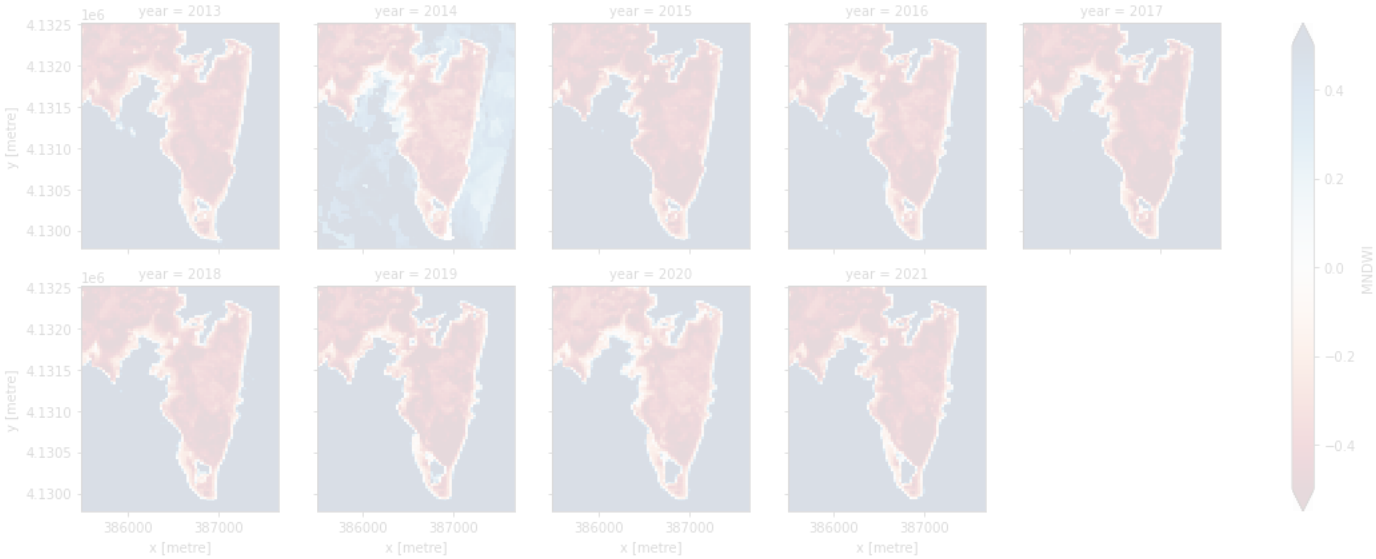


Coastal erosion in the Chesapeake Bay from Landsat imagery

Nikolay Nezlin

Global Science & Technology, Inc. (NOAA affiliate)

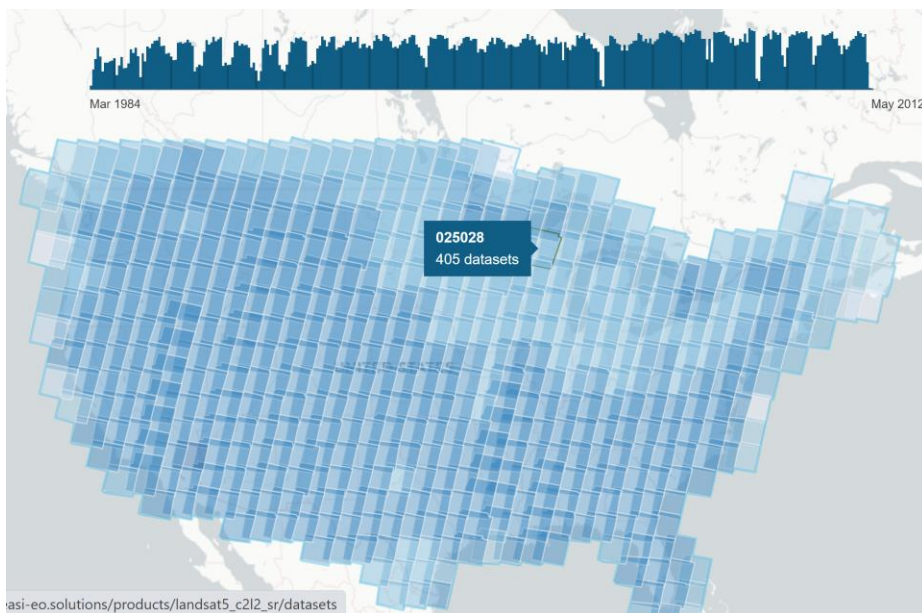


Earth Analytics Interoperability Lab (EAIL) datacube

<https://explorer.eail.easi-eo.solutions/>

The datacube has been built and configured by CSIRO and is hosted by the Chilean Data Observatory (www.dataobservatory.net).

Landsat-5: Spatial and temporal coverage



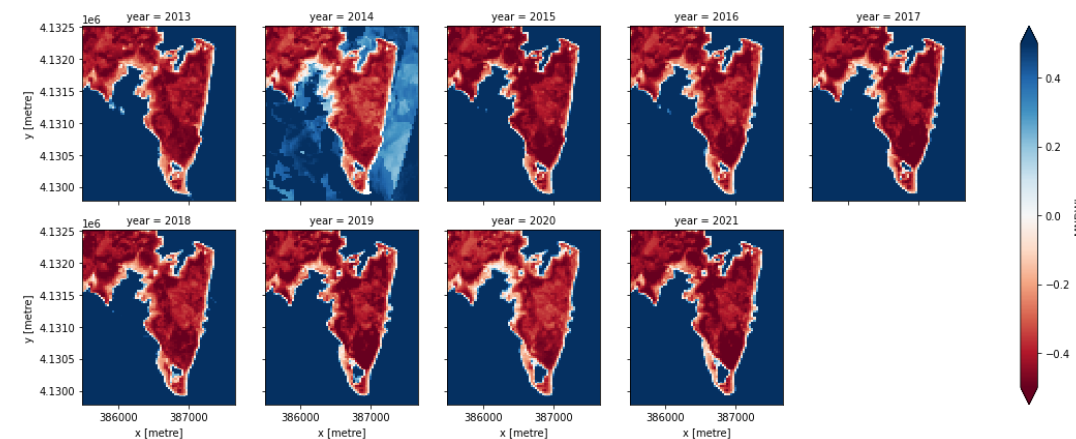
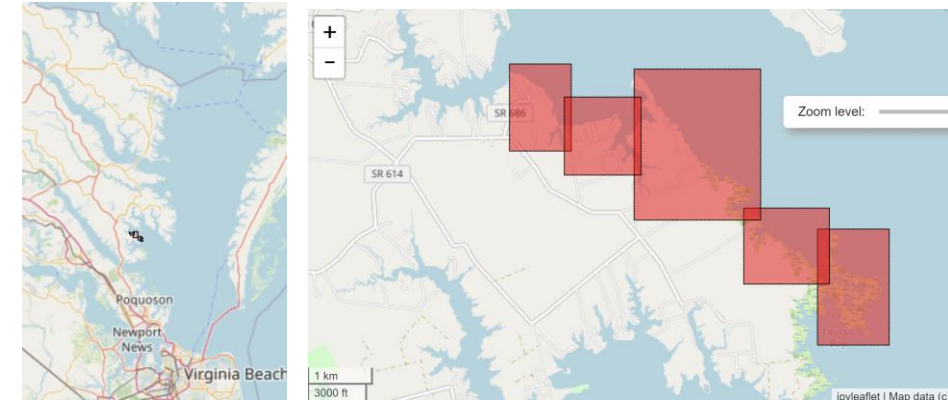
Available products:

- **Landsat surface reflectance: Collection 2 Level-2 Surface Reflectance Product. 30m UTM based projection**
- Landsat 5; Landsat 7; Landsat 8; Landsat 9
- Landsat surface temperature
- DEMs
- Landsat top of atmosphere (Level 1): Landsat 8 and Landsat 9
- Sentinel-1: Gamma0 normalised radar backscatter
- Sentinel-2a and Sentinel-2b imagery, processed to Level 2A (Surface Reflectance) and converted to Cloud Optimized GeoTIFFs

Analysis of coastal erosion in the Chesapeake Bay from Landsat-5/8/9 imagery

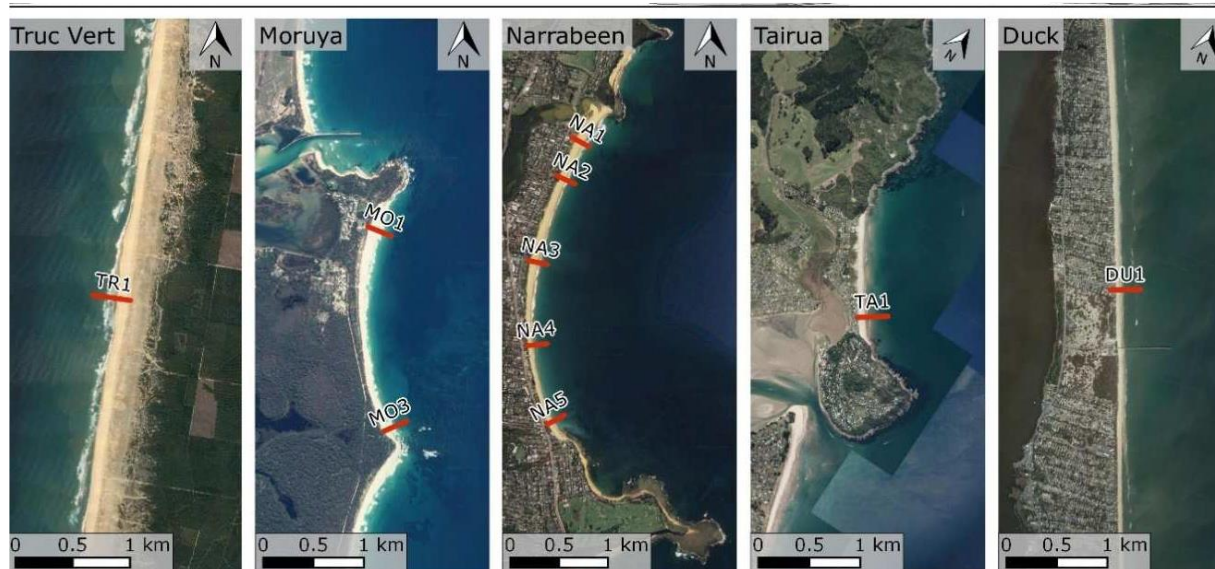
- Landsat imagery is analyzed using the approach and Ipython codes provided by the colleagues from **Geoscience Australia**
- Landsat imagery over USA is obtained from the **EAIL** datacube
 - We use Landsat-5 (1984-2012) and Landsat-8/9 (2013-2021)
 - Landsat-7 is not used in this study because of some technical problems
- The approach includes:
 1. Interactive selection of small coastal regions
 2. Filtering out the images collected during high and low tides using FES2014 tidal model
 3. Images resampled for quarterly (3-month) periods
 4. Modified Normalized Digital Water Index (MNDWI) is used to classify the pixels into land/water

$$\text{MNDWI} = (\text{Green} - \text{SWIR}) / (\text{Green} + \text{SWIR})$$



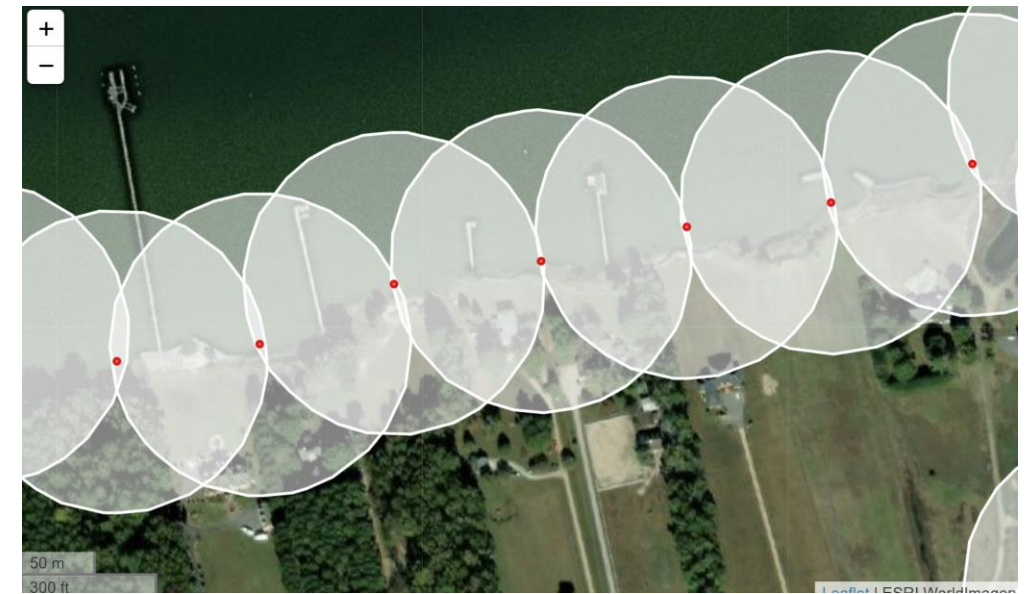
Geoscience Australia

The analysis of coastline evolution is based on cross-shore transects. This approach works well with “straight” parts of the coast like sand beaches



Chesapeake Bay

For highly indented coastline of the Chesapeake Bay, the assessment of changes is based on the portion of ‘land’ pixels in small (100-m radius) circular regions along the coastline



Coastal erosion was analyzed in small part of the Chesapeake Bay:

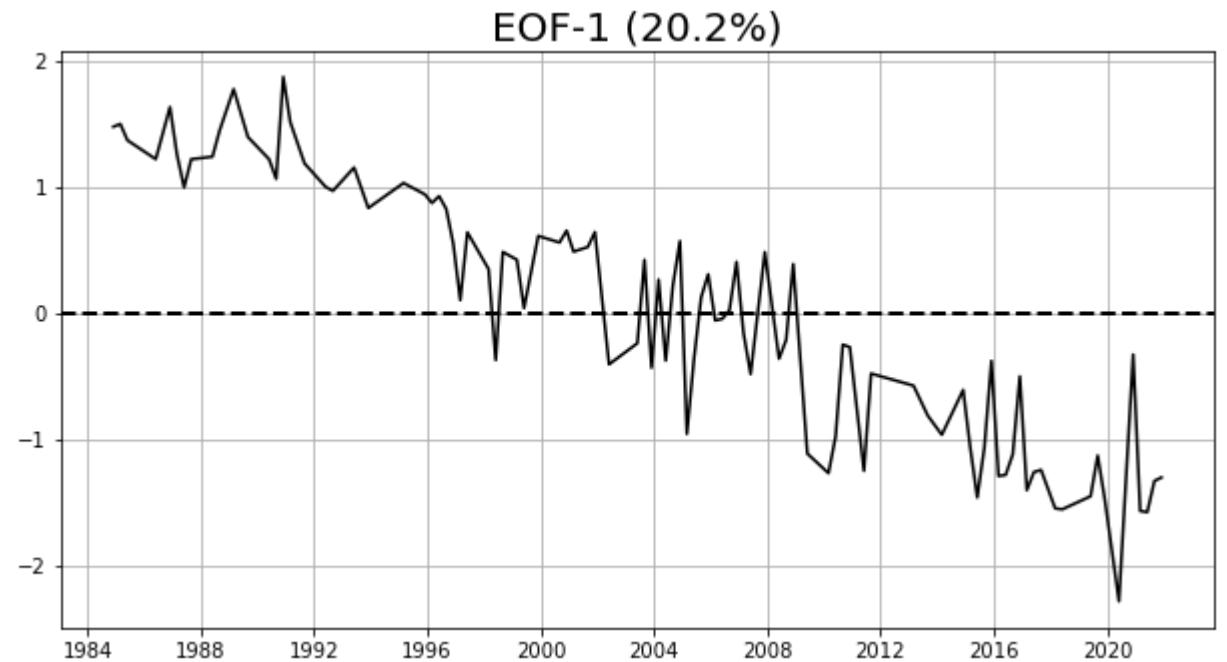
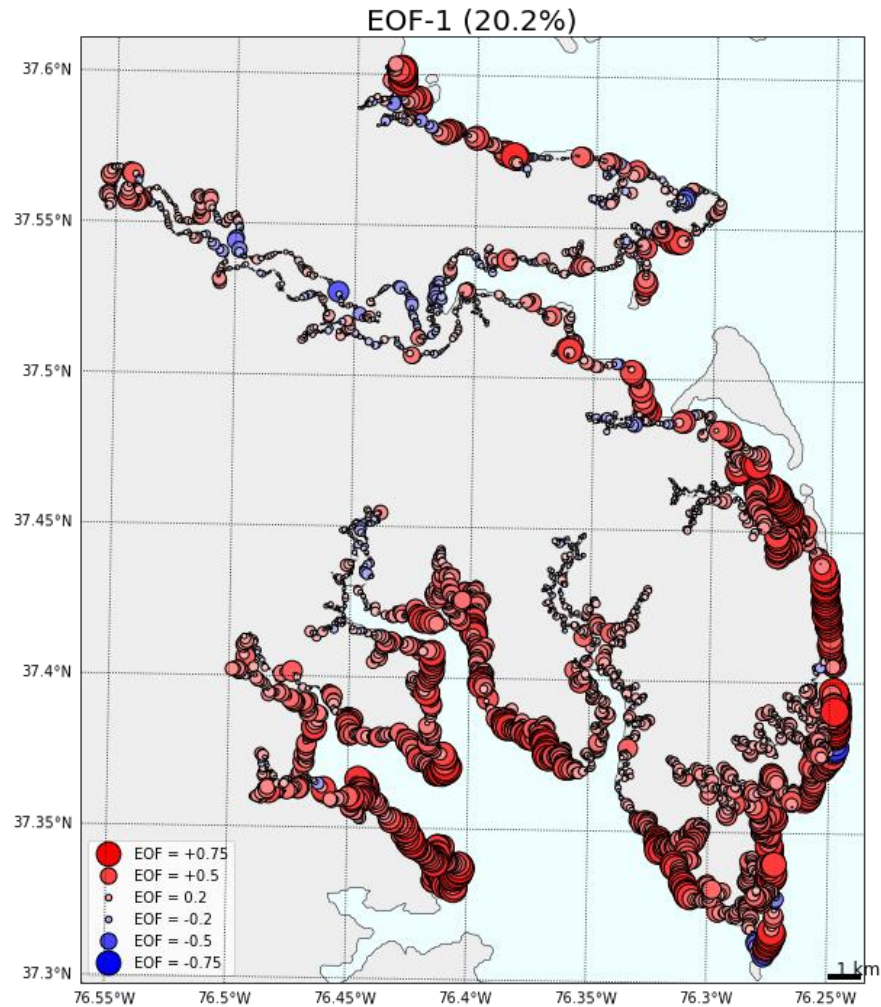
- Middle Peninsula (Middlesex, Mathews, Gloucester Counties in Virginia)
 - Between Rappahanock and York Rivers



The coastline variations are analyzed using Empirical Orthogonal Functions method

First EOF mode (20.2% of total variability)

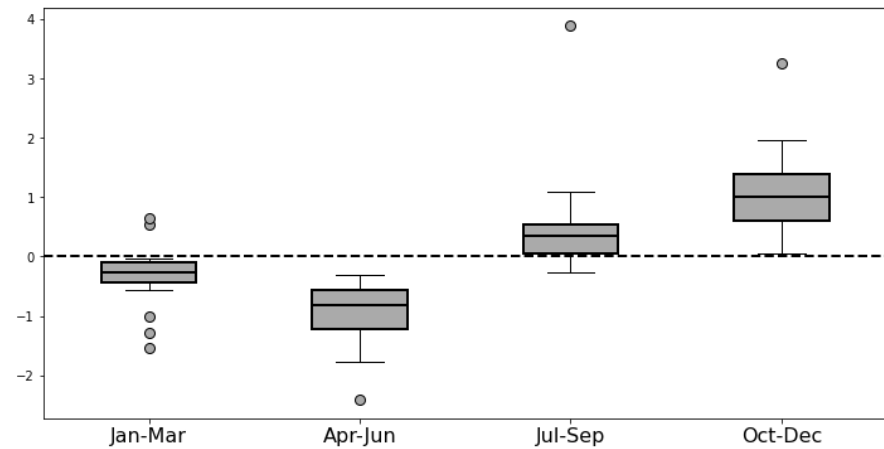
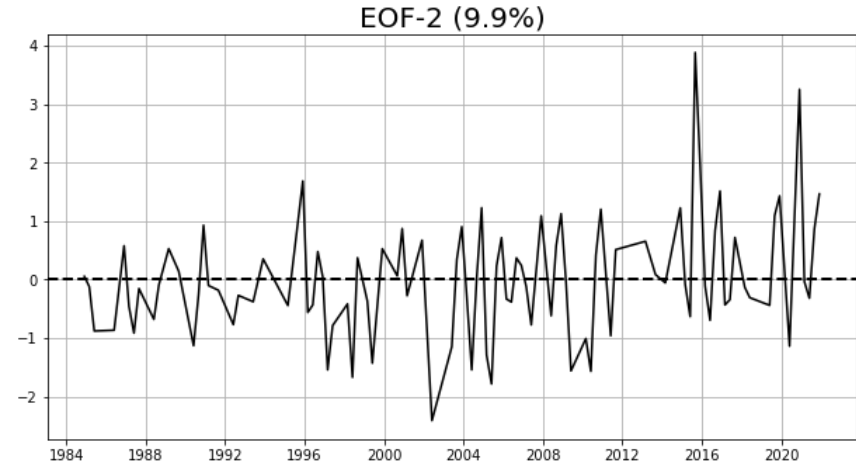
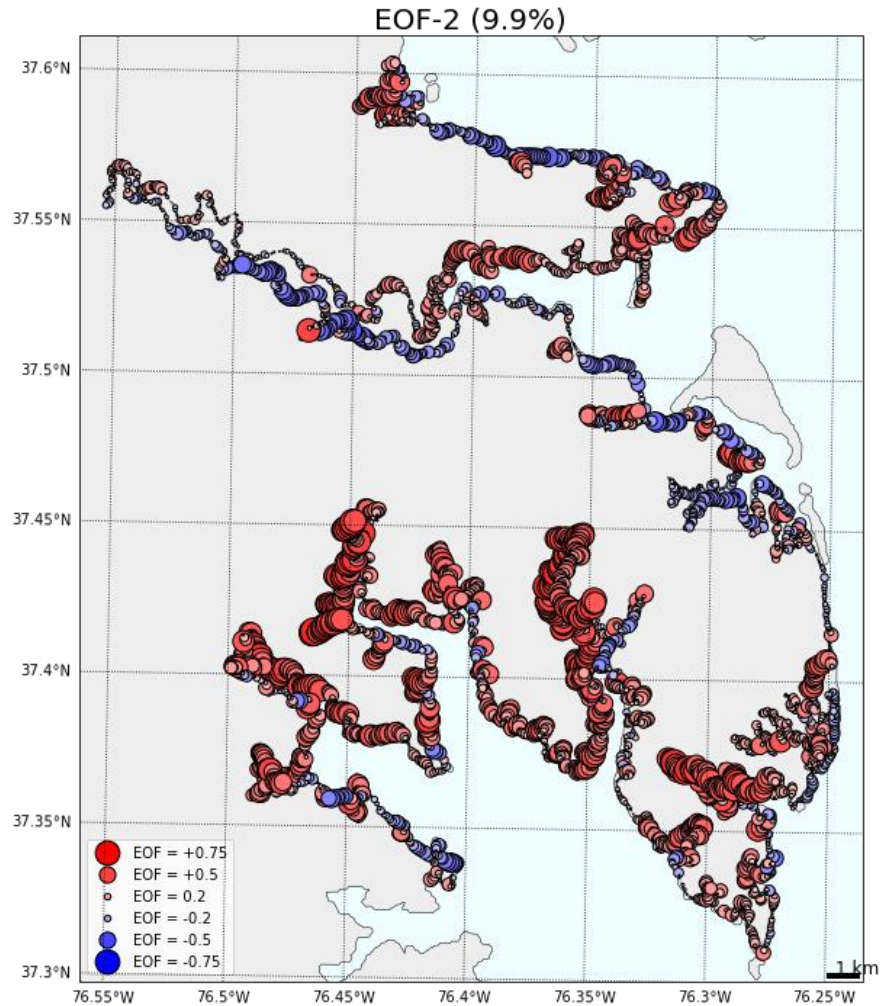
- Demonstrates linear decreasing trend (i.e., erosion) over the most of the analyzed coastline



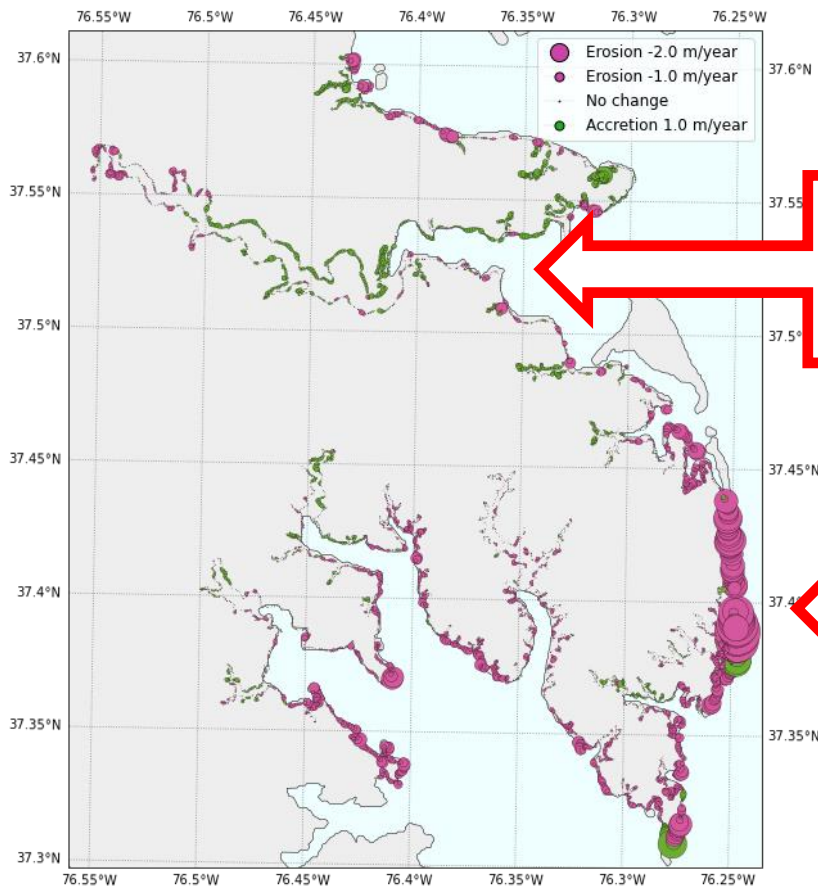
Second EOF mode (9.9% of total variability)

- Demonstrates cyclic (seasonal) variations in small bays and inlets

In small bays, we observe erosion in spring and accretion in late fall/winter

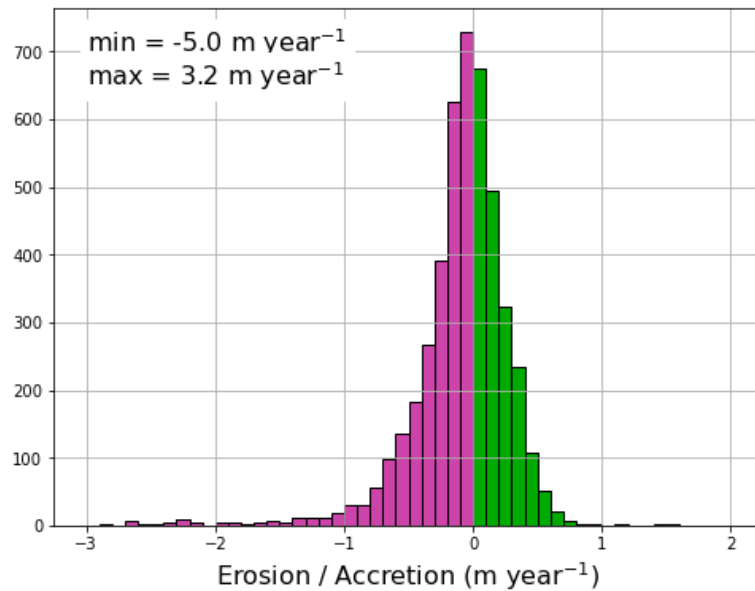


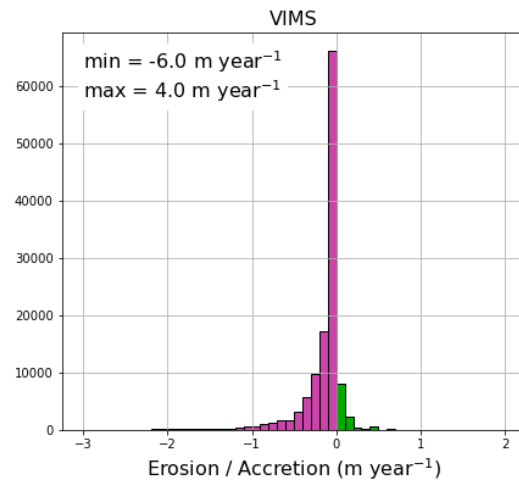
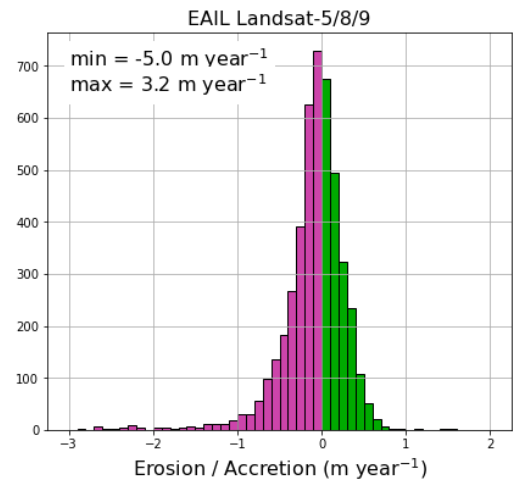
Linear trends during 1984 – 2021 (37 years)



Small accretion in the Piankatank River

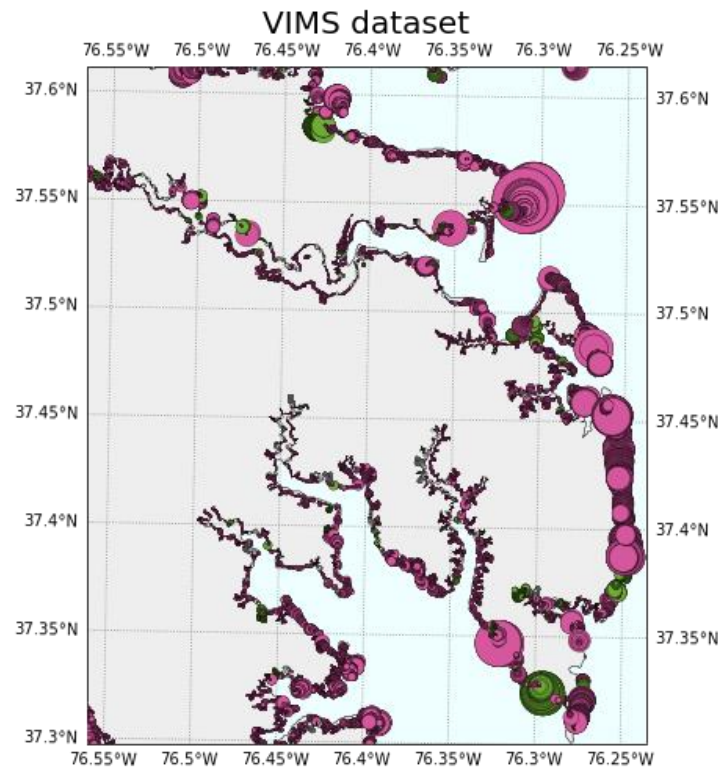
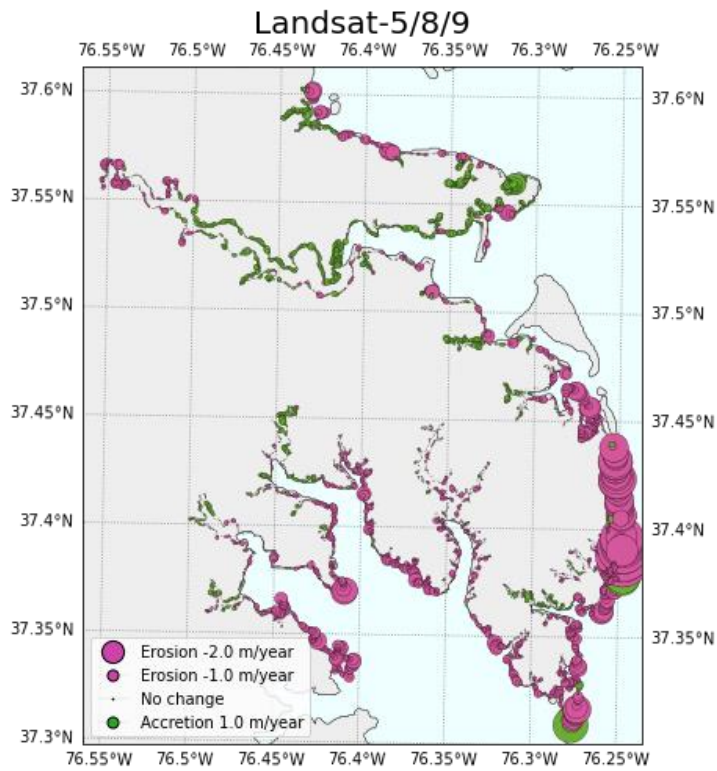
Erosion up to 5 m year⁻¹ in the Bethel Beach area



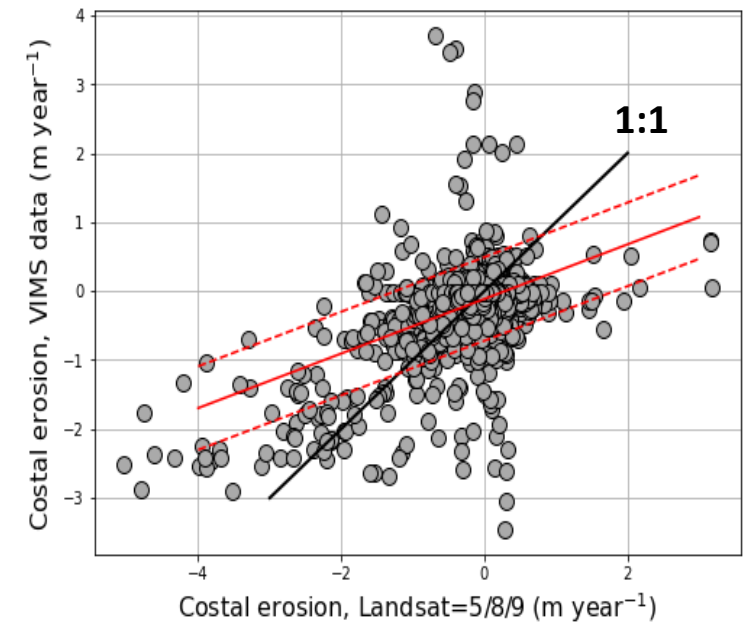


Compare Landsat results with the dataset collected by the Virginia Institute of Marine Science

Contact: Julie D. Herman



$$Y = -0.114 + 0.396 X; R^2 = 0.276$$



Next steps:

Additional available data source:

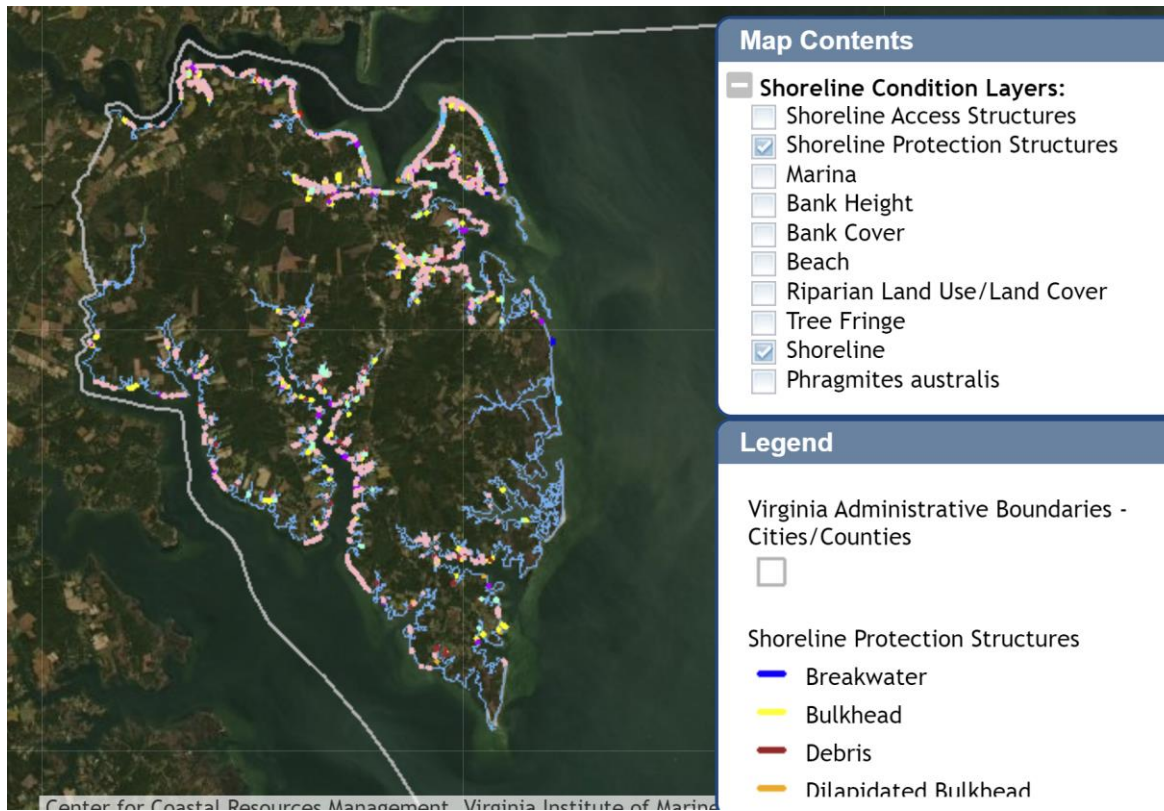
Shoreline & Tidal Marsh Inventory - *Virginia Institute of Marine Science*

<https://www.vims.edu/ccrm/research/inventory/index.php>

Shoreline condition data layers:

Shoreline Access Structures
Shoreline protection structures
Marina
Bank Height
Bank Cover
Beach
Riparian Landuse/Landcover
Tree fringe
Phragmites australis (common reed)
Tidal marsh
River Systems...

Shoreline BMPs (Best Management Practices), etc.



Thank you!
Questions?

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