Hurricane Katrina:
Lessons to learn

Atlantic Hurricane Season

<table>
<thead>
<tr>
<th>Source</th>
<th>Date</th>
<th>Named Hurricanes</th>
<th>Major Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average (1981-2010)</td>
<td>12.1</td>
<td>6.4</td>
<td>2.7</td>
</tr>
<tr>
<td>Record high activity</td>
<td>20</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Record low activity</td>
<td>4</td>
<td>21</td>
<td>05</td>
</tr>
</tbody>
</table>

Predicted activity - 2014

NOAA           | August 7, 2014 | 7–12  | 3–6   | 0–2   |

Actual activity | 4              | 3     | 0     |
Hurricane Katrina

Sunday August 28, 2005

New Orleans Refugees and Evacuations
Lines form at gas stations and outside the Superdome, which serves as many as 15,000 of the estimated 100,000 people who remain in the city.

Hurricane Katrina

Monday August 29, 2005

New Orleans Refugees and Evacuations
Officials estimate 80 percent of New Orleans residents obeyed the order to evacuate. The Coast Guard rescues 1,200 people from the flooded cities.
Tuesday August 30, 2005

Hurricane Katrina
Be afraid, very afraid
Mississippi drowning

Wednesday August 31, 2005

Bush Sees Long Recovery for New Orleans, 30,000 Troops in Largest U.S. Relief Effort
Thursday September 1, 2005

Hurricane Katrina

Friday September 2, 2005

The New York Times

MORE TROOPS AND AID REACH NEW ORLEANS; BUSH VISITS AREA; CHAOTIC EXODUS CONTINUES

Hurricane Katrina
The Mississippi

- Drains 41 states
- One of the largest watersheds in the world
- Transports 400 million tons of sediment to the Louisiana wetlands per year (the equivalent of 200,000 dump trucks per day)

Economic benefits
- $30 billion per year in petroleum products
- $7.4 billion per year in natural gas (21% of the nation's supply)
- 400 million tons per year of waterborne commerce
- $4.4 billion per year in commercial and recreational fishing

Life along the levee

Flooding was always a problem
1880s: Congress established the Mississippi River Commission who constructed levees
The Army Corps of Engineers now responsible for maintaining the waterway
Land loss ...the product of the levee system

- 1000 sq miles of Louisiana has sunk beneath the waves in the last 50 years
- The delta is sinking
- No fresh supply of sediment

New Orleans
“City in a bowl”
Levees to protect a city
Hurricane Katrina

River flooding + Hurricanes?

Hurricanes category 3 or greater within 100 km of New Orleans from 1852-2005
1927
Scattered Widespread flooding on the Mississippi left hundreds of thousands of people without food and shelter.

- Officials warned of disaster in preceding years
- Death toll unknown (thousands)
- One million homeless (1% of the U.S. population)
- 667,000 people fed by the Red Cross for months, some for a year

The 1928 Flood Control Act
The federal government took responsibility for flood control

1927
1957
Crushed A 12-foot storm surge from Hurricane Audrey flooded areas up to 25 miles inland. The death toll was 400.

Hurricane Audrey
- Death toll 534
- 40,000 homeless
1927 1957 1965
Breached Hurricane Betsy's surge overflowed levees, flooding parts of New Orleans. Higher levees were ordered built.

Higher levees were ordered built

1927 1957 1965 2005
Swamped Katrina's strongest winds hit elsewhere, but a day later breached levees led to flooding of most of the city.
Hurricane Katrina

• estimated deaths: 1500
• estimated economic toll: $135 billion
• insured losses: $20 to $35 billion
• where does the remaining $70 billion come from?

Costly Catastrophes

Hurricanes, with their destructive power and frequency, account for many of the disasters that have been the most expensive for property and casualty insurers.

<table>
<thead>
<tr>
<th>DATE</th>
<th>EVENT DESCRIPTION</th>
<th>INSURANCE PAYOUTS, IN BILLIONS OF 2004 DOLLARS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug. 1992</td>
<td>Hurricane Andrew</td>
<td>$20.05</td>
</tr>
<tr>
<td>Sept. 2001</td>
<td>World Trade Center and Pentagon terrorist attacks*</td>
<td>$20.05</td>
</tr>
<tr>
<td>Jan. 1994</td>
<td>Northridge, Calif., earthquake</td>
<td>$15.93</td>
</tr>
<tr>
<td>Aug. 2004</td>
<td>Hurricane Charley</td>
<td>$7.48</td>
</tr>
<tr>
<td>Sept. 2004</td>
<td>Hurricane Ivan</td>
<td>$7.11</td>
</tr>
<tr>
<td>Sept. 1999</td>
<td>Hurricane Hugo</td>
<td>$6.30</td>
</tr>
<tr>
<td>Sept. 2004</td>
<td>Hurricane Frances</td>
<td>$4.60</td>
</tr>
<tr>
<td>Sept. 2004</td>
<td>Hurricane Jeanne</td>
<td>$3.66</td>
</tr>
<tr>
<td>Sept. 1998</td>
<td>Hurricane Georges</td>
<td>$3.36</td>
</tr>
<tr>
<td>June 2001</td>
<td>Tropical Storm Allison</td>
<td>$3.10</td>
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</table>

Source: RIC, Insurance Information Institute

*Property coverage only.

Hurricanes and earthquakes are the most costly natural disasters

Natural disasters in the U.S.

The costs of natural disasters in the U.S.: $1 billion per week
Recovery?

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<tr>
<th>Year</th>
<th>Population</th>
<th>% Pre-Katrina Population</th>
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<td>2008:</td>
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2006-2007: College football returned
2007: Hosted NCAA Men’s Division 1 Basketball
2007-2008: New Orleans Hornets returned
2008: Hosted NBA All-Star game

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<tr>
<td>2006-2007:</td>
<td>369,000</td>
<td>81%</td>
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Recovery?

Most natural disasters were predicted
Their infrequency results in low priority or neglect of mitigation strategies
Help can be days in arriving
Individuals and communities must be able to survive by themselves for up to a week
The disruption to lives can last months years
The cost to the country is greater than $1 billion dollars per week

Lessons