Informing Decision Makers of the Potential Impacts of Sea Level Rise in the Coastal Region of New Jersey

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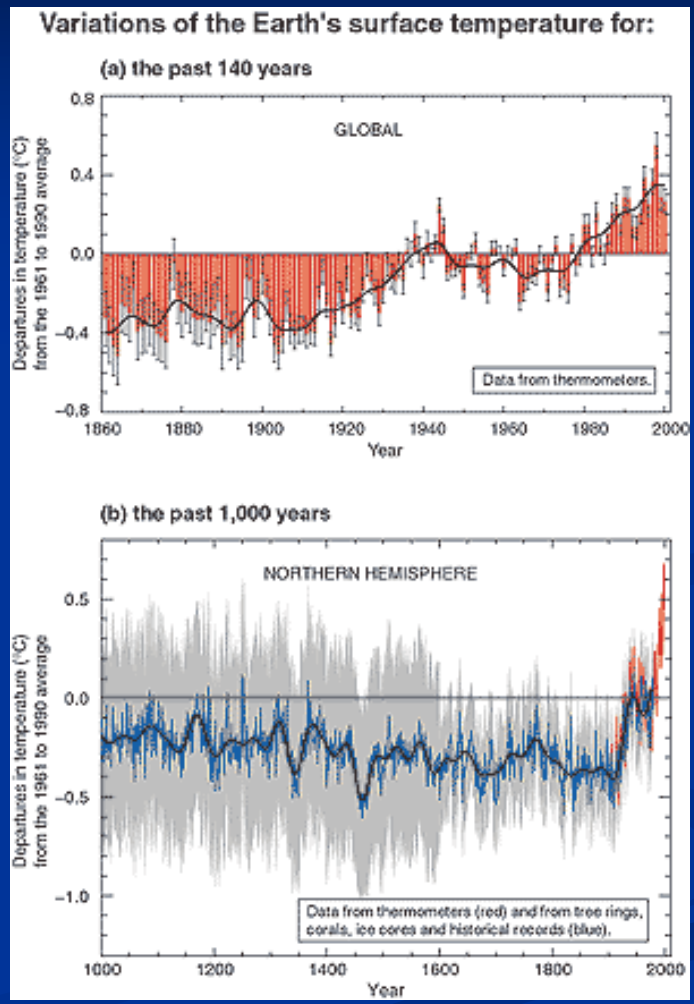
Introduction

- Sea Level Rise (SLR): significant and growing threat to New Jersey



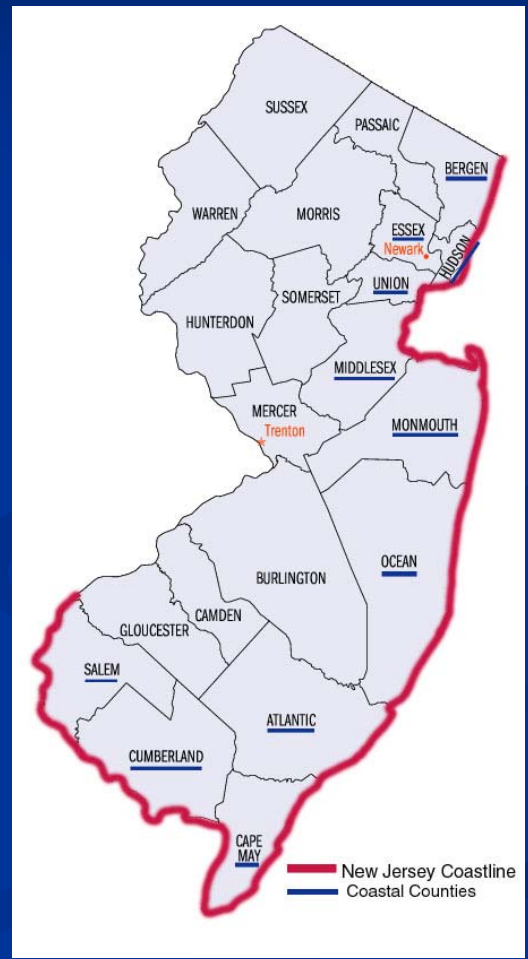
(IPCC, 2001)

- Changes in SLR related to fluctuations in global temperature (IPCC, 2001)

- Effects of SLR likely to intensify

Coastal Resources

- Atlantic coastline - 204 km; Raritan and Delaware Bays – 134 km
- Coastal population ~5.3 million (60% of total)
- Industry: $16 billion tourism; $50 billion maritime; $100 million commercial fishing

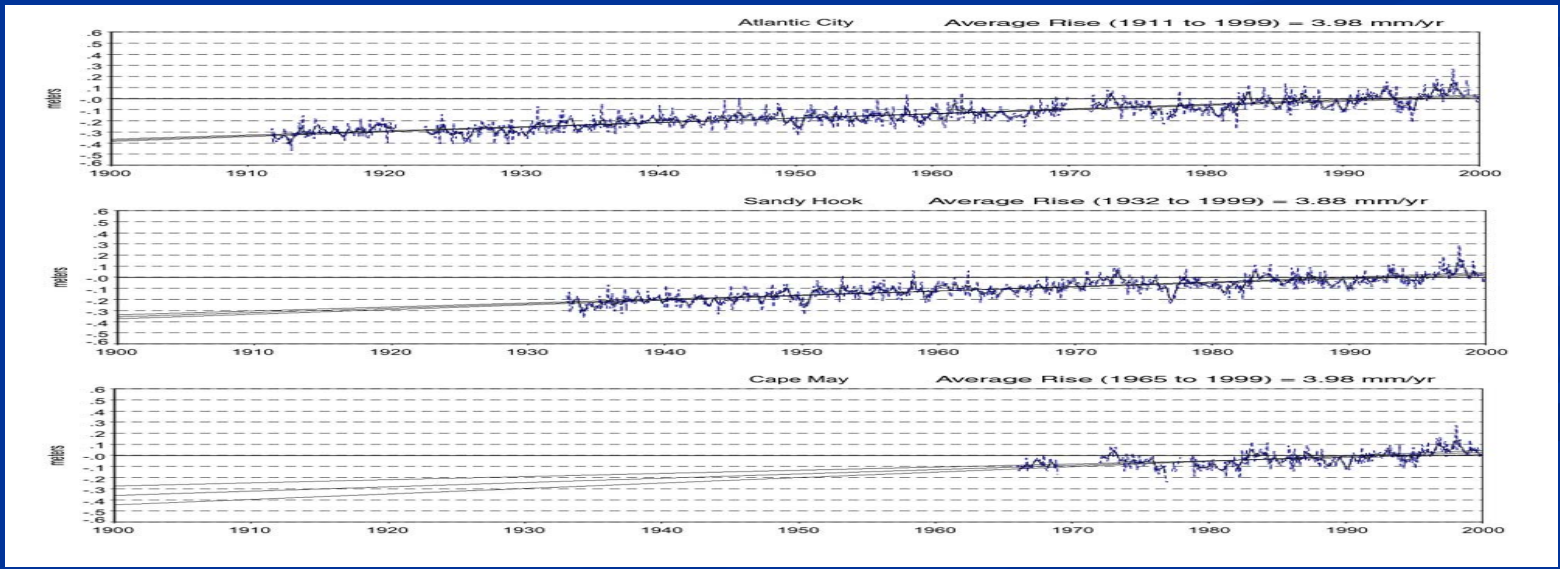


Coastal Resources

- 24 endangered or threatened species
- Atlantic flyway ~1.5 million migratory shorebirds
- World's largest population of horseshoe crabs

Methods – SLR Projections

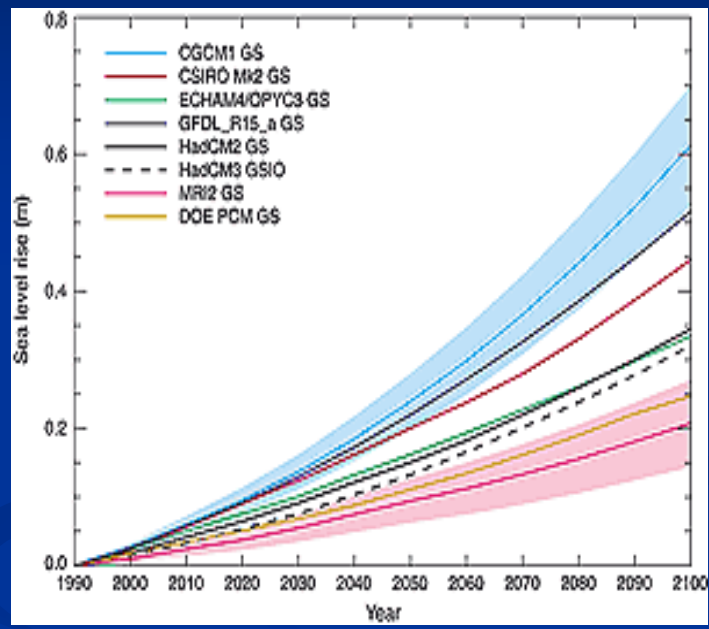
- NJ mean SLR trend = 3.53 mm/yr
- Global-mean SLR trend - 1.0-2.0 mm/yr or a total of 10-20 cm (IPCC, 2001)
- NJ → local component ~2 mm/yr



NJ Tide-Gauge Data (NOAA, 2004)

Methods – SLR Projections

- Projected global-mean SLR: 0.09 – 0.88 m over next century (IPCC, 2001)



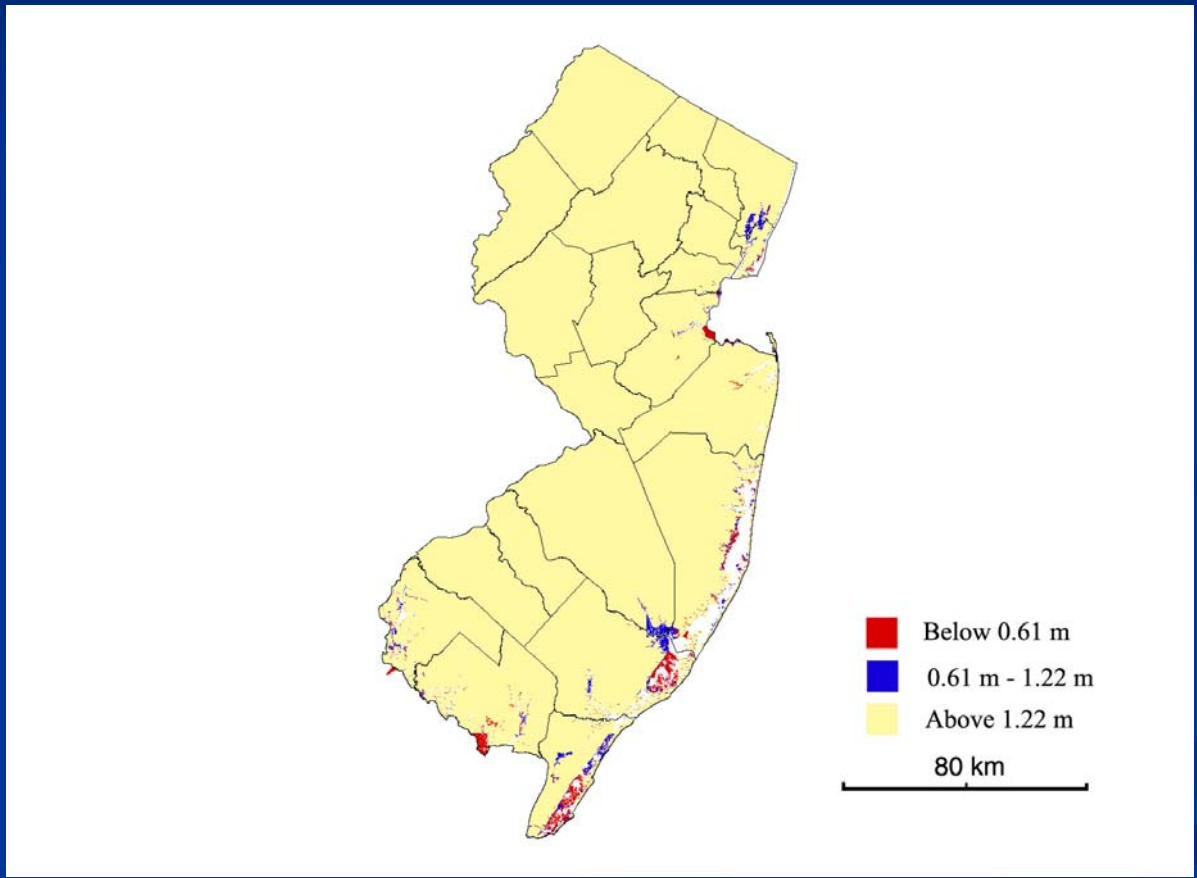
Projected global-mean SLR (IPCC, 2001)

- Projected NJ relative SLR: 0.31 - 1.10 m (global + local components)
- NJ SLR parameters:
  - 0.61 m (2 ft) (50% probability → 2100)
  - 1.22 m (4 ft) (1% probability → 2100)
- Applied SLR projections to digital elevation models
  - → Limitations: static representation, unable to represent future shorelines

Coastal Inundation

- 0.61 m SLR:
~170 km²
(1% land area)

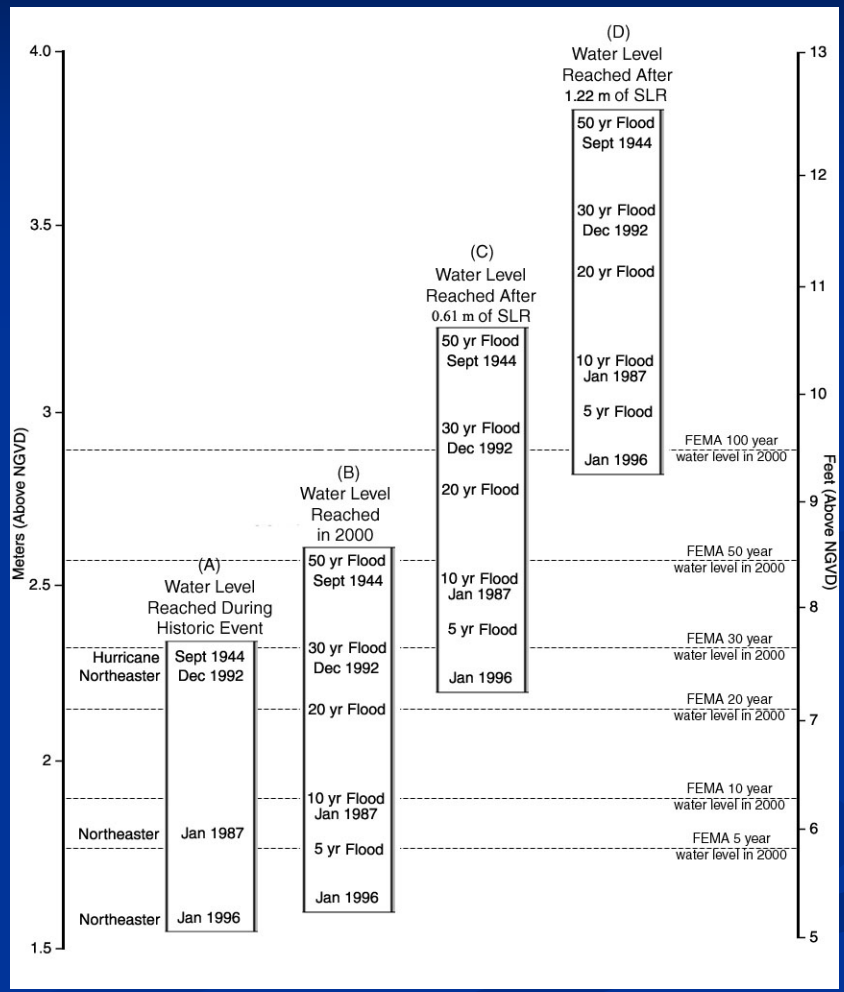
- 1.22 m SLR:
~442 km²
(3% land area)



Estimated land area susceptible to inundation applying SLR projections

Coastal Flooding

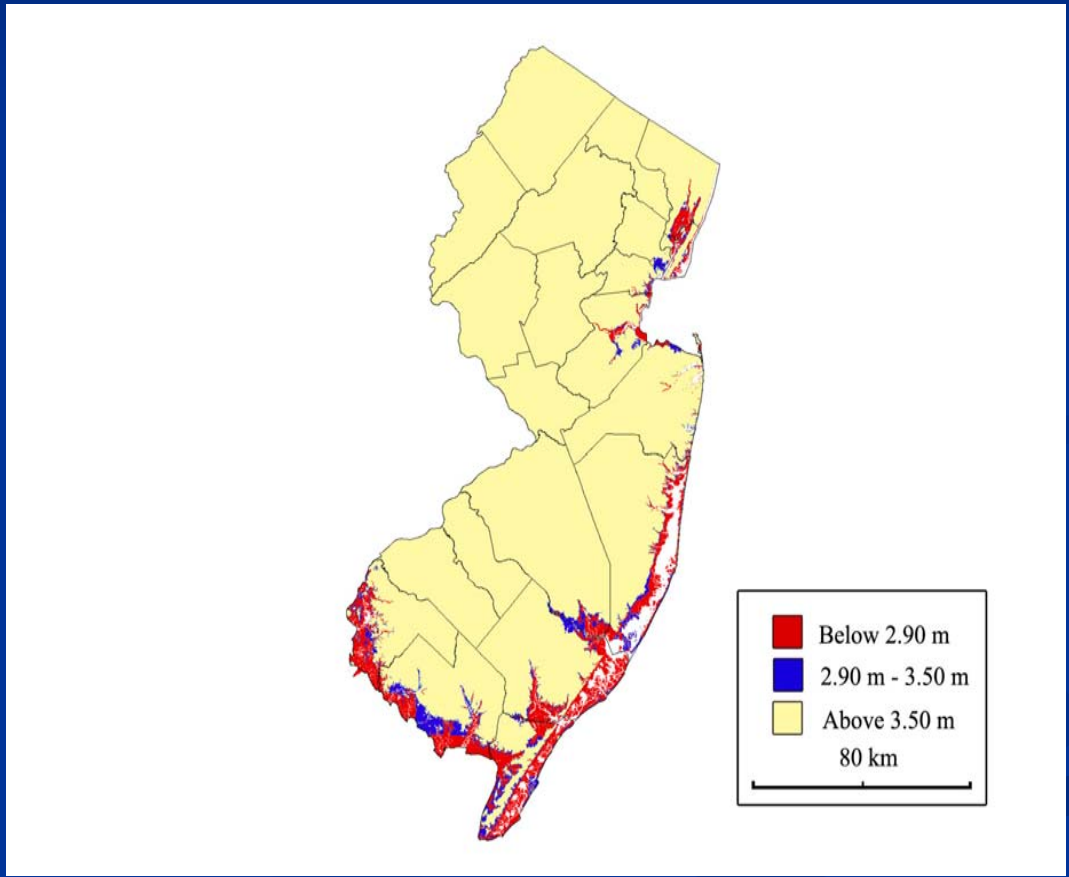
- Associated with storm events - episodic
- NJ 100-yr flood water level: ~2.90 m
- 100-yr flood water levels exceeded 4 – 20 times more frequently
- Current 100-yr flood water level could become:
  - 30-yr flood water level (0.61 m SLR)
  - 5-yr flood water level (1.22 m SLR)



Potential impact of SLR on tidal surge frequency and flood levels, Atlantic City, NJ

Coastal Flooding

- Episodic flooding w/ 0.61 m SLR: 1,787 km² → 9% land area



Estimated land area susceptible to flooding applying SLR projections

Coastal Erosion

- Future shoreline change rate with SLR: 73 -146 m – high variability (see Zhang et al., 2004)
- Significant coastal erosion

Saline Intrusion

- Increased salinity of surface and groundwater near coastal areas
- Alteration of coastal ecosystems

Potential Impacts on Socio-economic Systems

- Developed NJ coastline susceptible to:
  - Inundation: ~19.5 – 60 km²
  - Flooding: ~269 - 414 km²
    - Impacts ~145 km² previously unaffected developed shoreline
    - Communities currently safe from most severe flooding events will be impacted

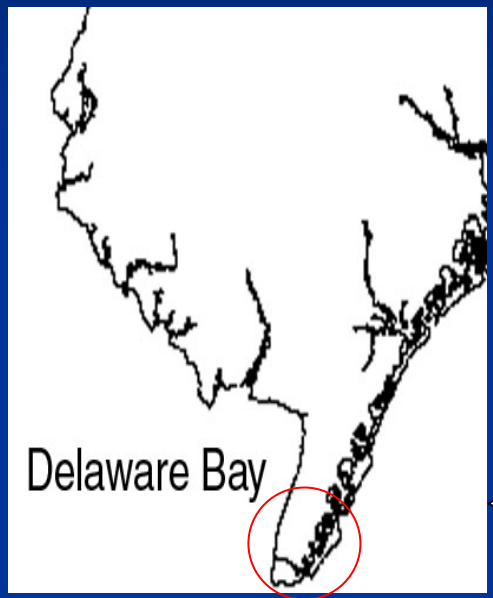
Atlantic City, NJ

Potential Impacts on Natural Systems

- Coastal wetlands susceptible to SLR:
  - Inundation: ~15 - 30% of saline marshes
  - More frequent episodic flooding
- Coastal wetlands risk inundation if SLR is faster than accretion rate or "squeezed" by development

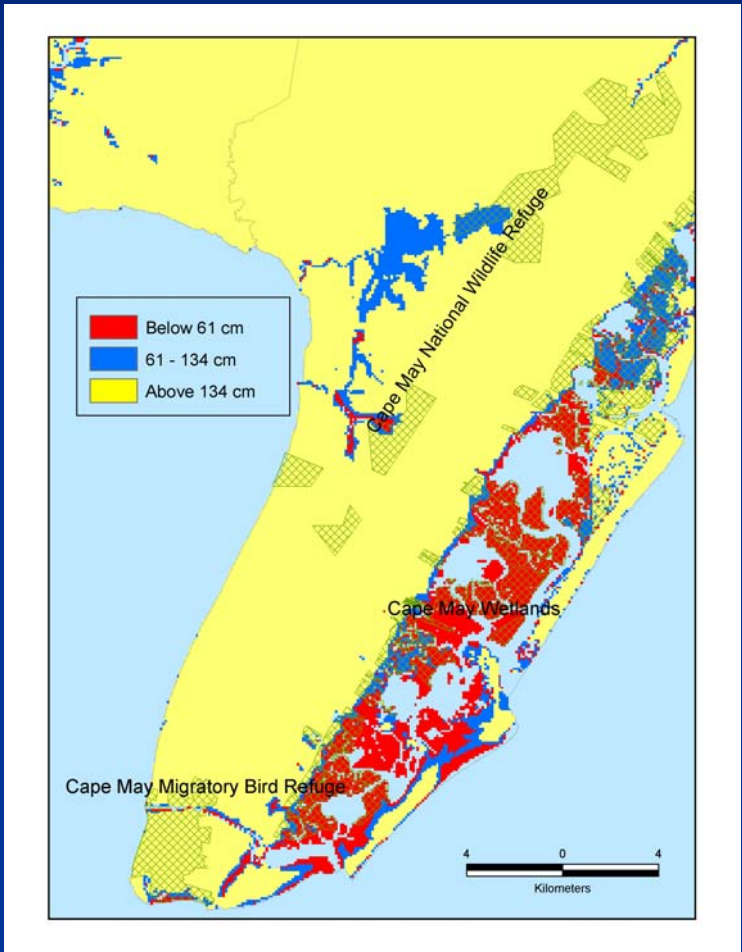
Cape May, NJ

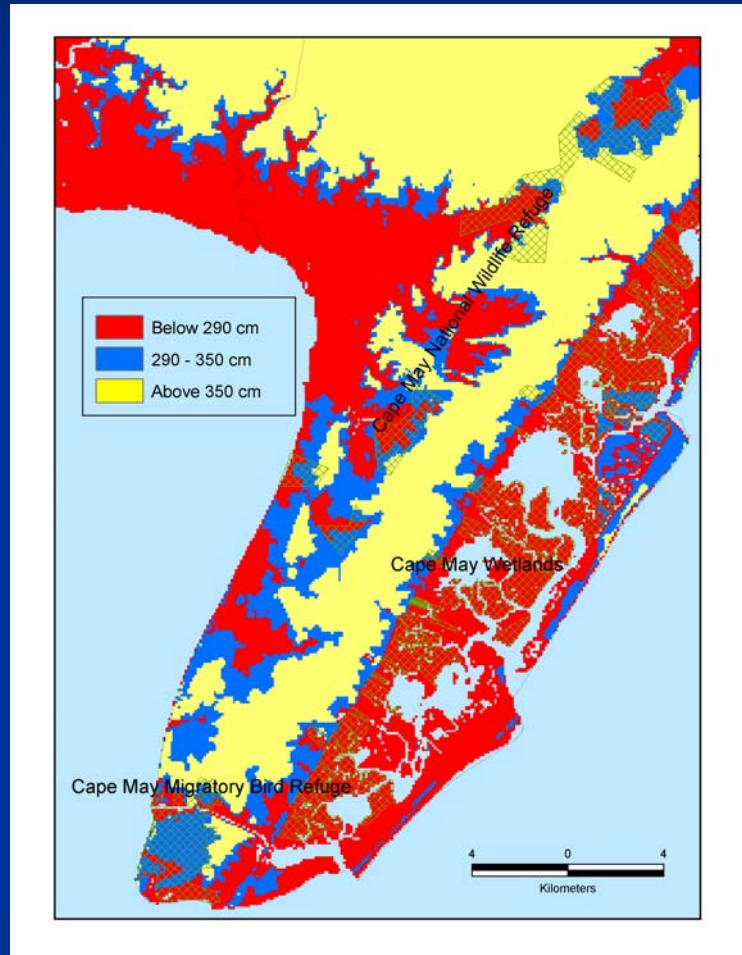
Case Study - Cape May NWR, Migratory Bird Refuge and Wetlands



- Globally important bird area (Chipley et al., 2003) ~ 90 km²
- 80% coastal wetlands
- Large concentrations of breeding, migrating, and wintering bird species
- Atlantic flyway
- World's largest population of horseshoe crabs

Case Study – Cape May NWR, Migratory Bird Refuge and Wetlands





Estimated land area susceptible to inundation and episodic flooding applying SLR projections

Case Study – Cape May NWR, Migratory Bird Refuge and Wetlands

- Inundation: 40 – 50% of bird areas
  - Coastal wetland loss → 38 – 49%
- Episodic flooding: 76 – 90% of bird areas
- Habitat change and alteration → able to sustain current population levels of coast dependent bird species? Horseshoe crabs??

Adaptation Opportunities

- Coastal management responses to SLR:
  - Defending the existing coastline (structural and non-structural approaches)

    → short-term: due to high property value/tourism cost effective

    → long-term: elimination of coastal wetlands and high costs

  - Allow coastline to naturally migrate inland

    → gradual withdrawal of development from coastline (Titus, 1991)

Adaptation Opportunities

- Coastal land use planning in New Jersey:
  - Development in hazardous and sensitive coastal regions
  - Current provisions do direct new development away from high hazard areas BUT…in place construction and expansion of existing development remains unaffected
  - NJ DEP: success at acquiring susceptible coastal areas

Adaptation Opportunities

- Political, legal and social challenges:
  - Largely unsuccessful defending coastal development permit denials when litigation brought by private parties
  - Acquisition of coastal resources → BUT can only protect a minority through acquisition

Informing Decision Makers

- Restating science in lay language – inadequate

- Dynamic & overlapping decision process:

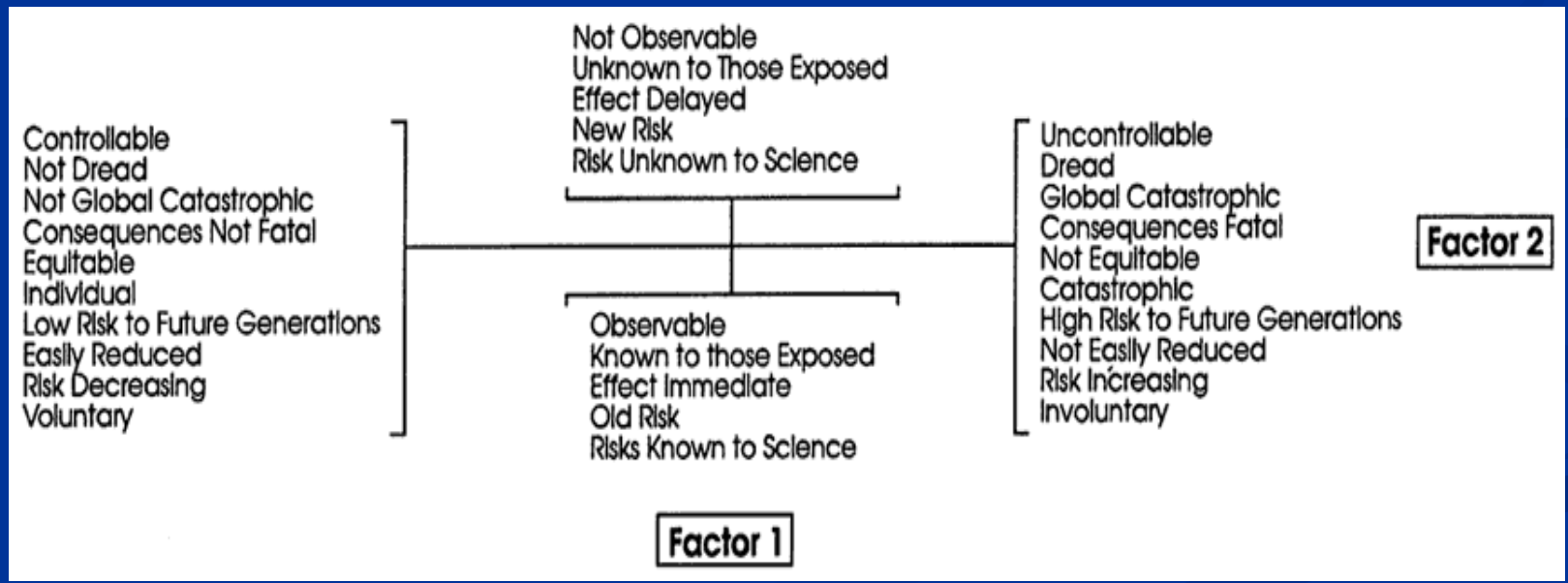
  → climate, SLR, ecological processes, coastal management, regulations, risk

Informing Decision Makers

- Decision process: SLR and coastal management
  - Routine problem → SOP and repetitive decisions
  - Repeated, complex & controversial problems → stakeholder participation model – "open process" (Stern and Fineberg, 1996)

Informing Decision Makers

- How is risk to SLR contextualized by technical experts, decision-makers, citizens??



(Slovic, 1987; adapted from Stern and Fineberg, 1996)

Informing Decision Makers

- Detailed and targeted scientific and technical information
  - Decision makers → understand enough to make good decisions
  - Stakeholders → understand enough to participate in good decisions
- Address uncertainty BUT "don't wait for certainty in an uncertain world"
- Adaptive management – strategy as hypothesis as well as plan
  - Flexibility → social learning → change
  - Expansion of decision making cycles – institutional patience
  - Make decision makers aware they are experimenting

Conclusions

- Katrina effect → which "policy window"??

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