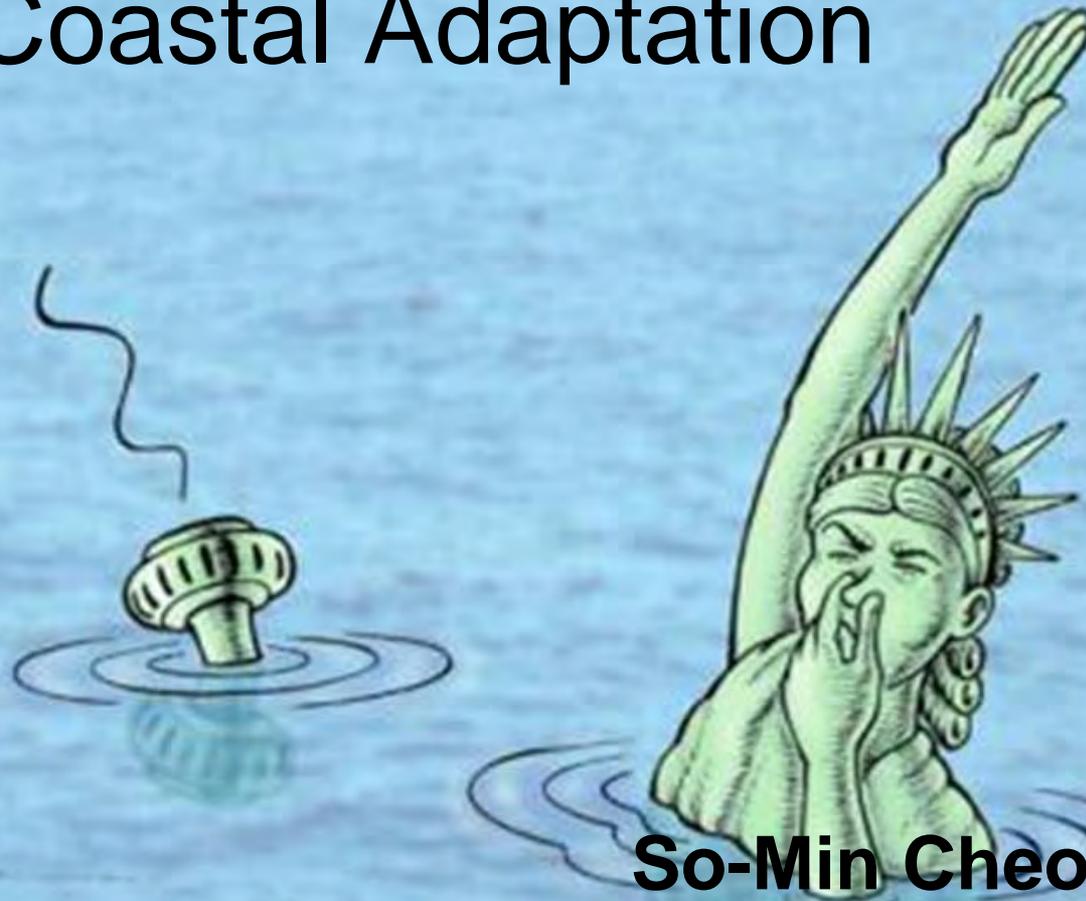


Coastal Adaptation



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A photograph of a beach with two signs. The sign in the foreground is larger and reads '2050 sea level'. The sign in the background is smaller and reads '2030 sea level'. The beach is white sand, and the ocean is blue with a clear sky and some clouds.

2050
sea level

2030
sea level

FREQUENCY & INTENSITY OF STORMS

- **Extreme climatic events**
 - Frequency of smaller storms
 - Increased magnitude of storms
- **surges that occur during storms at the same time as high tides**
 - e.g.) Temporary rise in sea level by 51 inches in a day in the Sacramento-San Joaquin Delta



Boats pushed ashore in the storm surge of hurricane Katrina, September 2005.
(Source: NOAA).

COASTAL EROSION



Credit: USGS



Coastal erosion in Rhode Island, USA has severely compromised a home. (Source: URI College of the Environmental and Life Sciences).

Can we pursue adaptation solely for climate change in the coastal zone?

COASTAL ADAPTATION TO CLIMATE CHANGE + COASTAL HAZARDS

WHY:

Political, infrastructural, and financial constraints

IPCC SREX REPORT



The Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation published in February 2012

This is a joint report by Working Groups I and II

Working Group I: The Physical Science Basis

Working Group II: Impacts, Adaptation and Vulnerability

HOW TO ADAPT TO HAZARDS+CLIMATE CHANGE

Use existing methods and strategies

Combine methods and strategies

ENGINEERING



Coastal defense. 150 years ago, a wash-over inlet became finally closed by a dike, which was constructed in alignment with the coastal dunes. Since then, the dunes have retreated due to erosion.

ELEVATED



FLOATING



I-90 floating bridge on Lake Washington in Seattle



Coastal wetland in Louisiana



Ecosystem

Mangrove roots cover the upper banks of the Daly Estuary, Australia, providing a protective barrier against erosion of the upper banks, although not protecting against undercutting in the lower banks (Source: E. Wolanski).

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Developing coastal adaptation to climate change in the New York City infrastructure-shed: process, approach, tools, and strategies

POLICY SOLUTIONS IN THE U.S.

Based on U.S. peer-reviewed lit, policy documents, and case studies

Concerning people and property

- Relocation
- Retreat
- Zoning
- Insurance

RELOCATION

Forced relocation

- extreme events force people out of their lived places temporarily or permanently
- government policies mandate relocation

Voluntary relocation

- Relocation programs
- Financial Incentives
- people's awareness of the high risk

PROBLEMS

Economic cost

- burdensome purchase of the land by the government
- Rebuilding cheaper
- Loss of property tax-base for local governments

Social cost

- Place attachment, meaning, identity
- lifestyle

SOLUTIONS

Consultation with the affected community

compensation to property owners who relocate

acquisition of at-risk coastal properties

***form a community relocation committee, consult relocation specialists in the design implementation of relocation plans, prepare for social conflicts in the host communities, budget for the prevention of the return of the relocated community**

RETREAT

Setbacks

- Erosion-based setbacks
 - Shoreline setback distances can be delineated by calculating the annual erosion rate times approximately 30 to 100 years and from the high-tide line, the extreme high water mark, the vegetation line, or the crest of the sand dune
- Mitigate the impacts of beach erosion and storm surges
- Create a buffer between the sea and the coastal property
- Provide public access

RETREAT2

coastal construction control lines in Florida

dune protection lines in Texas

state erosion plans

PROBLEMS

Unprepared for the changing rate of erosion over time, sea-level rise, catastrophic inundation

Takings issue

- Taking private property without just compensation

Development interest, political pressure

SOLUTIONS

Compromises

- Grandfather clause
- Variances
- Temporary provisions

Rolling easement

ROLLING EASEMENT

Easement for public access

allow development until the shore turns into an intertidal zone and people and structures yield to migrating shores

Experimental

The U.S. states Maine, Rhode Island, Massachusetts, South Carolina, Oregon, and Texas

ZONING

Hazard area zoning

- independent or overlaid onto existing zones

e.g) National Flood Insurance Program: Special Flood Hazard Areas place hazard-protection restrictions onto existing land use

PROBLEMS

most difficult to implement in highly developed areas

conflicts with existing land use that favors development interests

land values of designated hazard areas are known to decrease

SOLUTIONS

local governments exercise restrictive land uses in hazardous areas before the land is subdivided

If the land is already subdivided, the acquisition of individual parcels located in highly flood-prone areas

Apply to new zoning only

AGAINST INSURANCE

inadvertently encourages people to continue to build in high risk areas

increase the tax burden as the government shifts the cost of high-risk properties to tax payers in the provision of subsidized insurance

people are generally reluctant to purchase insurance when premiums are high, perceptions of personal vulnerability to hazard are low, and government assistance is available

Two extreme populations, rich and poor, immune to the effects of insurance

FOR INSURANCE

necessary to defray the cost of disaster relief

people could self-insure. This not only strains individual welfare but also diverts resources from other investments

Can include incentives for other disaster risk reduction measures and offer lower-premium insurance

SOLUTIONS

Comprehensive catastrophe insurance or insurance-based climate risk financing

Set up hazard mitigation measures as a part of insurance requirements

Make premiums reflect actual risk that accounts for all uncertainty

For low-income residents, provide subsidy instead of insurance