Climate Change and Economic Development on Europe's Coast

Robert J. Nicholls
Flood Hazard Research Centre
Middlesex University, London, UK

AVEC Summer School

"Integrated Assessment of Vulnerable Ecosystems Under Global Change"

Peyresq, France, September 2003

Plan

- Why care about the coast?
- Socio-economic changes
- Climate changes, especially sea-level rise
- Mitigation vs. adaptation to sea-level rise

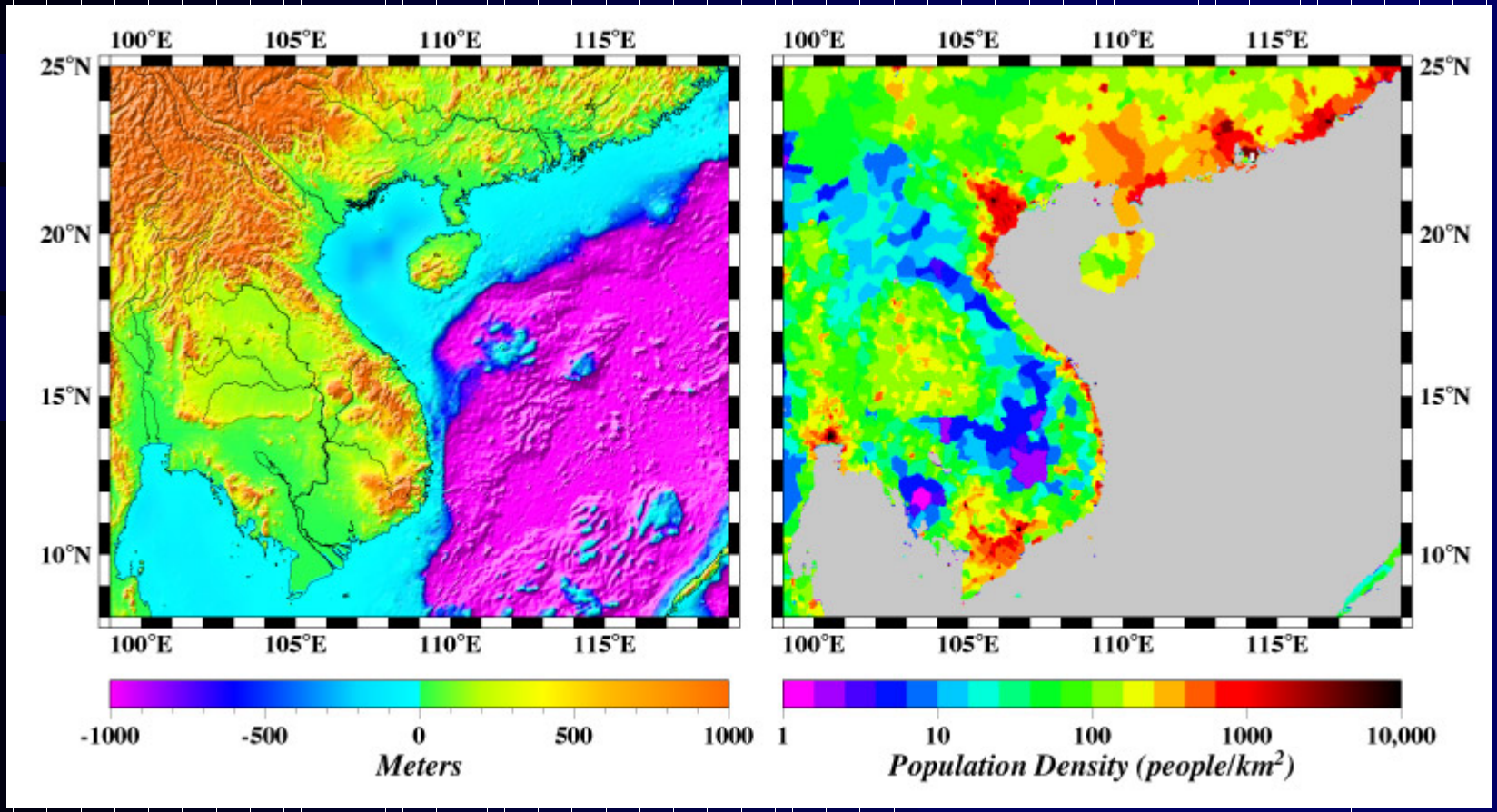
Why are coasts important?

Europe at Night

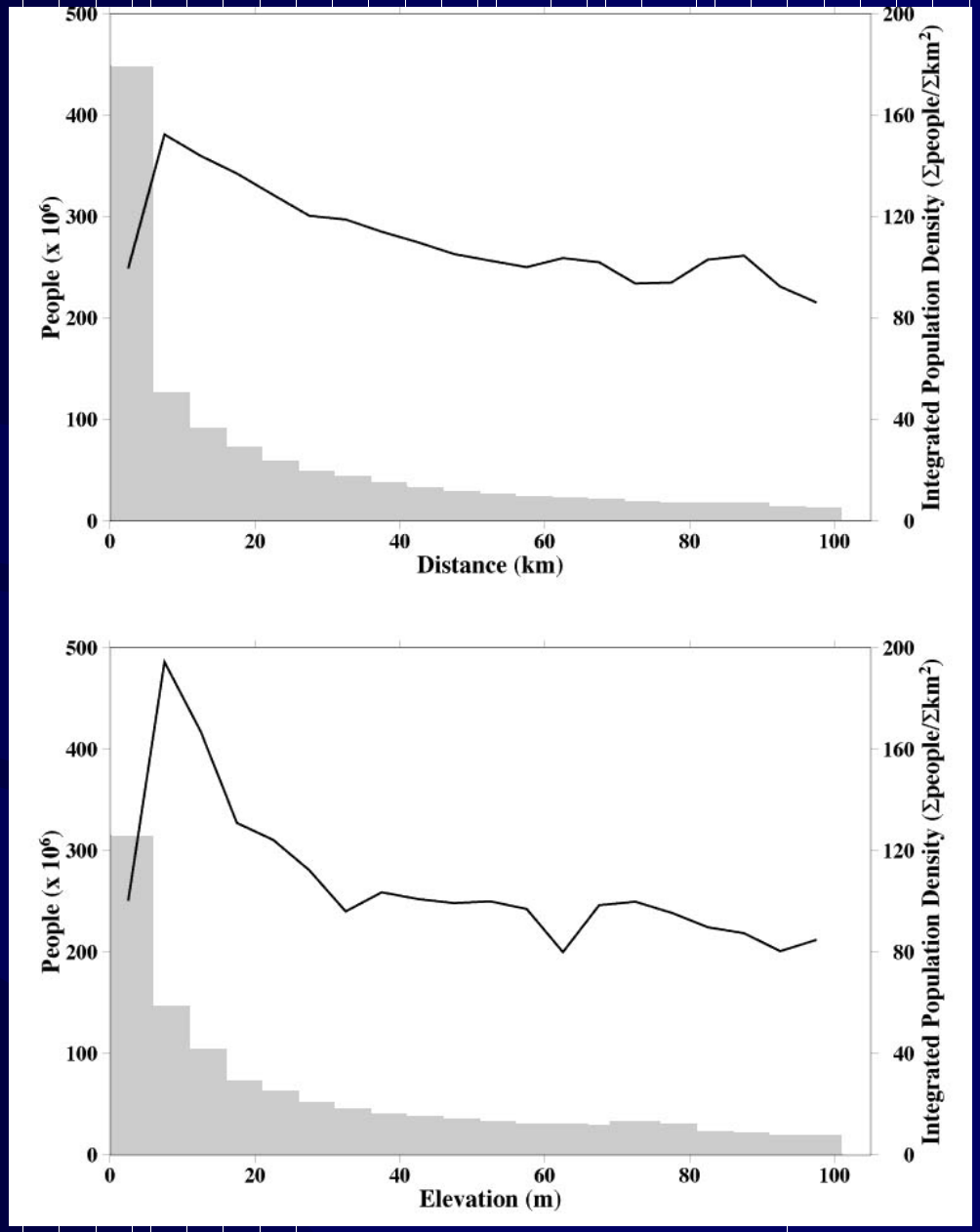
Population density

Night lights

Elevation and population density maps for Southeast Asia

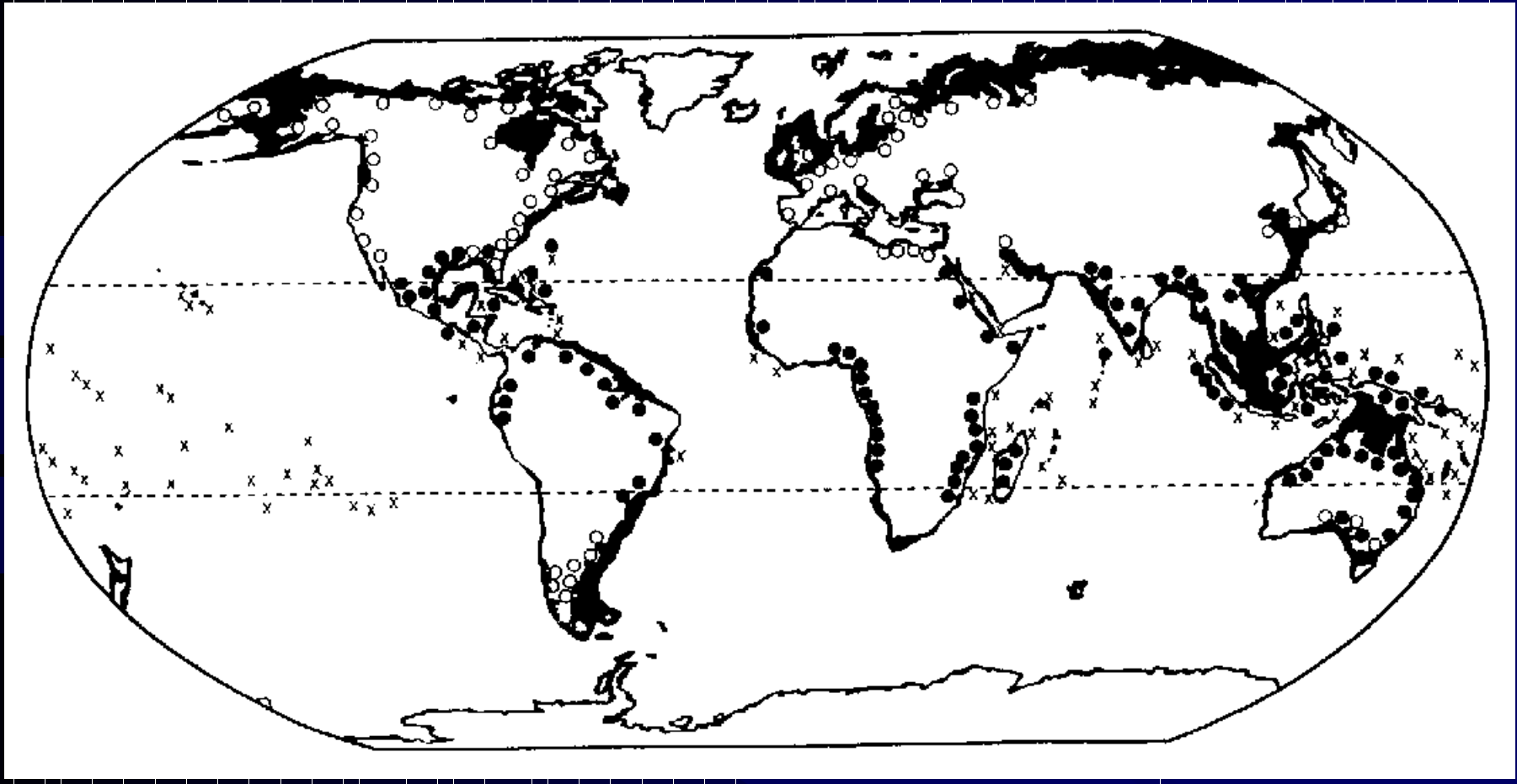


Global Population and Population Density vs. Distance and Elevation in 1990



Coastal Megacities (>8 million people)
Forecast for 2010

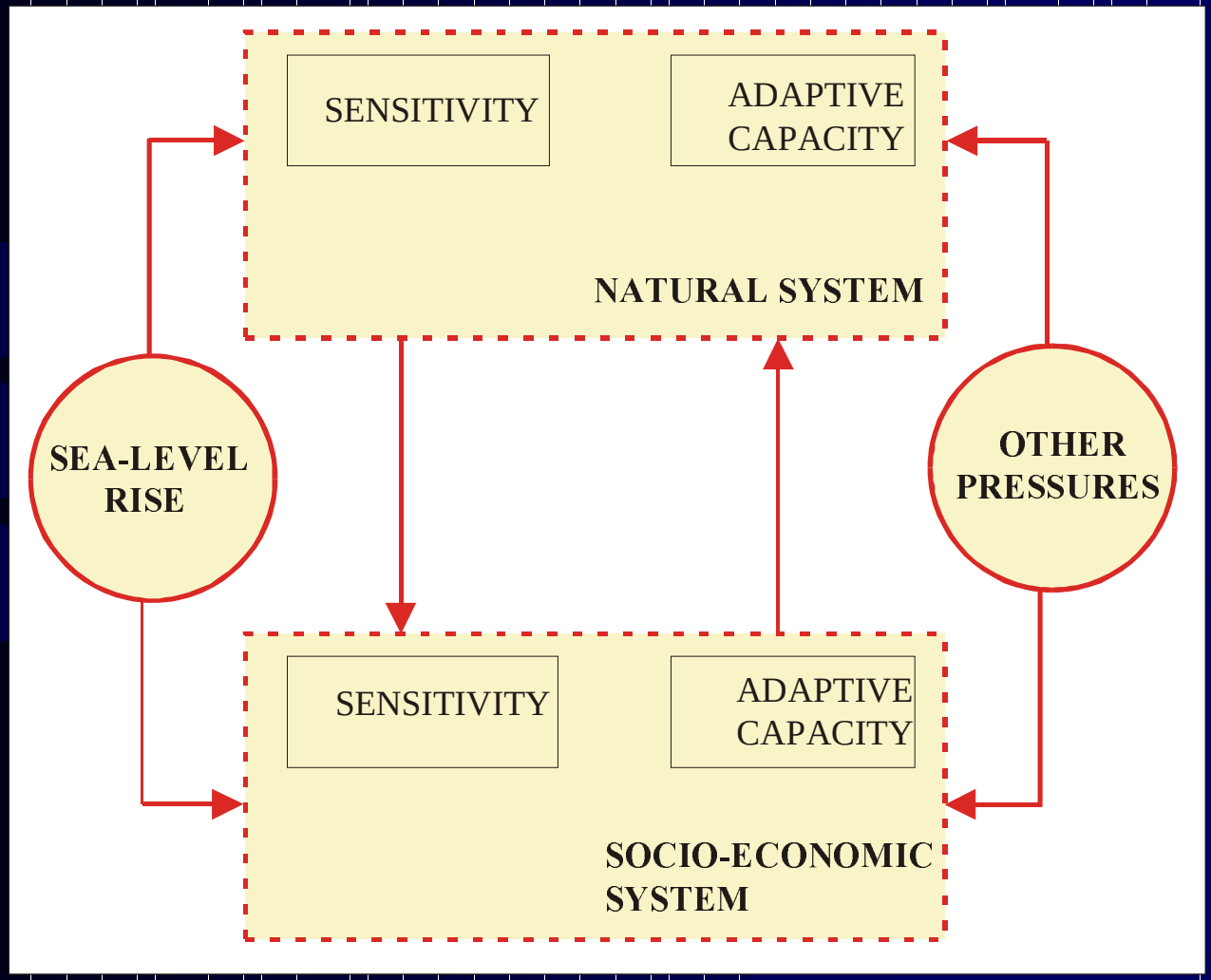
Coastal Ecosystems



KEY:

- mangroves, o saltmarsh, x coral reefs

The Co-Evolving Coastal System



Socio-economic changes

People and Europe's Coast

- Long history of destruction of intertidal systems -- land claim back to the Romans
- Growing population and rising living standards through the 20th Century
- Development of the Mediterranean as Europe's playground since 1950
- Other stresses include ports and harbours, aquaculture and reduced sediment inputs
- Increasing interest in integrated coastal management (ICM, or ICZM)

The SRES storylines

"A1 World"

- Increasing globalisation and convergence
- Rapid global economic growth
- Materialist / consumerist
- Rapid uniform technological innovation

"B1 World"

- Increasing global co-operation and convergence
- Environmental priority
- Clean and efficient technologies

"A2 World"

- Heterogeneous world
- Rapid regional economic growth
- Materialist / consumerist
- Diverse technological innovation

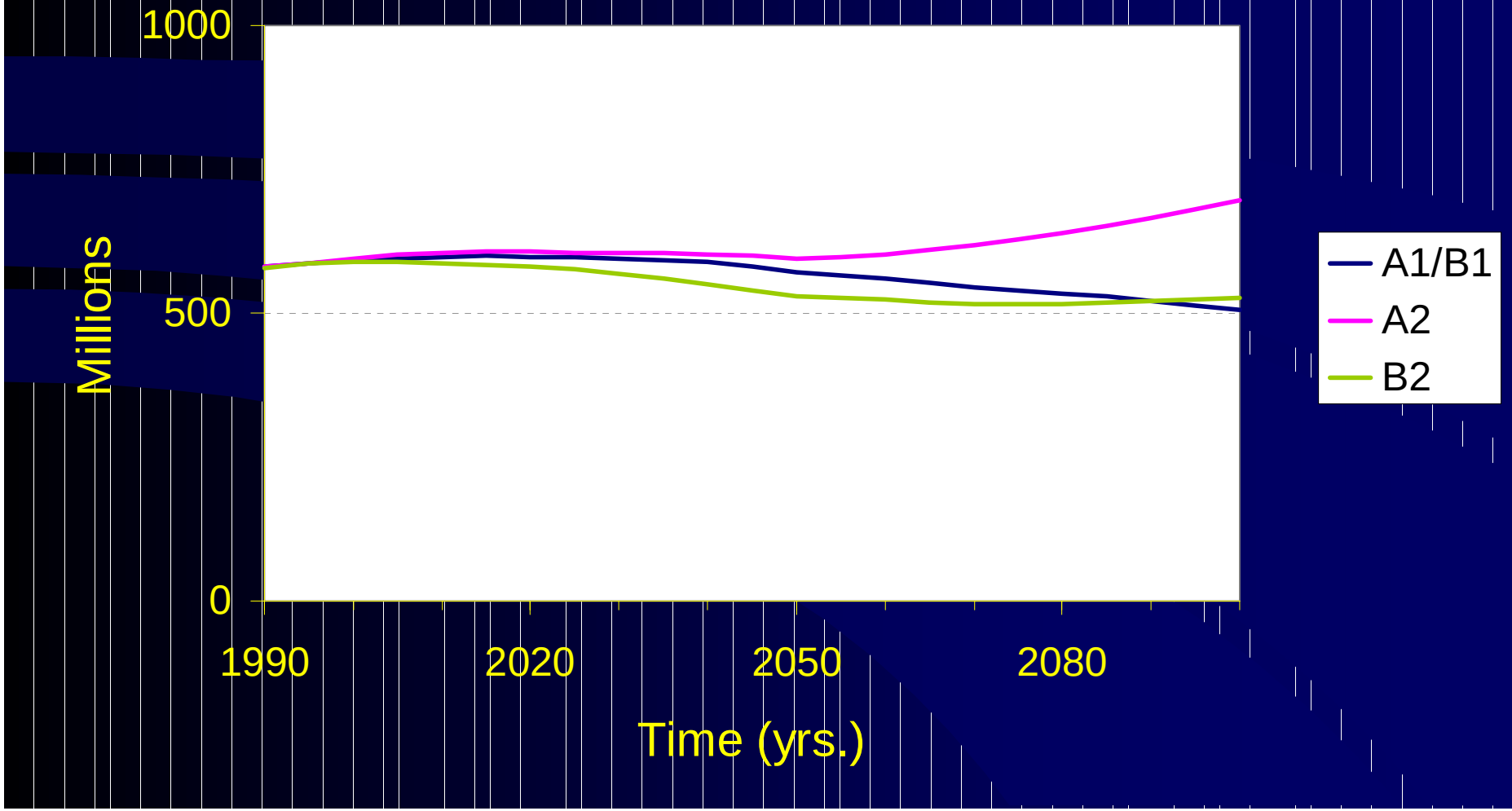
"B2 World"

- Heterogeneous world with local emphasis
- Environmental priority
- Clean and efficient technologies

SRES -- Special Report on Emission Scenarios of the IPCC

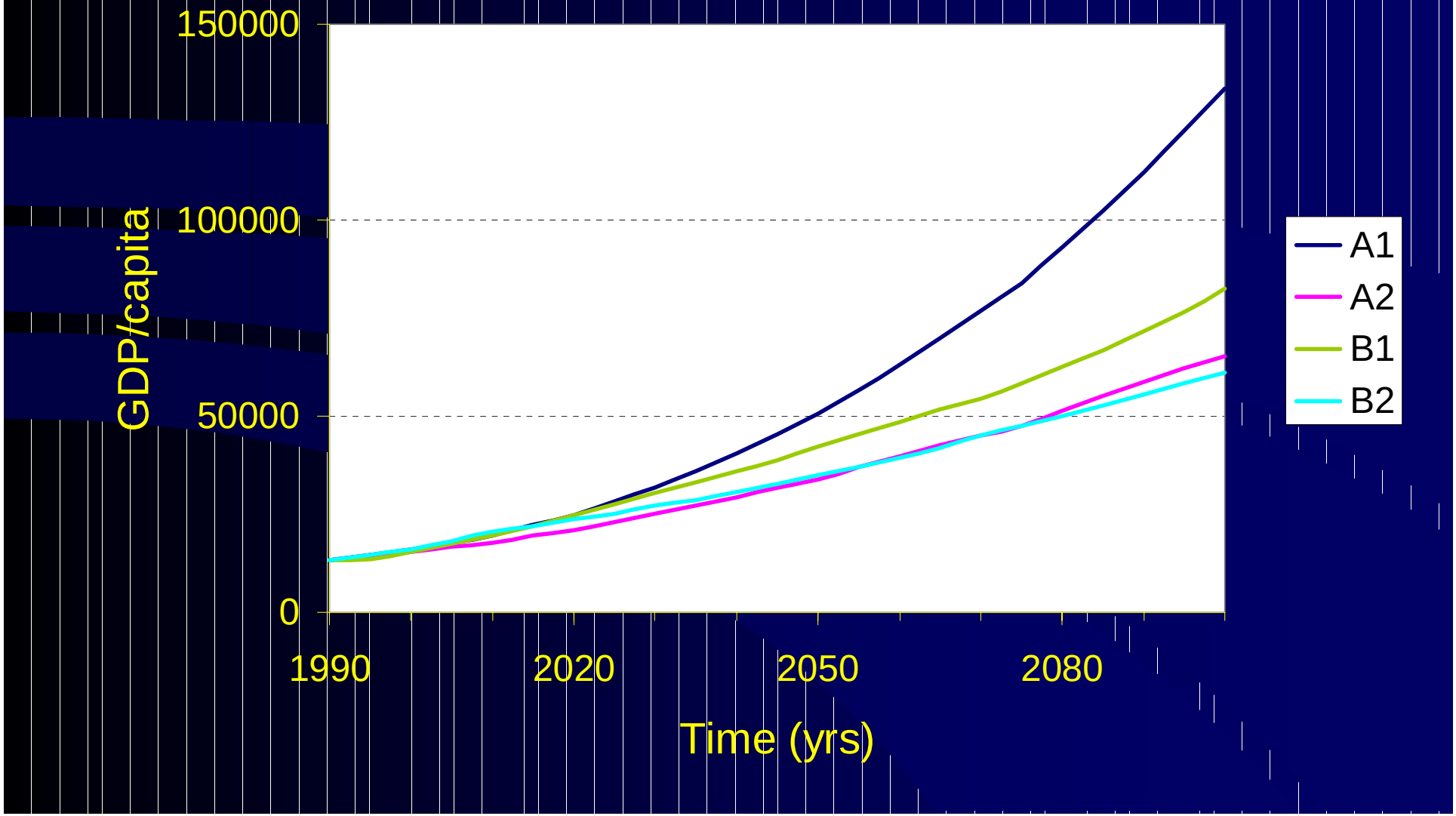
SRES European Population

(excluding Russian Federation)



SRES European GDP/capita

(excluding Russian Federation)



Coastal Interpretation of the SRES Storylines (downscaling)

"A1 World"

- High migration to the coast
- Hazard management – lower priority
- High non-climate wetland losses

"B1 World"

- High migration to the coast
- Hazard management – higher priority
- Low non-climate wetland losses

"A2 World"

- Low migration to the coast
- Hazard management – lower priority
- High non-climate wetland losses

"B2 World"

- Low migration to the coast
- Hazard management – higher priority
- Low non-climate wetland losses

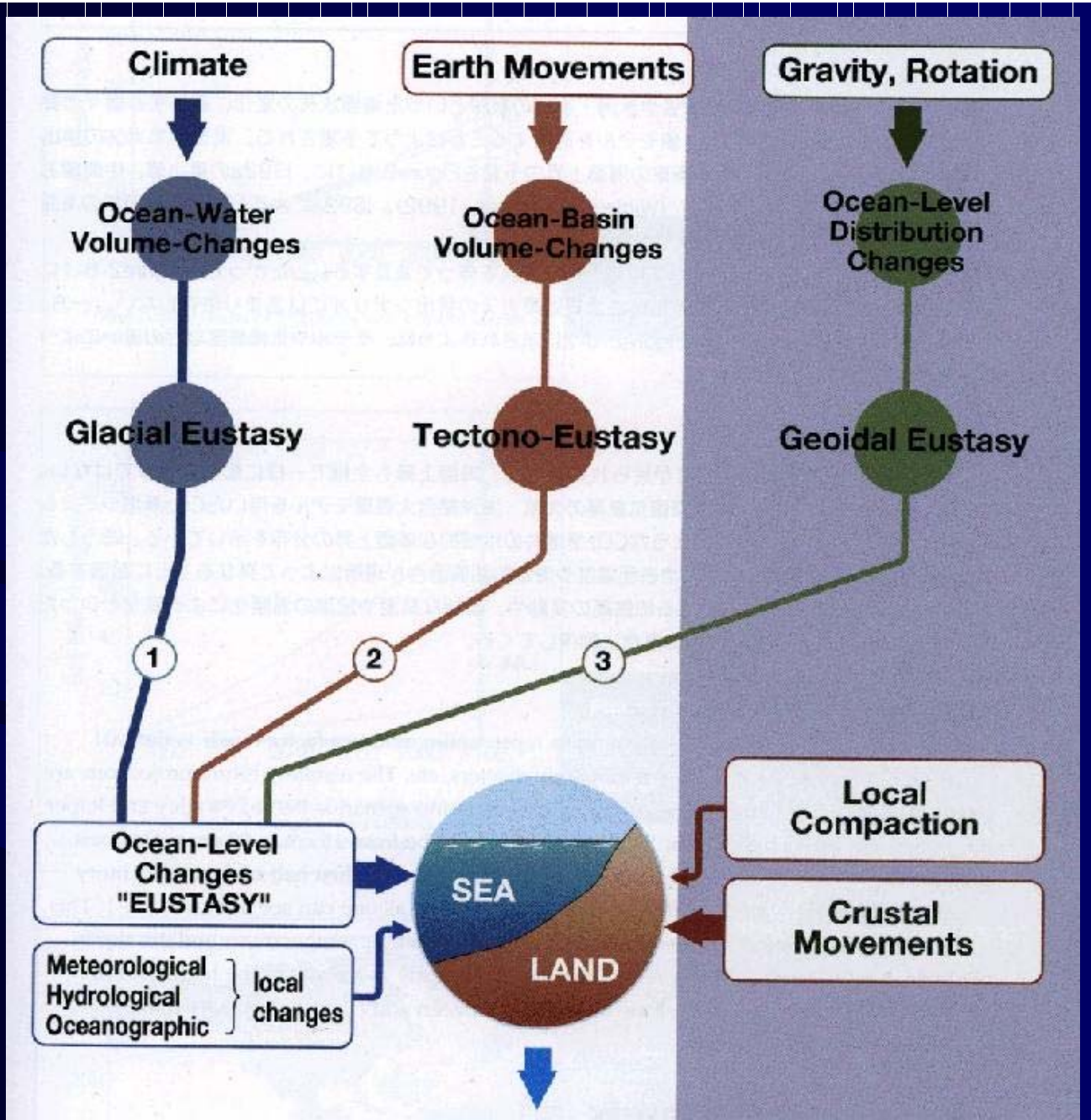
Human-induced climate change and sea-level rise

Global-Mean Sea-Level Rise

Rising temperatures may raise ocean volume by:

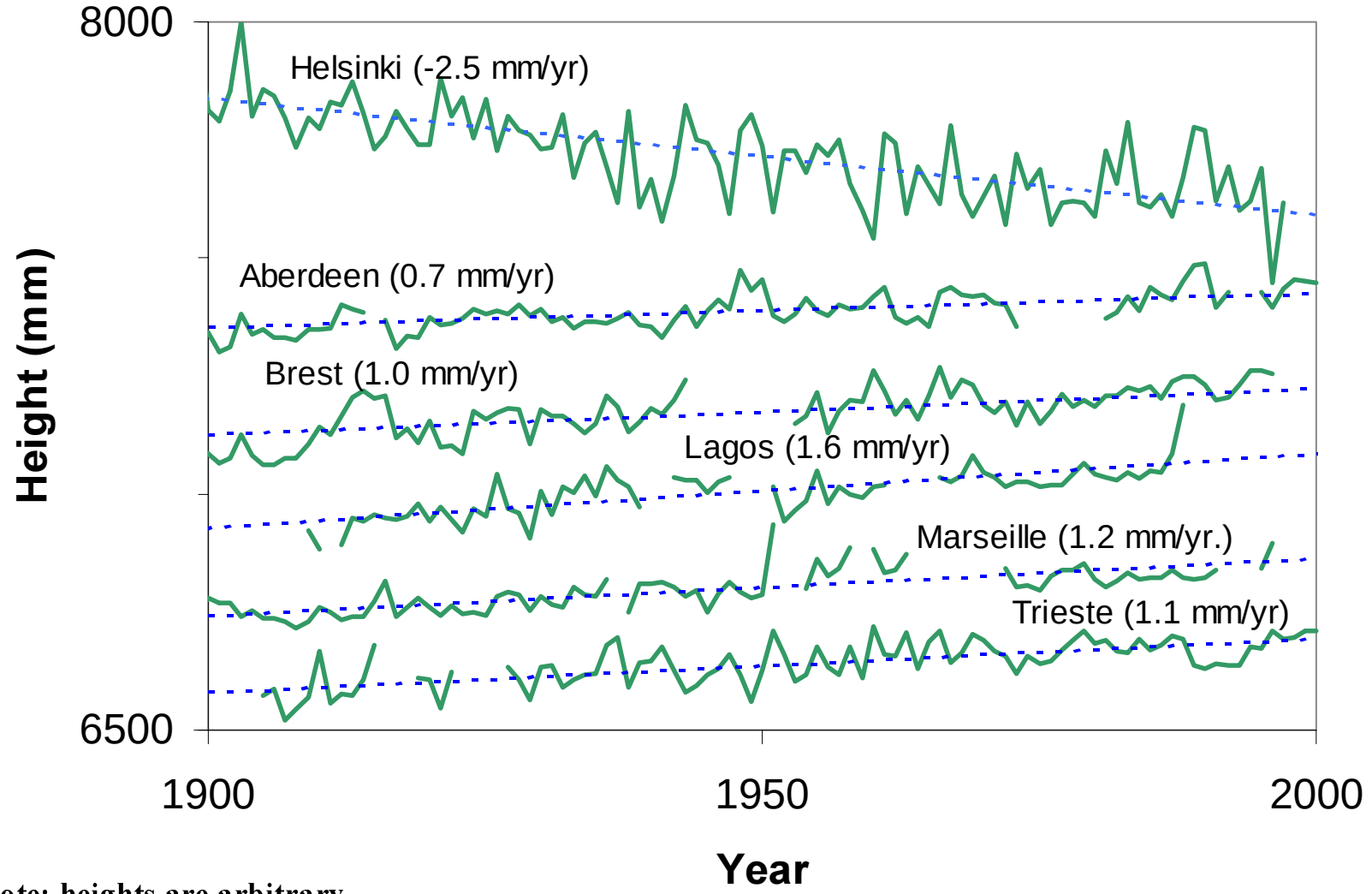
- Ocean temperature -- thermal expansion;
- Melting of land-based ice:
  - small glaciers;
  - Greenland;
  - Antarctica.

Processes controlling sea-level change

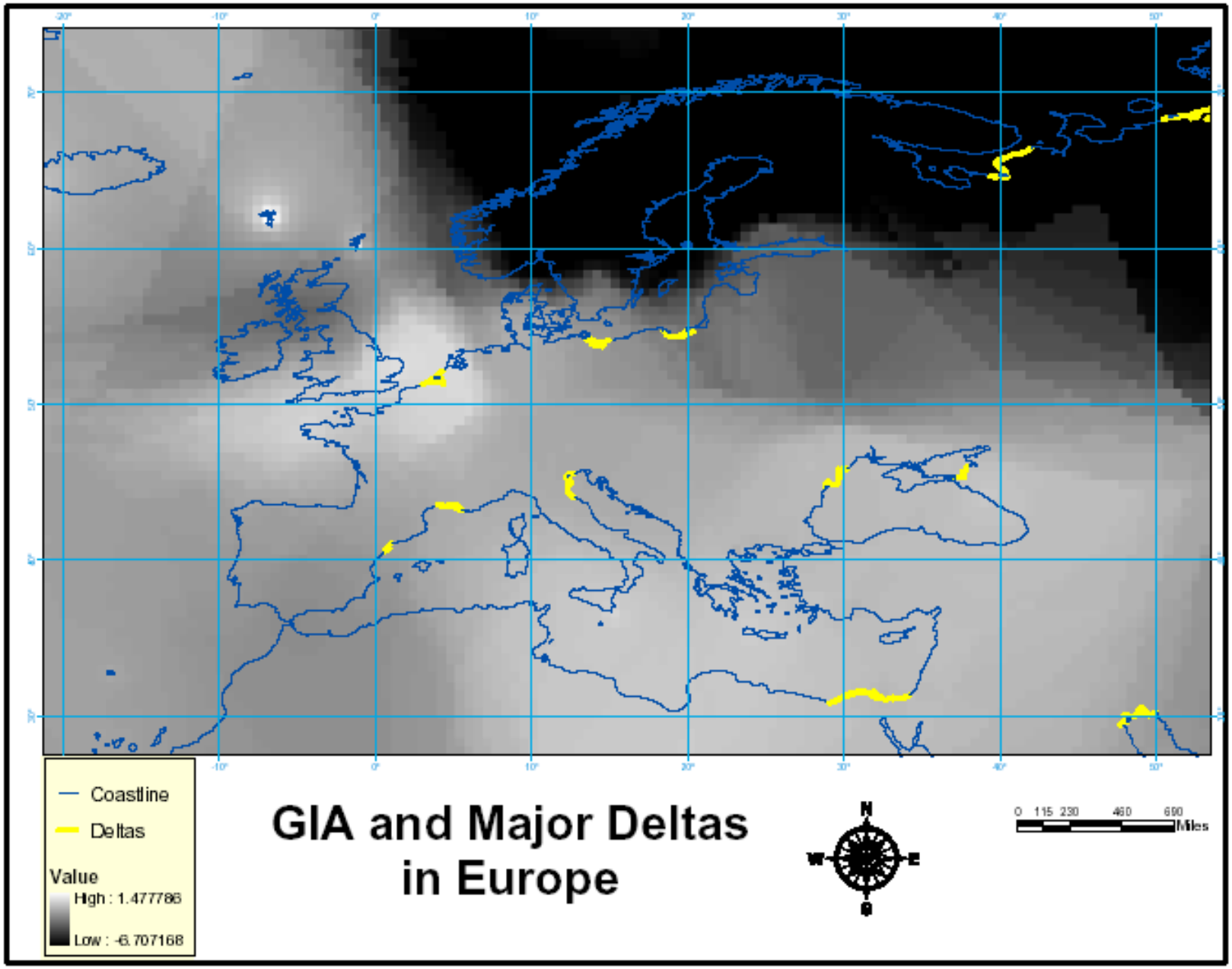


Relative sea-level changes

Long-Term Sea-Level Trends
in the 20th Century

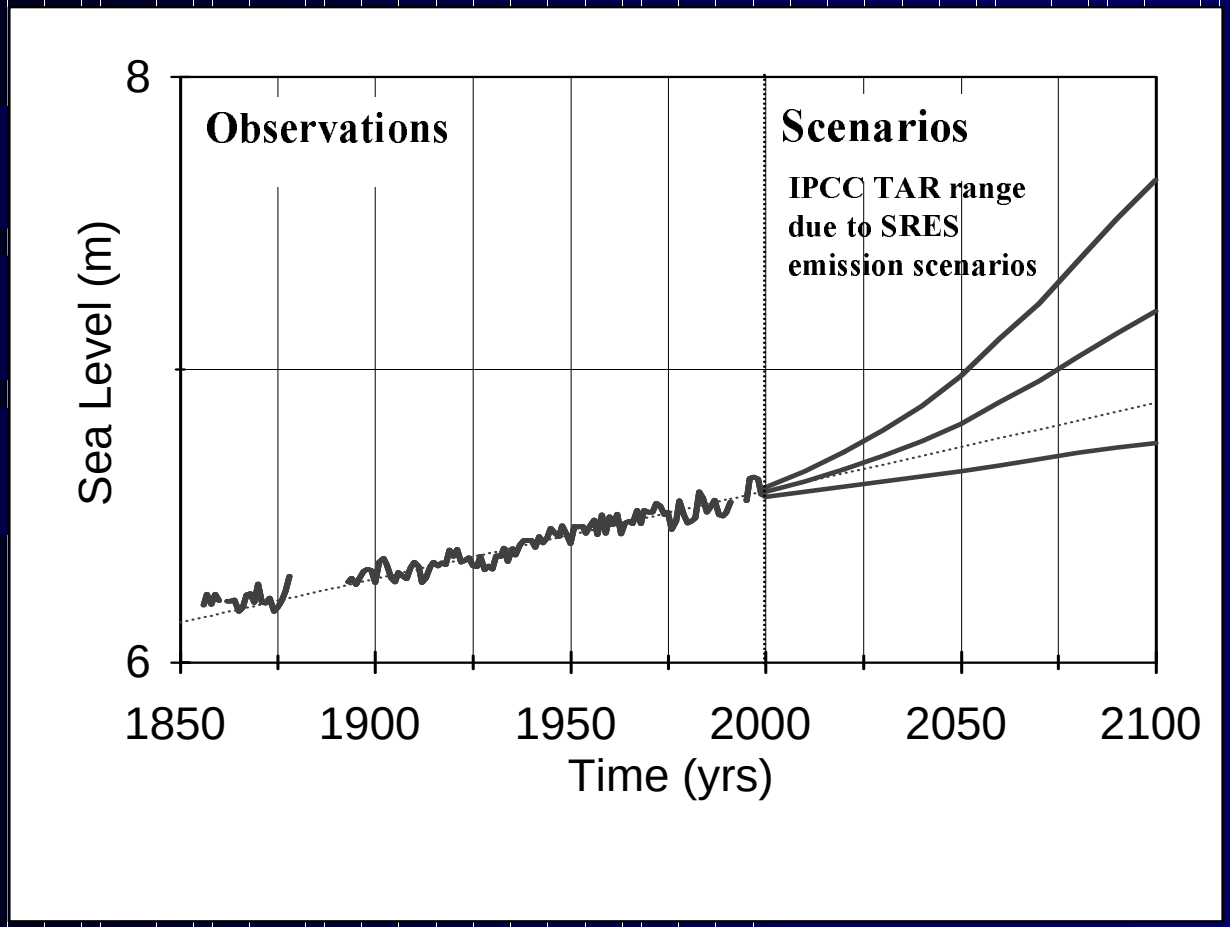


Note: heights are arbitrary



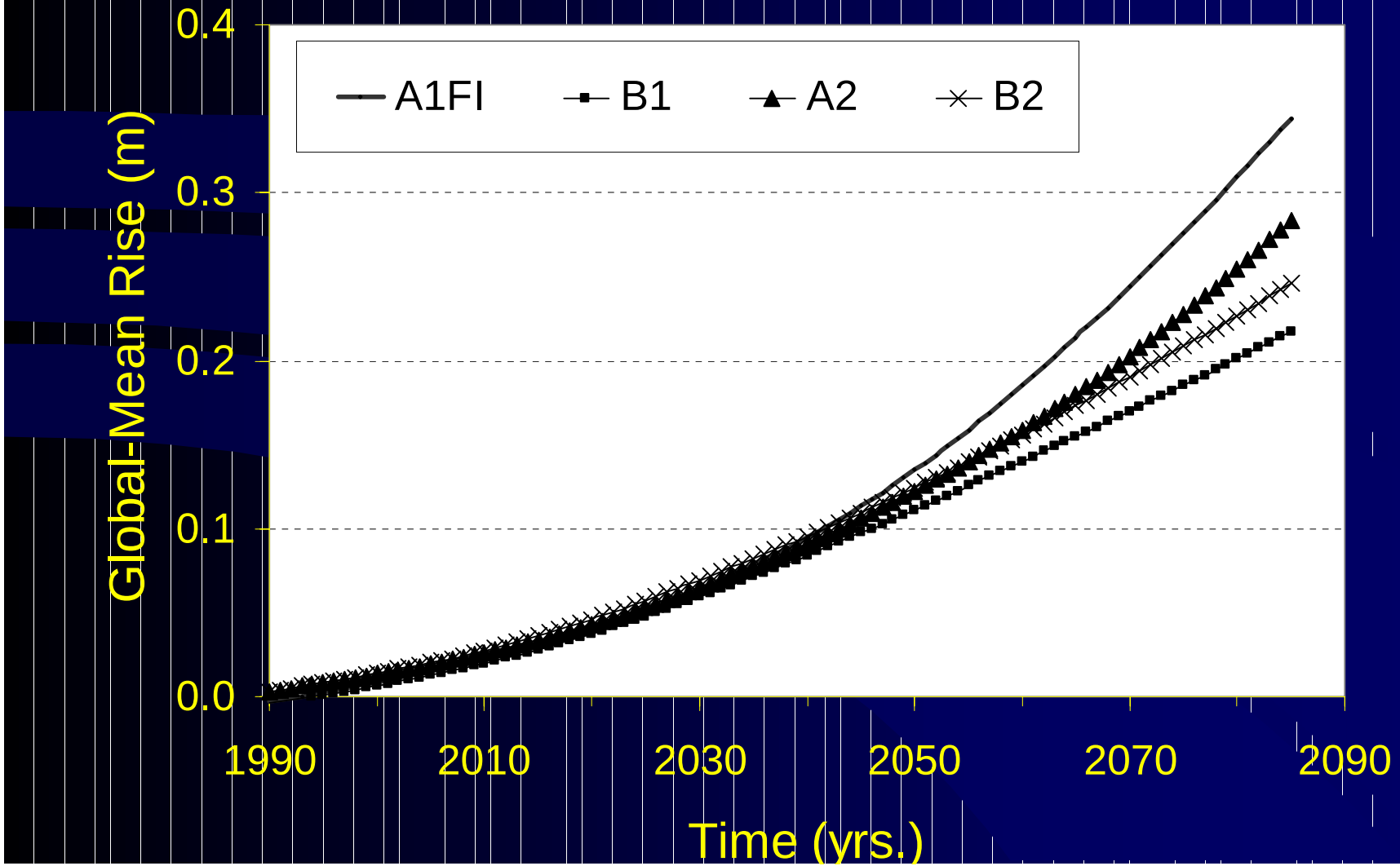
GIA -- Glacial Isostatic Adjustment

Sea-Level Rise at New York City 1850 to 2100



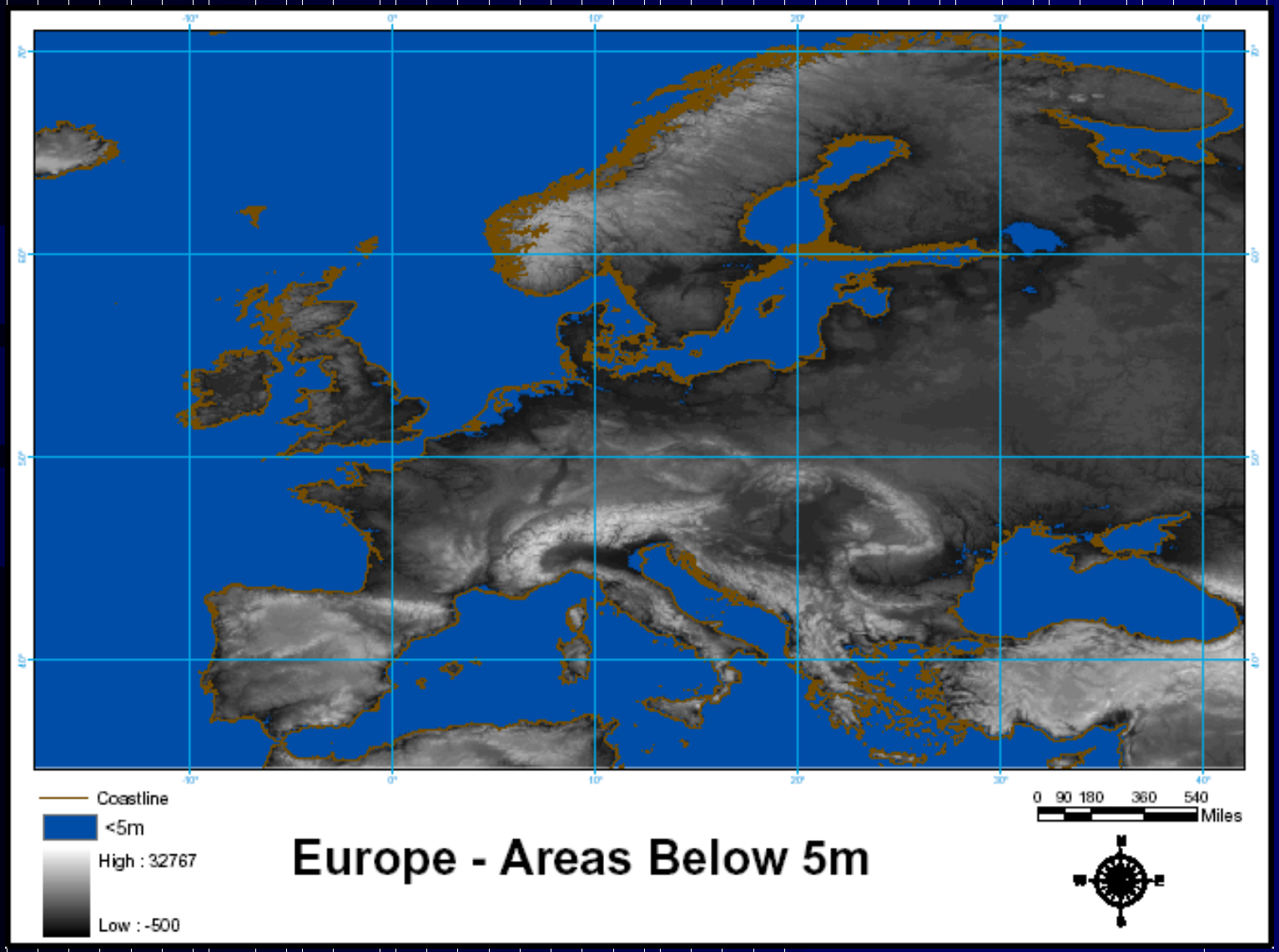
Global-Mean Sea-Level Rise

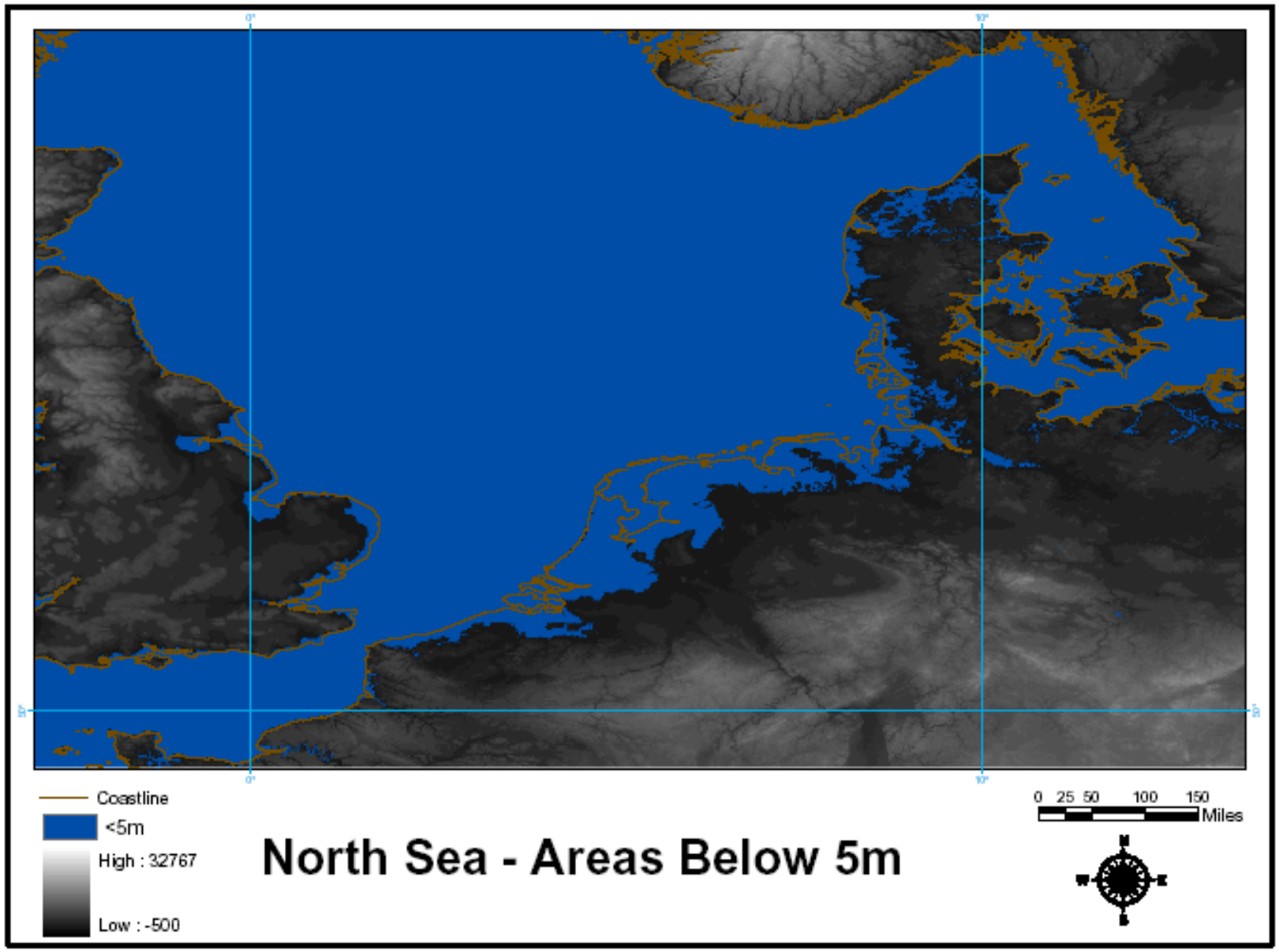
SRES emissions in HadCM3 model



High Consequence/Low Probability Events

Collapse of the West Antarctic Ice Shelf




Coastline
<5m
High : 32767
Low : -500
North Sea - Areas Below 5m
0 25 50 100 150
Miles

Other Climate Change

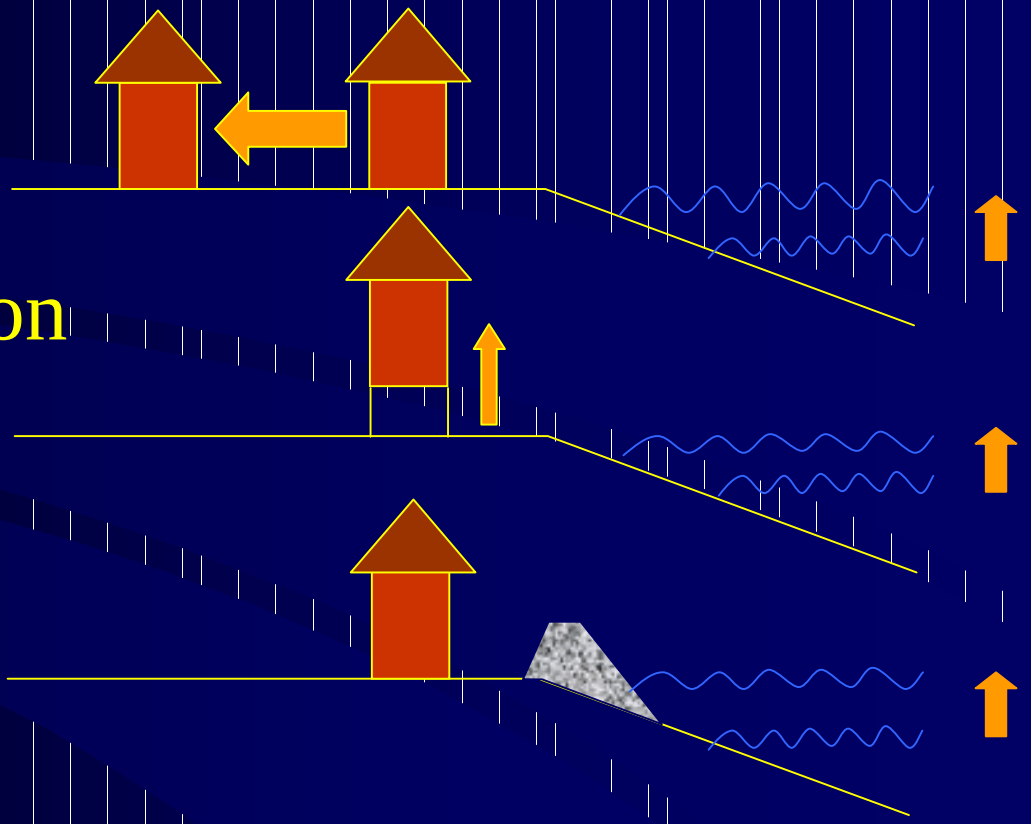
[Hurricane Andrew]

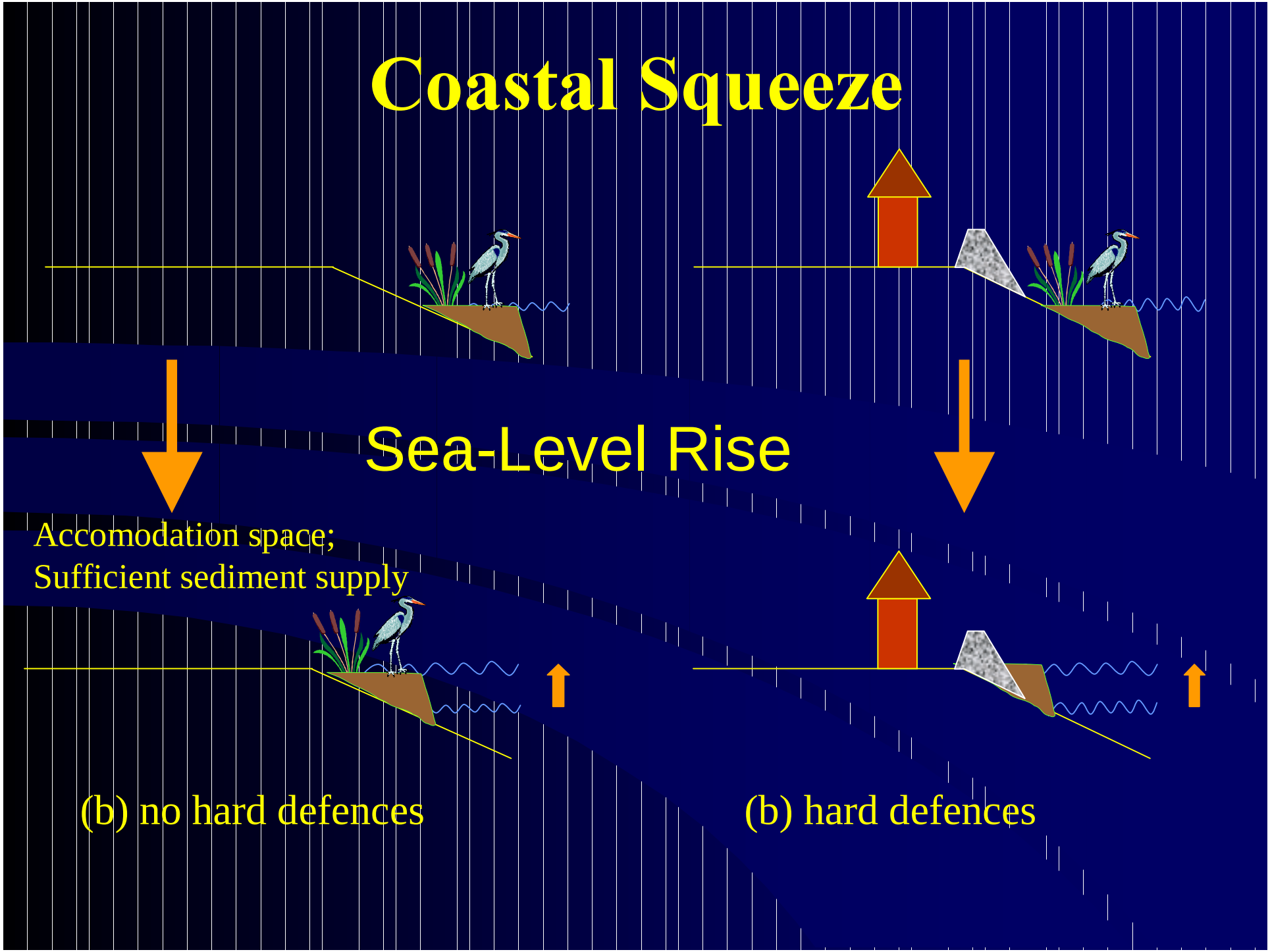
Climate Change and Coastal Ecosystems

CLIMATE FACTOR	*SIGN*	*COASTAL ECOSYSTEM IMPLICATIONS*	*COMMENTS*
Sea-level rise	+ve	Inundation/displacement of wetlands, etc; coastal erosion; salinisation	Consider relative sea-level rise; coastal squeeze
Sea surface temperature	+ve	Poleward migration of coastal species; Decreased sea ice; Increased coral bleaching	
Hydrological cycle	More intense	Changing sediment and water fluxes -- salinity regimes in estuaries	Large spatial variability; consider management effects
Waves and 'storminess'	?	Adjustments in coastal morphology	
Atmospheric CO_2	+ve	Increased productivity; Increased stress on coral reefs	

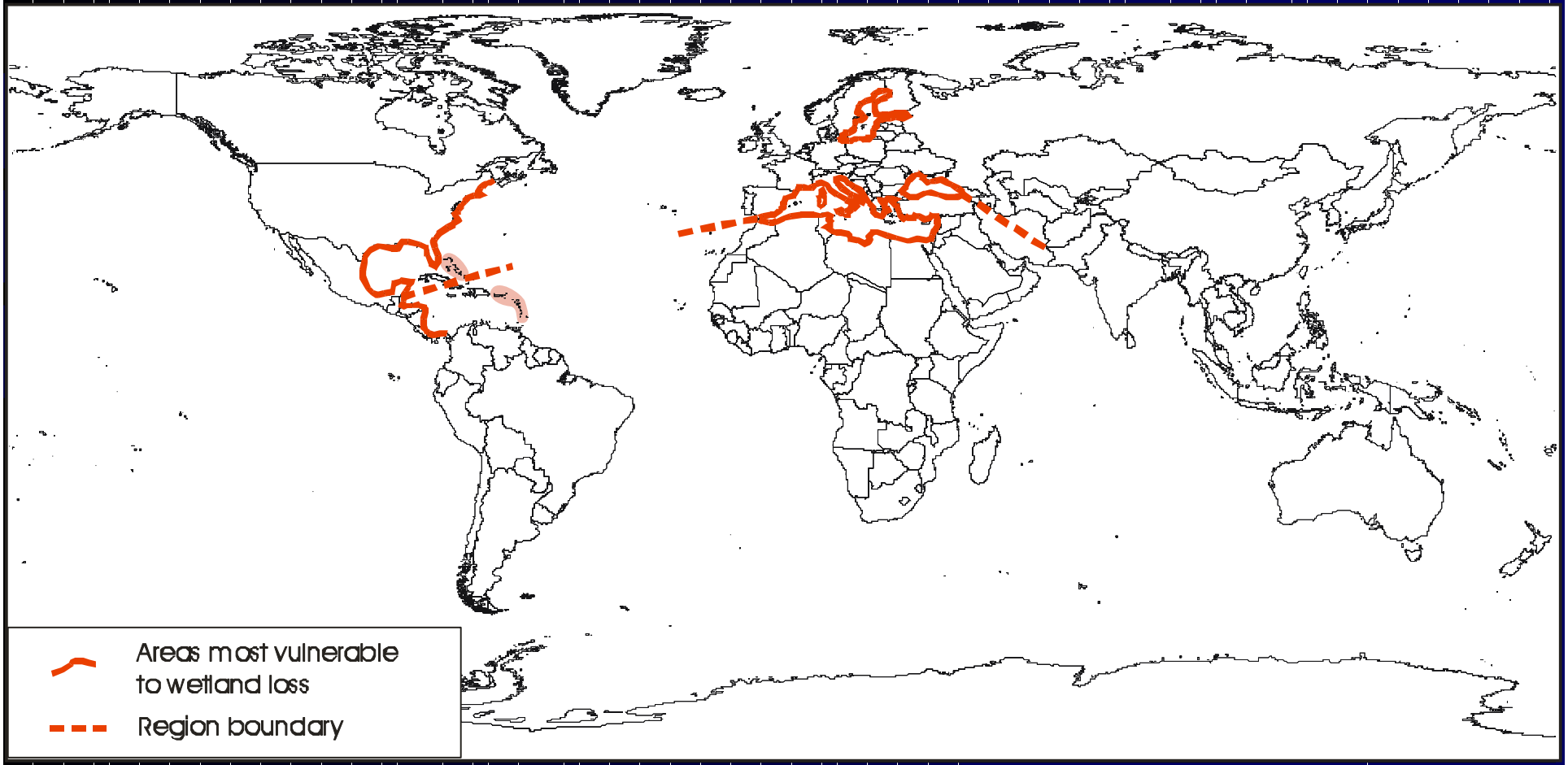
RESPONDING TO COASTAL HAZARDS (including sea-level rise)

- Retreat
- Accommodation
- Protect
  - soft
  - hard




Coastal Squeeze
Sea-Level Rise
Accomodation space;
Sufficient sediment supply
(b) no hard defences
(b) hard defences

Wetland Loss under Sea-Level Rise: Most Vulnerable Areas

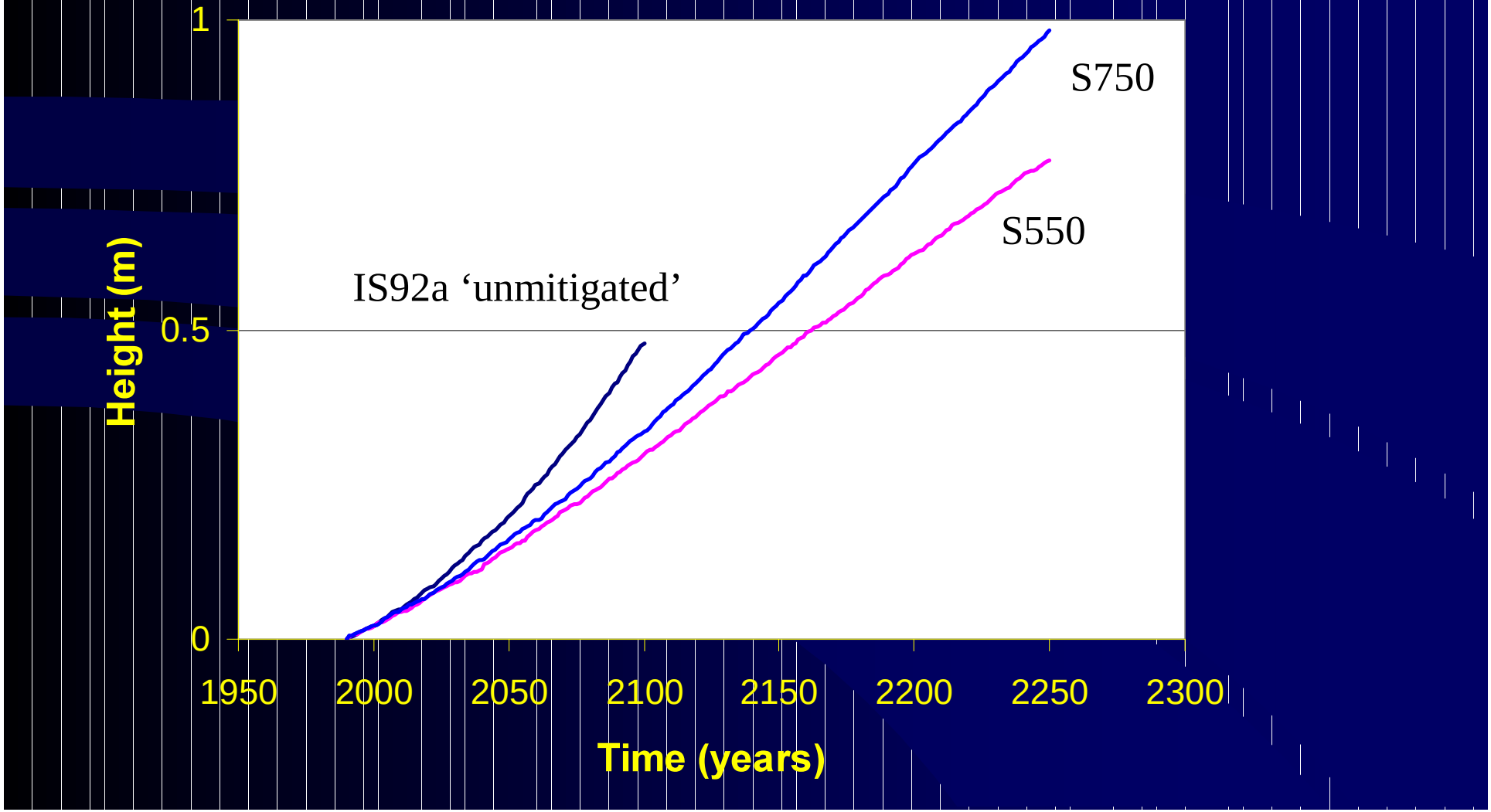


Responding to Sea-Level Rise and Climate Change

- Mitigation -- reduce greenhouse gas emissions
- Adaptation -- change behaviour in response to climate change

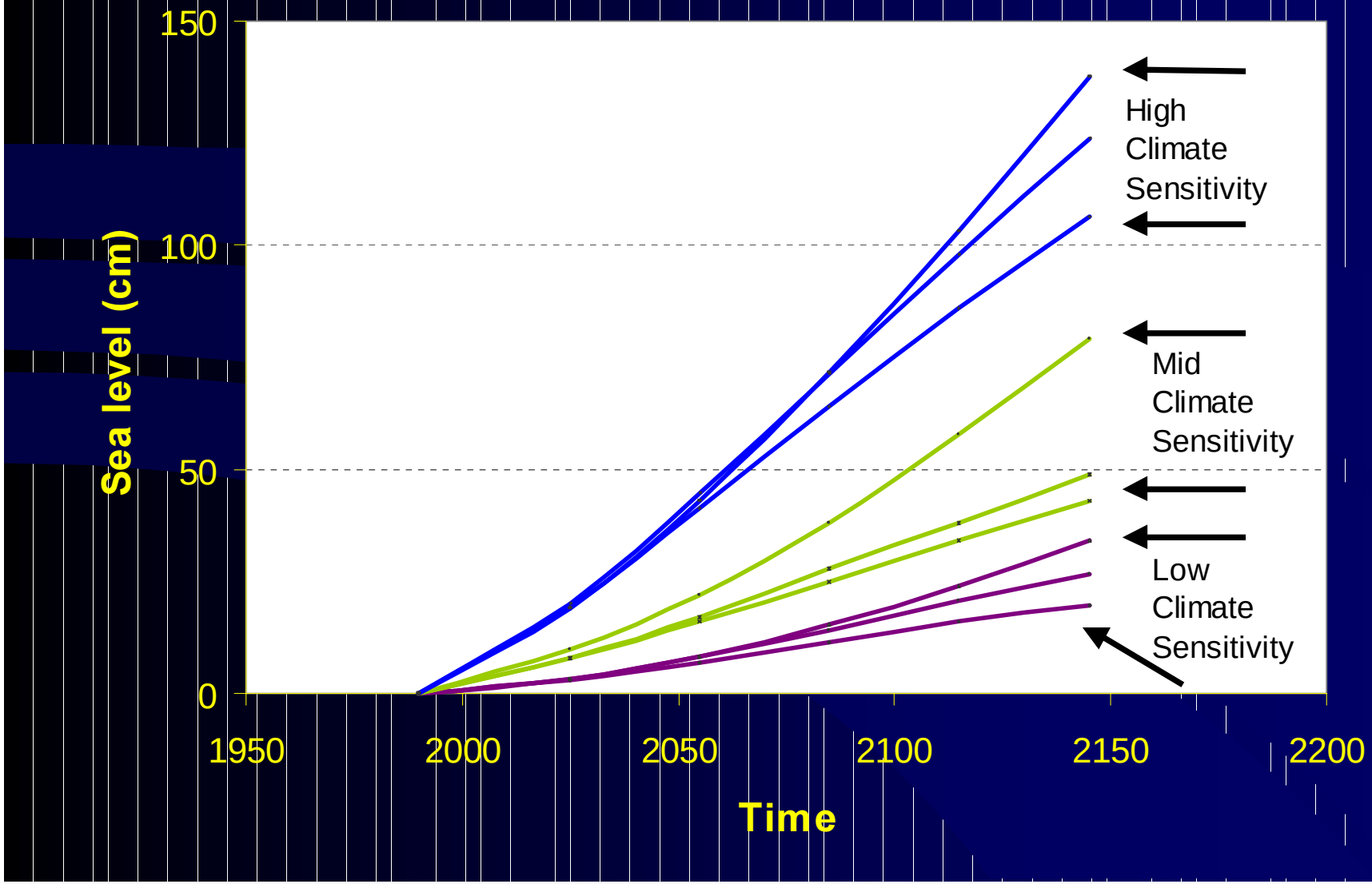
The 'Commitment to Sea-Level Rise'

Stabilisation with HadCM2 Model



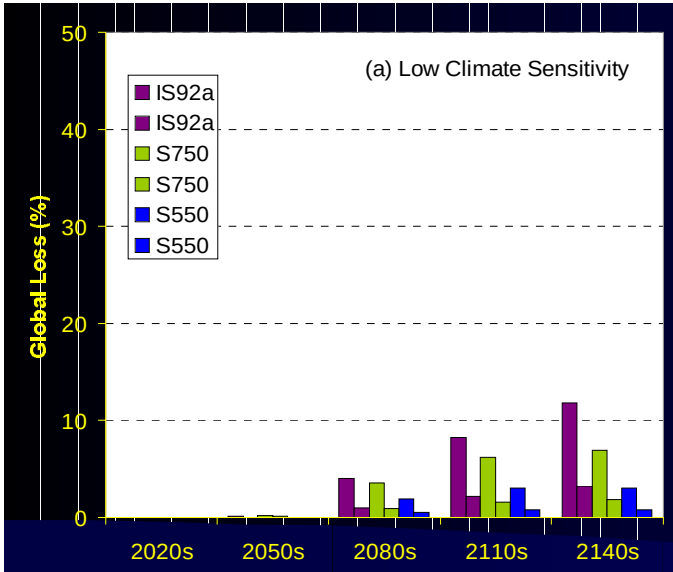
Global-Mean Sea-Level Rise

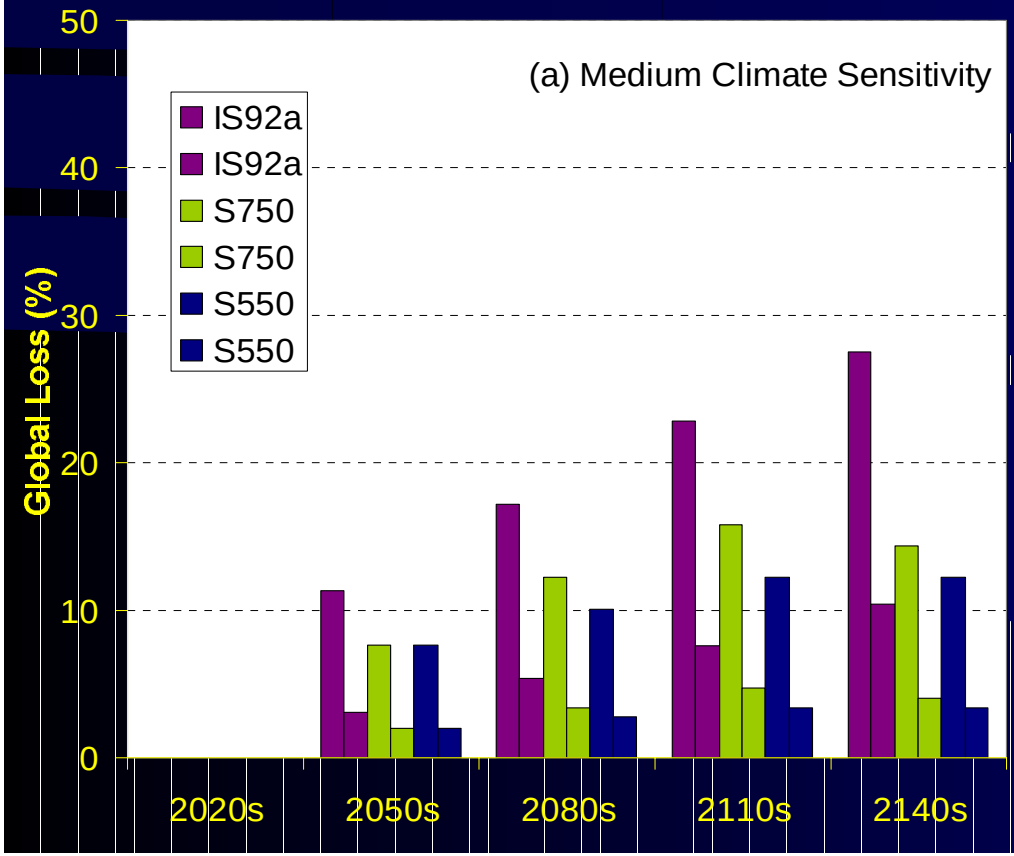
Unmitigated (IS92a) and Stabilisation Scenarios (S750 and S550)

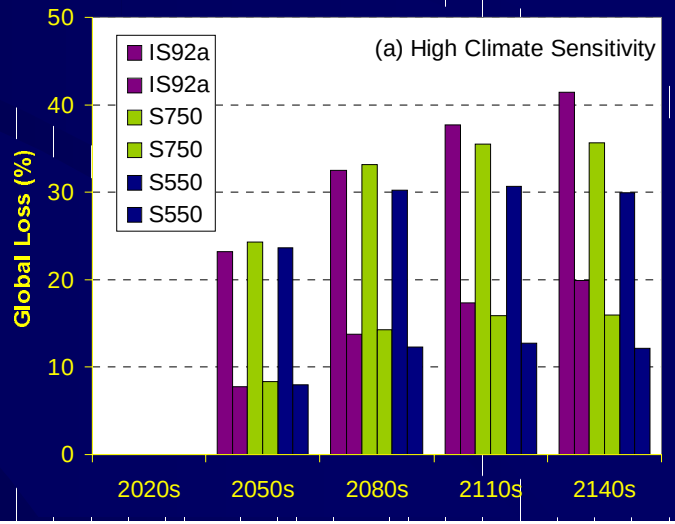


Coastal Wetlands

Global impacts due to sea-level rise given stabilisation

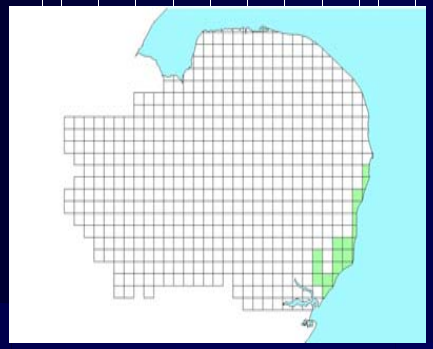


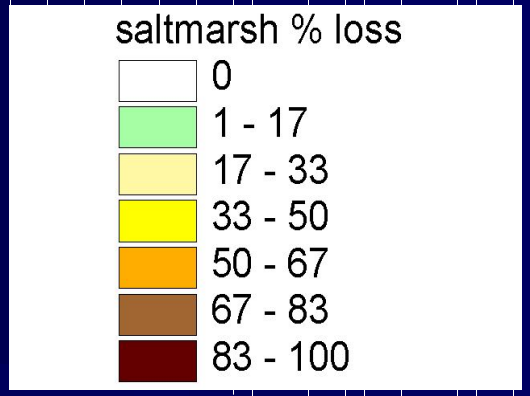


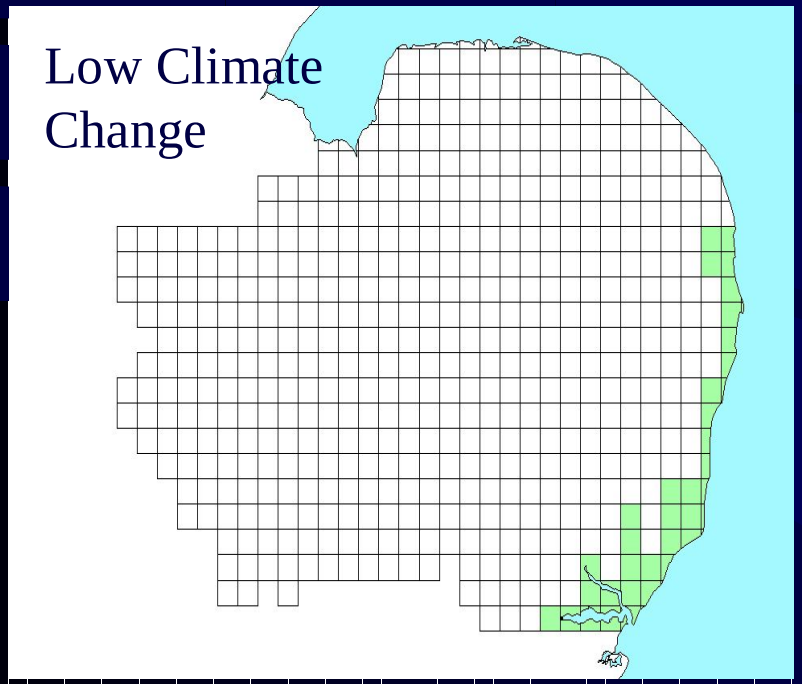


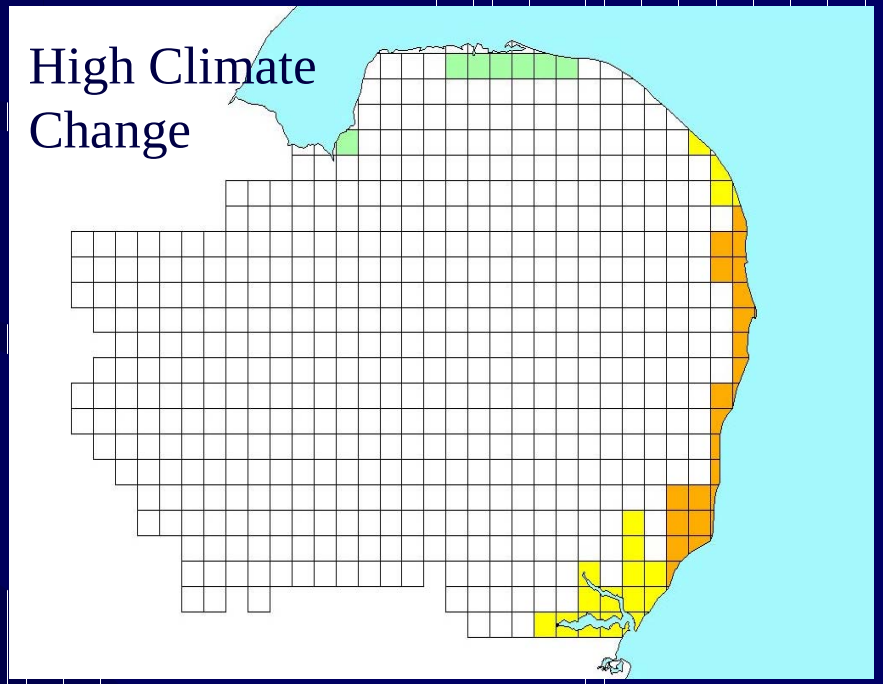
Saltmarsh Losses to 2050

Present day loss rate





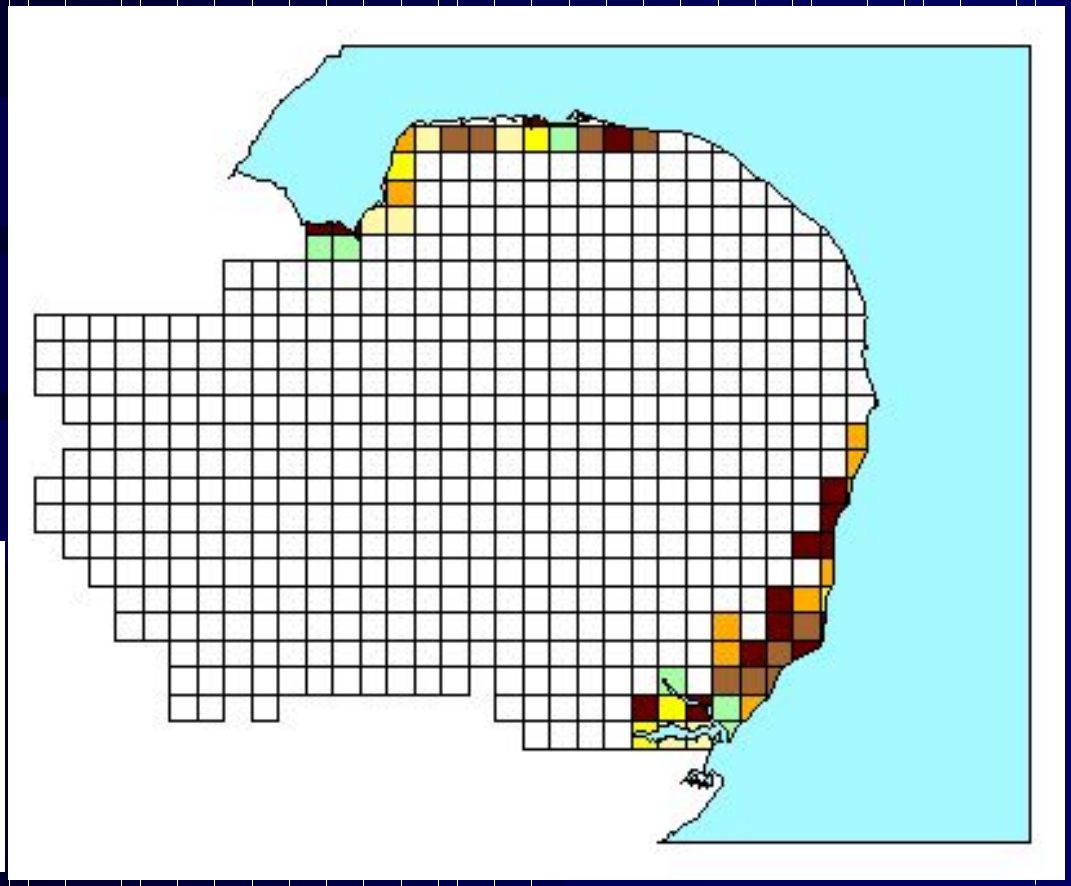




RegIS Project (Nicholls and Wilson, 2001)

Coastal Grazing Marsh Losses

assuming managed realignment is fully implemented



Concluding Remarks

- The coast is experiencing intense and growing human use leading to multiple pressures;
- Climate change and sea-level rise could be a serious additional problem, but the uncertainties are large;
- Reducing greenhouse gas emissions reduces but does not avoid sea-level rise impacts;
- Preparing to adapt to climate change would seem prudent, in the context of multiple stresses and managing existing problems.

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