Application of the Beach-*fx* Economic Model in St. Johns County, Florida

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- Beach-fx Introduction
- St. Johns County Study Area
- Overview of Economic Data Requirements
- Details of Engineering Input Development
- Future Work

Beach-FX Overview

- Developed by the US Army Engineer Coastal Hydraulics Lab and the Institute for Water Resources (IWR)

- Economic storm damage model for sandy coastlines

- PC-based, GIS compatible

- Only approved/certified economic model for Federal Coastal Storm Damage Reduction studies

Beach-FX Overview

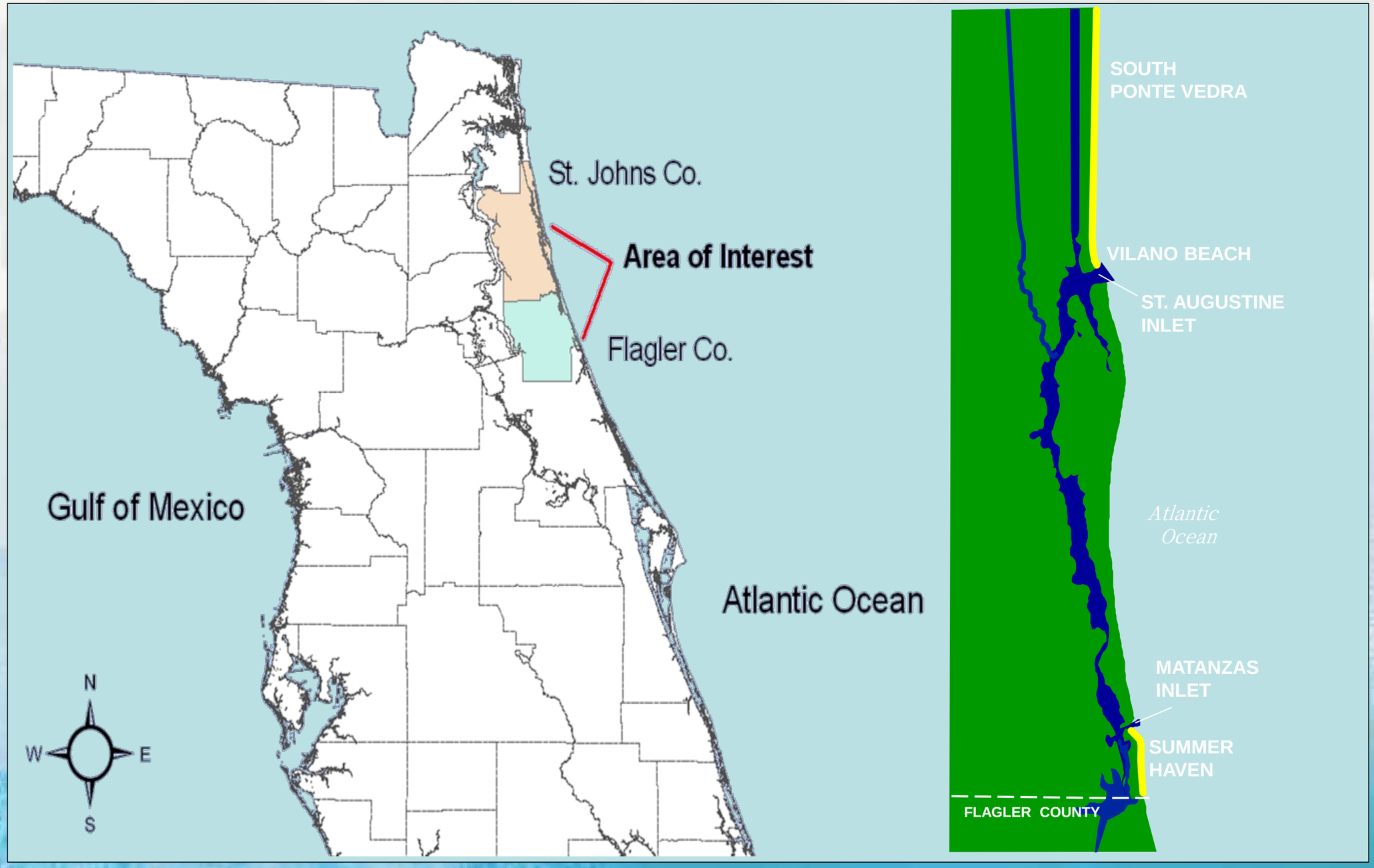
- Merges engineering and economic data
  - Predicted storm response
  - Database of ‘damage elements’
- Simulates project lifecycles
  - 50-years, 300 lifecycles
- Outputs
  - Average annual costs with/without project
  - Alternative evaluation/optimization

Why

- Common Context for Local/Regional/National Prioritization of Projects

- Previous models locally-developed
  - Inconsistent model assumptions
  - Inadequate coastal processes
  - Varying levels detail economic input

Study Area



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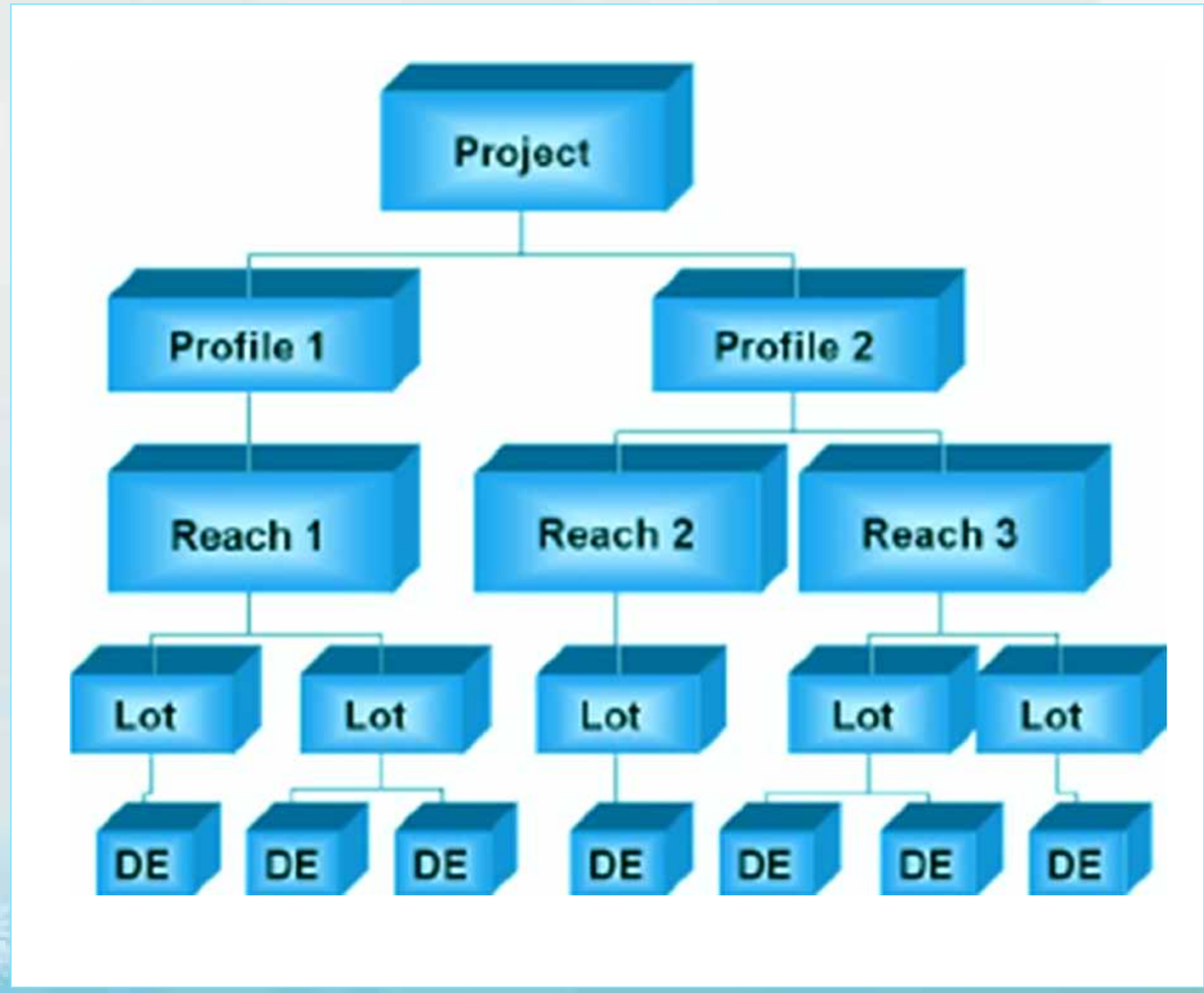
Beach-fx Development

- Formulation of input data
  - Economic
  - Engineering
- Calibration
- Without-project simulations
- Alternative evaluation

Economic Inputs

- Geographic hierarchy
- Profiles, reaches, lots, damage elements
- Damage elements: anything of economic value
  - Roads
  - Buildings
  - Pools
  - Dune walkovers



Economic Inputs

Reach/Lot/DE Attributes

- Armor status
- Armor rebuild cost/time
- Armor failure threshold
- Structure type
- Construction type
- Foundation type
- # Floors
- Dimensions
- XY coordinates
- Elevation
- Structure replacement $
- Contents replacement $

GIS structure database has value beyond Beach-fx

Beach-fx Engineering Inputs

- Plausible storms
- Representative beach profiles
- Shore response database: storm induced profile changes

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Historical Storms

- Tropical Storms/Hurricanes
  - Derived from NOAA HURDAT database 1887-1999
  - Water levels: HURDAT
  - Waves: FCFP, WIS, SPM method
  - St. Johns: 46 tropical storms/hurricanes
- Extra-tropical (Nor'easters)
  - NASA GISS Extra-tropical Storm Tracks (1961-1998)
  - Water levels: NOS gage data
  - Wave data: FCFP, WIS
  - St. Johns: 48 storms

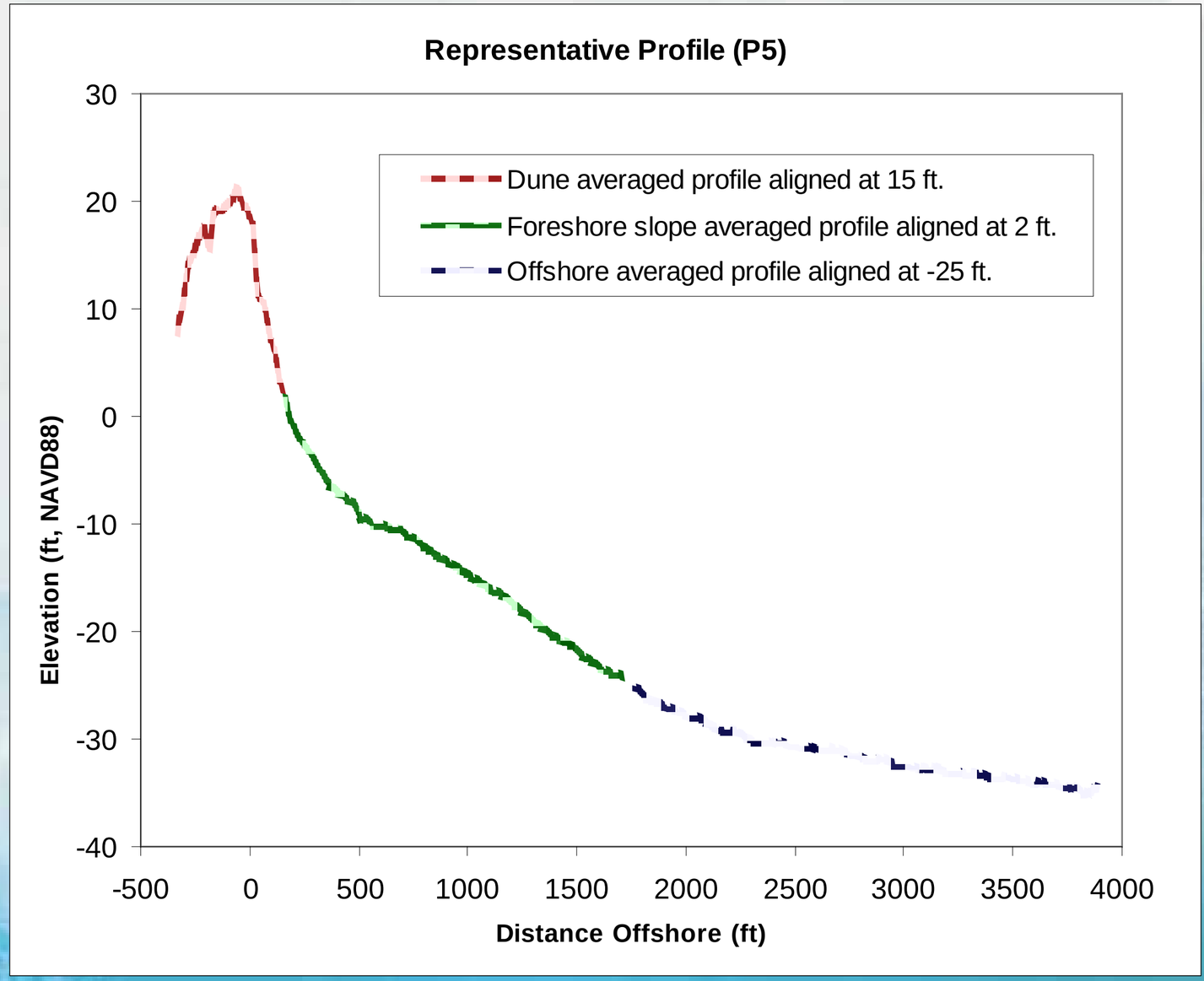
Plausible Storms

Potential water levels occurring during passage of Tropical storms

- 3 Tide ranges: spring, neap, mean
- 4 tide stages: high, mid-falling, low, mid-rising
- 12 static water surface elevations
- 12 elevations x 46 storms
- 552 tropical storms + 48 nor'easters
- Total of 600 plausible storms
- Used for both St. Johns and Flagler Counties

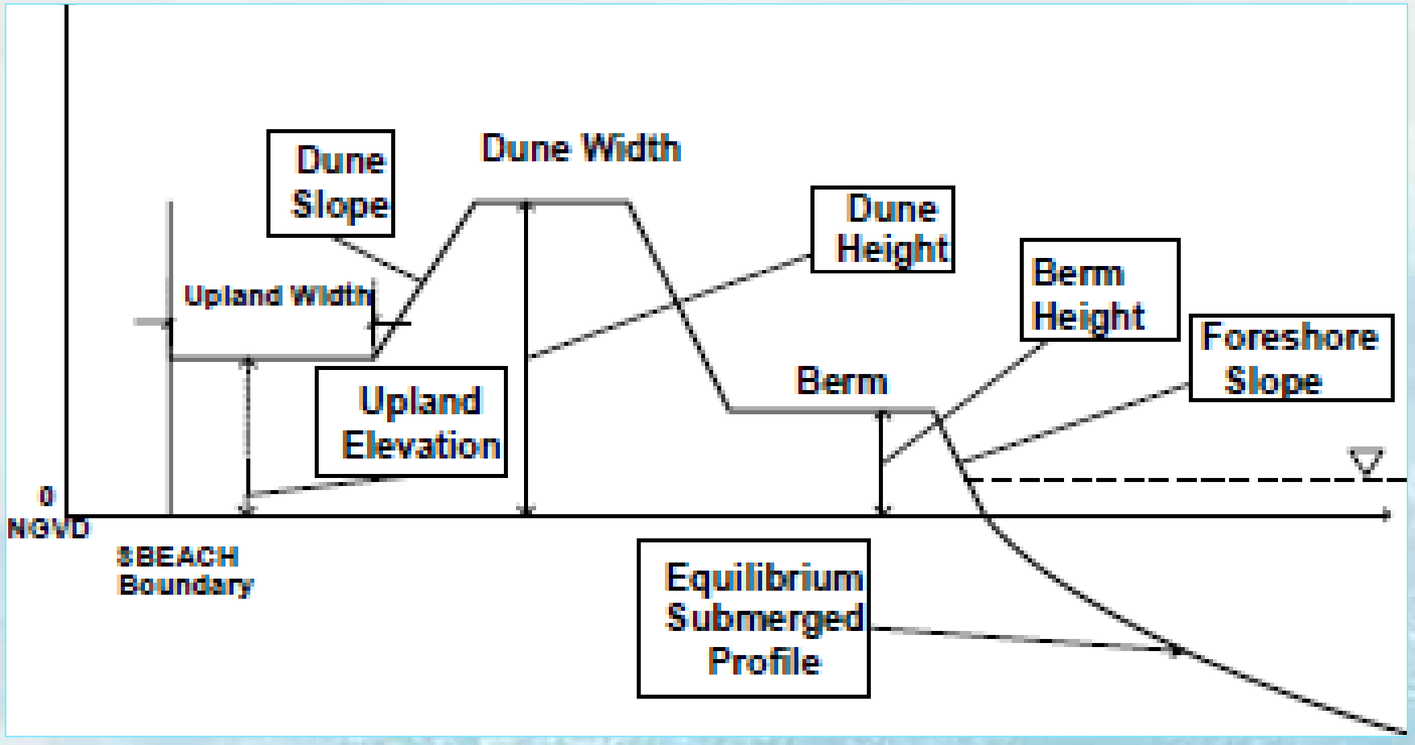
Representative Profiles

- Analysis of historical profile data
- Regions with similar profile dimensions
- Within segment, averages taken through three sections
- St. Johns: 15 representative profiles



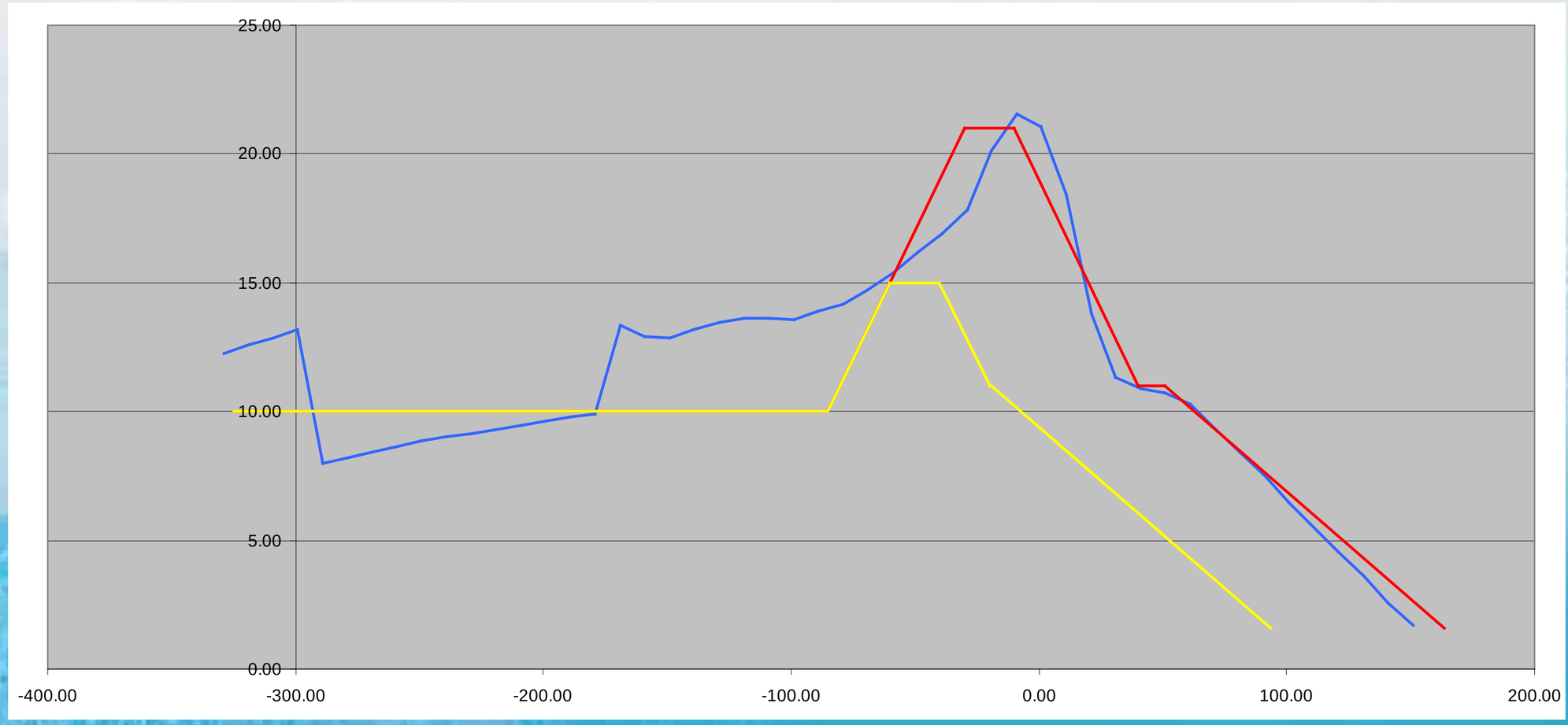
Simplified Profile

- Upland elevation
- Dune
  - height
  - Width
  - Slope
- Berm
  - Height
  - Width
  - Foreshore slope



Shore Response Profiles

- Starting with representative profile
- Range of possible future profiles
- Increments between a max/min profile
- St. Johns: 229 response profiles



Shore Responses

- SBEACH run for every profile/storm combination
- St. Johns: 600 storms x 229 profiles = 137,400 SBEACH runs
- SBEACH batch-run tool
- 30 batch runs
- Shore Response Database (SRD)

Shore Response Database

- SRD: database of storm-induced changes
  - Berm width
  - dune height
  - dune width

- SBEACH calibrated for performance based on these three parameters

Beach-fx Calibration

Goal: average erosion of many lifecycles = measured historical erosion

Two model parameters

- Storm erosion: berm width recovery factor (~90%)
- Background erosion: applied erosion rate (ft/yr)

Calibration not as time consuming as on engineering models like SBEACH, GENESIS

Summary

- GIS D.E. database a somewhat daunting task, but a valuable data set that can easily be integrated into a local/regional/state GIS databases.
- Engineering input data ‘larger’, but analysis is not more complicated—use familiar engineering models.
- Coastal processes model are run outside of Beach-fx, any improved/new models can easily be substituted in the future.

Future Work

St. Johns County Beach-fx

- Complete without-project model runs
- Alternative evaluation/optimization

Sensitivity testing of input variables

- First floor elevation
- Statistical assignment of D.E. variables

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