Loss of life caused by the flooding of New Orleans after hurricane Katrina:

A preliminary analysis of the relationship between flood characteristics and mortality

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Background

• Methods for estimation of loss of life are used to:
  • Assess consequence and risk levels
  • Analyse mitigation strategies
• A method has been developed for Netherlands, mainly based on Dutch 1953 data
• Objective: analyse relationship between flood characteristics and mortality for New Orleans
• Focus on direct mortality in flooded area
Analysis of mortality

1. Analyse flood characteristics
2. Estimate exposed population (incl. evacuation)
3. Analyse relationship between flood characteristics and mortality

Mortality (=nr. of fatalities/nr. exposed)
New Orleans: situation

City of New Orleans
Ground Elevations

From Canal St. at Mississippi River
to the Lakefront at U.N.O.

Area Map

Lake Pontchartrain

New Orleans

Floodwall Along Mississippi River

23 FT

18 FT Project Flowline

Avg Annual Highwater 14 FT

Gentilly Ridge

SPH Design Elevation 11.5 FT

Normal Lake 1.0 FT Level

Elevations in Feet NGVD

30

20

10

0

-10

-20
Hurricane Katrina
Levee systeem
Flood simulations

- 2D Hydrodynamic simulations
- To give insight in: depth, velocity, rise rate, arrival time

Input information:
- Breach characteristics (location, size, timing)
- Digital elevation model
- Hydraulic roughness

- Results compared with: flood maps, damage patterns, eyewitness accounts
Flood simulation
Flood simulations: results
Flood simulations: results (2)
Flood simulations: results (3)
Flood simulations: results (4)
Affected population and evacuation

- Flooded area: ± 450,000 inhabitants
- Evacuation rate: 80% to 90% ((Wolshon, 2006) based on traffic counts)
- Shelter in city (Superdome etc.) ±10%
- Estimate: 10% of population was ‘exposed’ to flooding
Data regarding Katrina related fatalities

• Source: State Louisiana DHH in cooperation with LSU Hurricane Center
• Total: 1118 fatalities in Louisiana
• Recovery locations geocoded for 771 victims (69%)
• Dataset also provides information on:
  • Age (elderly!)
  • Gender (50%-50%)
  • Ethnicity (similar to original population)
  • Type of structure / facility
## Results by ‘bowl’

<table>
<thead>
<tr>
<th>Bowl</th>
<th>Inhabitants (flooded area)</th>
<th>Exposed</th>
<th>Recovered nr. of fatalities*</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orleans</td>
<td>255860</td>
<td>25590</td>
<td>260</td>
<td>1.02%</td>
</tr>
<tr>
<td>St. Bernard</td>
<td>85420</td>
<td>8540</td>
<td>190</td>
<td>2.22%</td>
</tr>
<tr>
<td>New Orleans East</td>
<td>96290</td>
<td>9620</td>
<td>68</td>
<td>0.71%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>437570</strong></td>
<td><strong>43750</strong></td>
<td><strong>518</strong></td>
<td><strong>1.18%</strong></td>
</tr>
</tbody>
</table>

*Number of fatalities in the exposed population.
Results

Breach zone: $hv > 5 \text{m}^2/\text{s}$
\[ F_D = 0.053 \]
Remaining zone ($hv < 5 \text{m}^2/\text{s}$):
\[ F_D(h) = \Phi_N((\ln(h) - 5.20)/2.00) \]
Breach zone: Lower 9th Ward

Flood characteristics

- Many fatalities (75) near the Lower 9th Ward breaches
- Characterised by building collapse and $hv > 5m^2/s$

Building damage
Concluding remarks

- Overall event mortality (1%) comparable to historical events
- 2/3 of the fatalities associated with physical impacts of the flood
- Mortality rates were highest in areas with large water depths and near breaches
- Relationship between flood characteristics and mortality was found (but no influence of rise rate)

Recommendations
- Further analysis of mortality and population data is recommended
- Comparison with other methods (e.g. IPET)
- Application in consequence and risk assessments