Cedar Island Stabilization and Marsh Construction

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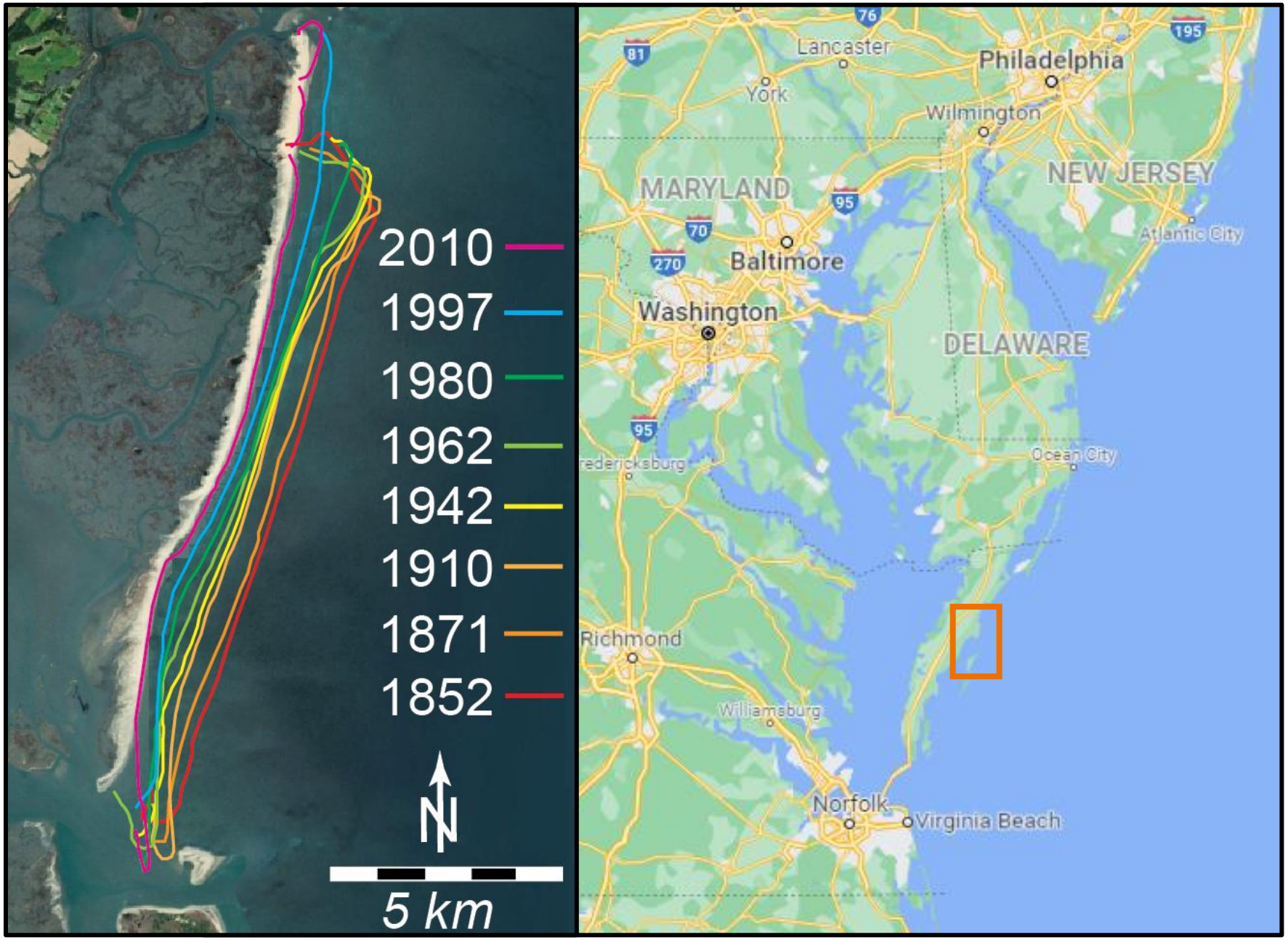
Background

Landward migration

- Nearly 1 km migration since 1852 (15 ft/yr)
- At southern end, almost half has occurred since 1990s

Rapid deterioration

- Complete loss of southernmost point since 2010
- No backbarrier marsh for rollover



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Landward migration and rapid deterioration

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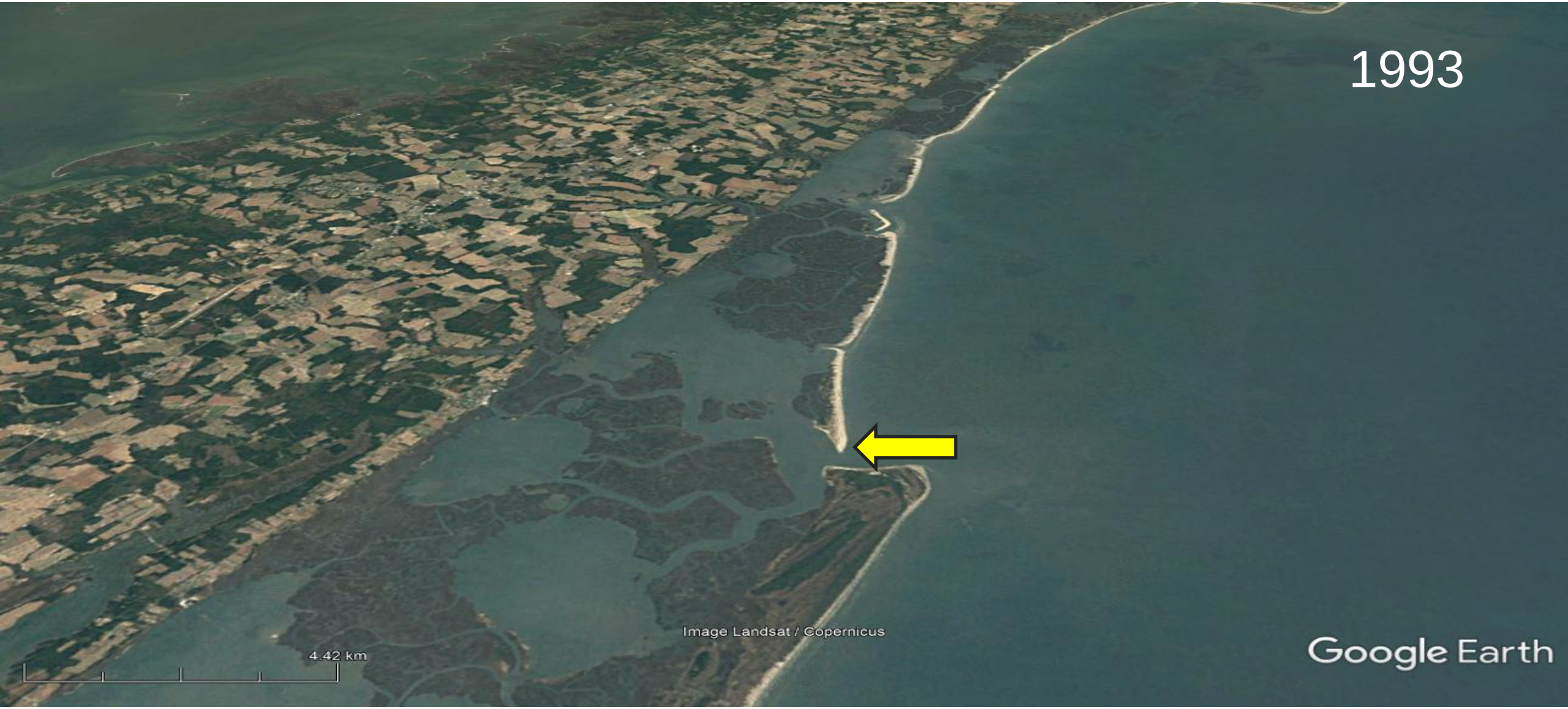

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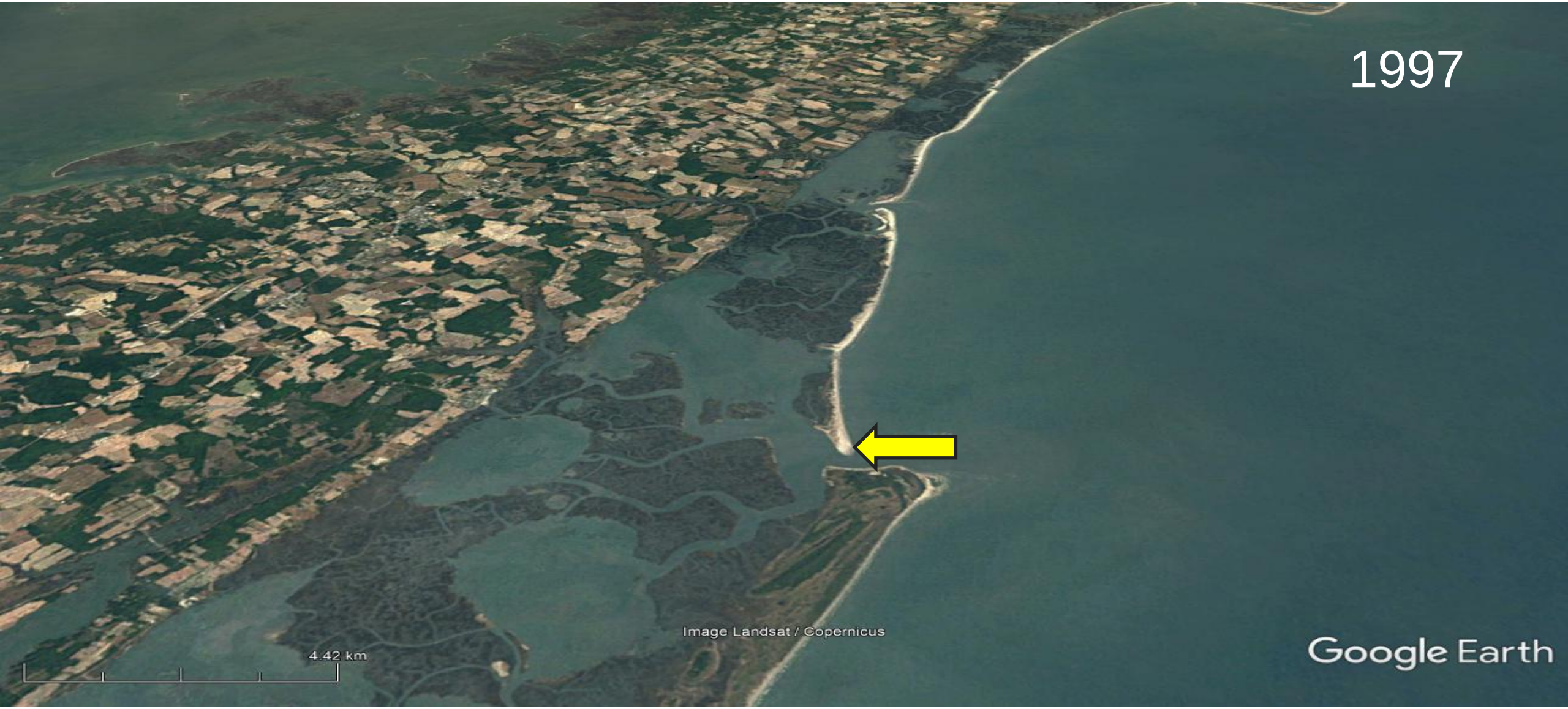

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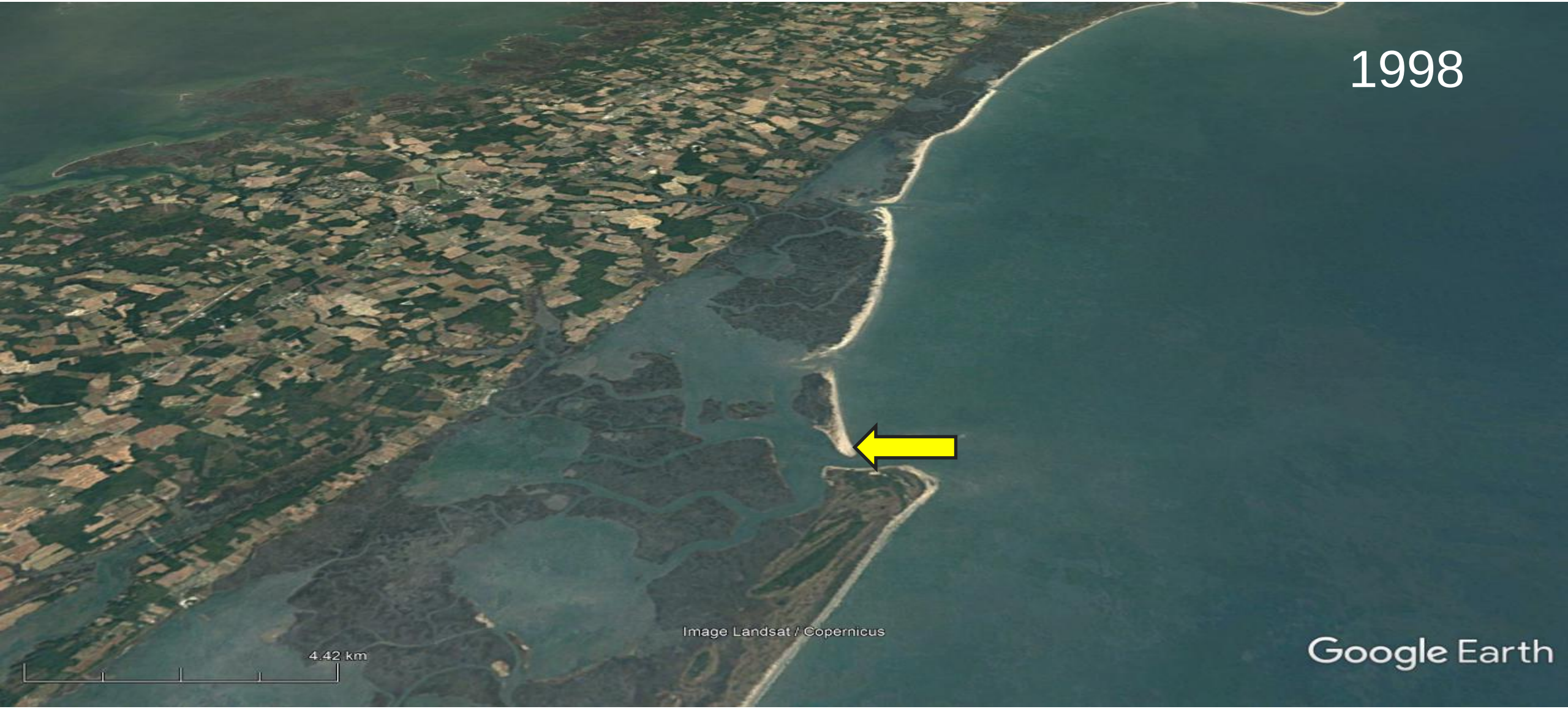

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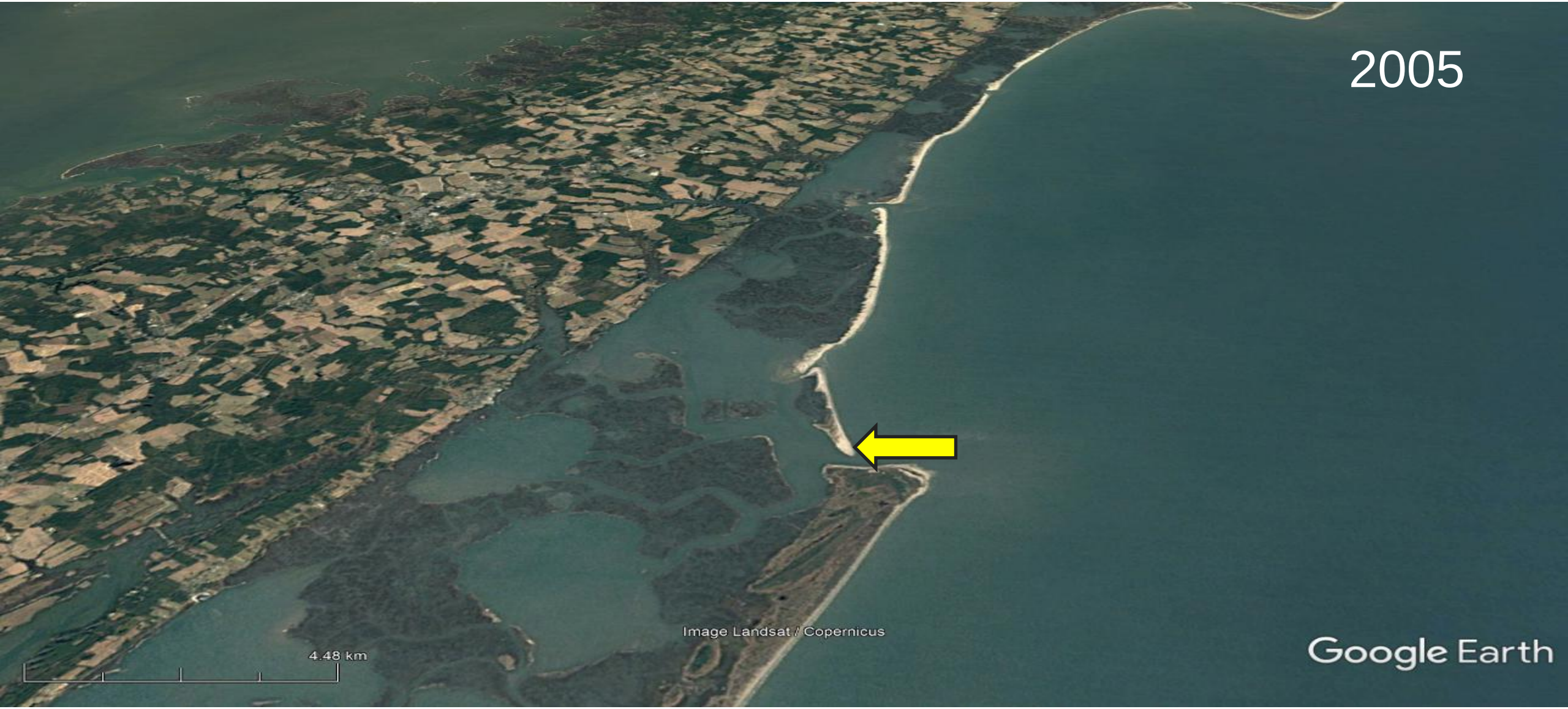
Landward migration and rapid deterioration



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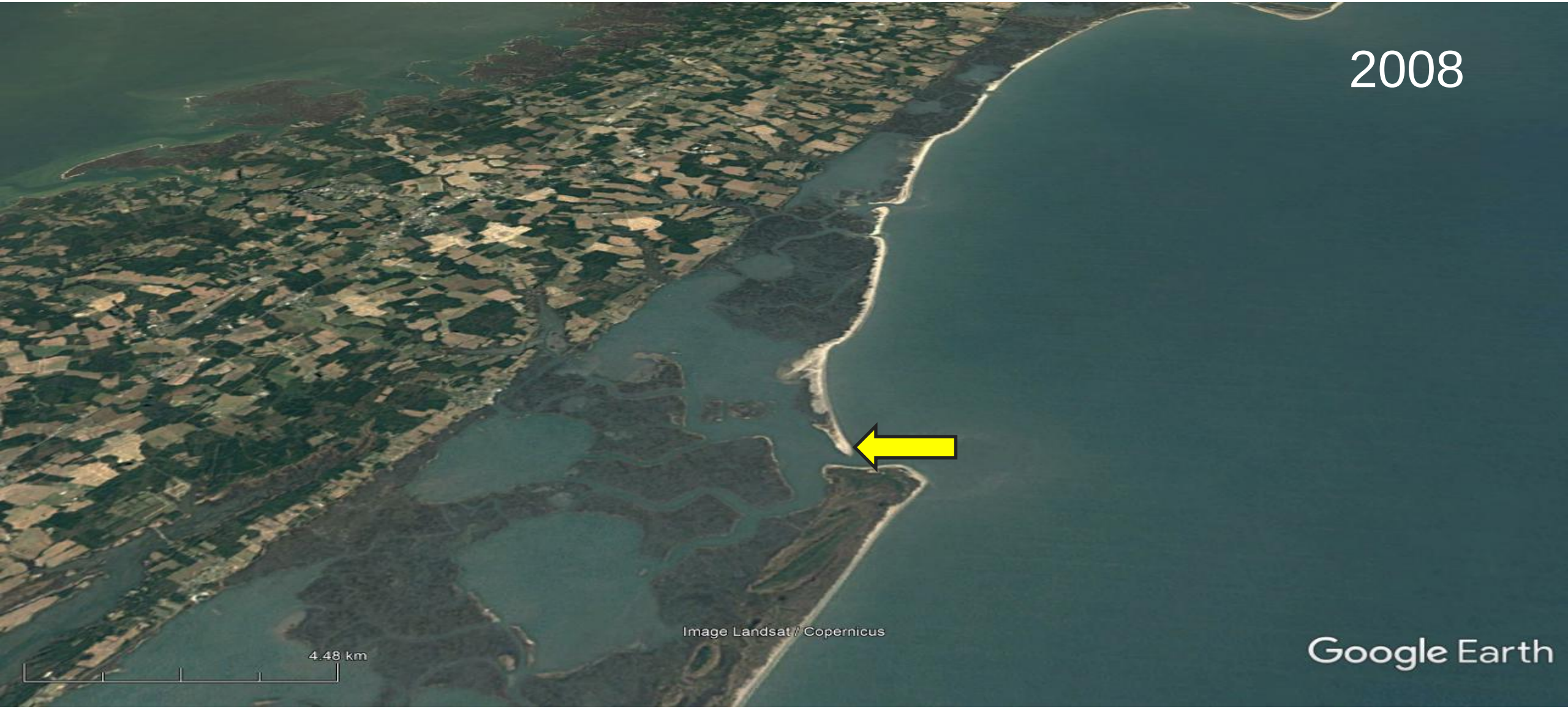
Landward migration and rapid deterioration



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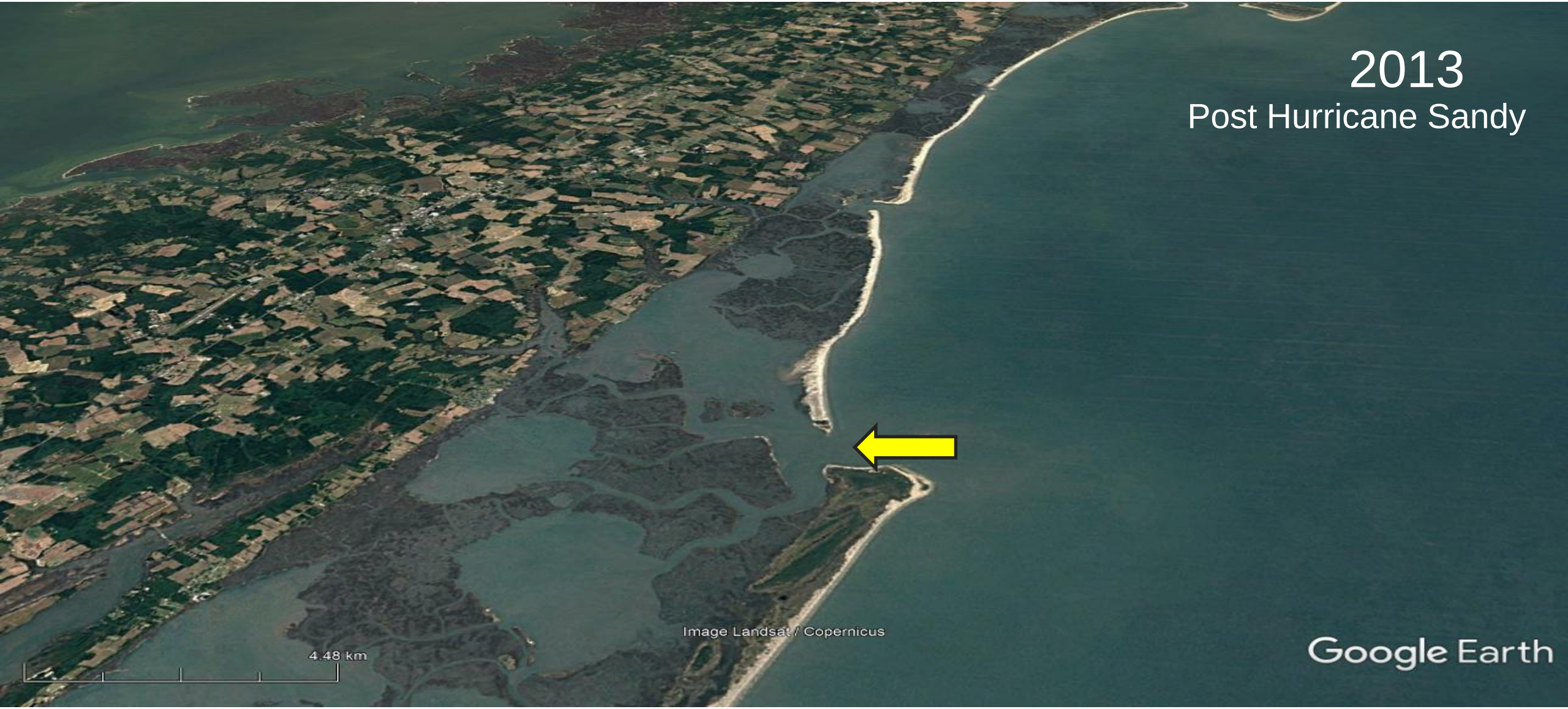

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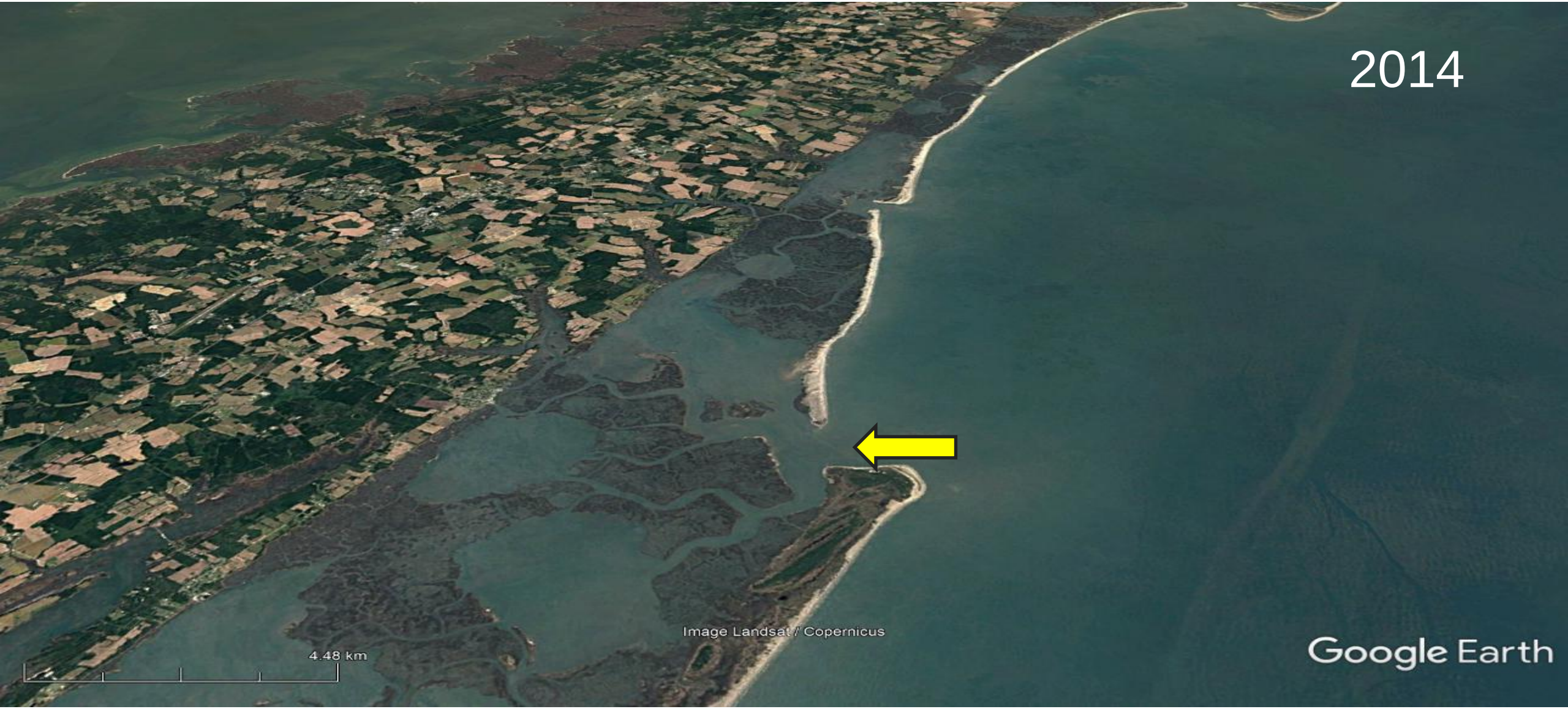

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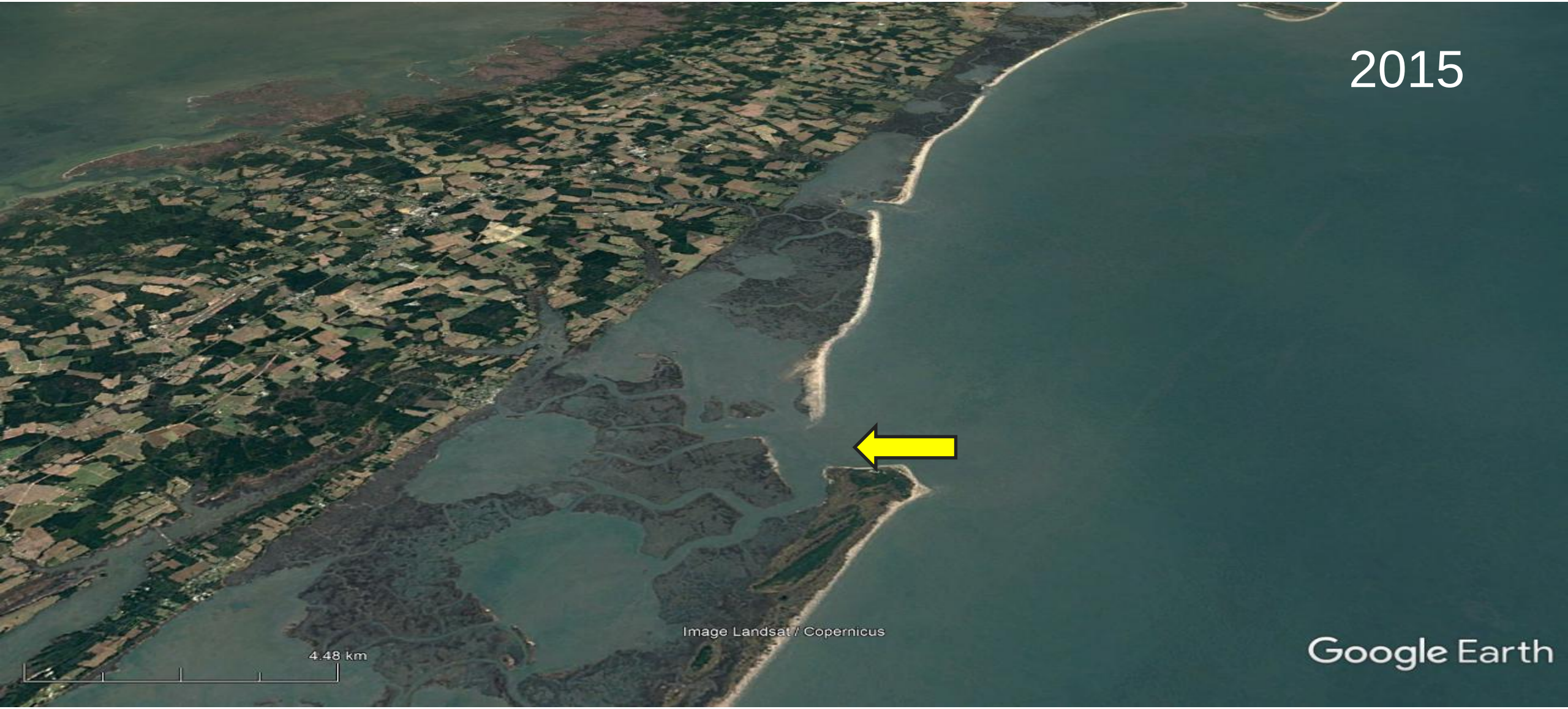

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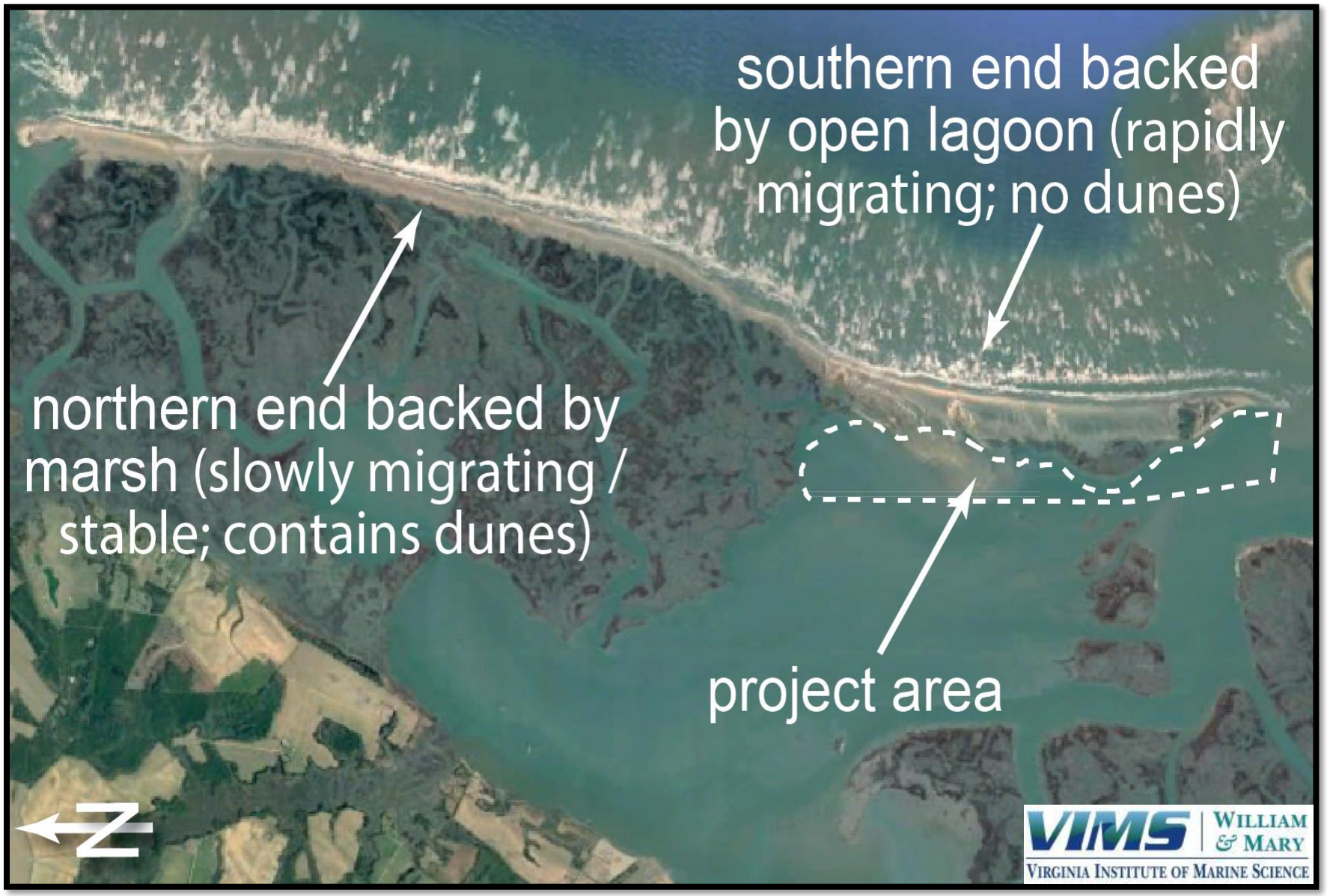
The Project

Goals/objectives

- Engineering design plans for marsh creation/restoration
- Increase marsh area, stabilize southern Cedar Island
- Buffer storm surge, reduce mainland flooding, stabilize inlet

Funding

- NFWF Coastal Resilience Grants



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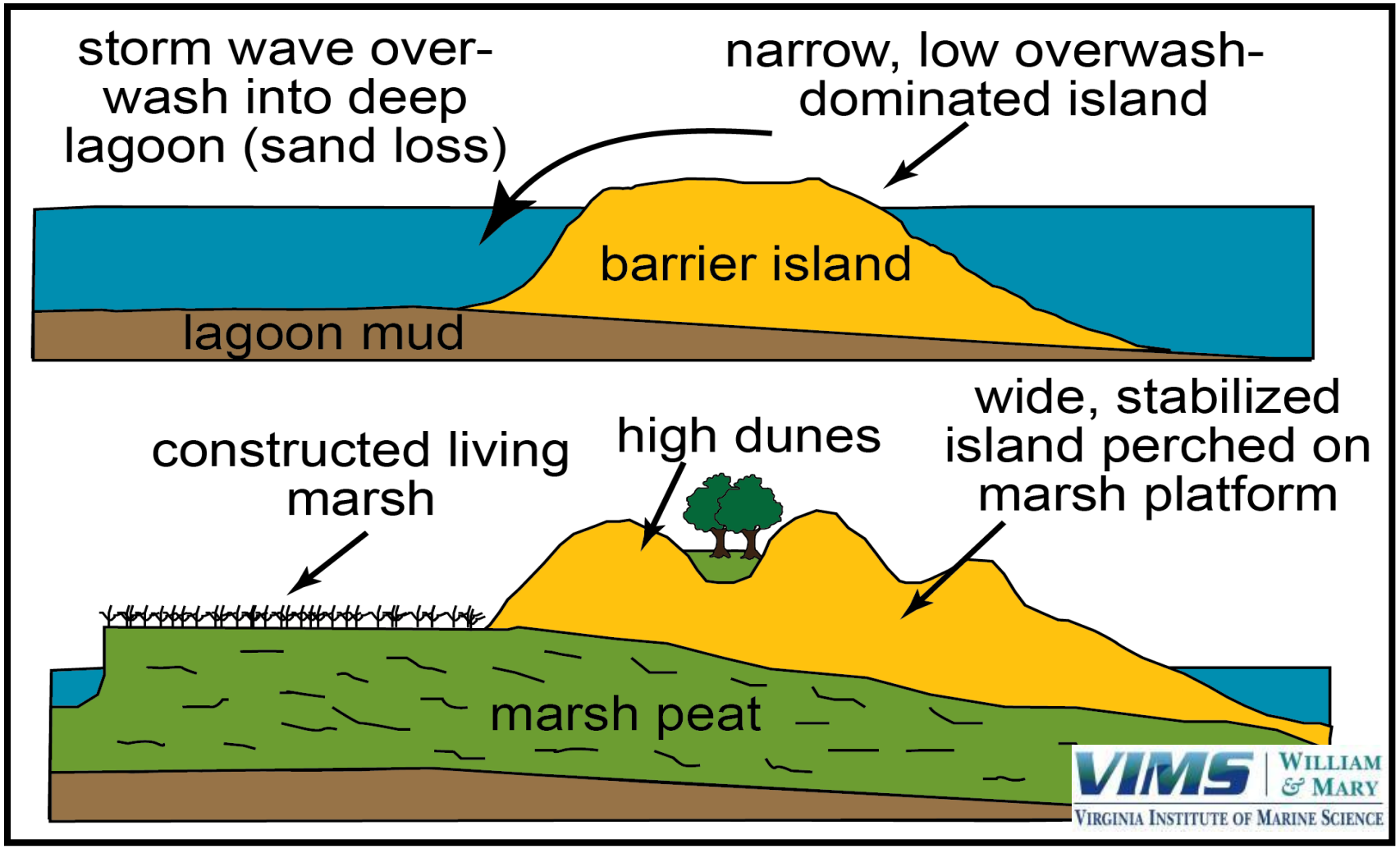
The Goal: Stabilization Through Marsh Restoration

Current scenario

- No backbarrier marsh
- Overwash material is lost in deeper water

Resilient solution

- Constructed marsh behind beach/dunes
- Provide a platform for natural rollover



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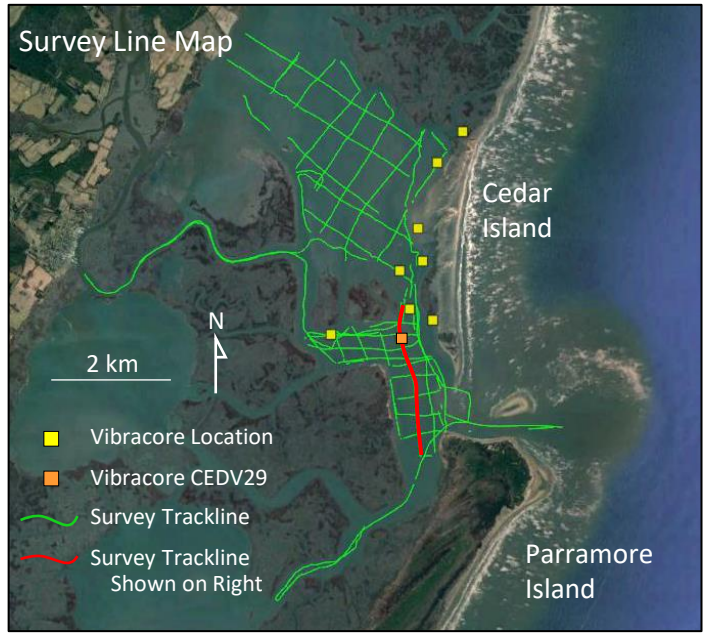
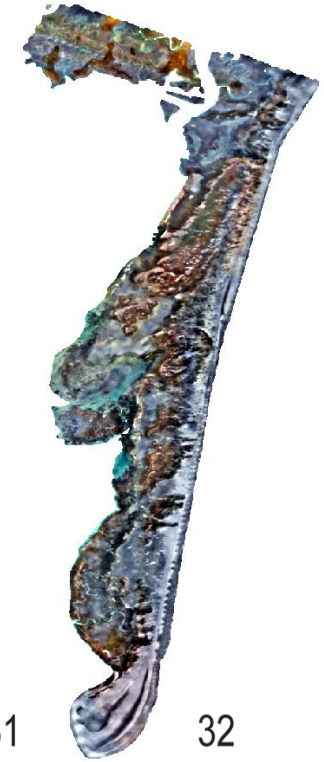
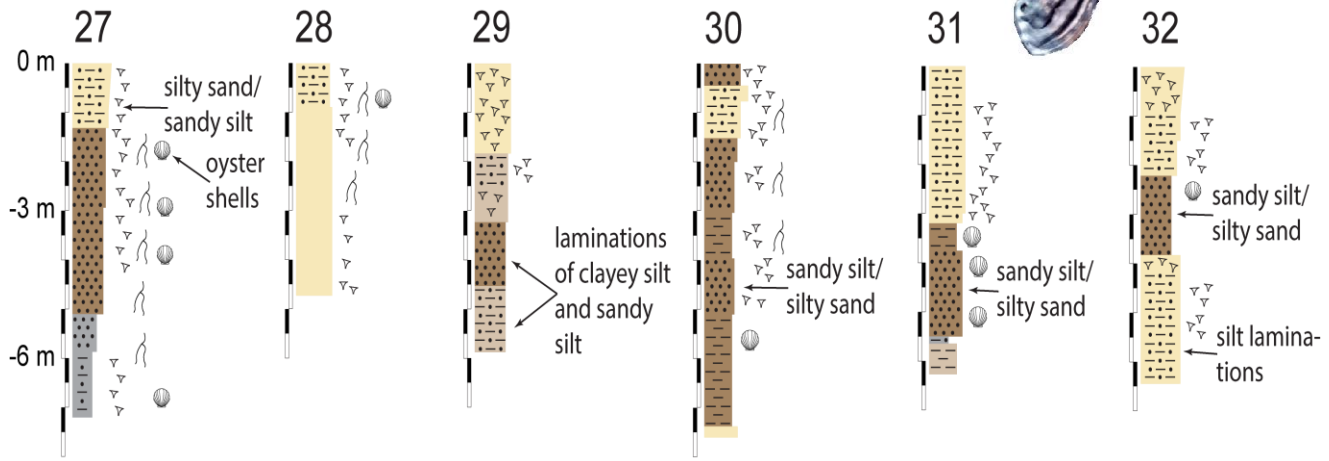
Previous Studies

- Benthic macrofauna and floral surveys
- Orthoimagery
- Digital Elevation Model
- Surface sediment samples
- Core borings
- Subbottom profiles







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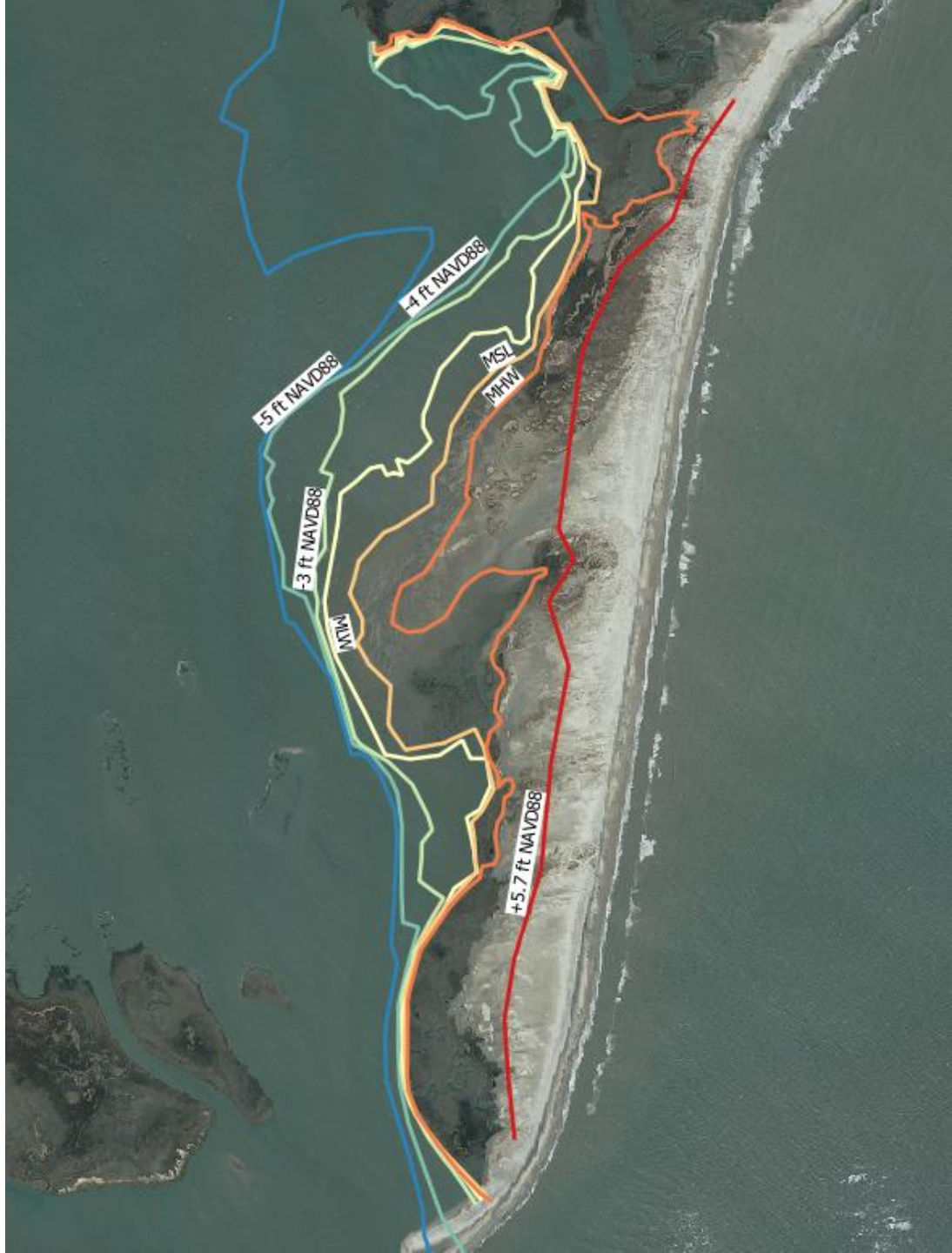
Topobathy and Tidal Datums

- Topobathy – merged into single set
  - 2016 USACE post-Matthew LiDAR
  - 2016 USGS CoNED TBDEM
  - 2010 ESVA DEM
- Tidal datums from NOAA at Wachapreague, VA (Station 8631044)
  - 1.5x tide range = +5.7 ft NAVD88
  - MHW = +1.54 ft NAVD88
  - MSL = -0.35 ft NAVD88
  - MLW = -2.44 ft NAVD88



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Preliminary Conceptual Design: Low & High Marsh

- Defined and delineated potential low marsh area, existing high marsh area based on preliminary concept fill template:
  - Extend fill area out to -5 ft NAVD88 contour
  - Max fill of +2 ft @ -2 ft NAVD88
  - Taper to 0 fill at MHW and -5 ft NAVD88
- Compute fill height at each point within project area

Combined elevation contours, original project area (red), proposed low (dark green) and high (light green) marsh areas.

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Preliminary Conceptual Design: Low & High Marsh

- Elevation existing grade to be raised by
  - Red = additional 2 ft
  - Blue = no fill
- Fill in low marsh area only
  - High marsh area already at suitable elevation

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Potential Borrow Areas

Vicinity of cores 28, 29, 31, 32

Borrow area	Approx. area (ft^2)	Depth of sand (ft)	Volume (cy)
CEDV28	1,065,626	16	592,015
CEDV29	1,496,182	6	332,485
CEDV31	839,584	10	310,957
CEDV32	1,410,070	7	365,574
Total			**1,601,030**

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Original Concept

The Marsh Platform

- Southern Cedar Island marsh restoration (~4 km x 0.5-1.0 km area)
- 3-4 potential borrow sites
- Marsh restoration only (no beach fill)

Combined elevation contours, proposed low (dark green) and high (light green) marsh areas, beach and dune fill (sand), and borrow areas (blue).

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Modified Concept

The Northern Marsh Platform

- Partial implementation of Original Concept
- Northernmost ~1.5 km of project area
- Balance effectiveness with budget and other concerns
- Location of narrowest part of the area and former breach

Combined elevation contours, proposed low (dark green) and high (light green) marsh areas, beach and dune fill (sand), and borrow areas (blue).

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Fill vs. Realized Marsh Area

- Dashed lines show new MSL and MLW contours vs. existing (solid)
- Low marsh will extend to MSL and somewhat deeper
- Entire fill area =/= marsh area

Combined elevation contours, proposed low (dark green) and high (light green) marsh areas, beach and dune fill (sand), and borrow areas (blue).

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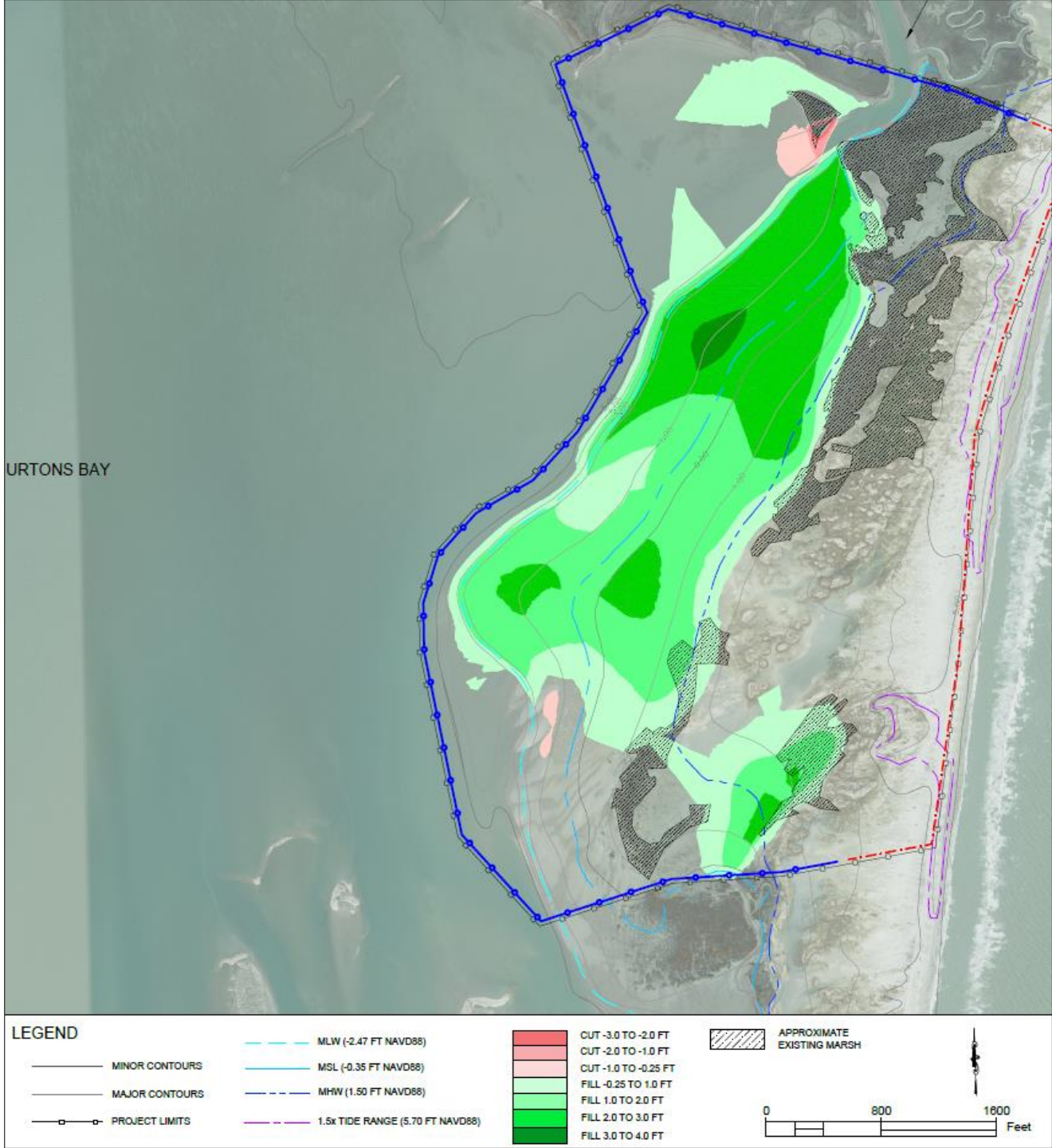
The Northern Marsh Platform: 30% Design

- Cut volume: 6,695 cy
- Fill volume: 380,250 cy
- Existing marsh: 51 ac
- High marsh: 114 ac
  - MHW (+1.5 ft NAVD88) to +4.5 ft NAVD88
  - *spartina patens*
- Low marsh: 103 ac
  - MSL (-0.4 ft NAVD88) to MHW (+1.5 ft NAVD88)
  - *spartina alterniflora*



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The Northern Marsh Platform: Next Steps

- Hydrodynamic modeling
  - Changes before/after borrow site dredging and fill placement
  - Storm surge with/without breach
- Fill template refinement
  - Varying high/low marsh ratios
- Sea level rise (2017 int-high) considerations

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Thank you!

Hein CJ, Fenster MS, Gedan KB, Tabar JR, Hein EA and DeMunda T (2021) Leveraging the Interdependencies Between Barrier Islands and Backbarrier Saltmarshes to Enhance Resilience to Sea-Level Rise. Front. Mar. Sci. 8:721904. doi: 10.3389/fmars.2021.721904
https://www.frontiersin.org/articles/10.3389/fmars.2021.721904/full

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