INNOVATION & DESIGNING FOR THE FUTURE: SEA LEVEL RISE AND STORMS

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Restore America's Estuaries
Living Shorelines Tech Transfer Workshop

Outline

01 Overall Living Shoreline Goals
02 Future Sea Level Rise & Storms
03 Performance Considerations
04 Creating Robust Designs
05 The Bigger Picture

I. Overall Living Shoreline Goals

Strategy vs. Solution

Remember, we aren't necessarily "solving" a problem here!

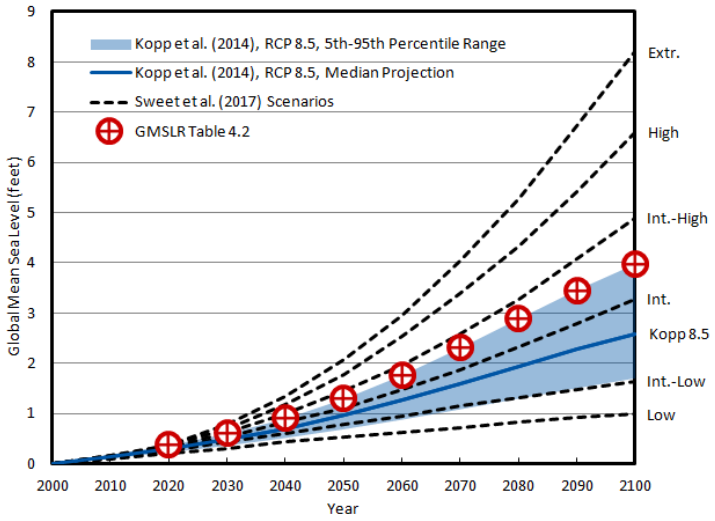
- A strategy for ***managing*** shorelines and protecting the intertidal zone
- Manage shoreline erosion through natural and/or constructed elements that preserve or enhance habitat
- Provision or facilitation of ecosystem services

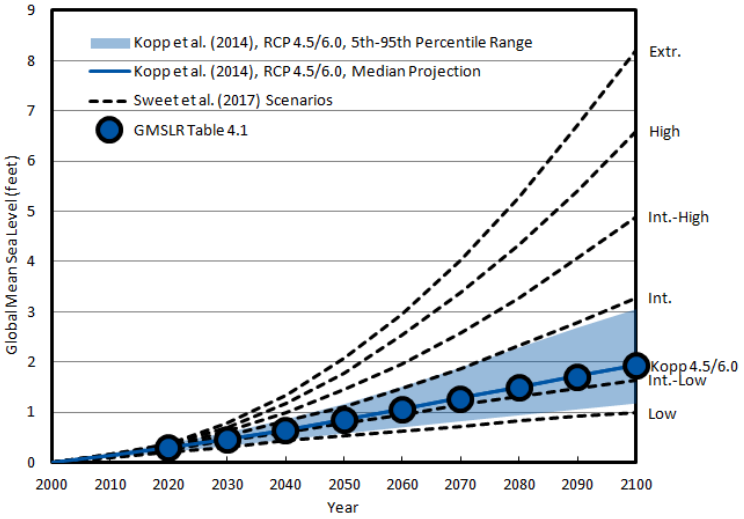
II. Future Sea Level Rise & Storms

Caution: Work Ahead!

Preparing for an uncertain future…

- Mean sea level is the fundamental, geologic control on shoreline position worldwide!
- Global sea levels are rising
- Local/regional processes are making the rate of rise appear GREATER in most places
- Significant uncertainty in future scenarios





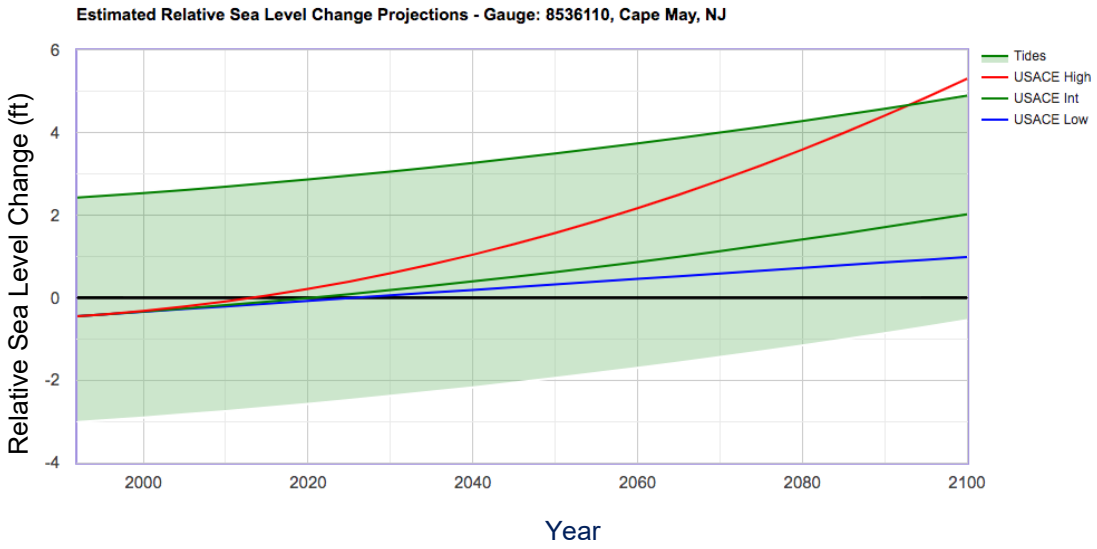
USDOT FHWA 2020 HEC-25 3rd Ed.

II. Future Sea Level Rise & Storms

Caution: Work Ahead!

Preparing for an uncertain future…

- All "datums" will increase with future SLR
  - Tidal datums
  - Storm datums
  - Biological datums
  - Ecological datums



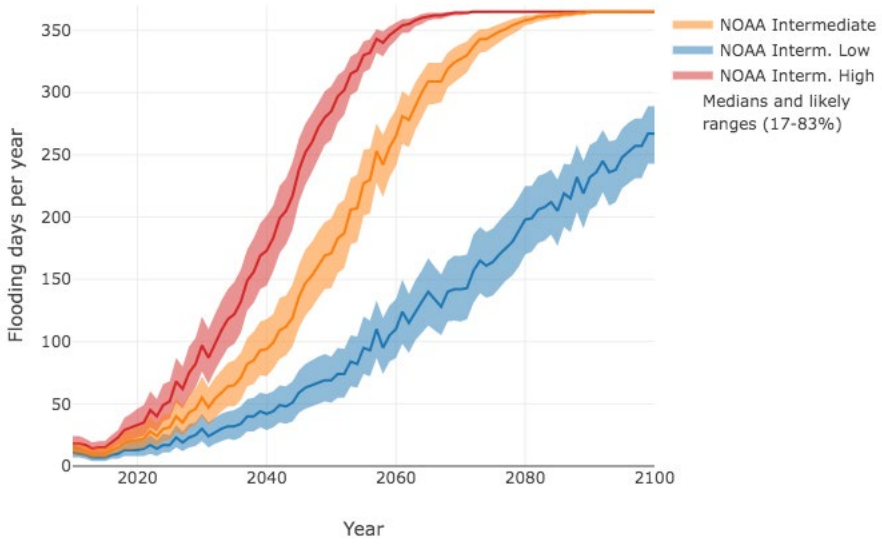
https://cwbi-app.sec.usace.army.mil/rccslc/slcc_calc.html

II. Future Sea Level Rise & Storms

Caution: Work Ahead!

Preparing for an uncertain future…

- Future SLR leads to more frequent and greater amounts of inundation
- Static infrastructure without adaptive capacity will become less effective over time
- Some ecological communities may not keep pace with higher rates of SLR



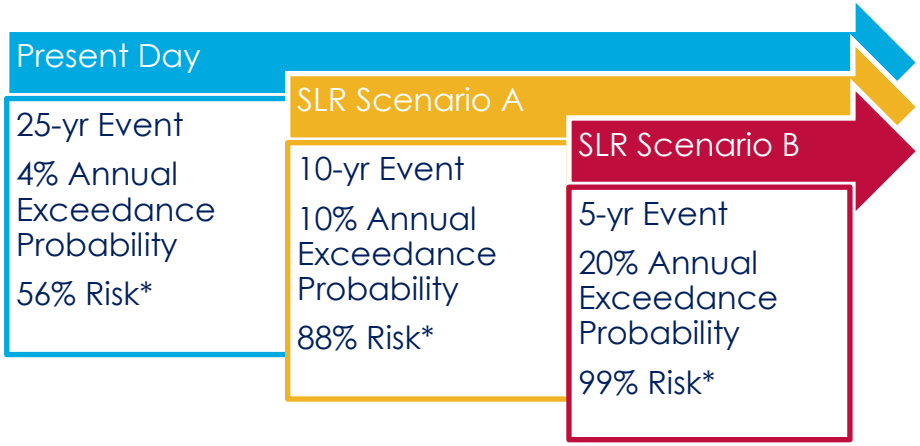
https://sealevel.nasa.gov/flooding-days-projection/

II. Future Sea Level Rise & Storms

Caution: Work Ahead!

Preparing for an uncertain future…

- Overall increase in frequency of lower return period (high exceedance probability)
- Future SLR will lead to higher future water levels and larger wave heights
- LS function needs to address system reliability while the design is resilient to hazard risk



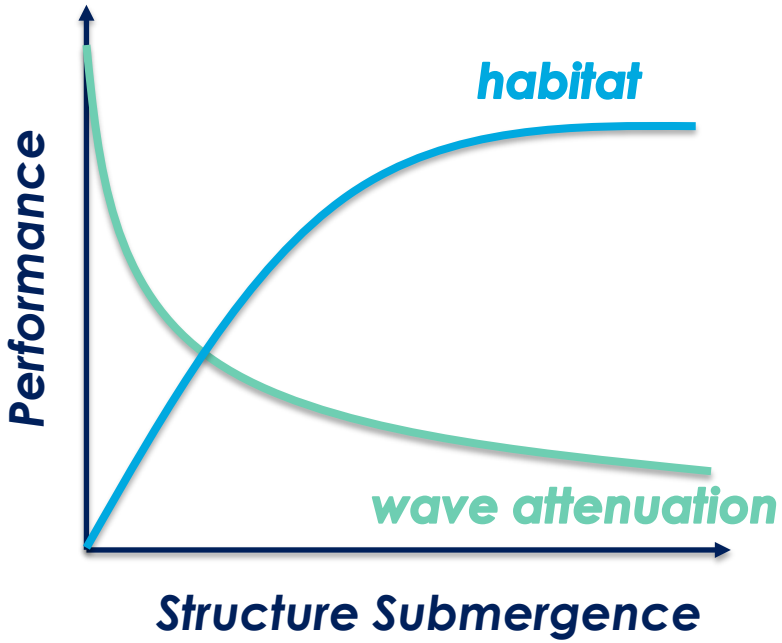
*Based on 20-yr Design Life

III. Performance Considerations

Potential Challenges

Engineering & ecological issues…

- For components that have no natural adaptive capacity…
- Subtidal habitat benefits may increase
- Performance of some physical processes (e.g., wave attenuation) may diminish

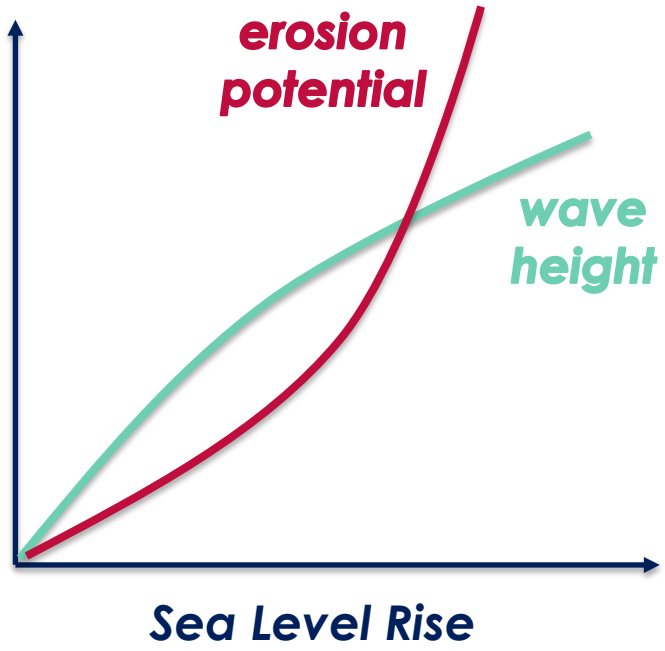


III. Performance Considerations

Potential Challenges

Engineering & ecological issues…

- What about changes in the physical processes?
- SLR will lead to larger wave heights $H \sim f(d^{3/4})$
- Erosion is proportional to wave energy and power and $E \sim f(H^2)$
- Example: 1 m of SLR could increase erosion potential by 3x!!!

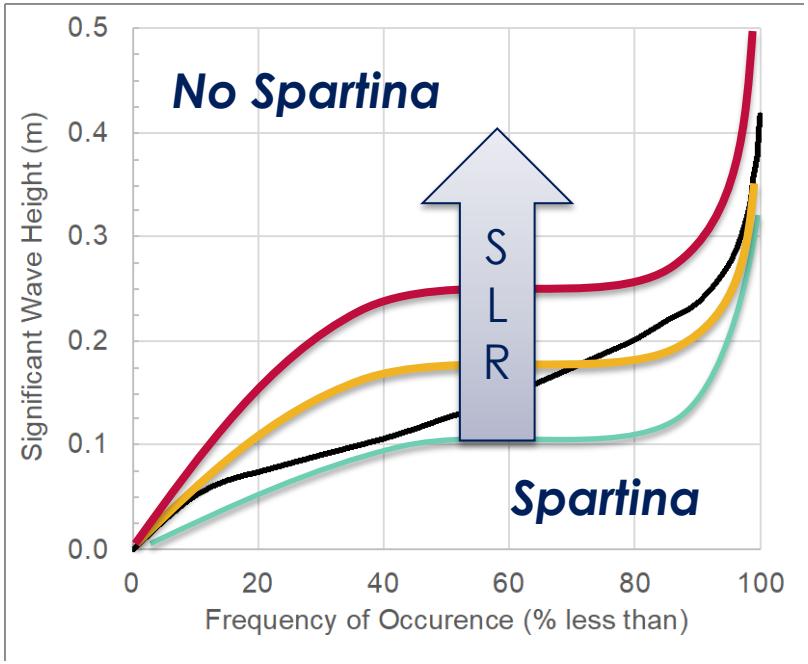


III. Performance Considerations

Potential Challenges

Engineering & ecological issues…

- What about the ecological systems?
- Consider wave tolerance of *Spartina alterniflora*
- SLR and increasing frequency of low intensity storms change the frequency distribution of waves



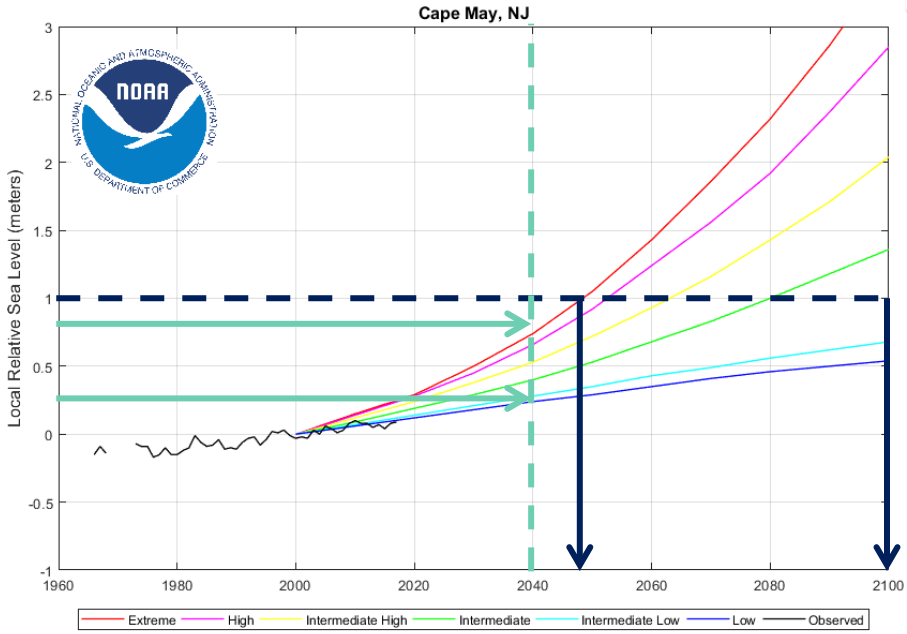
Roland & Douglass (2005)

IV. Creating Robust Designs

Adaptive Capacity

Be flexible, but be realistic…

- Select and apply an appropriate design strategy
- Top down vs. bottom up
- Select appropriate project performance periods and design events
- Communicate risk and uncertainty



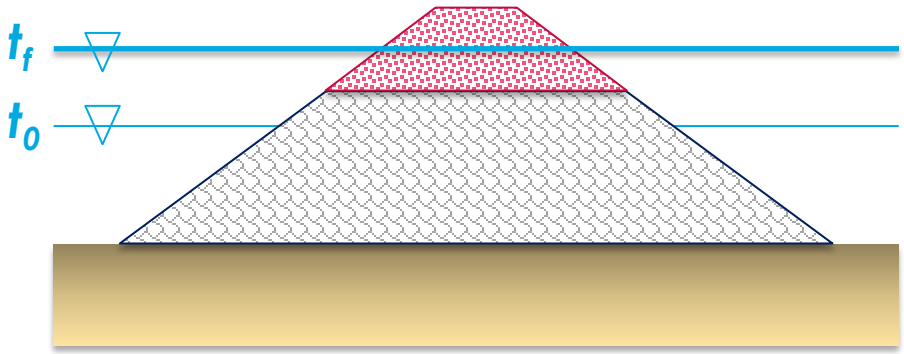
https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?id=8536110

IV. Creating Robust Designs

Adaptive Capacity

Be flexible, but be realistic…

- What is the inherent adaptive capacity of the system?
  - Reefs
  - Marshes
  - Mangroves
  - Oysters
  - Gray infrastructure



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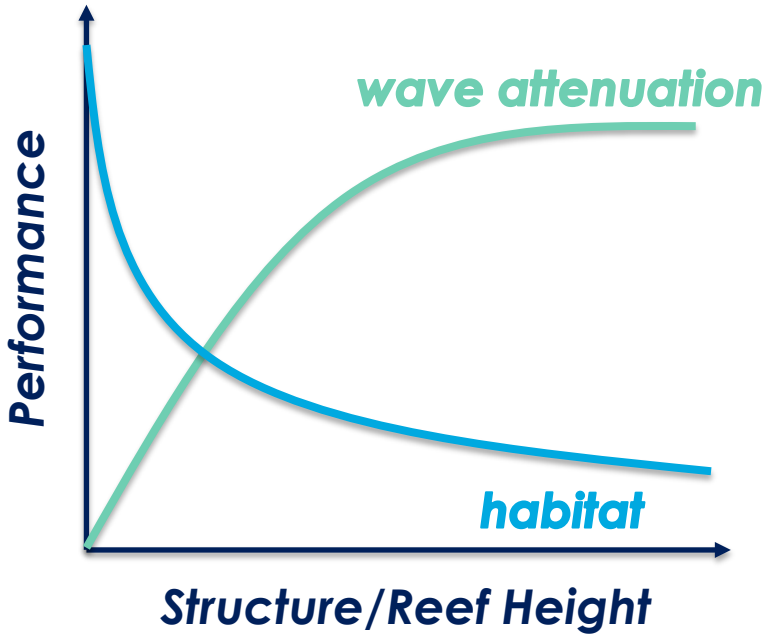

IV. Creating Robust Designs

Adaptive Capacity

Be flexible, but be realistic…

- For natural systems…
  - Provide accommodation space for migration and adjustments to SLR
  - Spread out over the intertidal zone to maximize benefits
  - Avoid scenarios that may lead to drowning in place

Morris Landing, North Carolina

IV. Creating Robust Designs

Adaptive Capacity

Be flexible, but be realistic…

- Consider tipping points in functional design…
  - When will it stop working?
  - When will a client/homeowner do something else?
  - What is the expected timeframe for these decisions and tipping points?

Gulf Breeze, Florida

The Bigger Picture

Choose Wisely

Storms are fleeting…
but sea level rise is forever!

Set Realistic Goals

You cannot stop SLR and they won't prevent storm damage!

The Bottom Line

Living shorelines are a management strategy!