

Department of Natural and Environmental Resources

Rising Sea Levels and Coastal Management



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2011



Vulnerability: Relevant Statistics

Emerged land:	9,497 km² (3,508 mi²)
Territorial waters:	9 mn (10.35 mi)
Population:	~3.8 millones (26th U.S.)
Coastal Population:	2.73 millones (70%)
Urban areas:	40%
Urban/coastline ratio:	24%
PTB:	~\$ 95.7 billones/año

Economy (2009):

- **Manufacture: 45.5%**
- **Finances, Insurance and Real Estate: 19%**
- **Services: 12.8% (Turismo: 7%)**
- **Government: 9.7%**
- **Comerce: 7.8%**
- **Transportation and Services: 3.2%**
- **Construcción: 1.9%**
- **Agriculture: 0.7**



PRPB 2010

Critical Infraestructure within 1 Km



- Eight ports



- Eight airports

- Six Power Plants

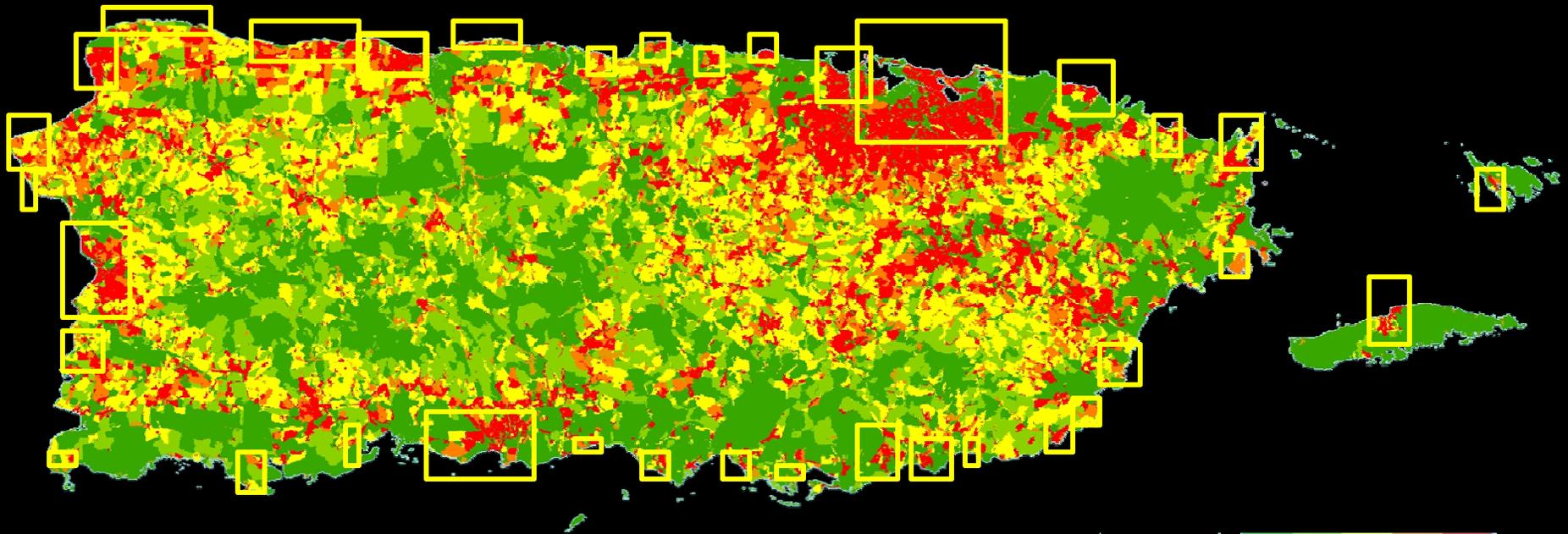
- 1,080 miles of sanitary infrastructure



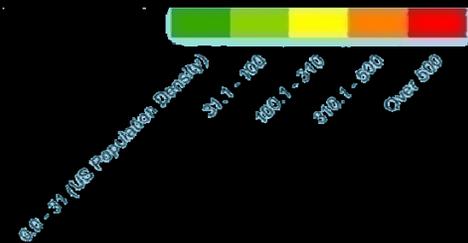
- 81 industrial parks

- 114 miles of primary roads

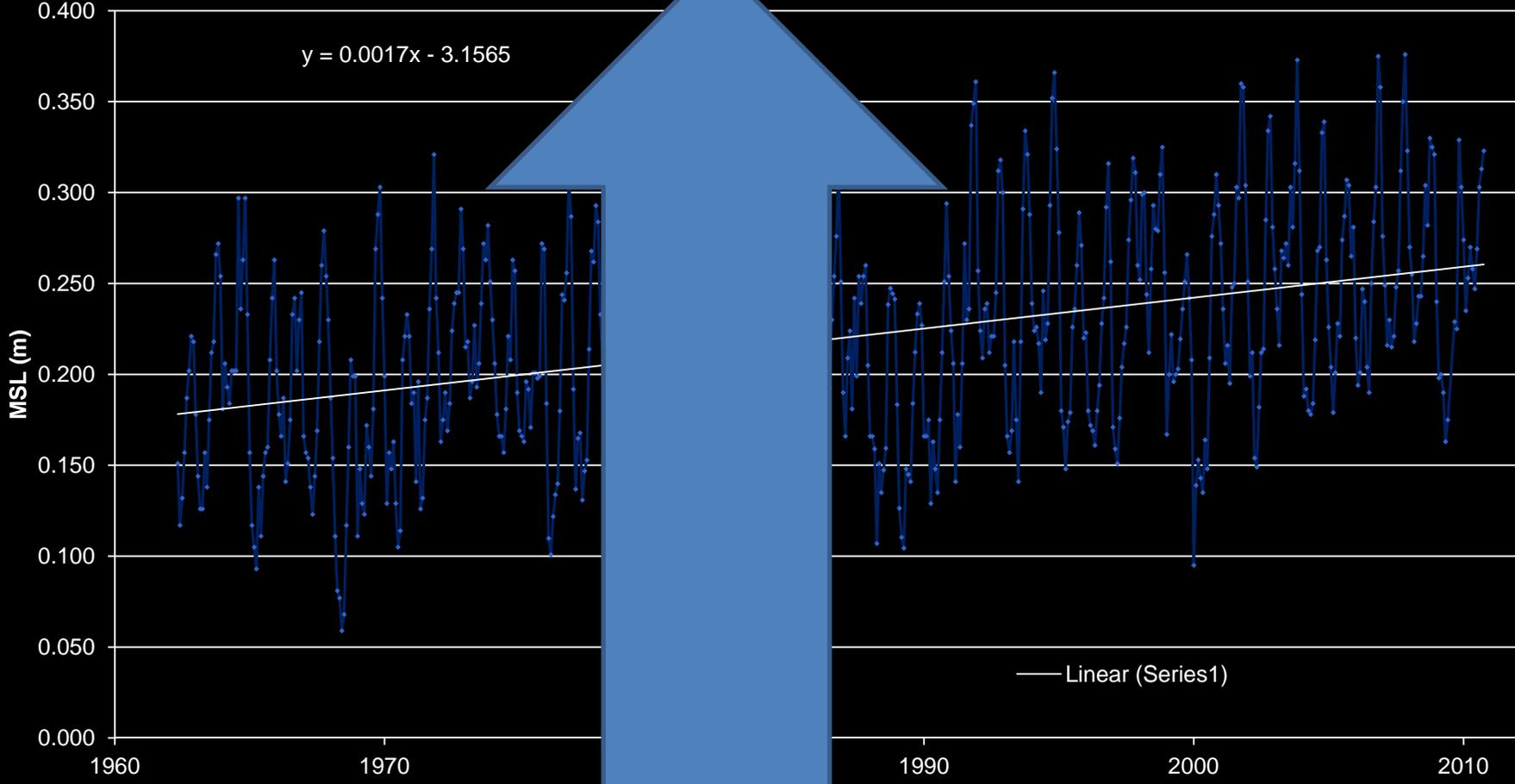
Population density



24% urban / coastline ratio

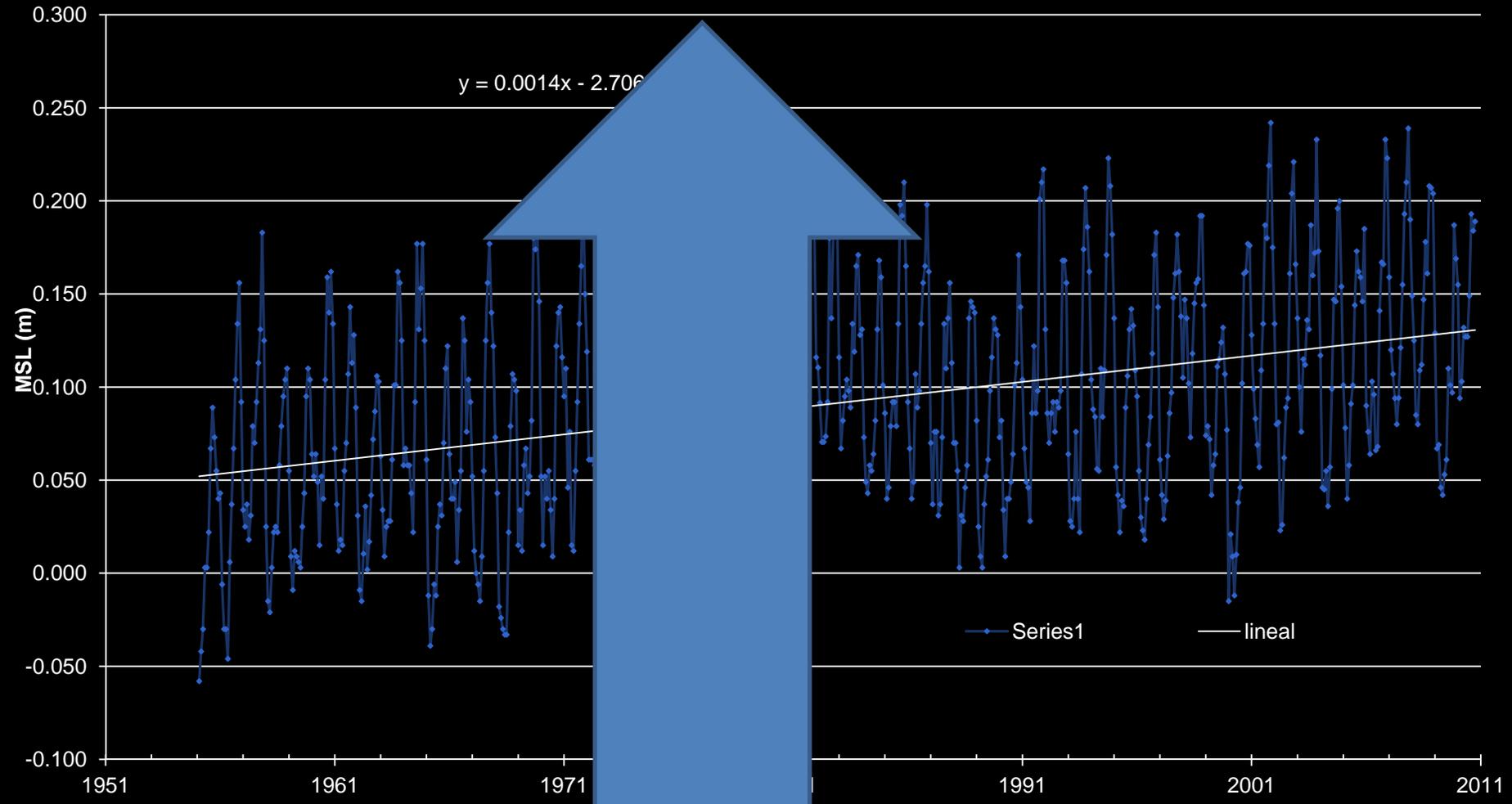


San Juan Monthly Mean Sea Level 1962-2010



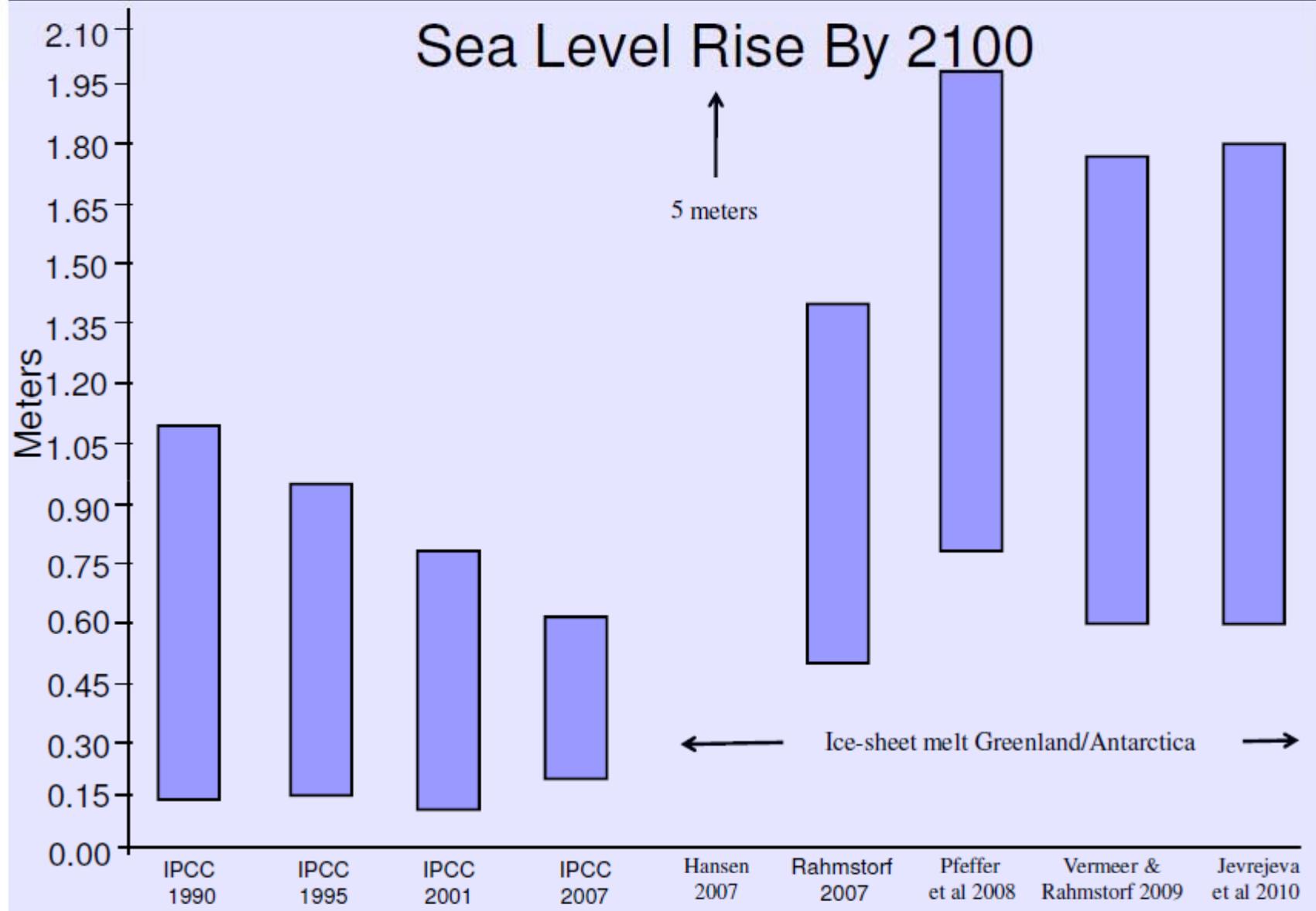
0.414 m (2100)

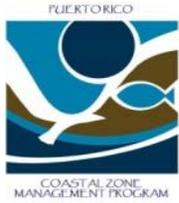
Magueyes - Monthly Mean Sea Level 1955-2008



0.256 m (2100)

Sea Level Rise By 2100





Effects of relative sea level rise: climate and non-climate factors (from Nicholls, 2002).

Biogeophysical effect		Other relevant factors	
		Climate	Nonclimate
Inundation, flood and storm damage	Surge	Wave and storm climate, morphological changes, sediment supply	Sediment supply, flood management, morphological changes, land claim
	Backwater effect (river)	Runoff	Catchment management and land use
Wetland loss or change		CO ₂ fertilization Sediment supply	Sediment supply, migration space, direct destruction
Beach Erosion		Sediment supply, wave and storm climate	Sediment supply
Saltwater intrusion	Surface waters	Runoff	Catchment management and land use
	Groundwater	Rainfall	Land use, aquifer use
Rising water tables/impeded drainage		Rainfall	Land use, aquifer use



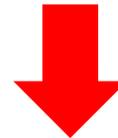
Coastal Inundation



Increased salt water intrusion to
ground water aquifers



Impacts to water supply – water insecurity
Damage to roads
Impacts to port and airport operations
Temporary or permanent interruption of operations



High replacement cost of infrastructure or
permanent loss of infrastructure



Erosion



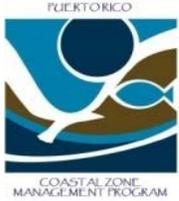
Beach loss



Damage/potential loss of beach front properties, hotels, etc.



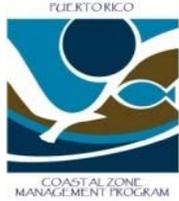
Loss or revenue from Tourism and Real Estate



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Puerto Rico is at risk from:

- Continuing development in high hazard areas
- Elimination of dunes, reefs, mangroves and other naturally protective features
- Poor maintenance of existing shoreline stabilization structures
- Poor maintenance dredging of rivers, canals, and reservoirs
- Poor maintenance of stormwater management systems
- Poor soil management practices on land



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Recommendations and challenges

Natural ecosystems at risk from sea-level rise are undervalued or ignored in traditional economic analyses (i.e., wetlands, dunes loss or changes) - Improved methods for incorporating them into future studies are needed.

Local governments or regional planning agencies should conduct detailed studies to better understand the potential impacts of sea-level rise in their communities.

Future development should be limited in areas that are at risk from rising seas.

Current efforts to build, maintain, or modify structures in coastal areas at risk of sea-level rise should now be based on estimates of that rise.

Climate change knowledge and projections must be integrated into the design of all coastal structures.

Departamento de Recursos Naturales y Ambientales

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