Impact of Sea Level Rise on Virginia’s Coast

Skip Stiles
Executive Director, Wetlands Watch

www.wetlandswatch.org
MID-ATLANTIC COASTLINE – Full Glacial Melt

+ 120 feet
MID-ATLANTIC COASTLINE – 14,000 Years Ago

- 120 Feet
RECENT MID-ATLANTIC SEA LEVEL RISE

Norfolk

Source: UNC Research Laboratories of Archeology
RECENT MID-ATLANTIC SEA LEVEL RISE

Source: UNC Research Laboratories of Archeology
14,000 YEARS AGO

10,000 YEARS AGO

Source: UNC Research Laboratories of Archeology
Source: UNC Research Laboratories of Archeology
14,000 YEARS AGO
10,000 YEARS AGO
7,000 YEARS AGO
5,000 YEARS AGO

Source: UNC Research Laboratories of Archeology
The Cost of Holding Back the Sea, Titus, et al.
U.S. Sea Level Trends: 1900-97

30.8 cm = 1 Foot

Galveston, TX
New York, NY
Baltimore, MD
Key West, FL
San Francisco, CA
Sitka, AK

25 cm
(~ .8 Foot)

The Cost of Holding Back the Sea, Titus, et al
Sewells Point Historical Sea Level Record

The mean sea level trend is 4.42 millimeters/year (1.45 feet/century)

Monthly Mean Sea Level 1927 – 1999 (units in tenth of meter/yr)
Sewells Point Historical Sea Level Record

The mean sea level trend is 4.42 millimeters/year (1.45 feet/century)

Monthly Mean Sea Level 1927 – 1999 (units in tenth of meter/yr)
Sea level rise is driven by temperature rise

Temperature Rise is accelerating…

…FAST!

IPCC 2000
Hampton Roads has the highest NOAA predicted sea level increases on East Coast for major metro area.

Source: Larsen. 1998. *Rising Sea Level in the Chesapeake Bay*. USGS.
100 year Sea Level Rise

~ 1 foot

SEA LEVEL RISE - BASE

1.8 – 2.8 mm/yr from thermal expansion and melting of land glaciers
Relative Sea Level Rise in Hampton Roads

An additional ~2 mm/yr due to regional subsidence from

• isostatic rebound
• groundwater removal
• comet impact

SEA LEVEL RISE - BASE

1.8 – 2.8 mm/yr from thermal expansion and melting of land glaciers
100 year Sea Level Rise

SEA LEVEL RISE - BASE
1.8 – 2.8 mm/yr from thermal expansion and melting of land glaciers

~ 1 foot

~ .6 feet

Relative Sea Level Rise in Hampton Roads
An additional ~2 mm/yr due to regional subsidence from
• isostatic rebound
• groundwater removal
• comet impact

Localized Relative Sea Level Rise
> 7 mm/yr in some parts of H.R.
A Semi-Empirical Approach to Projecting Future Sea-Level Rise

Stefan Rahmstorf

Base Projection = 28 – 53 cm by 2100
Glaciers Dominate Eustatic Sea-Level Rise in the 21st Century

Another 10 CM – 25 CM by 2100
Newest (8/2007) Estimates

Relative Sea Level Rise in Hampton Roads

An additional ~2 mm/yr due to regional subsidence from

• isostatic rebound
• groundwater removal
• comet impact

SEA LEVEL RISE - BASE

2.8 – 5.3 mm/yr from thermal expansion and melting of land glaciers (New Data)
Chesapeake Bay is at risk from sea level rise –

Loss of wetlands will be significant ~50-80%
Chesapeake Bay is at risk from sea level rise –

Loss of wetlands will be significant ~50-80%

Outside of New Orleans, Hampton Roads is largest population area at highest risk in the US.
North Carolina at risk as well – significant loss of tidal wetlands in critical waterfowl habitat
Ecosystem Impacts

All Atlantic Flyway Vegetated Tidal Wetland Ecosystems at risk.

Wetland-dependant fish and shellfish ecosystem threatened:

American Eel, Sturgeon, Alewife, Blueback Herring, Striped Bass, Atlantic Rangia Clam, Banded Killifish, Bay Anchovy, Blue Crab, Cobia, Grass Shrimp, Mummichog, Naked Goby, Red Drum, Sheepshead Minnow, Silversides, Spotted Sea Trout, Atlantic Croaker, Atlantic Menhaden, Shrimp, Southern Flounder, Striped Mullet, Black Sea Bass, Pinfish, Summer Flounder (NC Division of Marine Fisheries)
Economic Impacts on Virginia

Commercial Fishery = $130 million in 2005
(VMRC 2005)

Saltwater Angling = $820 million in sales, $480 million in services, 9,000 jobs, $2 million in state saltwater fees (VOP 2007)

Waterfowl hunting = $14 million in 2001 (FWS 2001)

Wildlife Watching = $941 million (FWS 2007)
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<td>6.4 feet</td>
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<td>September 1, 2006</td>
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$ 153,000 taxpayer dollars!
$4.5 million program in Norfolk –
$26 million state-wide in Virginia
Previous studies suggest that the expected global warming from the greenhouse effect could raise sea level 50 to 200 centimeters (2 to 7 feet) in the next century.

The total cost for a one meter rise would be $270-475 billion, ignoring future development.

**To ensure the long-term survival of coastal wetlands, federal and state environmental agencies should begin to lay the groundwork for a gradual abandonment of coastal lowlands as sea level rises.**
Anticipatory Planning For Sea-Level Rise Along The Coast of Maine

This report a joint effort in cooperation with State of Maine's State Planning Office.

"THE STATE SHOULD PREVENT NEW DEVELOPMENT WHICH IS LIKELY TO INTERFERE WITH THE ABILITY OF NATURAL SYSTEMS TO ADJUST TO CHANGES IN SHORELINE POSITION."
A SEA LEVEL RISE RESPONSE STRATEGY
FOR THE STATE OF MARYLAND

Zoe Pfahl Johnson
NOAA Coastal Management Fellow

for

Maryland Department of Natural Resources
Coastal Zone Management Division
October, 2000
NC LOSES ABOUT 780 ACRES OF TIDAL WETLANDS PER YEAR
FUTURE SEA LEVEL RISE AND THE NEW JERSEY COAST

Assessing Potential Impacts and Opportunities

Matthew J.P. Cooper
Michael D. Beevers
Michael Oppenheimer

November 2005

Science, Technology and Environmental Policy Program
Woodrow Wilson School of Public and International Affairs
Princeton University
Figure 2. National Map Showing Spatial Distribution of Events by State.
Private Insurance Companies “Blue Lining” Tidewater, VA

Allstate stopped writing new policies in 19 coastal communities:

Accomack, Gloucester, Isle of Wight, King and Queen, Lancaster, Mathews, Middlesex, Northumberland, Northampton, Southampton, Surrey, Sussex, York counties and Chesapeake, Franklin, Hampton, Newport News, Norfolk, Virginia Beach

Nationwide withdrawing from any new coastal coverage

State Farm will not write new policies within one mile of shoreline
Allstate stopped writing new policies in 19 coastal communities:

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Nationwide withdrawing from any new coastal coverage

State Farm will not write new policies within one mile of shoreline

= 55% of private insurance market in Mid-Atlantic Region
Virginia’s Plan?????
CEDAR ISLAND (Eastern Shore of Virginia)
• Evaluate the potential impact of climate change on the Chesapeake Bay watershed, particularly with respect to its wetlands, and consider potential management options.
Environmental Drivers & Biogeomorphic Process Controls on Vertical Wetland Development

- Storms
- Disturbance (herbivory, fire)
- Elevated Atmospheric CO₂
- Sea-Level Rise
- Altered River Flows (freshwater & sediment)
- Salinity
- Flooding Depth/Duration
- Plant Growth / Turnover
- Sedimentation & Erosion
- Soil Elevation
- Nutrient Input (eutrophication)
- Nutrients
- Biomass Accumulation
- Decomposition
- Subsidence (shallow & deep)
Wetlands Can Maintain Elevation in Face of Modest Sea Level Rise

Decayed plant material/detritus

2-3 mm/yr ~ 1 foot
Rapid Sea Level Rise forces Landward Migration

Migration

Decayed plant material/detritus

3-5 mm/yr

MHW

MLW

Sediment
...Unless Barriers are Encountered

3-5 mm/yr
Wetlands Have No Escape from Sea Level Rise
Impact of Sea level Rise on Beaches

**Bruun Rule**

\[ s = \sim 50 \text{ to } 200a \]

- \( s \) = beach recession
- \( a \) = sea-level rise

Eastern US: \( s = 110 \text{ to } 181a \)

18 cm rise ---\( \sim 20 \text{ m recession} \)

Leatherman et al. 2000
Impact of Sea Level Rise on Virginia Beach

300 FEET
Impact of Sea Level Rise on Virginia Beach

2 foot sea level rise = loss of 200+ feet of beach

2100 Shoreline (max)
Sandbridge widened to 200 Feet

New Condominiums

The “Sanctuary at False Cape”

2010 Shoreline
One meter Sea Level Rise Impact – Hampton, VA
Global sea level is currently predicted to increase by up to 17 inches by 2100. In this simulation of North Carolina's Albemarle Peninsula, sea ranges from 4 to 32 inches.
State Strategy for Virginia Sea Level Rise

Live up to promises made in Chesapeake 2000 – PLAN!

Map coastal regions with 10 cm contours - LIDAR

Assess ecosystem impacts on coastal ecosystem – wetlands, dunes, buffers

Identify mitigation areas and begin protection

Develop land use “tool box”
Governor Tim Kaine
Office of the Governor
Patrick Henry Building, 3rd Floor
1111 East Broad Street
Richmond, VA 23219

Dear Governor Kaine:

We are writing regarding sea level rise and wetlands ecosystems. We have been reviewing the recent modeling of the areas of the state’s tidal tributaries, the coastal bays, and bays in the Currituck Sound in Norfolk.

With a relative sea level rise of 7 inches in the last century, a “best guess” for the next century is a sea level rise of 2 feet. This will cause the remaining vegetated tidal wetlands to be adversely impacted. Adjacent shoreline areas will also be affected at mitigation. Adjacent shoreline areas will also be affected at mitigation.

The assessment of Virginia’s plight is not much different from what several environmental agencies and universities have been noting for years. The U.S. Geological Survey, for example, in 1999, publicly released research that ranked Virginia’s risk from a sea level rise as “very high.”

Such messages, however, have largely been downplayed by the scientific community over the years.

The U.S. National Oceanic and Atmospheric Administration and NASA, however, have warned that the rate of rise is still pushing against the scientific community’s understanding of climate change.

Kevin Hall, a spokesman for the Virginia Department of Conservation and Recreation, said that the state is “very concerned about the future.

You can argue whether technical details of the climate change models are critical to the state’s decision-making process, but it’s clear that the state is taking action to mitigate the effects of rising sea levels.

In his letter to Kaine, the director of Wetlands Watch said, “We need to work with the state and with local governments to get Virginia moving.

We need to understand and plan for a new reality in the state’s coastal areas. We need to work with the communities that are at risk to ensure that they have the tools and resources they need to adapt.”

Sincerely,

[Signature]
Governor Timothy M. Kaine

Testimony

Before the

United States Senate Committee
on Environment and Public Works

Hearing on

“Climate Change and the Chesapeake Bay”

September 26, 2007
Land Use Options

Local Governments Take Conservation Easements (no shoreline hardening a condition) – Sec 10.1-1701

Tax Exemptions for shoreline features – Sec. 58.1-3666

Expanded Buffers under CBPA – 9VAC10-20-80 B(4)

No exemptions for CBPA – 9VAC10-20-150 C(1)(d)

Make Shoreline protection part of subdivision process

Joe Lerch - CBF
Regulatory Options

Better Integration of CBPA/Wetlands & Primary Dune Regulations

Phase out of exemptions for wetlands alterations

“Grazing, haying, and cultivating and harvesting agricultural, forestry or horticultural products” [Code of Virginia Sec 28.2-1302(3)(5)]

“normal residential gardening, lawn and landscape maintenance, or other similar activities that are incidental to an occupant's ongoing residential use of property and of minimal ecological impact” [§62.1-44.15:21]
Land Use Options

Special Zoning Districts:

Waterfront Residential Overlay District - Lancaster County

Sensitive Natural Resource Area Preservation Overlay District – Northampton County

Mathews County Comprehensive Plan –
uses elevation from sea level to designate development policies = lower lands have lower density

“Wherever possible, vegetative approaches are to be preferred over man-made structures.”
Living Shorelines and Sea Level Rise

- **Migration**
- **Sea Level Rise**
- **Breakwater Elevation**

**UPLAND BUFFER**
- Native Deciduous Trees in Buffer

**BANKFACE**
- Deep Rooted Native Grasses & Shrubs on Banks

**COASTAL WETLANDS & BEACH STRAND**
- Wetlands Plants Matched to Tidal Elevation & Salinity
- Sills, Stone Surface Groins, Marsh Toe Revetments, Marshy Islands etc. Matched to Wave Climate & Shoreline Environment

**SUBTIDAL WATERS**
- Submerged Aquatic Vegetation
- Artificial Oyster Reefs - Marl Stone with Oyster Spat

Burke Environmental Associates
Thank You

www.wetlandswatch.org
Regulatory Options

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LIDAR Pricing Trends

• Average bare earth DEM pricing runs about $300/sq.mile (small areas) to less than $100/sq mile and is falling as technology improves.
• Large areas would further decrease price

Sanborn Mapping Company
Living Shorelines and Sea Level Rise

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Living Shorelines and Sea Level Rise

Migration

Sea Level Rise

- Extreme High Tides & Storms
- Mean High Tide
- Mean Low Tide

TIDAL MARSH
- Irregularly Flooded
- Regularly Flooded

SAV

LIVING BREAKWATER

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