15.023J / 12.848J / ESD.128J Global Climate Change: Economics, Science, and Policy
Spring 2008

Sea-level Rise
Science and Impacts

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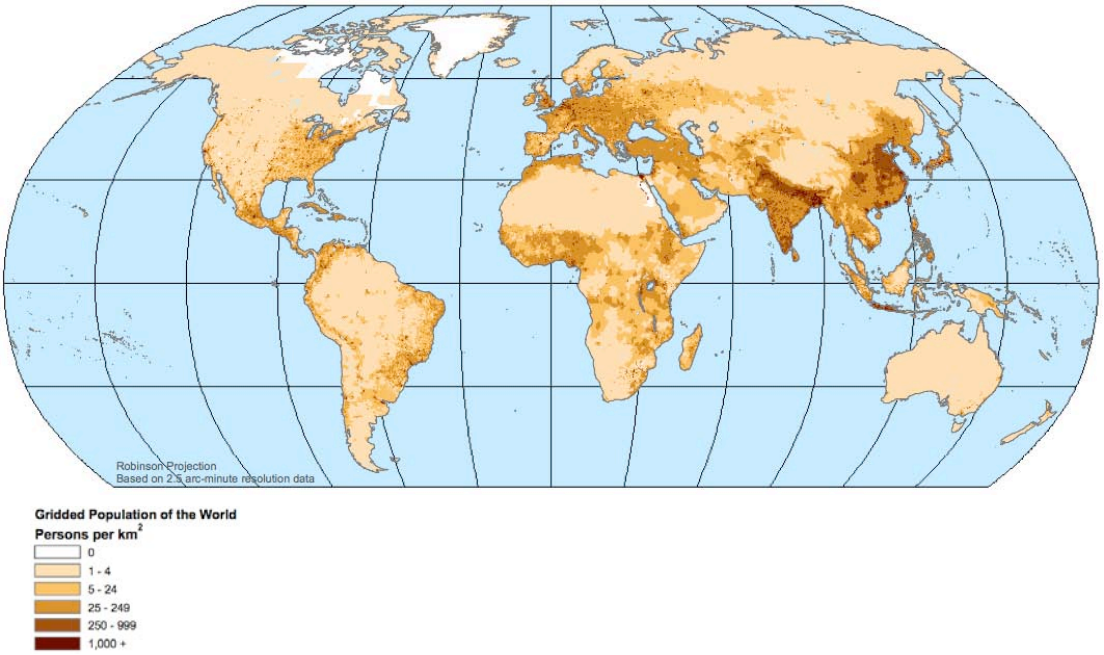
15.023 / 12.848 / ESD.128
16 April 2008

Agenda

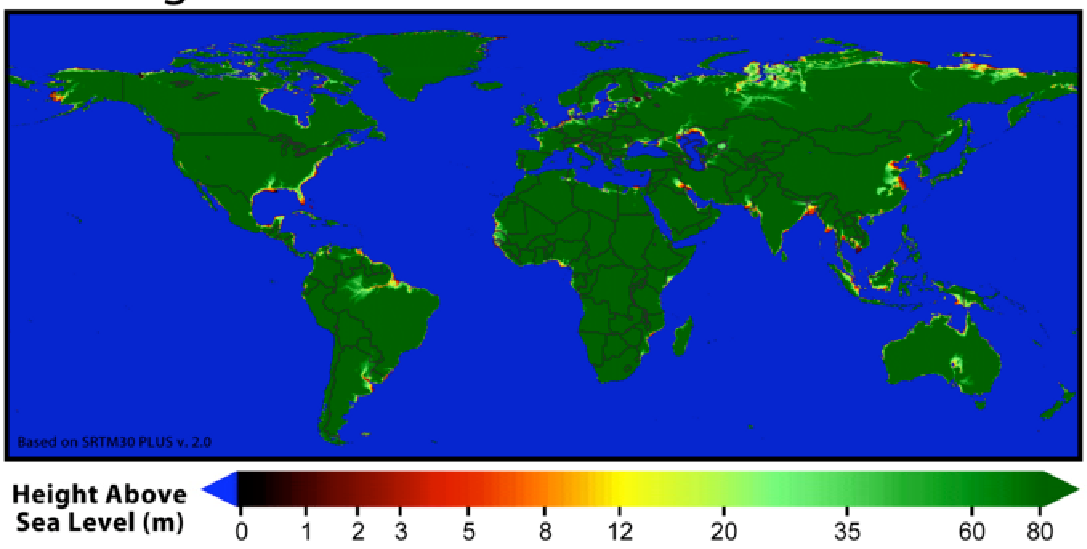
- Discussion of IPCC reports and SLR estimates
- Scientific controversy and the long tail
- Social coastal-zone trends and impacts

Motivation: Millions live near the coast

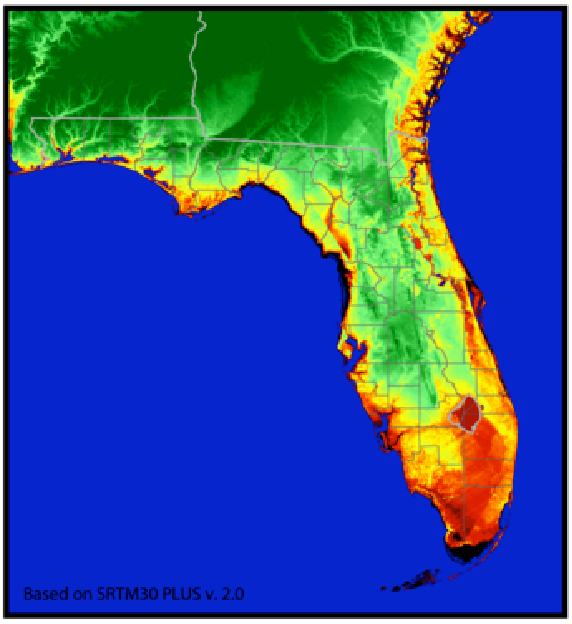


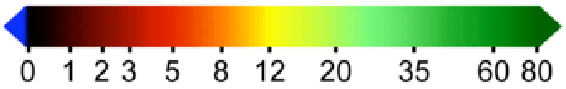
Courtesy of the Socioeconomic Data and Applications Center, Columbia University. Used with permission. The World: Population Density, 2000. Center for International Earth Science Information Network (CIESIN), Columbia University; and Centro Internacional de Agricultura Tropical (CIAT). 2005. Gridded Population of the World Version 3 (GPWv3). Palisades, NY: Socioeconomic Data and Applications Center (SEDAC), Columbia University. Available at http://sedac.ciesin.columbia.edu/gpw.

Regions Vulnerable to Sea Level Rise



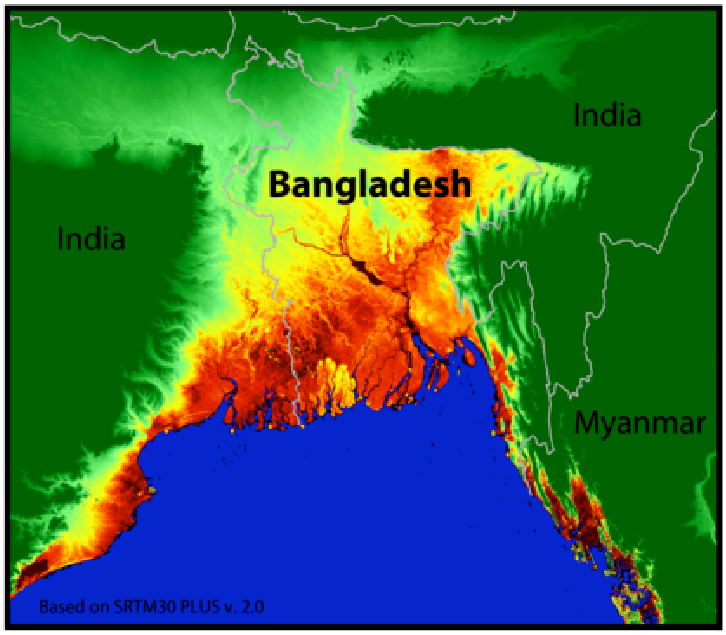
Sea Level Risks - Florida

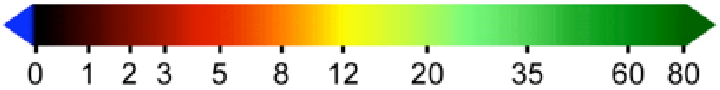




Height Above Sea Level (m)

Sea Level Risks - Bangladesh



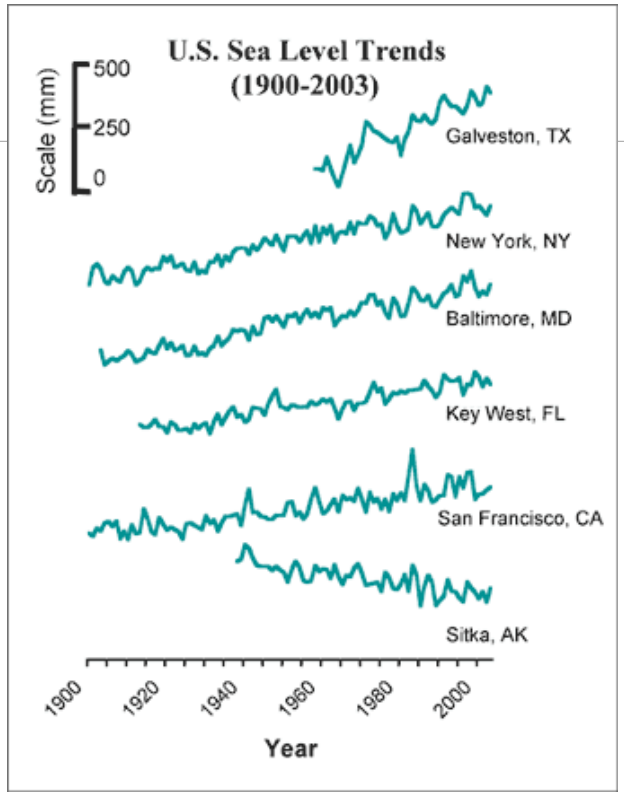


Height Above Sea Level (m)

Causes and Projections

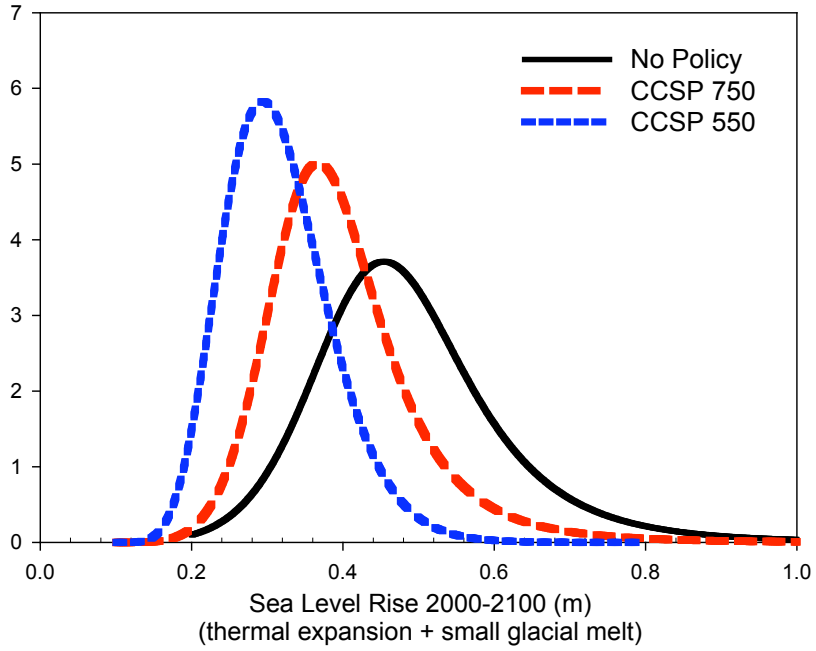
- Causes are thermal expansion, glacial melt, subsidence or uplift => Relative SLR
- Historic:
  - Sea level rose at an average rate of about 1.8 mm/year during the years 1961-2003. The rise in sea level during 1993-2003 was at an average rate of 3.1 mm/year. It is not clear whether this is a long-term trend or just variability.
- Projections
  - 9 to 88cm by 2100 (IPCC TAR, 2001)
  - 18 to 58cm, plus 10-20cm for polar glaciers

    (IPCC AR4, 2007)



Source: http://www.epa.gov/climatechange/science/recentslc.html

Joint Program SLR Estimates



Joint Program SLR Odds

	Sea Level Rise > 0.3m	**Sea Level Rise > 0.6m**
No Policy	19 in 20	3 in 20
Stabilize at 750	17 in 20	1 in 25
Stabilize at 650	15 in 20	1 in 50
Stabilize at 550	11 in 20	<1 in 400
Stabilize at 450	1 in 4	< 1 in 400

Large Ice Sheets and Dams

- The IPCC and MIT ranges don't include SLR because of Antarctica and Greenland
- Two studies estimate much higher ranges (~0.8m to 1.5m) by 2100
- Chao *et al.* (2008) estimate that reservoirs and other inland water impoundments have held large amounts of mountain glacial melt
  - Historical sea-level estimate would be biased low

Photograph of melting ice sheet removed due to copyright restrictions.

Economic and Social Trends

- Historically, coasts have been important for commerce and travel
  - Vast amounts of trade enters the US via ship
- Recent decades: population and capital investment along the coast has grown *faster* than the national average
- Costs of tropical storms have increased dramatically in recent history

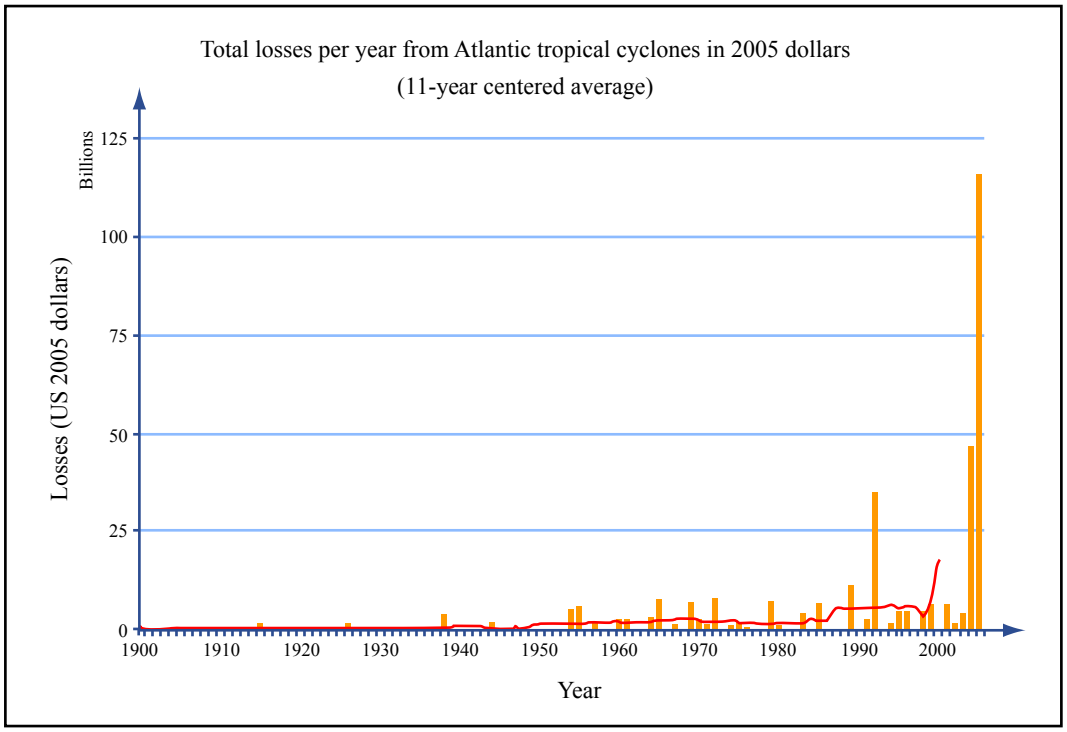


Figure by MIT OpenCourseWare, adapted from Pielke Jr. et al., *Natural Hazards Review*, 2008.

Economic and Social SLR Studies

- Titus (1988) gave economic estimates of flooded US land value
- Yohe et al (1996) show that information could lower costs dramatically if the markets could react accordingly
- Gibbons and Nicholls (2006) show that people might make different choices than purely rational assumptions would dictate

- Highlight:
  - Non-linearities in the social response
  - Limited foresight, bounded rationality
  - Value of information (econ)

Coastal Zone Managers Perceptions

- Recent Federal Studies:
  - NAS - “Potential Impacts of Climate Change on U.S. Transportation”
  - CCSP 4.1 - “Coastal Sensitivity to Sea Level Rise”
- Coastal managers are not planning for future sea-level rise
  - New infrastructure projects could be at risk
  - Zoning and building codes could be refined or improved to reduce risk
- If they have considered SLR, confusion over what values to consider

Coastal Zone Issues

- Fast economic growth
- Large amount of critical infrastructure
- Value natural ecosystems
  - Beaches for tourism and coastal protection
  - Wetlands for habitat, coastal protection, fishing
- Non-climate environmental issues, including river runoff and sedimentation
- How to manage coastal zones?
  - Benefit/cost?
  - Cost effectiveness?
  - Role of science?

Questions?
(Remember no class Monday)