Geospatial and Field Assessment of Sea Level Rise in Accomack County, Virginia

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GEOG 496

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Introduction

- Accomack County, Virginia
- Sea Level Rise (SLR)
- Shoreline Erosion
- Why were we interested?
  - Repercussions of global warming close to home
- <u>Research Question</u>
  - How vulnerable is the Accomack County shoreline?

Source: http://upload.wikimedia.org/wikipedia/commons/thumb/e/e3/Map_of_Virginia_highlighting_Accomack_County.svg/1280px-Map_of_Virginia_highlighting_Accomack_County.svg.png

Sub-research Questions

- What are Limitations of SLR models?
- What are the Impacts of SLR and erosion?
- How much shoreline change has occurred?

Accomack County

- Background of County
  - Population (2013): 33,148
  - Total Land Area: 449.50 Square Miles
- Large Marshland Habitat
- Historic Fishing/Waterman County

Areas of Interest

- Saxis Island
- Hunting Creek

Sea Level Rise (SLR)

- Holocene (~11,700 years ago)
  - Anthropocene

- Eustatic Sea Level Change
- Isostatic/Relative Sea Level Change
  - Isostatic Rebound

Source: *Geoarchaeological Proxies for Late Holocene Sea level Rise: A Test of Middle Atlantic Marine transgression model, Darrin Lowery, Ph.D*

"Climate related sea-level variations over the past two millennia"

Source: http://www.pnas.org/content/early/2011/06/13/1015619108.abstract

Methods

- Investigated NOAA's SLR model
- Collected Data
  - Tidal Gauge Data
  - Geographic Data
  - Archaeological Data
- Field Assessment
  - GPS
  - Waypoints
- Geospatial Assessment
  - Mosaicked & Georeferenced Historical Maps
  - Generated Maps to Visualize Data

Mosaicked Map of Accomack County in 1820

Archaeological Sites

- Virginia Department of Historic Resources
- Reference Points
- Stable landmarks
- Reliable data

NOAA Model

- Sea Level Rise Viewer
  - Elevation data
  - IPCC scenarios
  - Mean Higher High water
- Modeling technique
  - Modified Bathtub Approach

Source: http://csc.noaa.gov/slr/viewer/

Tidal Gauge Data

Spatial Scale	SLR rate (mm)
Global Average	1.8 mm/yr
East Coast	3.4 – 6.1 mm/yr

2x to 3.4x Average Global Rate!!

Source: http://tidesandcurrents.noaa.gov/sltrends/index.shtml

Tidal Gauge Data (con't)

Area of Interest

Sea Level Trends
mm/yr (feet/century)

- 6 to 9 (2 to 3)
- 3 to 6 (1 to 2)
- 0 to 3 (0 to 1)
- -3 to 0 (-1 to 0)
- -6 to -3 (-2 to -1)
- -9 to -6 (-3 to -2)

Source: http://tidesandcurrents.noaa.gov/sltrends/index.shtml

Sea Level Rise Scenarios – Kiptopeke Area (40 miles south our of project area)

Source: http://www.corpsclimate.us/ccaceslcurves.cfm

Geographic Data Collection

- Coastline and Topology Maps
  - Department of Commerce and Labor Coast and Geodetic Survey
  - United States Geological Survey and the National Ocean Service
  - Virginia Board of Public Works Maps
- Shapefiles
  - Virginia Institute of Marine Science Data
  - National Atlas
  - U.S. Fish and Wildlife Service
  - Web Soil Survey
  - Virginia Department of Historic Resources
- Raster
  - National Oceanic and Atmospheric Administration Digital Coast (NOAA)

Mosaicked Map of Accomack County in 1820

Coastal Erosion and Protection Methods

Accomack County, Virginia

Protection Techniques

- breakwater
- bulkhead
- groin
- jetty
- riprap

Erosion

- high
- undercut

0 0.75 1.5 3 Miles

*Data provided by
Virignia Institute of Marine Science (VIMS), 2000

Field Assessment

- Trimble GeoXH GPS
  - Used to locate waypoints
  - Delineated Coast Lines
  - Marked Points of Interest
- Visualized change
  - Erosion
  - Sea Level Rise
  - Impacts on Archaeological Sites

The Crew

From Left to Right:
Michael Hammerstrom, Brad Anderson, Dr. Carole Nash, Dr. Paul Ewell

Photo Credit

Hunting Creek Trip

Vulnerable Archaeological Sites in Accomack, Virginia

** Elevation of archeological site's centerlod was derived from NOAA's digital elevation model.*

Sources: Layers obtained from Virginia Institute of Marine Science, US Fish and Wildlife Service, Virginia Department of Historic Resources, and NOAA Digital Coast

NORTH

Visualization, Accomack County

1904 - 2012

POCOMOKE SOUND
CHESTOSESSEX CREEK TO POCOMOKE RIVER
VIRGINIA
0
1.25
2.5
5 Miles

POCOMOKE SOUND
CHESTONESSEX CREEK TO POCOMOKE RIVER
VIRGINIA
0
1.25
2.5
5 Miles

POCOMOKE SOUND
CHESTON & ESSEX CREEK TO POCOMOKE RIVER
VIRGINIA
0
1.25
2.5
5 Miles

0
1.25
2.5
5 Miles

0
1.25
2.5
5 Miles

Halfmoon Island

1904 - 2013

Halfmoon Point
Halfmoon Island
Moon
0
0.25
0.5
1 Miles

Halfmoon Point
Halfmoon Island
Moon
0
0.25
0.5
1 Miles

Halfmoon Point
Halfmoon Island
0
0.25
0.5
1 Miles

Halfmoon Point
Halfmoon Island
0
0.25
0.5
1 Miles

0
0.25
0.5
1 Miles

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
0
0.25
0.5
1 Miles

Picture of Half Moon After Sandy

Thorofare Hill

Surveyed Island

The Notch
0 250 500 1,000 Feet

The Notch
0 250 500 1,000 Feet

The Notch
0 250 500 1,000 Feet

The Notch
0 250 500 1,000 Feet

0 250 500 1,000 Feet

0 250 500 1,000 Feet

Direct Shoreline Erosion

Soil layer undercut from erosion

Jack’s Island

1904 - 2012

Archaeological sites documented less than 20 years ago

Zaren Marsh Point
44A C0496
44A C0497
44A C0504
0
625
1,250
2,500 Feet

Zaron Marsh
Point
44A C0496
44A C0497
44A C0504
0
625
1,250
2,500 Feet

Zarow Marsh Point
44A C0496
44A C0497
44A C0504
0
625
1,250
2,500 Feet

44A C0496
44A C0497
44A C0504
0
625
1,250
2,500 Feet

44A C0496
44A C0497
44A C0504
0
625
1,250
2,500 Feet

44AC0497
150
Feet!
0
125
250
500 Feet

Source: *Geoarchaeological Proxies for Late Holocene Sea level Rise: A Test of Middle Atlantic Marine transgression model, Darrin Lowery, Ph.D*

Illustration of Shoreline Erosion & SLR

As Sea Level Rises:

Destruction of the Bank and Marshland

Uprooting of Trees

Bank Erosion

Aeolian soil Layers from the Pleistocene and Holocene

Destruction of Vegetation

Uprooted Trees and the underlying sand layer

Soil Erosion

Soil washing out into the Creek

Dix Cove

1904 - 2012

44AC0496
44AC0497
44AC0504
44AC0496
44AC0501
44AC0502
0
0.375
0.75
1.5 Miles

44AC0495
0
250
500
1,000 Feet

Site: 44AC0495
81 feet

Direct Bank Erosion

Destruction of bulkhead

Conclusions

- NOAA Sea Level Rise Viewer Limitations
  - Does not account for:
    - Rate of erosion
    - Spatial Variance
    - Storm Surges
- Impacts of Sea level Rise
  - Interruption of coastal geomorphic processes
  - Loss of heritage
  - Population displacement
- Accomack County's Vulnerability
  - Current Erosion Rate ~1 ft inland per year (in surveyed areas)

Recommendations

- Future Research
  - Mapping out current conditions of other Archaeological Sites
  - Calculating the overall landform change
  - Identifying most vulnerable areas
- Possible Protection Methods
  - Beach Nourishment?
  - Seawalls?
  - Other options?

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Questions?

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