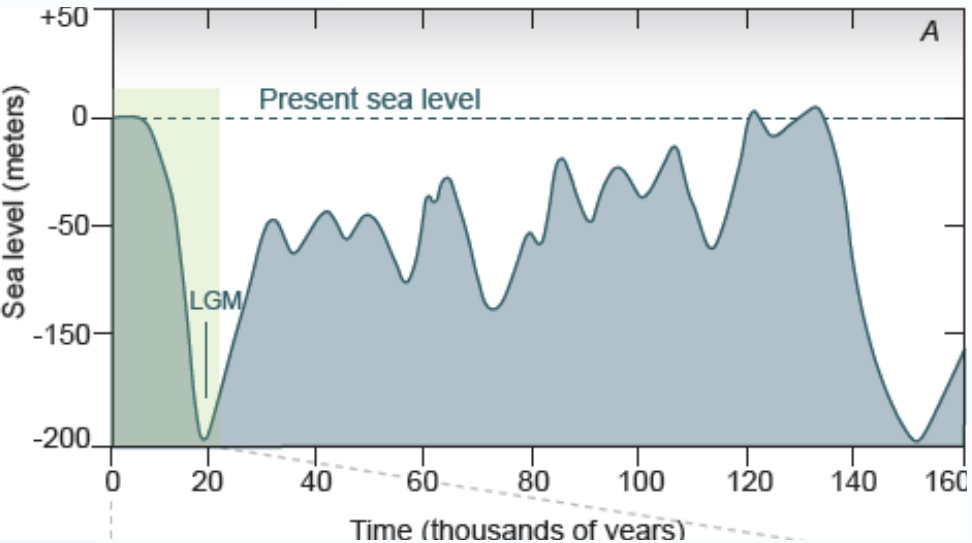
The Shifting Sand of Provincetown

Greg Berman

(Woods Hole Sea Grant & Cape Cod Cooperative Extension)

March 15, 2019

Glacial History



25,000 yr ago
400’ below SL, ~1 mile thick
By ~ 15,000 ice was gone.

11,000 years ago

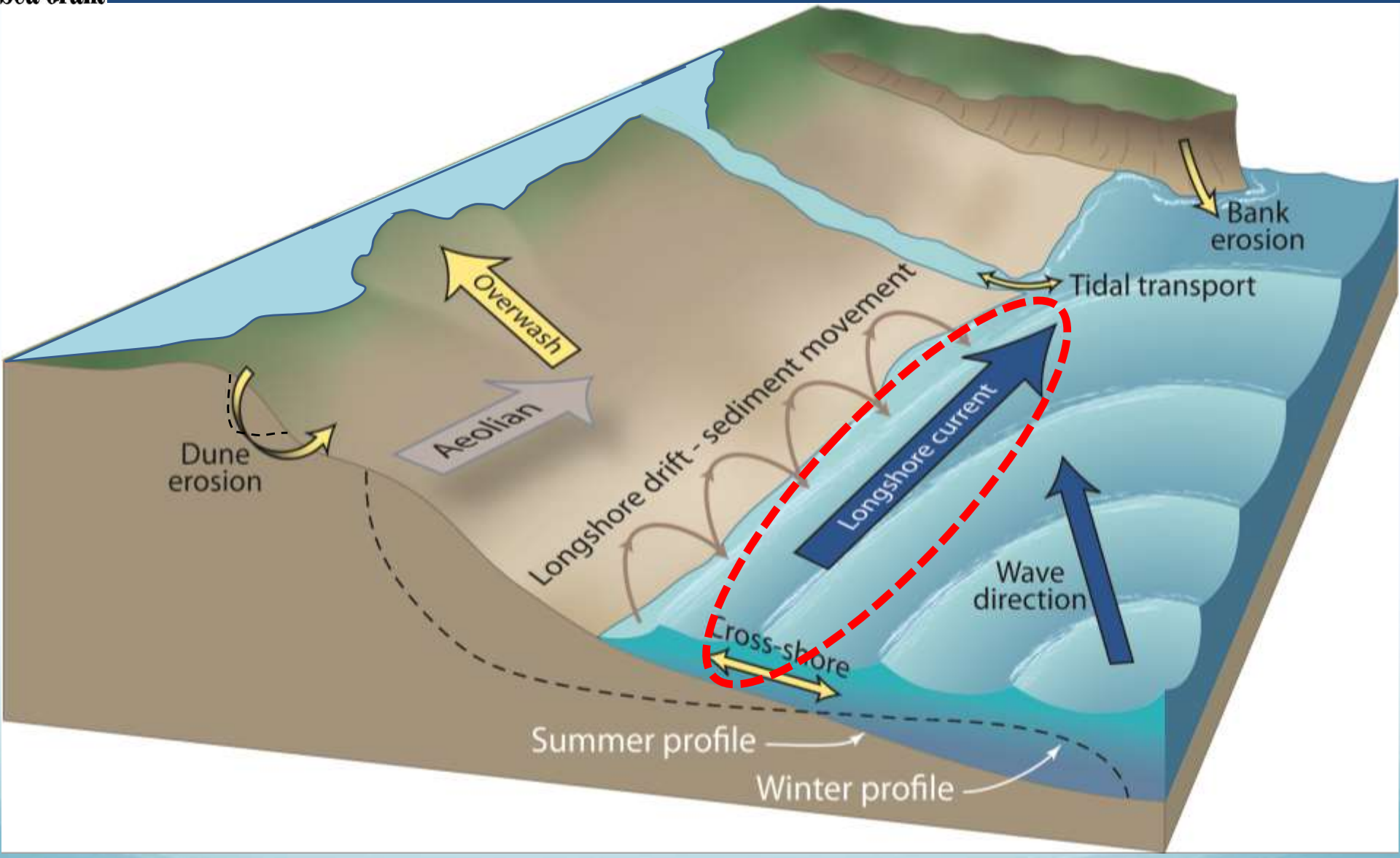
(Shaw et al., 2002)

6,000 years ago

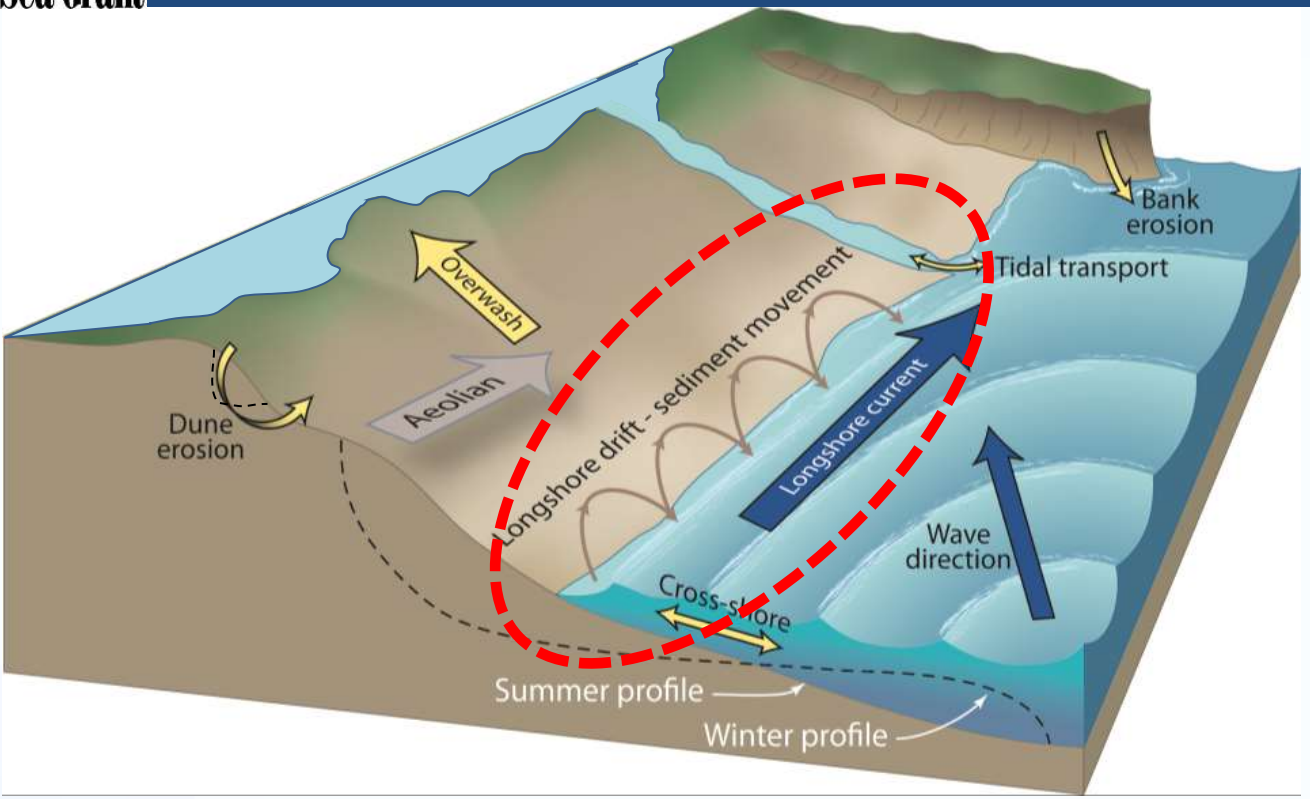
Present Day

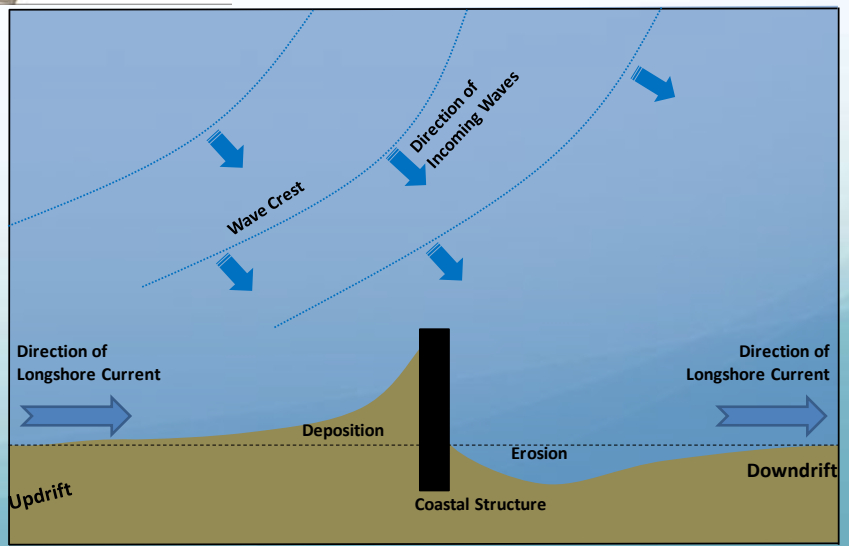
Arm of Cape Cod being reshaped over time ...

General Coastal Processes



Longshore Sediment Transport





Longshore Sediment Transport

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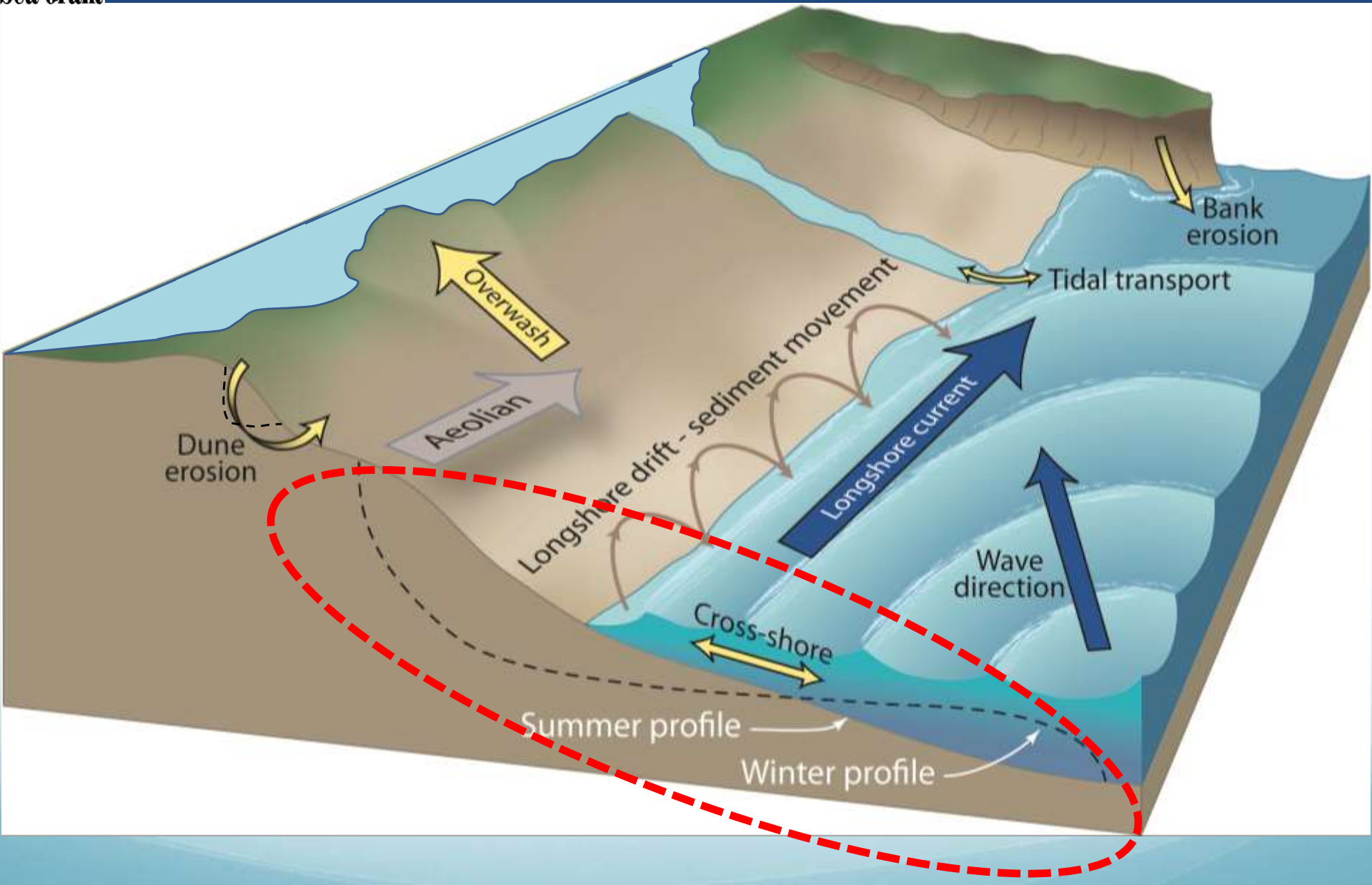
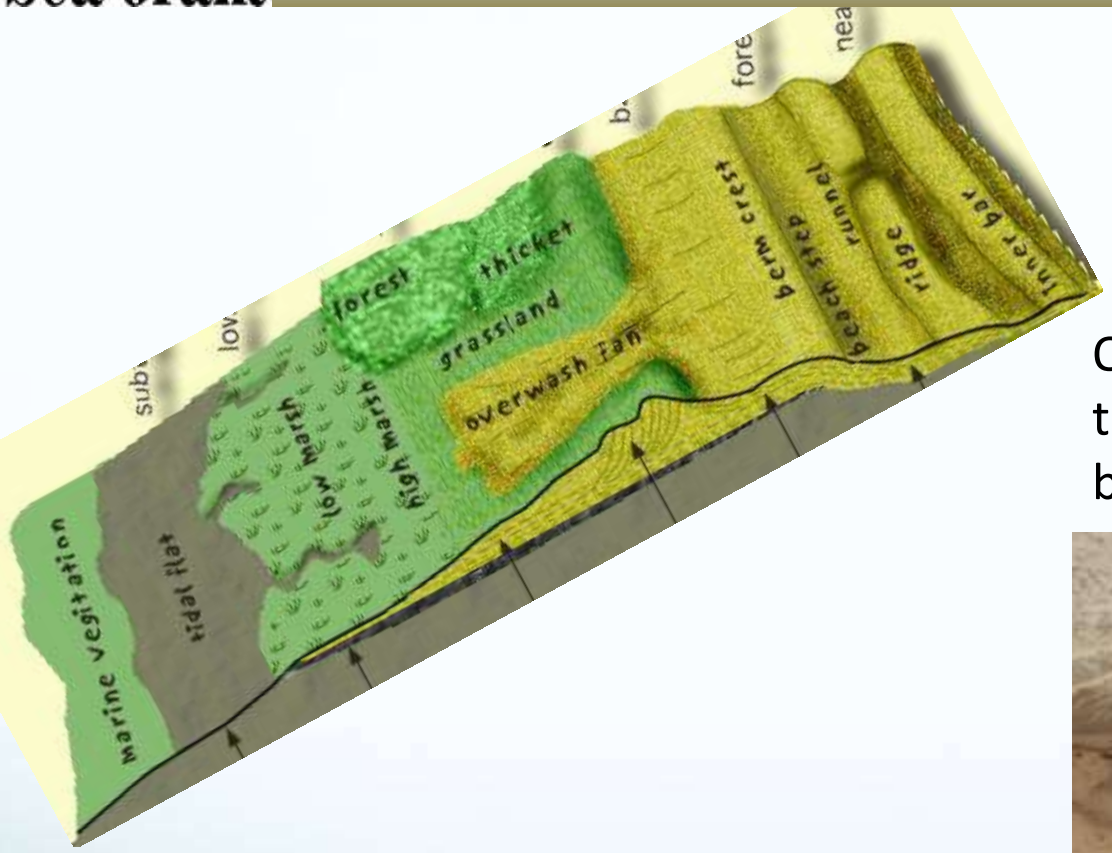
Google Earth Engine: Timelapse is a global, zoomable video that lets you see how the Earth has changed over the past 32 years. It is made from 33 cloud-free annual mosaics, one for each year from 1984 to 2016, which are made interactively explorable by Carnegie Mellon University CREATE Lab's Time Machine library.

General Coastal Processes



Coastal Processes: Barrier Migration Perpendicular to Shore



Waves

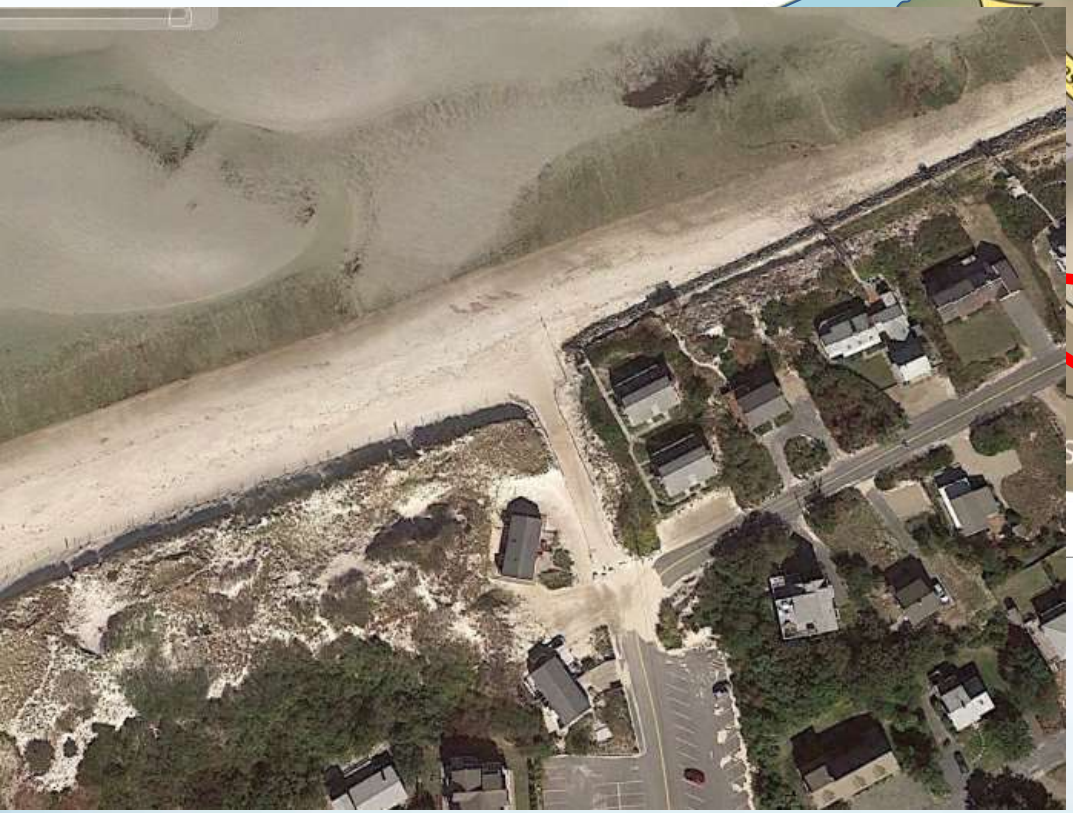
Overwash: Storms push sand across the island and into the lagoon area beyond. Barrier `rolls over on itself.‘

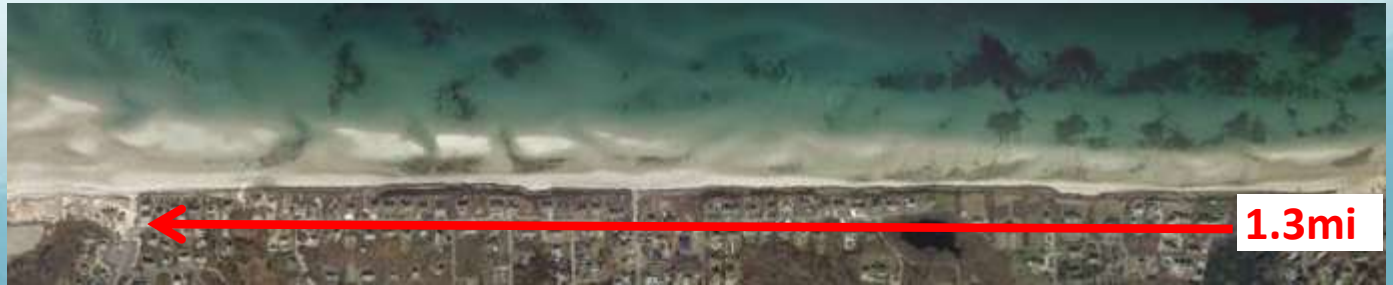
Adapted from http://www.nasa.gov/vision/earth/lookingatearth/katrina_poststorm.html

Peggotty Beach 2016

Video by Peter Miles

Perpendicular Transport…….Blocked



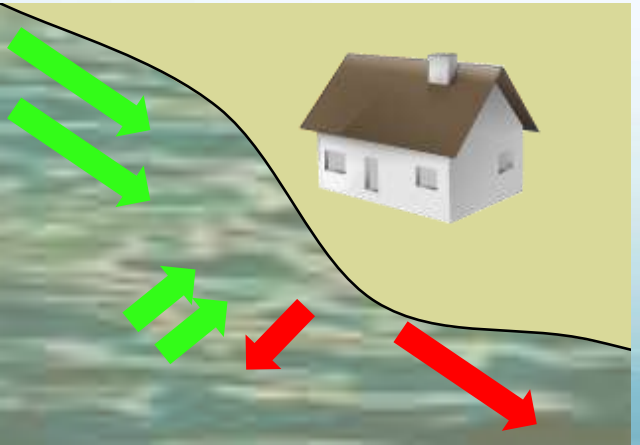


What is Erosion?

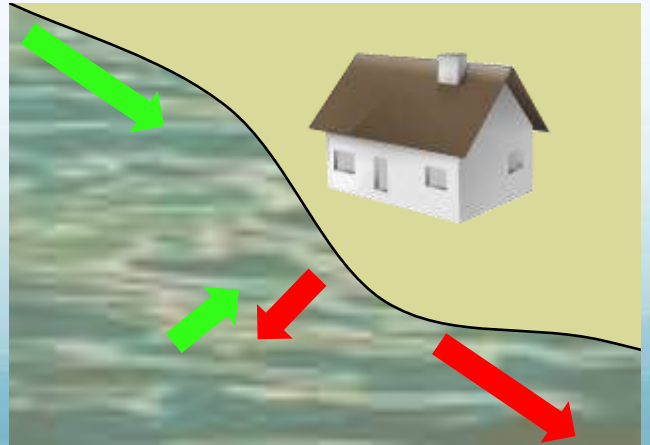
It’s all sediment transport!

What is Erosion???..... just more leaving than coming in

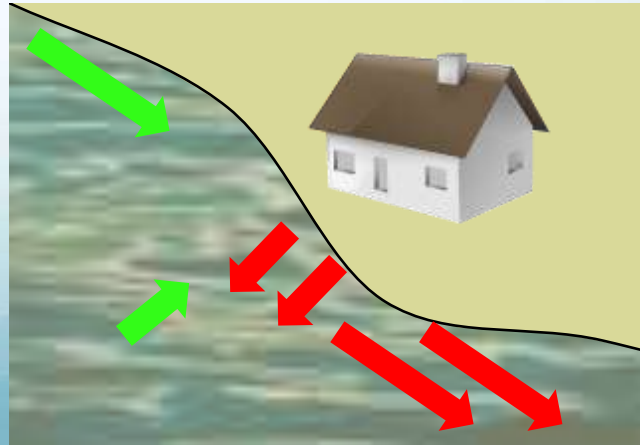
Accretion



Dynamic Equilibrium



Erosion



Living with Erosion

1. **Erosion of glacial landforms is the MOST important source of sediment for dunes and beaches in Massachusetts.**

2. **Wind and waves then transport sediment.**

3. **Without erosion and then longshore re-deposition there would be no beaches.**

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WHAT STRATEGIES INCREASE COASTAL RESILIENCY ON CAPE COD?

The Spectrum of Coastal Erosion Control Methods

- Do nothing
- Vegetation
- Re-grade
- Managed retreat
- **Beach nourishment = Fill of a CRA**

Photo Credit: Ted Keon

Sacrificial

Cobble (Mixed)

Photo Credit: CZM

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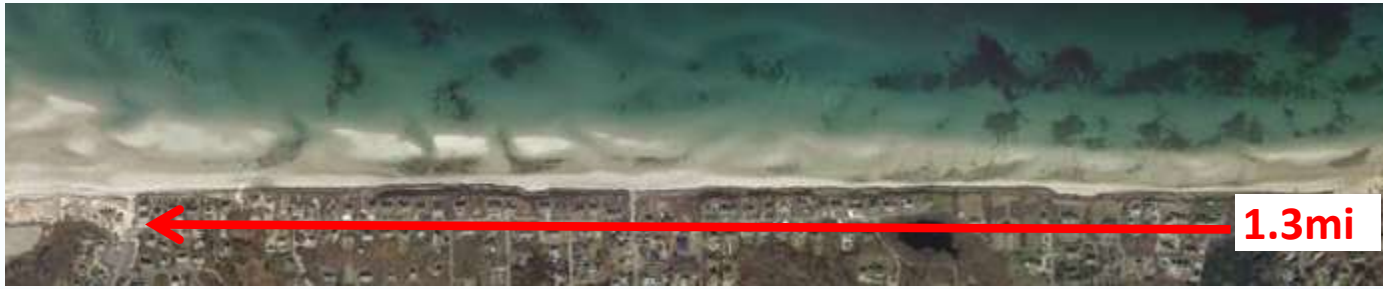
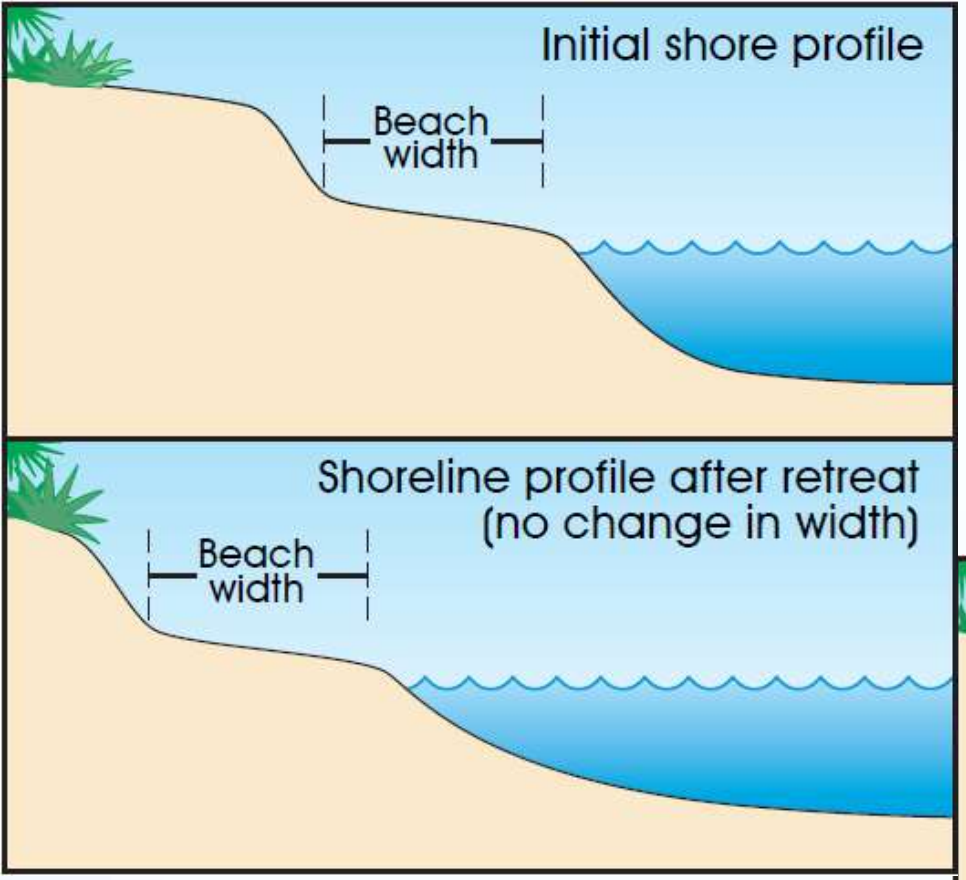
- Fiber rolls
- Coir Envelopes



C E S

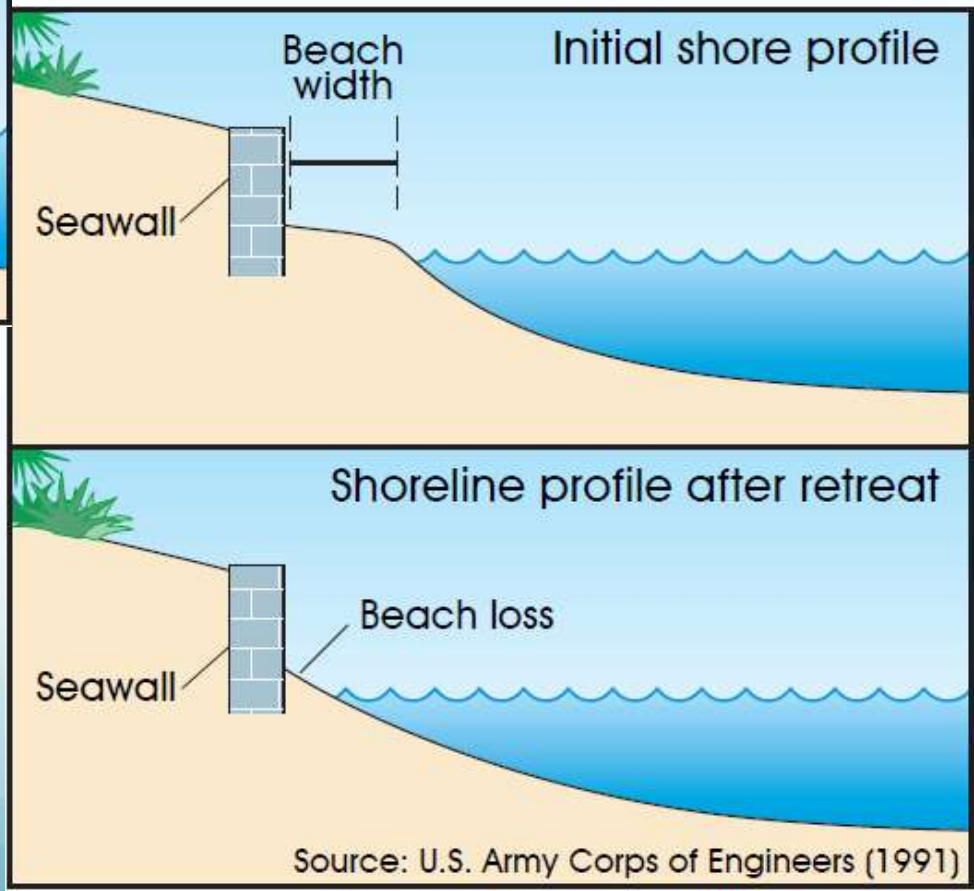
- Groin
- Jetty

- Sand Bags
- Gabion
- Breakwater / Sill
- **Revetment**



A beach undergoing net longterm retreat will maintain its natural width.

Beach loss eventually occurs in front of a seawall for a beach experiencing net longterm retreat.



Images adapted from ***Natural Hazard Considerations for Purchasing Coastal Real Estate in Hawaii - A Practical Guide of Common Questions and Answers,*** by University of Hawaii Sea Grant College Program, 2006.

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C E S

- Groin
- Jetty
- Sand Ba
- Gabion
- Breakwa
- Revetme
- **Seawall**

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- Breakwater / Sill
- Revetment
- **Sea**

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- Vegetation
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C E S

- Groin
- Sand Bags
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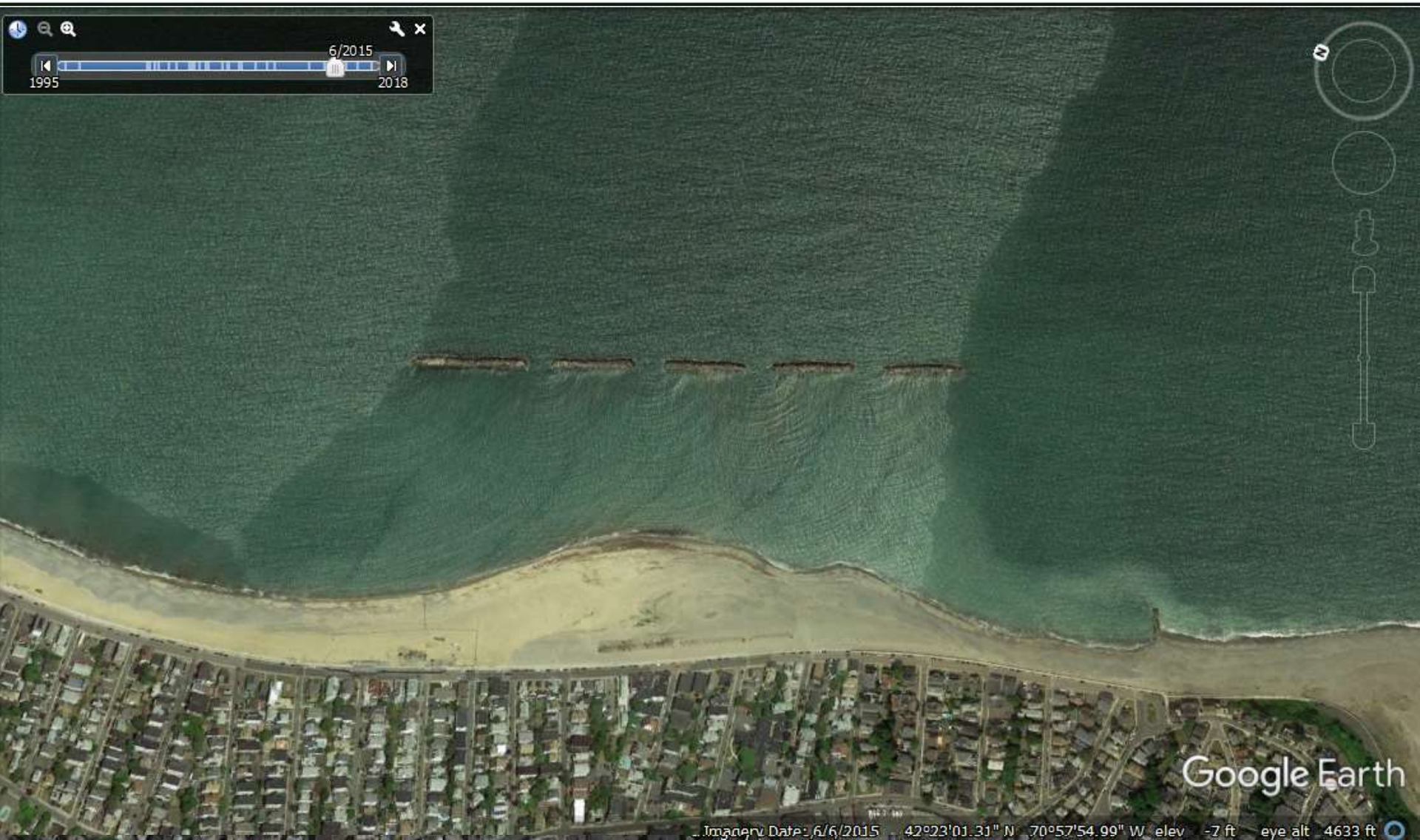
- **Breakwater / Sill**
- Jetty

Sediment Management On Cape Cod

$30 million Winthrop Beach Project, DCR



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Images from the 10/2010 Report of the CRWG to the Falmouth BOS

09/29/2015 - 01/15/2016 - 10/12/2017

Sediment Management On Cape Cod

Chatham - Andrew Harding's Beach

July 2005

Photo Credit: Ted Keon

Sediment Management On Cape Cod

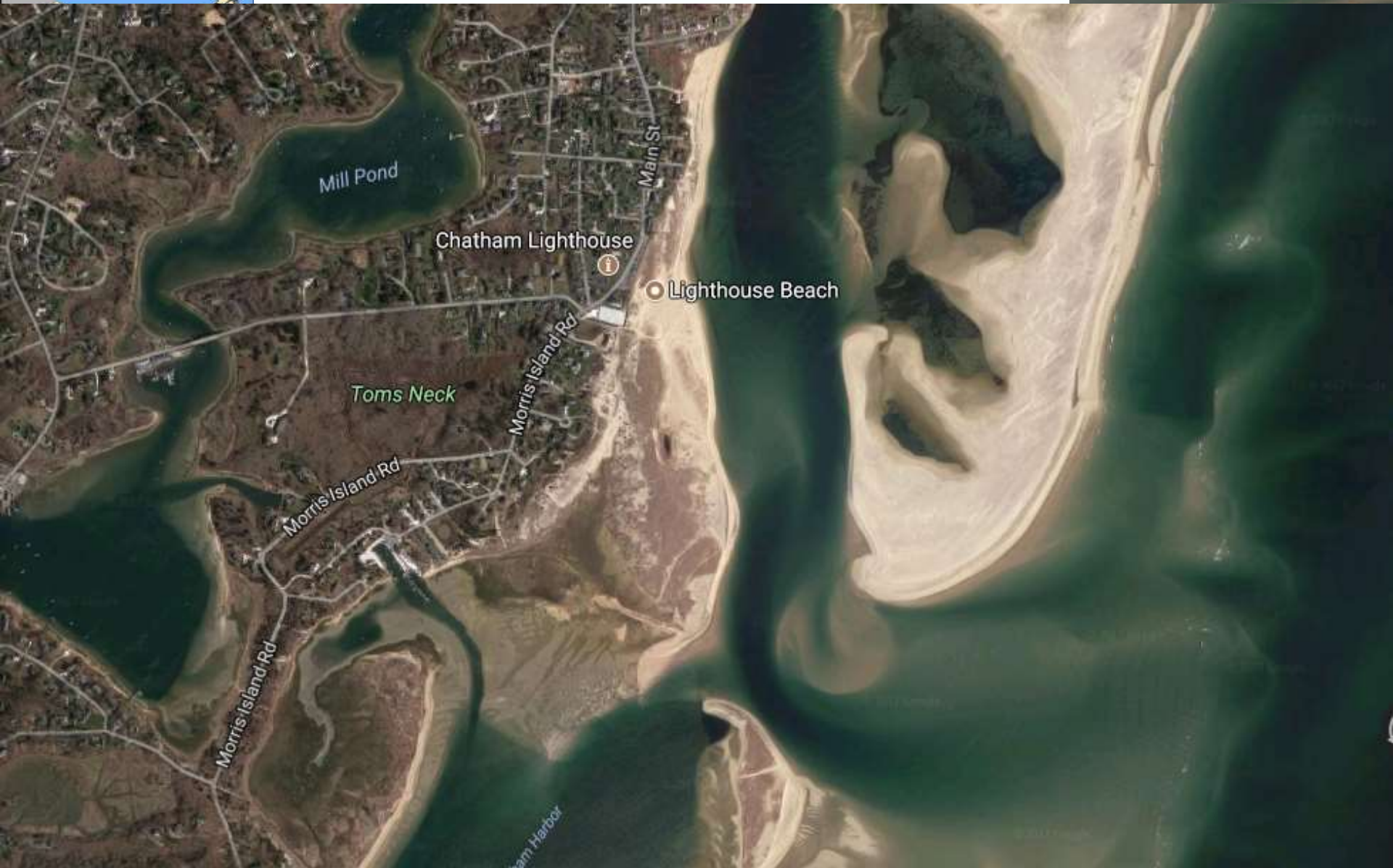
Chatham - Andrew Harding's Beach

July 2011

Photo Credit: Ted Keon

Sediment Management On Cape Cod

The only constant is change:



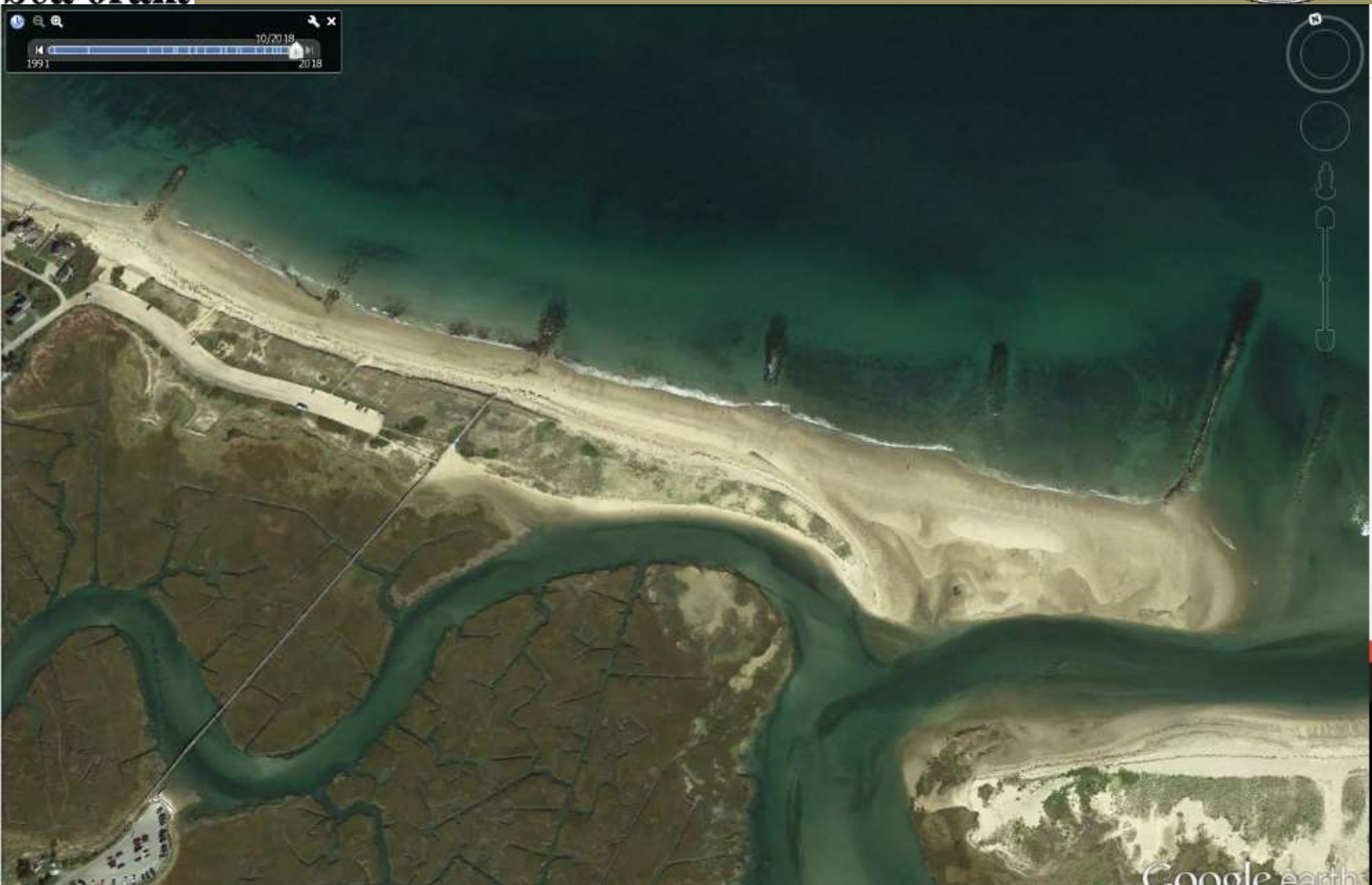
Sediment Management On Cape Cod

Chatham – Cockle Cove

permitted dredging locations

permitted placement locations

Sandwich – Town Neck



Sandwich – Town Neck

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Video by Peter Traykovski, WHOI

Sandwich – Town Neck

Video by Peter Traykovski, WHOI , Image by Issac Benaka

Sandwich – Town Neck

Victim of our own success?

Land-use change, population 4.75x 1950s

Questions?

Keep in mind:

- Assess local erosion and flooding
- Evaluate hazards & management
- Incorporate higher projected SL in coastal designs
- Avoid vulnerable areas