Sea-Level Rise and Future Risk of Coastal Flooding in Maine

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GGR 904 GIS for Research and Analysis
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Outline

- Flooding Impacts
- Current Risk Communication
- Change in Conditions
- Research Objective
- Risk Assessment

Flooding Impacts

Wednesday, April 18, 2007, Nor'easter damage in York County, Maine. (AP Photo/Pat Wellenbach)

Tuesday, April 17, 2007, in the Ferry Beach section of Saco Bay, Maine. (AP Photo/Robert F. Bukaty)

Flooding Impacts

17, 2007, in the Ferry Beach
Photo/Robert F. Bukaty)

Wedı
York

Mothers Day Flood 2006 York County, ME

Flooding Impacts

- **Causes more economic losses than any other natural hazard[1]**
- **Increase in property flood losses: $3.3 to $6 billion a year (1980s–2005)[1]**
- **Loss of life: about 100 people annually (1983-1997)[2]**

[1] King, R. 2005. *Federal flood insurance. Congressional Research Service Report for Congress*. The Library of Congress, Washington, DC.

[2] Pielke Jr., Roger A. and Mary W. Downtown. 2000. Precipitation and damaging floods: Trends in the United States, 1932-97. Journal of Climate 13, no. 20 (October): 3625-3637.

Current Risk Communication

- **Flood Insurance Rate Maps (FIRMs)**
  - Primary tool for flood risk assessment
  - Cover most of the U.S. territory
  - **Out of date**

- **FEMA Map Modernization Program**
  - Launched in the late ‘90s
  - Update and conversion of the FIRMs to DFIRMs
  - **Does not consider future changes**

Current Risk Communication

National Flood Insurance Program (NFIP)

- Established in 1968
- Protects properties
- Uses the FIRMs to determine the necessity for insurance coverage
- Mandatory flood insurance for properties inside the 100-year floodplain
- Often criticized for ineffectiveness[3]

[3] Patterson, Lauren A. and Martin W. Doyle. 2009. Assessing effectiveness of national flood policy through spatiotemporal monitoring of socioeconomic exposure. *Journal of the American Water Resources Association* 45, no. 1 (February): 237-252.

Current Risk Communication

FIRMs/DFIRMs

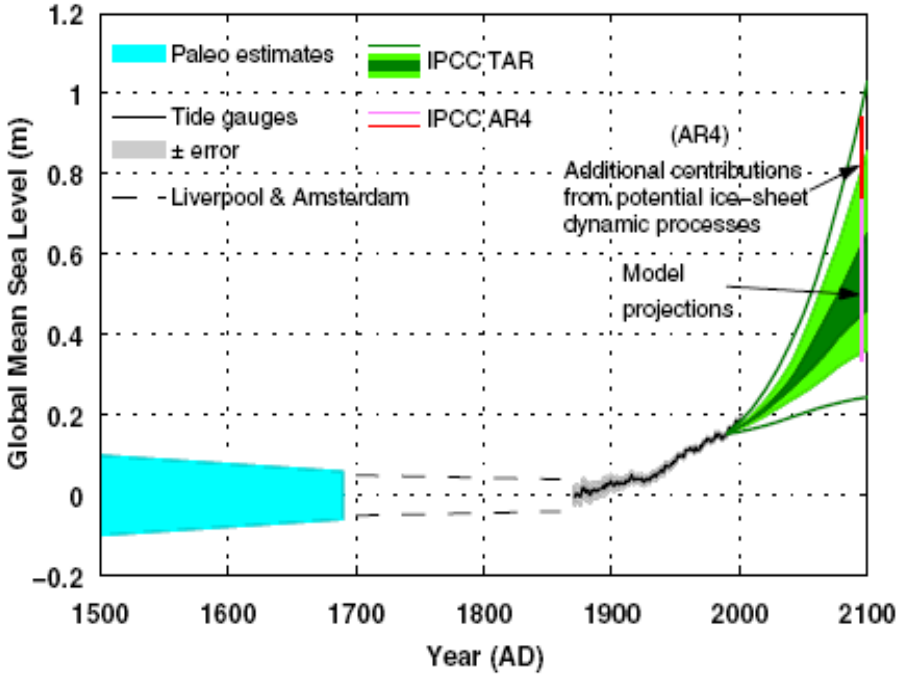
"100-year floods can happen 2 years in a row"[4]

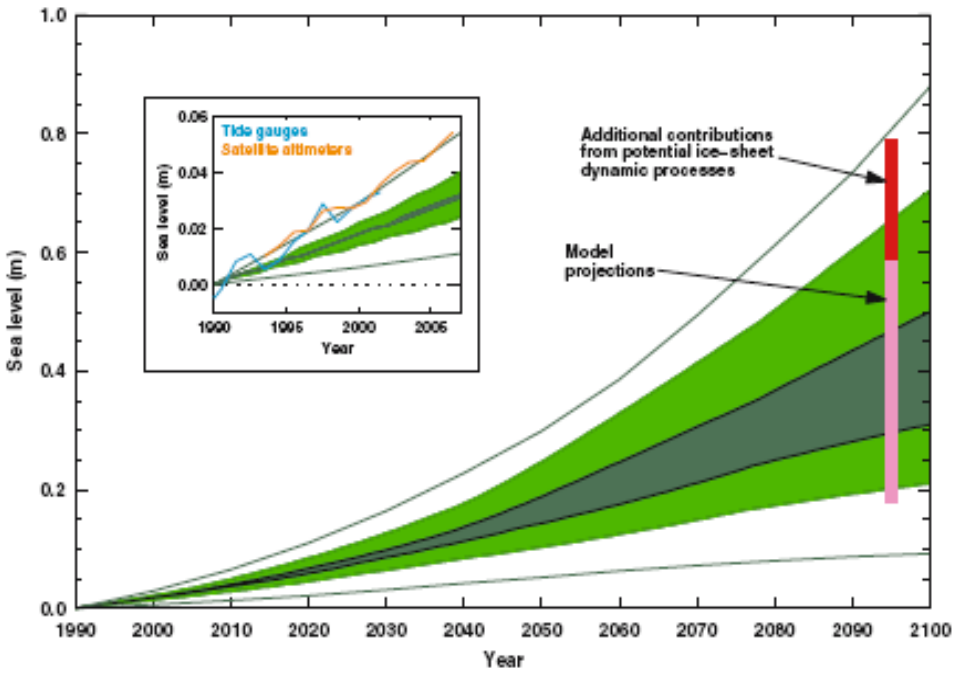
- 100-year flood: at least 1% chance to occur in any given year
- 100-year floodplain (Special Flood Hazard Zones - SFHZ): delineate the borders of the 100-year flood
- 500-year flood: 0.2% to 1% chance to occur in any given year

[4] http://ga.water.usgs.gov/edu/100yearflood.html

Change in Current Conditions

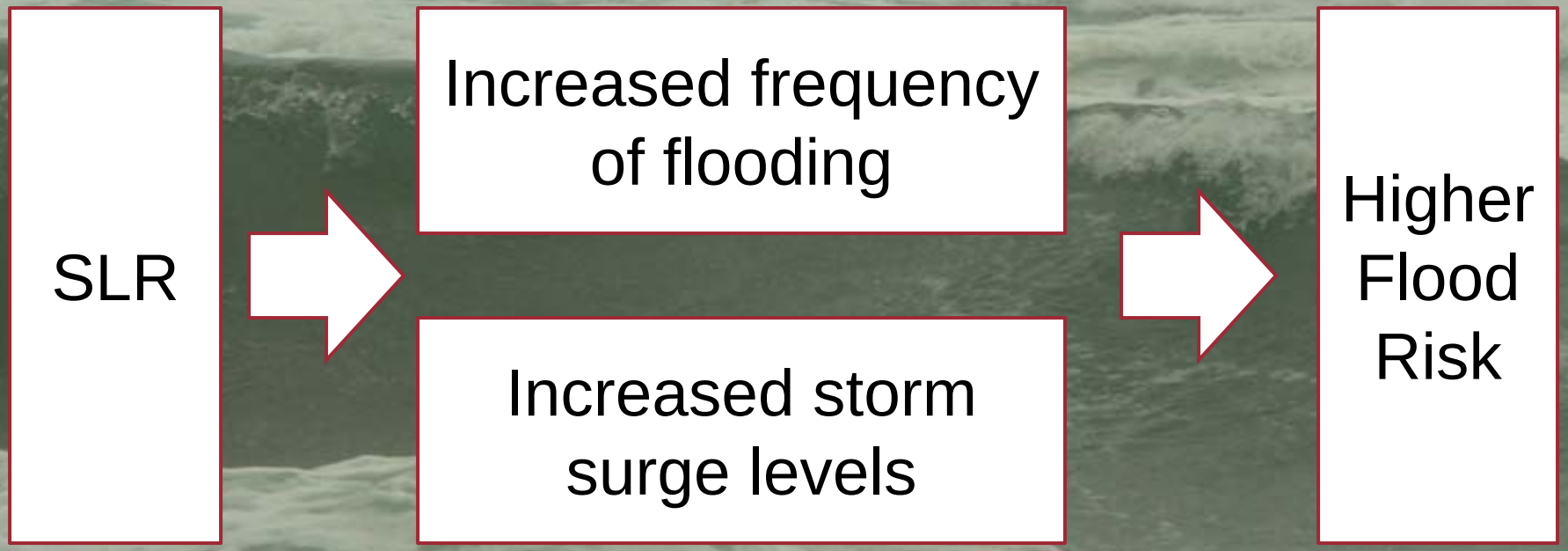
- **Global Sea-Level Rise (SLR)**





Source: Church et al. 2001. Understanding Global Sea Levels: past, present, and future. *Sustainability Science* 3, no.1 (April): 9-22.

Change in Current Conditions



Kirshen et al. 2007. Coastal flooding in the Northeastern United States due to climate change. *Mitigation and Adaptation Strategies for Global Change* 13, no. 5-6 (December): 437-451.

Wu et al. 2008. Potential impacts of sea-level rise on the Mid- and Upper-Atlantic region of the United States. *Climatic Change* (December).

Research Objective

To assess the current and future risk of coastal flooding in Maine, examining:

- The current physical exposure to coastal flooding in the state of Maine
- The future physical exposure to coastal flooding in 2020s, 2050s, and 2100s
- The extent of the 100-year floodplain in 2020s, 2050s, and 2100s

How the distribution of flooding risk will change from the current situation to 2020s, 2050s, and 2100s

Research Objective

Defining Risk

RISK = HAZARD x EXPOSURE

HAZARD = COASTAL STORM

EXPOSURE = ELEVATION

Current Risk Assessment

1. **Finding the current water height during coastal storm**

Current Mean Sea Level	+	Current Mean Tide Height	+	Storm Surge Height

Data Source: NOAA Tides and Currents website

2. **Applying the result to a Digital Elevation Model (DEM) to determine the areas under water**

Data Source: Digital Terrain Model (DTM) from Maine GIS (MEGIS)

Current Risk Assessment

1. **Finding the current water height during coastal storm**

3. **Compare the extent of the modeled flood areas to the extent of the FIRMs flood zones by percentage of flooded territory**

Data Source: 1996 and 1997 FIRMs from MEGIS

Model (DEM) to determine the areas under water

Data Source: Digital Terrain Model (DTM) from Maine GIS (MEGIS)

Future Risk Assessment

Sea level rise projections for Maine

- 61 cm (2 ft) by 2100s
- Sea level rise per year

  (2100 – 2009) = 91 years

  91y/61cm = 7mm/year

- 8 cm (0.3 ft) by 2020s
- 29 cm (1 ft) by 2050s

Slovinsky, Peter A. and Stephen M. Dickson. 2006. *Report: Impacts of future sea level rise on the coastal floodplain*. MGS Open-File 06-14.

Future Risk Assessment

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- 61 cm (2 ft) by 2100
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  - 8 cm (0.3 ft) by 2020
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Apply these three projections to the DEM to determine areas under future risk of flooding

Compare modeled flood zones with FIRMs flood zones by percentage of flooded territory

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In Summary…

Increasing Flood Losses

Outdated FIRMs

Sea Level Rise

Risk Assessment Investigations


Thank you