The State of the Coast - Shorelines in Motion

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Dynamic Coastal Landscape

Scales of change

- Seconds – wave by wave
- Hours – tides & storms (Hurricanes)
- Days – storms (Nor’easters)
- Years – sea level rise, changes in sediment supply (natural and/or anthropogenic)
South Cape May (?)
Beaches and Dunes
NJ Shoreline Evolution

• Coastline of NJ changes on many scales:
  • Long-term
  • Seasonal
  • Episodic

• To manage these coastal changes, we have altered the coast through:
  • Shore protection structures
  • Inlet stabilization
  • Beach nourishment and sand management
Long-term Coastal Changes

For typical NJ beaches 1’ of SLR translates into a 50 ft recession in beach width.
Seasonal Coastal Changes

• The cross-shore extent of the beach undergoes erosion and accretion on a seasonal basis

  • In the summer and fall, small waves transport sand up onto the beach
  • In the winter and spring, large storm waves erode sand
  • Transition provides natural protection for the beach.
  • Shoreline can change 100 ft or more
Episodic Shoreline Change

- New Jersey Coast is impacted by two types of Coastal Storms:
  - Hurricanes
  - Northeasters

- Main Drivers
  - Maximum Water Level
  - Storm Waves
  - Storm Duration
Name that storm

1944 Hurricane

1962 Ash Wednesday Storm

1984 Nor'easter

December 1992 Nor'easter
Name that storm

2017 Winter Storm Jonas

Superstorm Sandy

2009 Veterans Day Storm

2018 Four’easter
Technologies for Understanding the Response of Beach/Dune Systems
Beach/Dune Status Update

What we know

- Damage/erosion is related to water levels, wave heights, and storm duration
- Wide beaches and large dunes reduce damage during storms
- Freeboard reduces damage during storms
- Bulkheads, seawalls, revetments reduce damage to landward structures during storms

What we don’t know

- How well hybrid coastal protection systems perform
- Details of flow/waves over land
- Details of structure response
- How long will existing coastal management approaches be effective
- Feedbacks
- Thresholds
Interior Shorelines
Historically much less attention
Suffer many of the same impacts
Will be the first to feel the influence of sea level rise
Multiple scales and a large range in wind, wave, tide and current forcing
Wakes and ice
Still Dynamic?
Living Shorelines

Low"er" Energy Approaches

- Common structural materials include vegetation, shell, coir logs, coir mats
Living Shorelines

Moderate"er" Energy Approaches

● Common structural materials include concrete blocks and smaller stone
Living Shorelines

High”er” Energy Approaches

● Common structural materials include gabion baskets, geotubes, large rock
Interior Shoreline Status Update

What we know

- Historically natural systems have provided protection to the upland
- Living shorelines can reduce wave energy
- Higher energy sites require more “structure”
- Living shorelines projects take time to take hold – maintenance may be required
- Marshes have a limited ability to adapt to rising sea levels

What we don’t know

- How do we quantify ecological benefit
- What is the impact of wakes/ice
- How transferable is living shorelines design guidance
- How successful will the projects be at adapting to sea level rise
- How do biologic processes affect engineering performance
- What is the collective impact of multiple small projects
Urban Shorelines
Traditional Approach

Separate People from the Water
Modern Approach

Encourage Interaction with the Water
Modern Approach

Incorporate Ecological Considerations
Modern Approach

Live with the Water
Modern Approach

Large-scale Engineering (possibly)

Project MOSES: How it will work

1. Barrier stays on seabed until high tides and storms are forecast
2. Air is pumped into each hollow gate to raise barrier
3. Gates move independently, allowing barrier to deal with rough seas

Venice
Lagoon
Adriatic Sea

4 miles
Urban Shoreline Status Update

What we know

● Small shoreline modifications can have a large ecological impact
● Generally speaking…
  • Vertical is bad – sloping is good
  • Straight is bad – curvy is good
  • Rugosity is good
● Large scale interventions have the potential for unforeseen large-scale impacts

What we don’t know

● How do we quantify ecological benefit
● How do urban eco-shorelines perform over the long term
● Quantification of cumulative impacts
● Fine scale hydrodynamics associated with overland flow
● What are the potential impacts (good & bad) of large scale interventions
Thank You

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