**Extreme winds
and tornadoes**

**Extreme Rainfall
and freshwater flooding**

Windborne/floodborne debris

Raid-induced landslides

Erosion/scour/washover



Secondary Hazards

- **Fire**
- **Contaminated floodwaters/debris**
- **Combined environmental & technological hazards**
 - e.g. hazardous materials releases caused by storm damage to pipelines, storage tanks, etc.
- **Floodborne diseases**

Surge, Wind, Waves



Flood and Wind



Hurricane Ivan

Hurricane and Tornado Winds



Hurricane Ivan



Paradigm Shift Required

- **Hurricanes have and will continue to strike inhabited coastal areas of the world**
- **Building, infrastructure, and community design professionals should explicitly consider this fact**
- **New engineering methods, tools, materials, and technologies required**
- **Education of designers of built infrastructure crucial**



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Hurricane Engineering: A New Curriculum for a Planet at Risk

LSU College of Engineering
LSU Hurricane Center
and

National
Science
Foundation





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What is Hurricane Engineering?





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What is Hurricane Engineering?

**Engineering of the built environment
with due consideration of the complete
array of hurricane hazards**



State of Practice

Earthquake vs Hurricane

Hurricanes cause more casualties and property damage than earthquakes, but are somehow not explicitly considered in the normal engineering design process



Earthquake

- Seismic safety is a fundamental design consideration
- Consumers 'relatively aware' of risk
- Design professionals have a minimum level of understanding and competence
- Specialty seismic portions of professional registration exams
- Earthquake engineering part of Civil Engineering curricula
- Textbooks and curricular materials readily available
- Faculty members active in research and practice
- NEHRP - \$100M+ annual research budget for earthquake engineering



Hurricane

- Hurricanes are not fundamental design consideration
- Consumers “relatively unaware” of risk
- Design professionals do not have a minimum level of understanding and competence
- No specialty sections on professional registration exams
- Hurricane engineering not part of Civil Engineering curricula (with a very few exceptions)
- Textbooks and curricular materials not readily available
- Few faculty members active in research and practice
- Wind - \$5 Million annual research budget

Structural Engineering



- Wind Engineering
 - Wind, Debris
- Design for Lateral and Uplift Loads



- Design of Building Envelope
- Flood Protective Design

Geotechnical Engineering



- Foundation Design
 - Lateral loads
 - uplift loads
- Rain-Induced Landslides
- Earth Structures
 - Levees
 - Dams
- Erosion/deposition/scour

Transportation Engineering



- Evacuation and Reentry
 - Planning, Operations, Monitoring, Communications
 - Design for Contraflow
- Design of Storm Resistant Transport Infrastructure
- Rapid Assessment and Repair



Water Resources Engineering



- Storm surge flooding and waves
- Inland Rainfall Flooding
- Structural flood controls
- Nonstructural flood controls

Environmental Engineering



- Water and Wastewater Treatment Facilities
 - Design, response, recovery
- Contamination
 - Surface water, ground water, soils, flooded structures
- Solid Waste (Debris) Disposal
 - Transportation, Landfills, burning



Beyond Engineering

- Architecture
- Land Use Planning
- Coastal Sciences
- Information Technology (GIS)
- Emergency Management





Project Highlights

- Developed a brand new engineering curriculum
- Created web site for distribution of curricular materials
- Created & taught 5 new courses at LSU
- Writing the first book on hurricane engineering
- Coastal and Hurricane Engineering Minor in approval process



Web Site

- Hurricane Engineering Resources
 - Instructor reference materials
 - syllabi
 - sample problems and exams
 - Powerpoint lecture files
 - Much material posted now – will continue to add to it

www.HurricaneEngineering.lsu.edu



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Project Team

- Lead units -
 - LSU Civil and Environmental Engineering
 - LSU Hurricane Center
- Other LSU Departments
 - Mechanical Engineering
 - Chemical Engineering,
 - Landscape Architecture
 - Environmental Studies
- Collaboration with
 - University of Missouri-Rolla
 - Southern University



LSU Research & Operations Support -

Katrina

The LSU Hurricane Center

Assessment and Remediation of Public Health Impacts from Hurricanes

Over 20 investigators

- Engineering
- Environmental Sciences
- Social Sciences
- Medical/Health Scientists

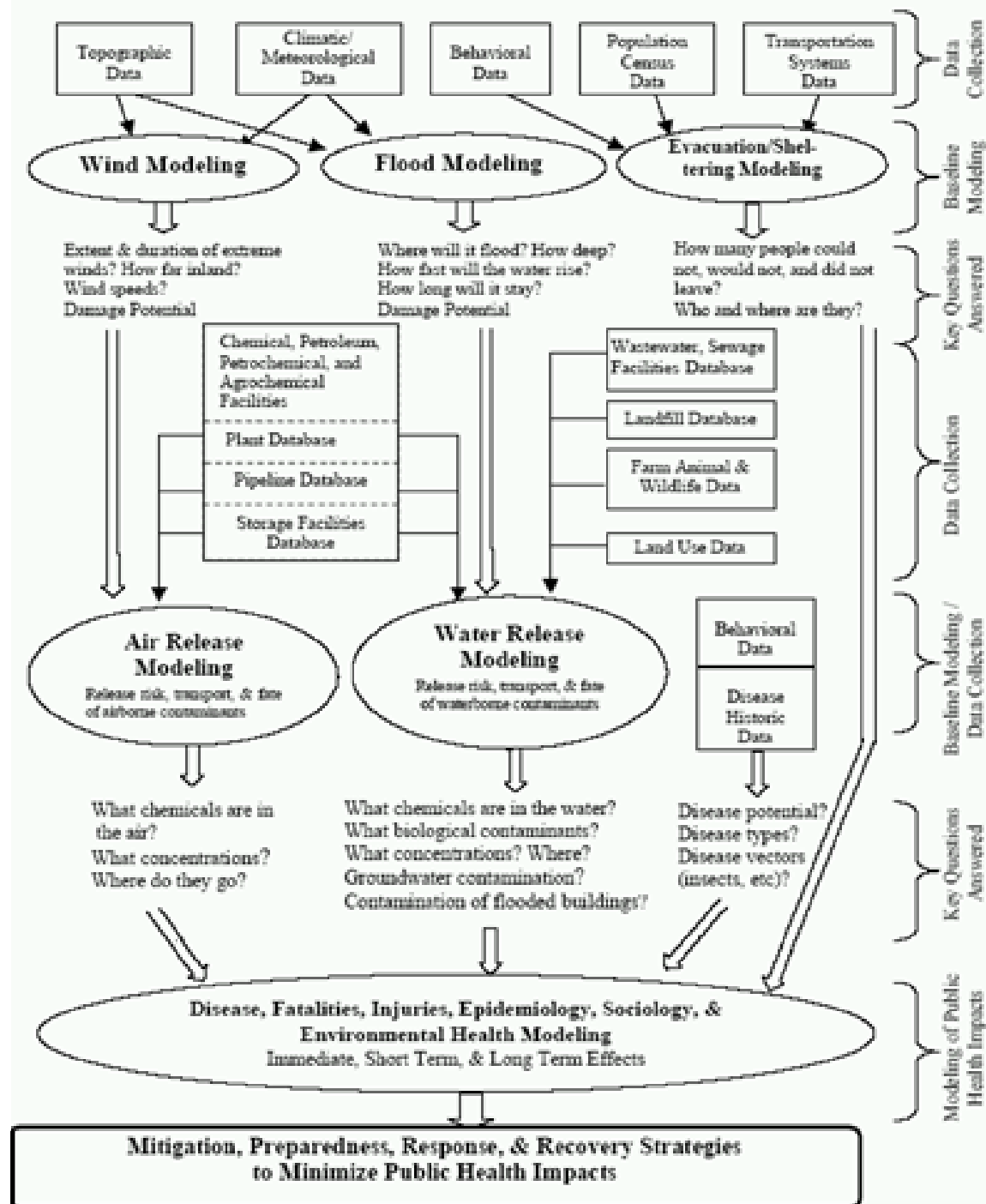


Center for the Study of _____
PUBLIC HEALTH IMPACTS
of Hurricanes



Lt. Chris Bodet, LSP, discusses evacuation updates for New Orleans, LSU CSPHIH Advisory Board Meeting, April 2004

Flowchart of Research Activities



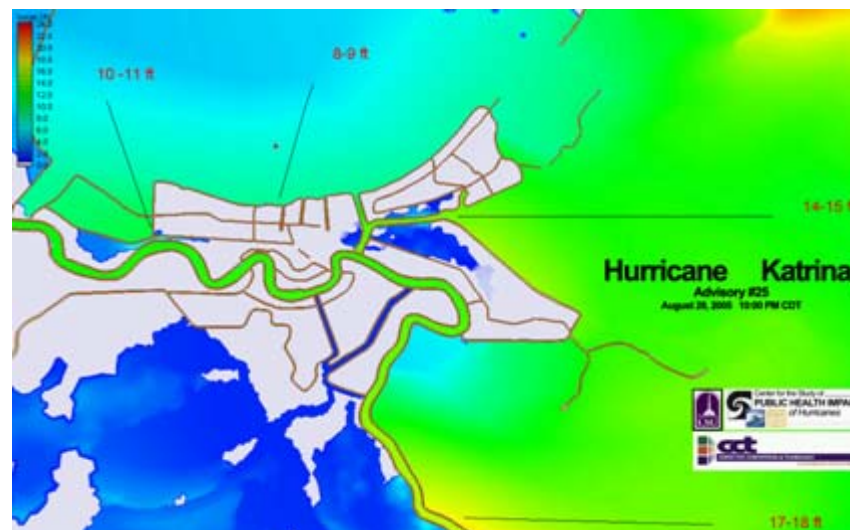


LSU Research & Operations Support - Katrina

The LSU Hurricane Center

New Orleans Pilot Study – Applied during Katrina

- Experimental Storm Surge Modeling (ADCIRC)
- Evacuation Studies
- Flood Casualty Modeling
- New Orleans Population Survey
- Wind Damage to Petrochemical Structures
- Water and air contaminant modeling
- Public health aspects
- Animal evacuation
- other study areas



*Experimental storm surge modeling,
Hurricane Katrina*



LSU Research & Operations Support

Katrina

The LSU Hurricane Center

Support for Katrina Response - Prelandfall

LSU Hurricane Center activated Saturday morning Aug 27

- Satellite storm tracking
- Meteorological support
- Storm surge modeling
- Damage estimates
- Consultation on evacuation and sheltering decisions
- Briefings every 2-3 hours



LSU Research & Operations Support

Katrina

The LSU Hurricane Center

Support for Katrina Response – Post Landfall

Staffed the 'LSU' workstation at the Louisiana Emergency Operations Center 24/7 for next 3 weeks

- Post-Landfall Activities

- Stood up GIS/Remote Sensing/Mapping capability in less than 24 hours
- Meteorological support
- Upgrading surge model to account for levee damage state
- Water quality sampling – results shared with EPA
- FEMA Data Clearinghouse – LSU allocated 20 Terrabytes of space



Questions/Opportunities Raised

- Role of Higher Education in Emergency Preparedness and Mitigation
 - Unique expertise and capabilities
 - Technology transfer
 - Coordination with state and local EM agencies before disaster wrt capabilities



Questions/Opportunities Raised

- Role of Higher Education in Operational Disaster Support
 - Unique expertise and capabilities
 - Surge capacity
 - Invaluable learning experience for students, faculty and research staff



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Questions?

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