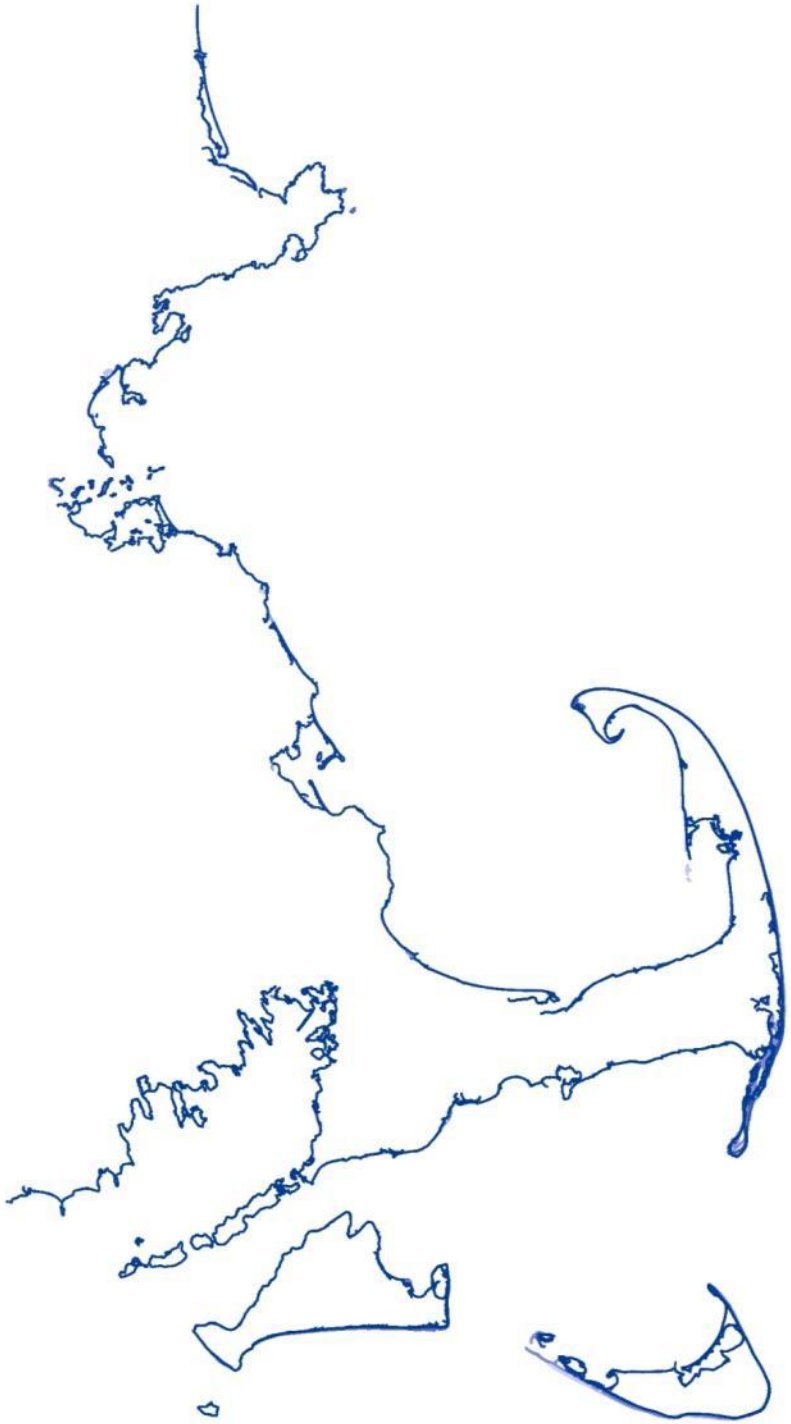


Massachusetts Shoreline Change Project

Julia Knisel

MA Office of Coastal Zone Management

Massachusetts Water Resources Commission
June 14, 2012

Shoreline Change – Natural Process

- Dunes & banks erode
- Coastal landform erosion supplies beaches with sand

Coastal Property Damages

- Development along the shoreline is susceptible to risks from winds, waves, storm surge, flooding, sea level rise *& associated erosion*

Coastal Infrastructure Impact

- Seawalls & other structures may or may not stabilize shorelines
- Structures also increase erosion along adjacent properties

Public Health and Safety

- Erosion can expose septic systems & sewer pipes, contaminating shellfish beds & other resources

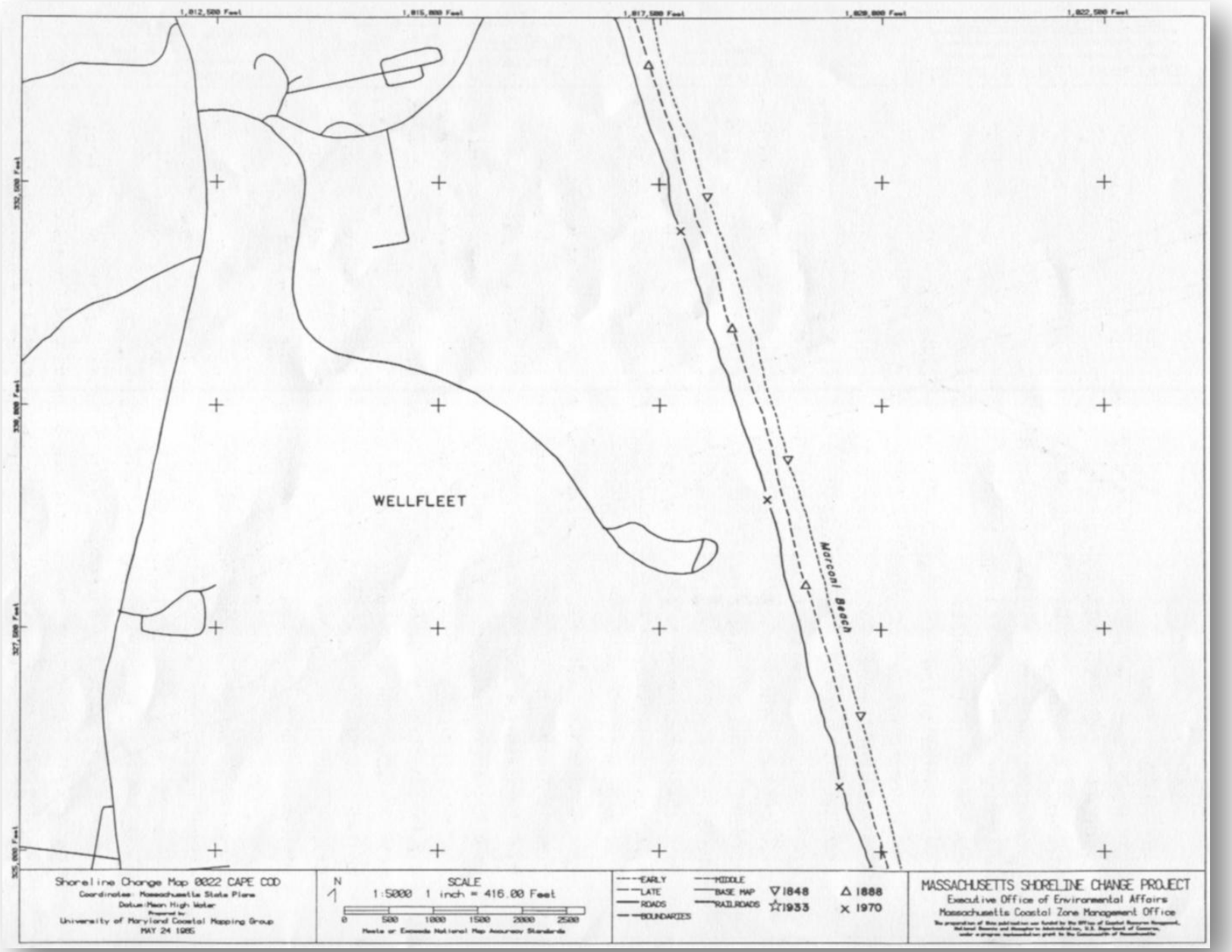
Coastal Management Challenge

- Site development in a manner that accommodates shifting conditions
- Understand & work with erosion – not against it!

CZM Shoreline Change Project Timeline

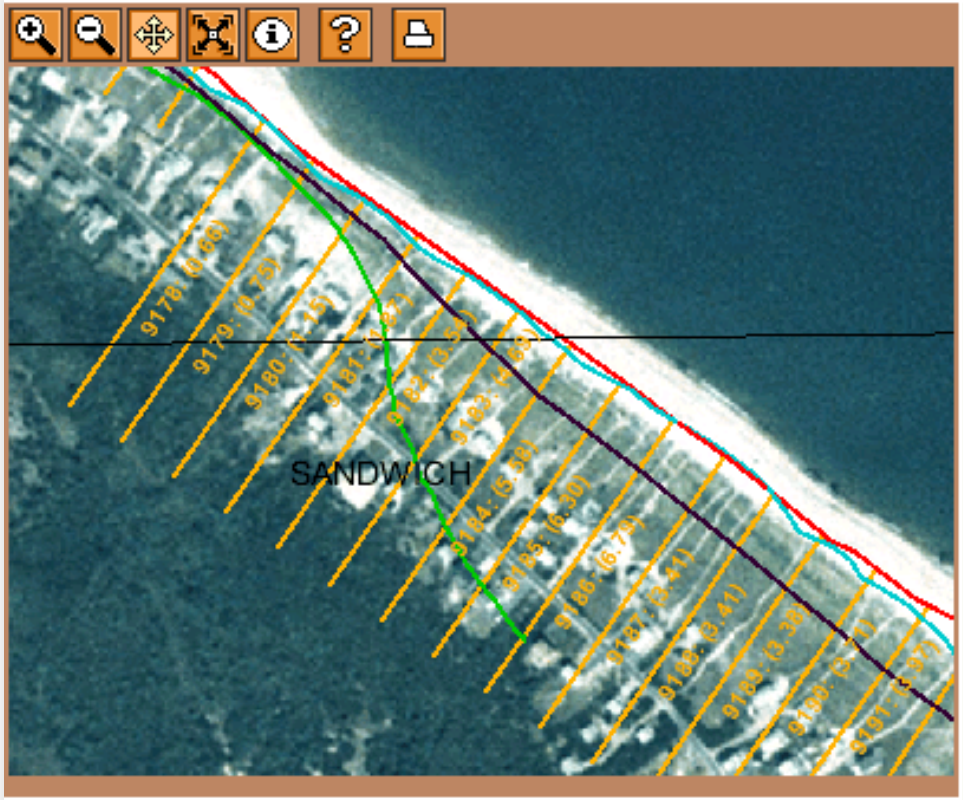
- **1989**: produced maps for entire coast with shorelines from the mid- 1800's to 1982
- **1997**: completed analysis of shoreline change rates every 40 meters alongshore
- **2001**: added 1994 shoreline & updated rates with assistance from USGS & WHOI
- **2006**: contracted Applied Coastal to delineate 2001 shoreline for South Shore
- **2012**: release 2008/2009 shoreline mapped & analyzed by USGS

1989 Shoreline Change Maps



2001 Shoreline Change Browser

Mass.Gov · get things done · agencies · elected officials · help



Find Shoreline Changes

Enter the Transect Number: Search

Choose a Place

View Legend

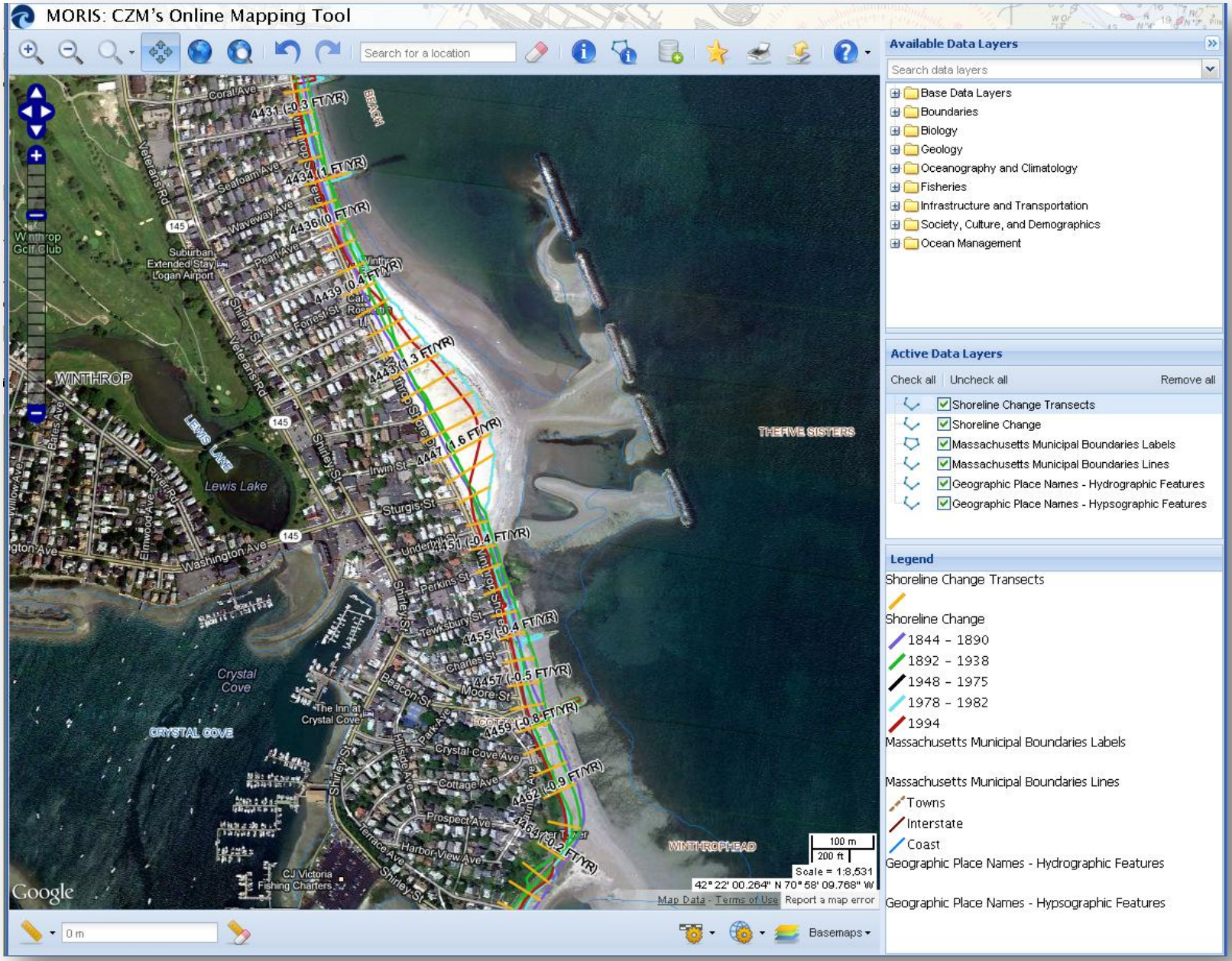
Important Data Information

SANDWICH, MA

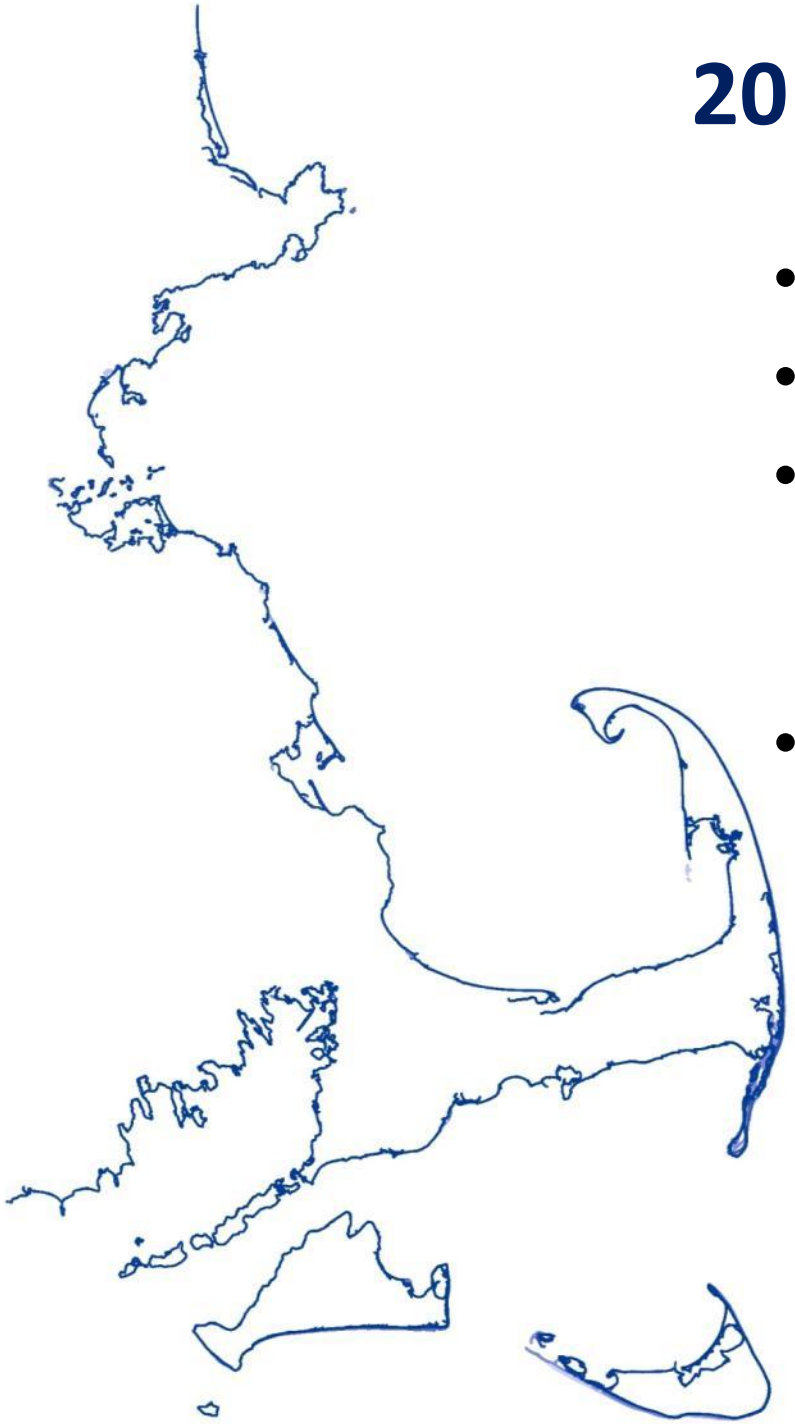
Transects

Transect Number:	9182
First Time Period:	07/1909-07/1952
Change(Ft)First Time Period:	202.8867
Rate(Ft/yr)First Time Period:	4.7244
Second Time Period:	07/1952-07/1978
Change(Ft)Second Time Period:	77.6573
Rate(Ft/yr)Second Time Period:	2.9856
Third Time Period:	07/1978-07/1994
Change(Ft)Third Time Period:	9.8425
Rate(Ft/yr)Third Time Period:	0.6234
Fourth Time Period:	
Change(Ft)Fourth Time Period:	0
Rate(Ft/yr)Fourth Time Period:	0
Long Term Shoreline Change Rate (this is calculated using linear regression)(Ft/yr):	3.54

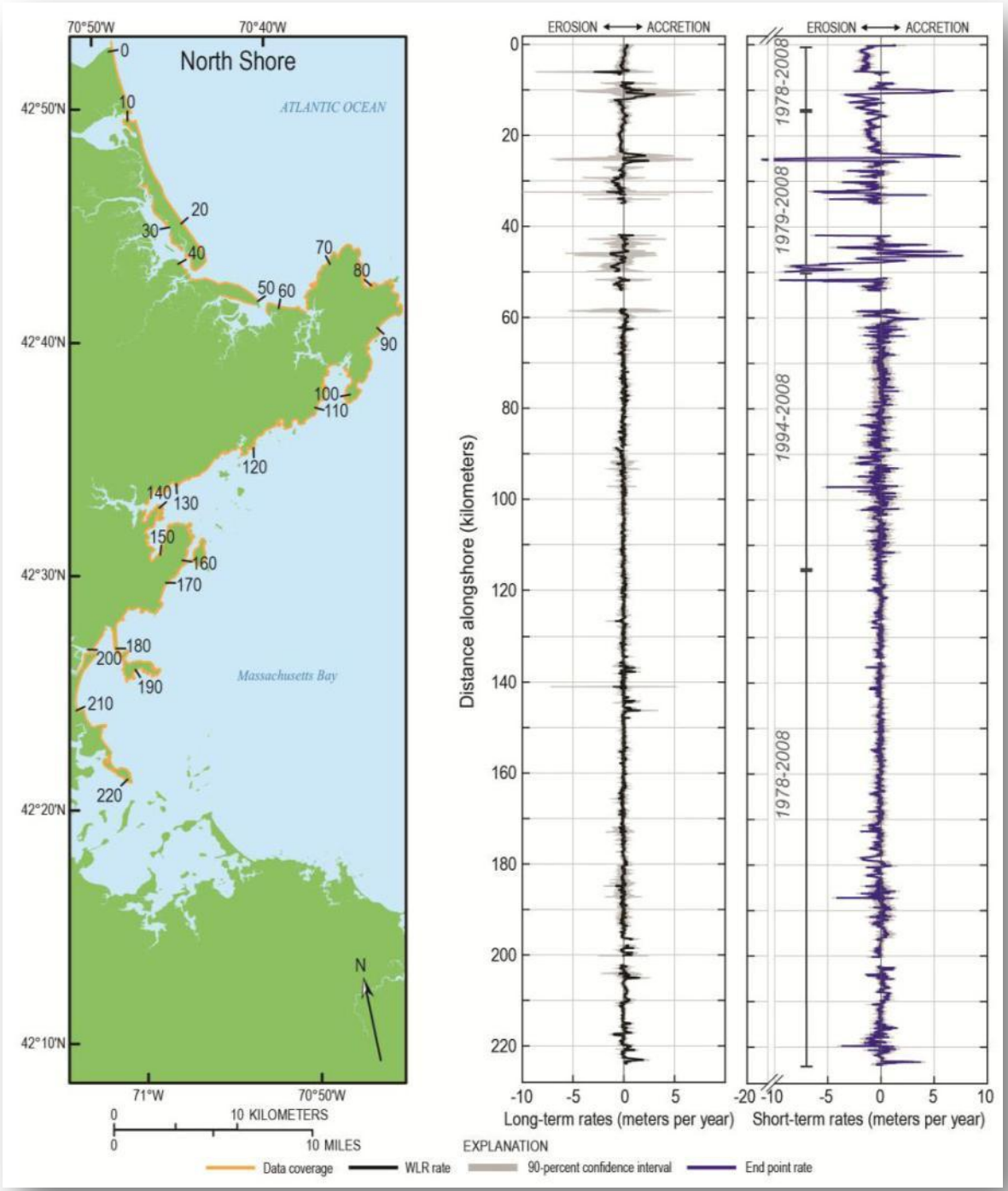
Shoreline Change in MORIS



2012 Update



- Shorelines from 1845 to 2009
- 26,615 transects along 1,676 km
- Long-term rates:
  - 150 years
  - State avg. = -0.19 ± 0.02 m/yr
- Short-term rates
  - 30 years
  - State avg. = -0.29 ± 0.07

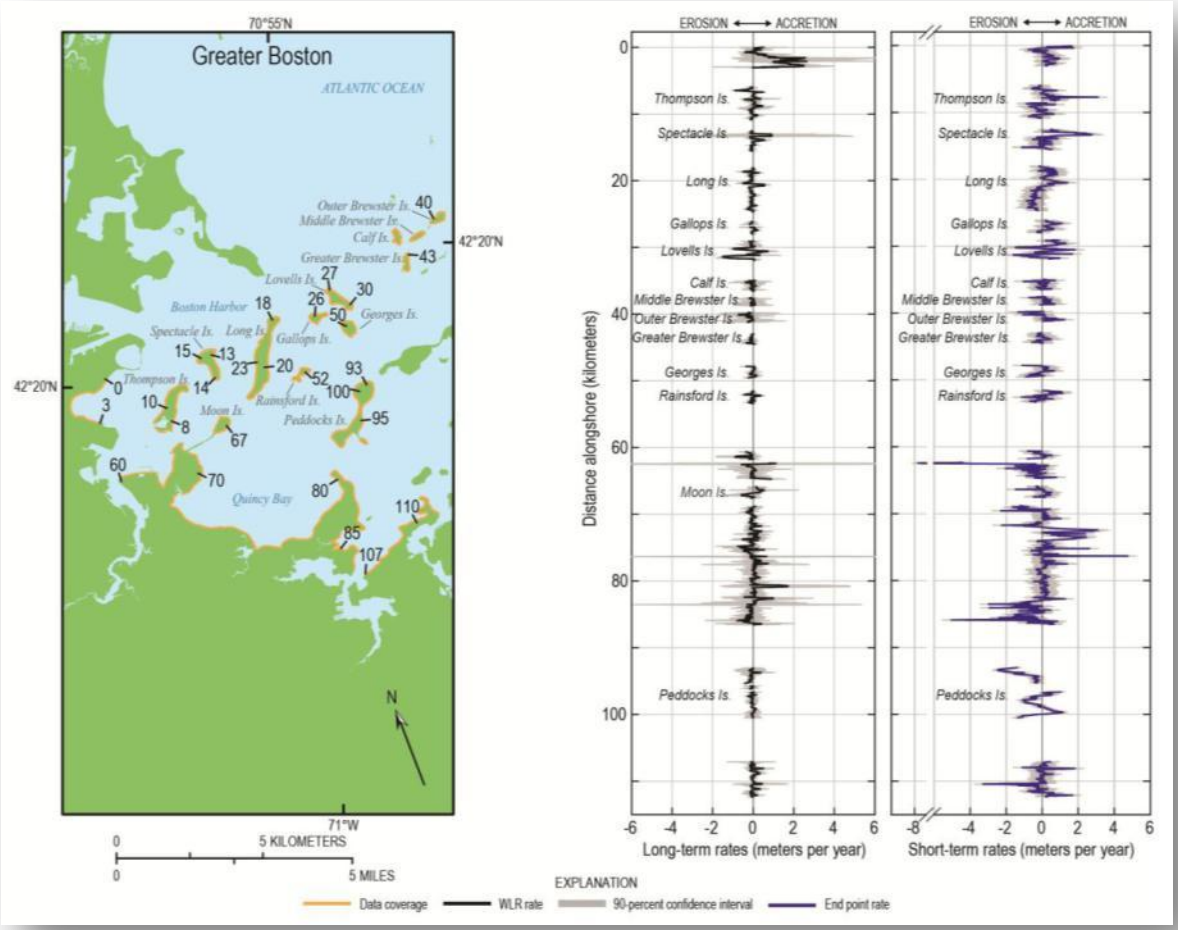


North Shore

Regional Rates (m/yr):

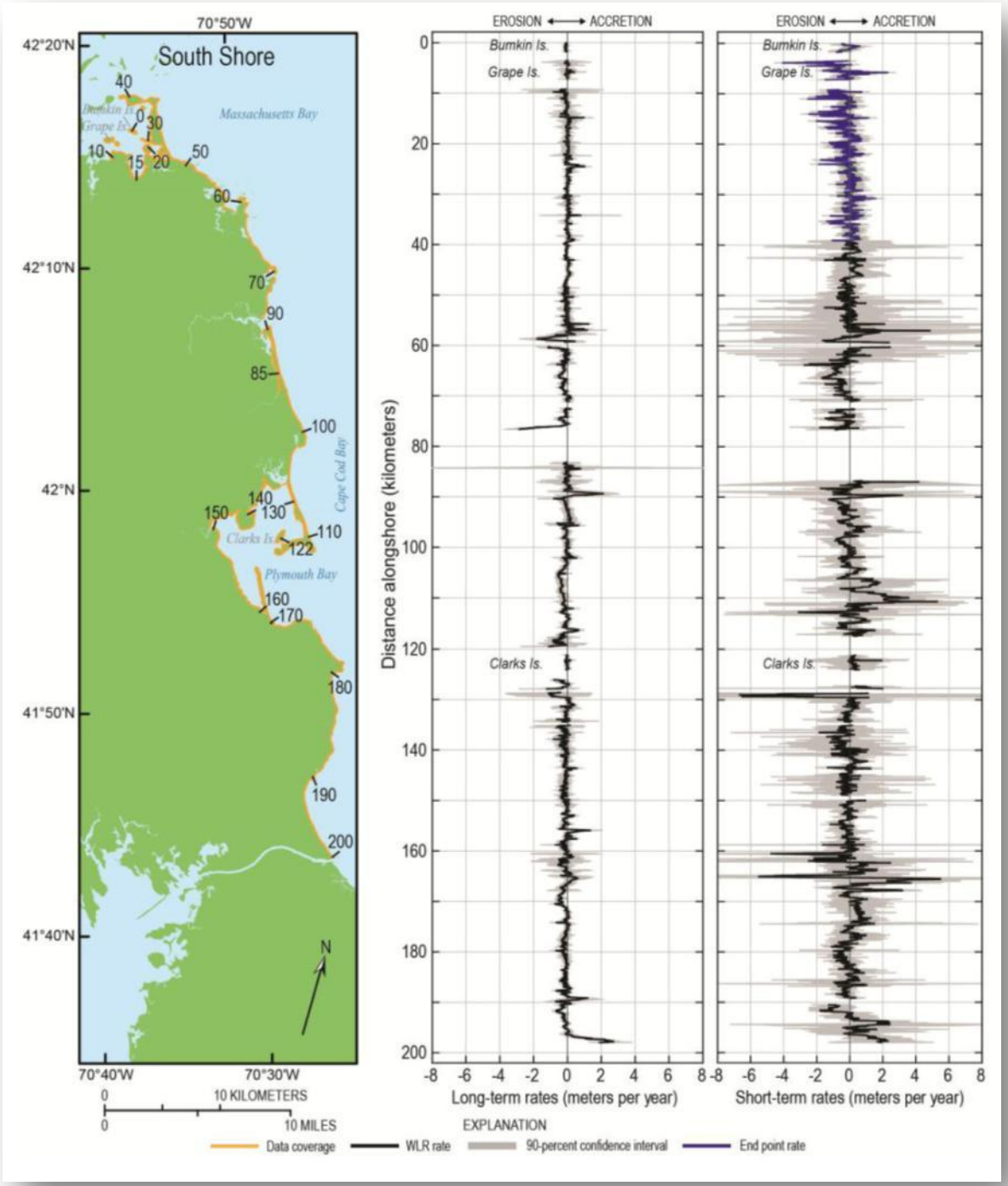
- LT avg = -0.02 ± 0.06
- LT max = -1.3 ± 1.2
- ST avg = -0.24 ± 0.10
- ST max = -16.3 ± 0.19

Boston Harbor



Regional Rates (m/yr):

- LT avg = 0.02 ± 0.03
- LT max = -1.5 ± 0.14
- ST avg = -0.01 ± 0.17
- ST max = -7.7 ± 0.61

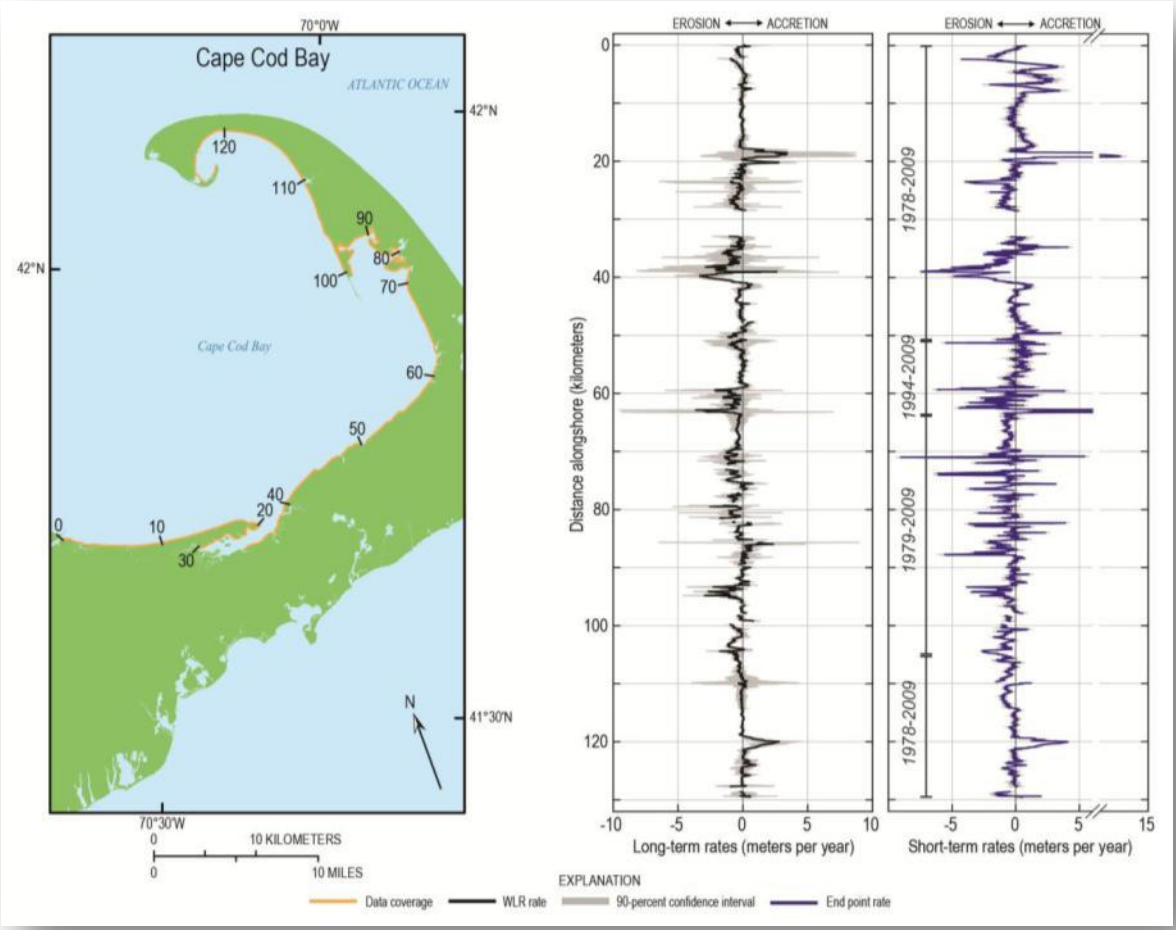


South Shore

Regional Rates (m/yr):

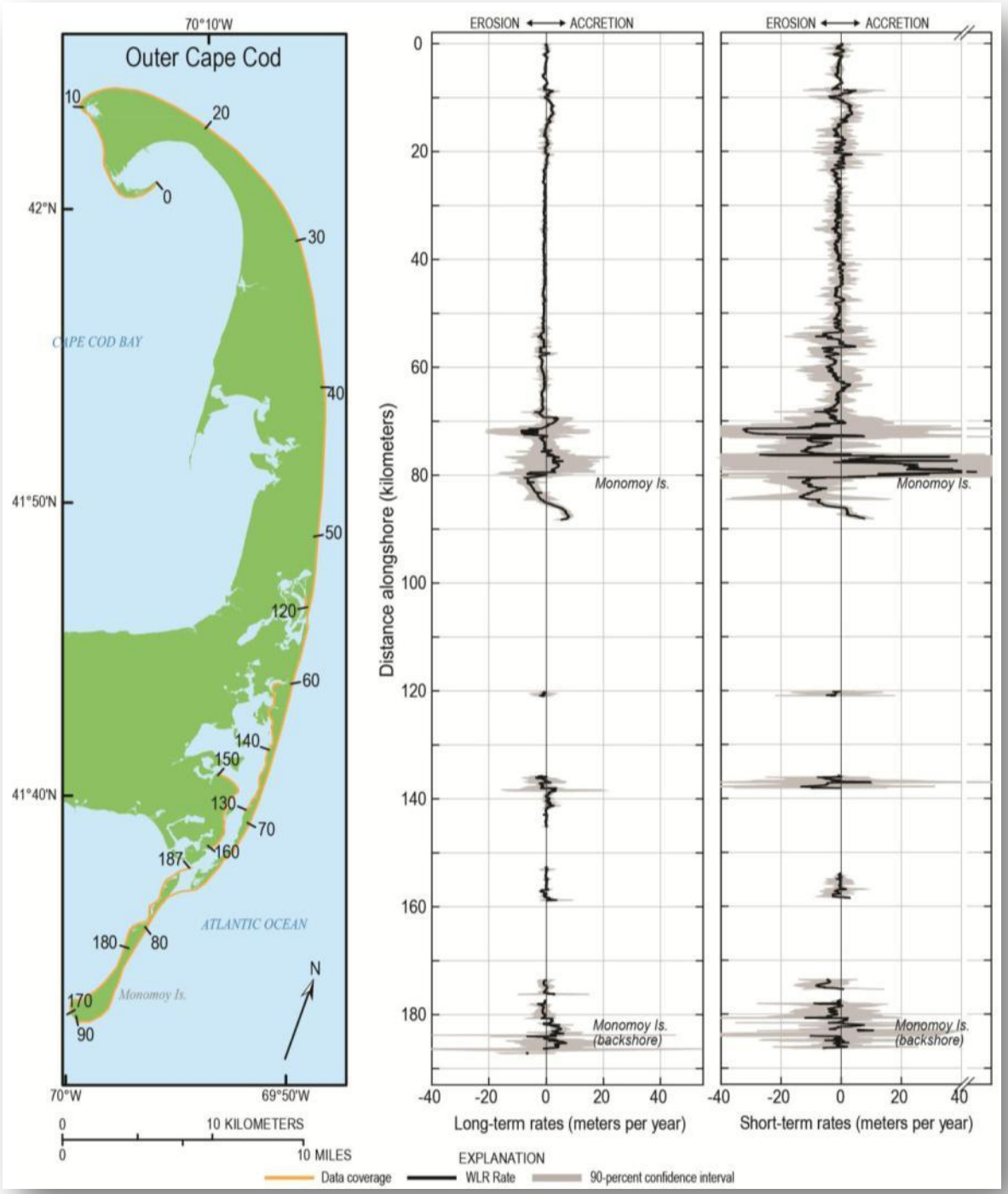
- LT avg = -0.08 ± 0.02
- LT max = -2.6 ± 0.98
- ST avg = 0.07 ± 0.12
- ST max = -5.7 ± 4.5

Cape Cod Bay



Regional Rates (m/yr):

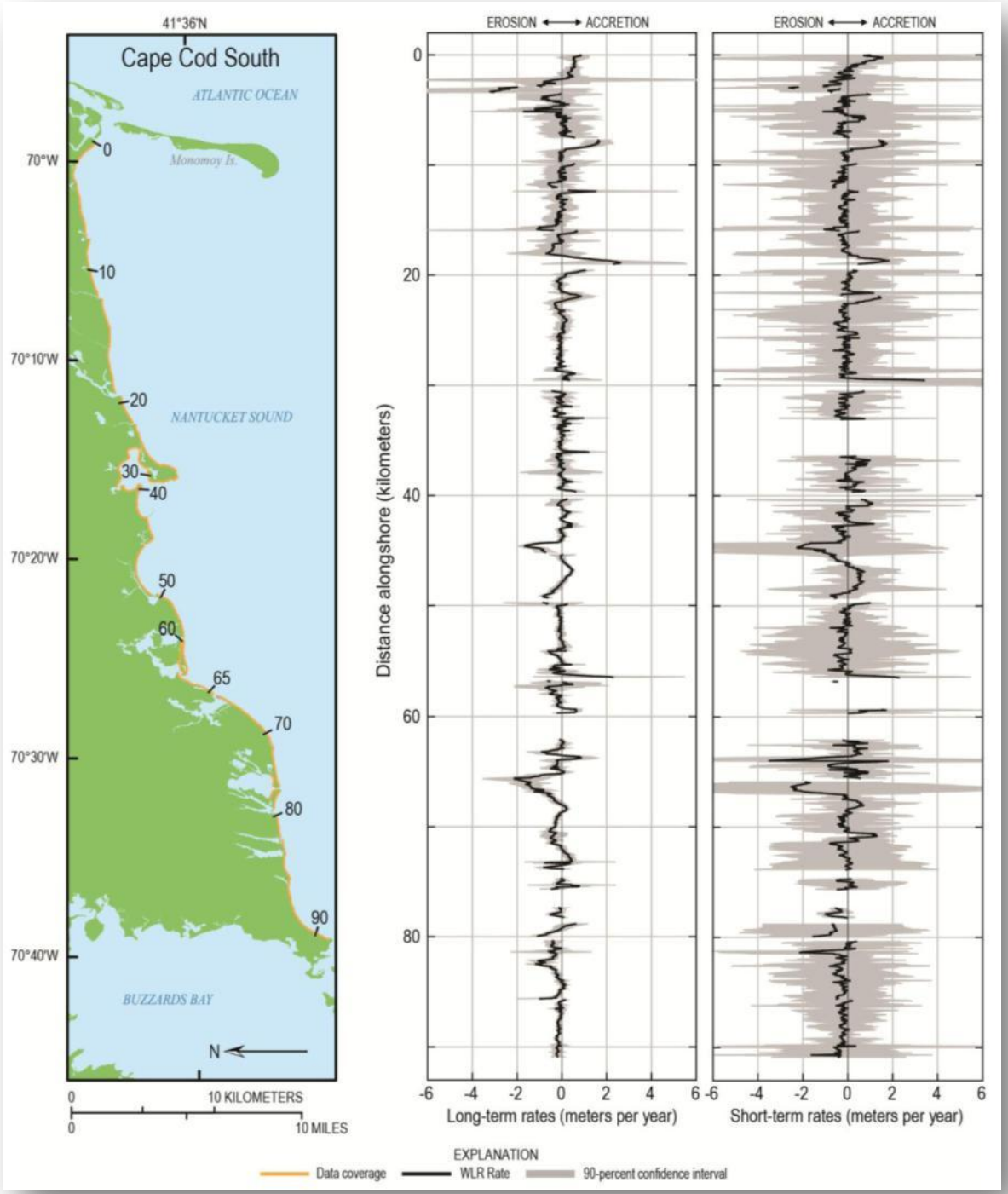
- LT avg = -0.22 ± 0.05
- LT max = -3.4 ± 1.5
- ST avg = -0.17 ± 0.06
- ST max = -9.0 ± 0.39



Outer Cape Cod

Regional Rates (m/yr):

- LT avg = -0.29 ± 0.49
- LT max = -7.7 ± 3.7
- ST avg = -1.27 ± 1.92
- ST max = -11.0 ± 2.9

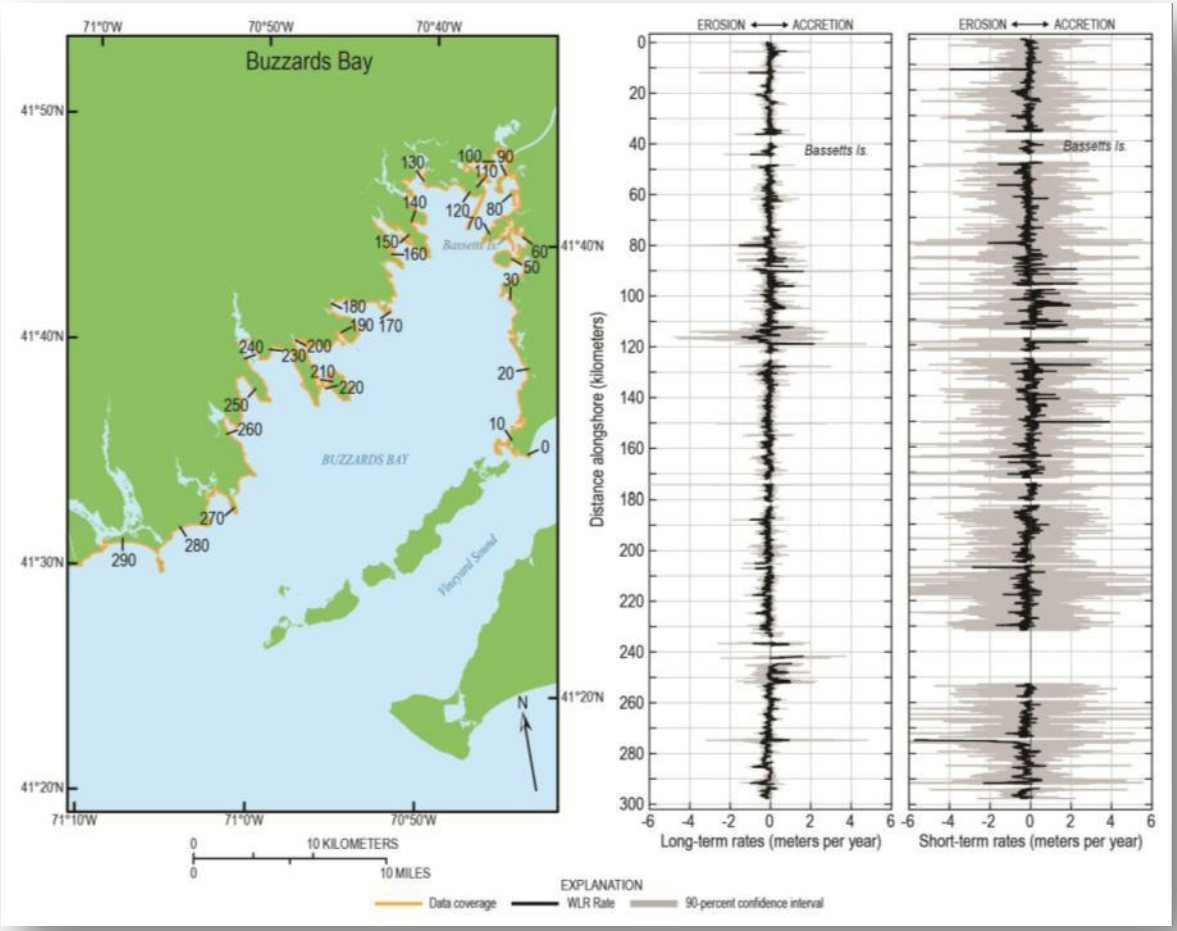


Cape Cod South

Regional Rates (m/yr):

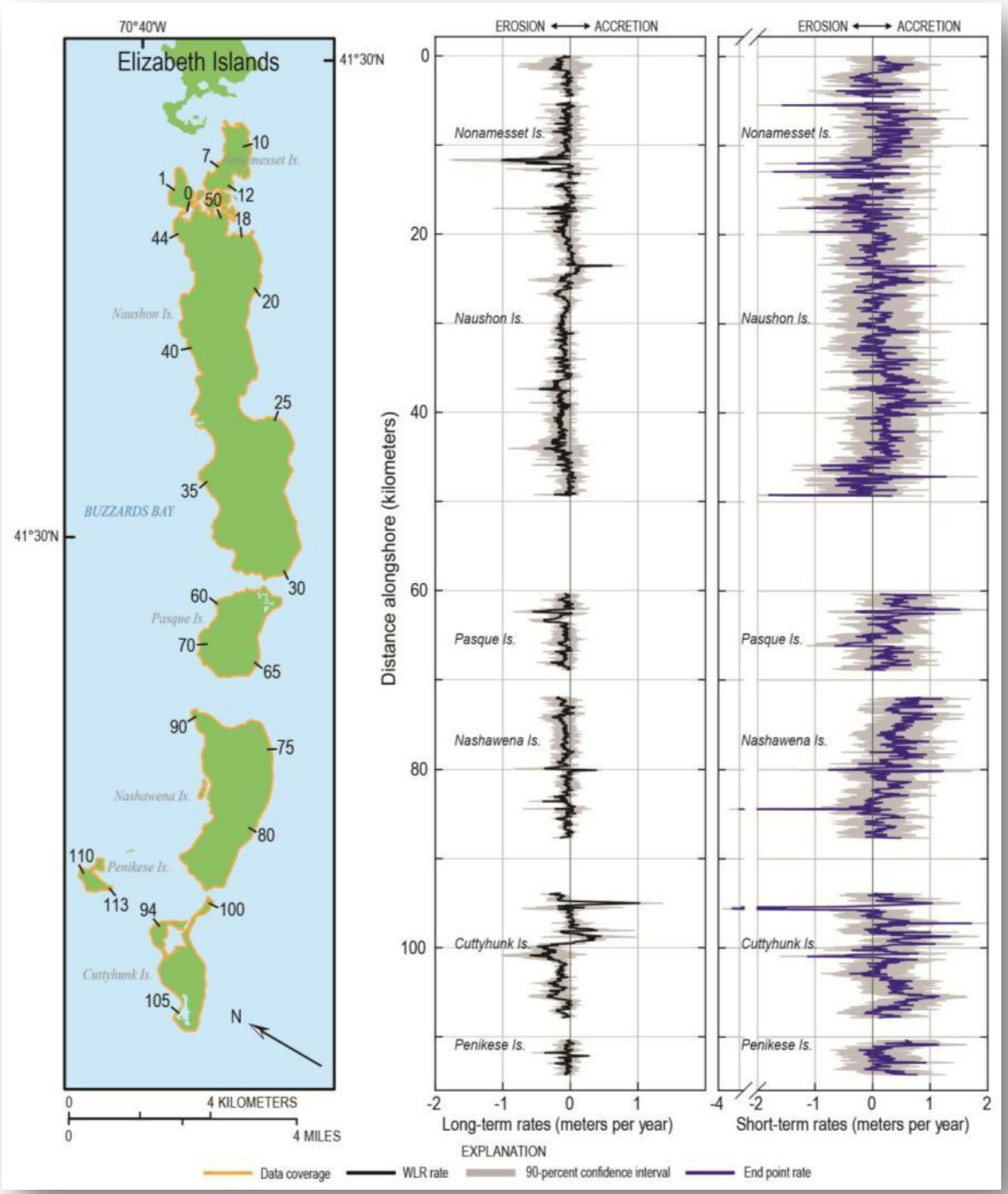
- LT avg = -0.13 ± 0.07
- LT max = -4.2 ± 1.67
- ST avg = -0.07 ± 0.12
- ST max = -2.6 ± 2.8

Buzzards Bay



Regional Rates (m/yr):

- LT avg = -0.06 ± 0.02
- LT max = -0.99 ± 0.47
- ST avg = -0.07 ± 0.08
- ST max = -5.4 ± 7.9

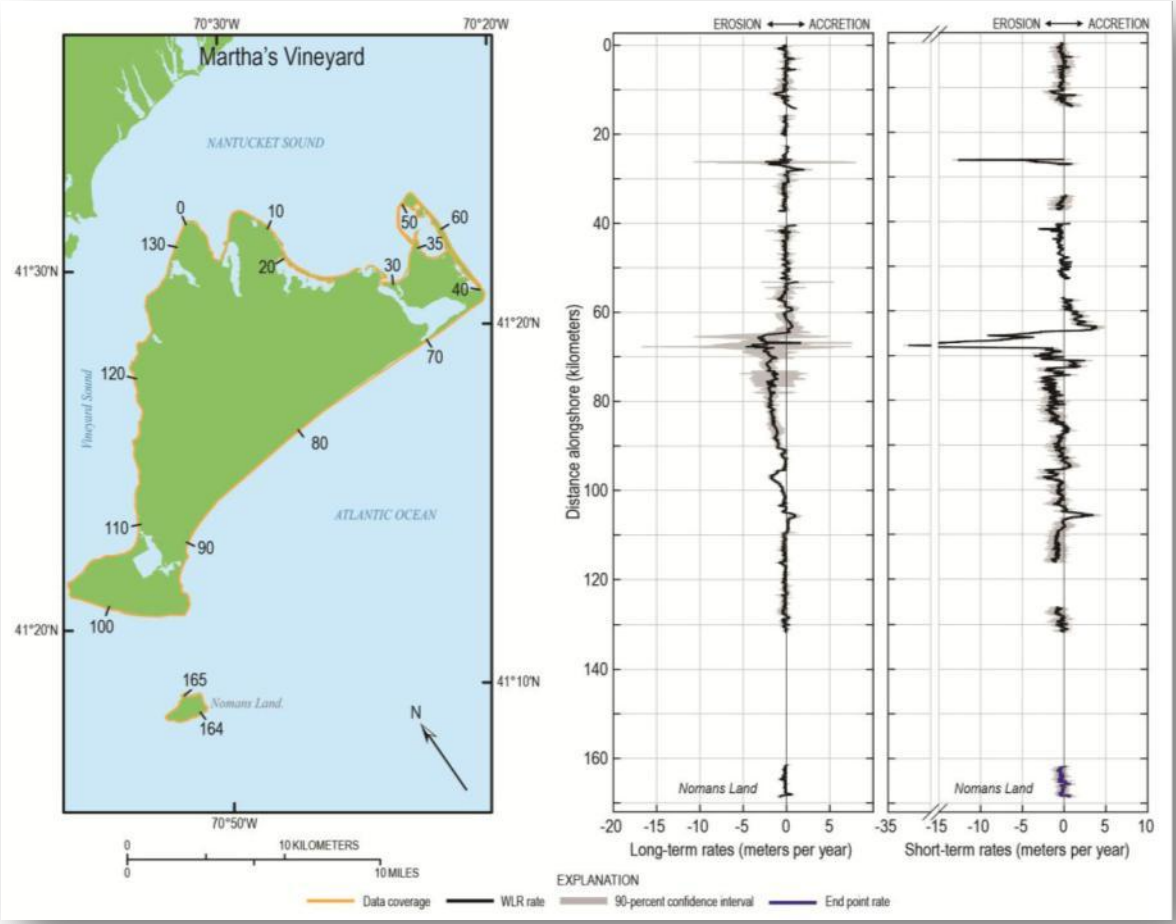


Elizabeth Islands

Regional Rates (m/yr)

- LT avg = -0.08 ± 0.01
- LT max = -1.0 ± 0.69
- ST avg = -0.06 ± 0.02
- ST max = -1.1 ± 0.08

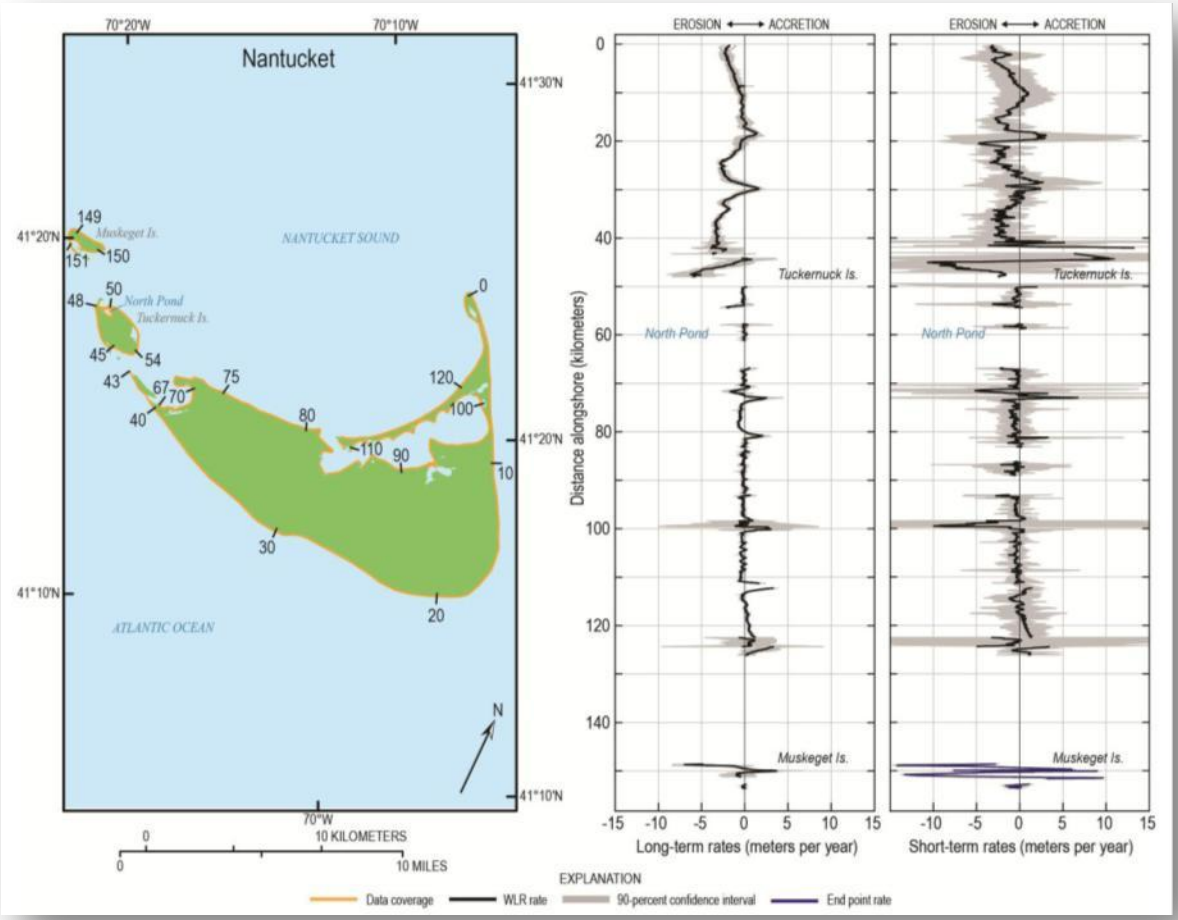
Martha's Vineyard



Regional Rates (m/yr):

- LT avg = -0.52 ± 0.08
- LT max = -3.6 ± 0.13
- ST avg = -0.66 ± 0.94
- ST max = -5.79 ± 3.78

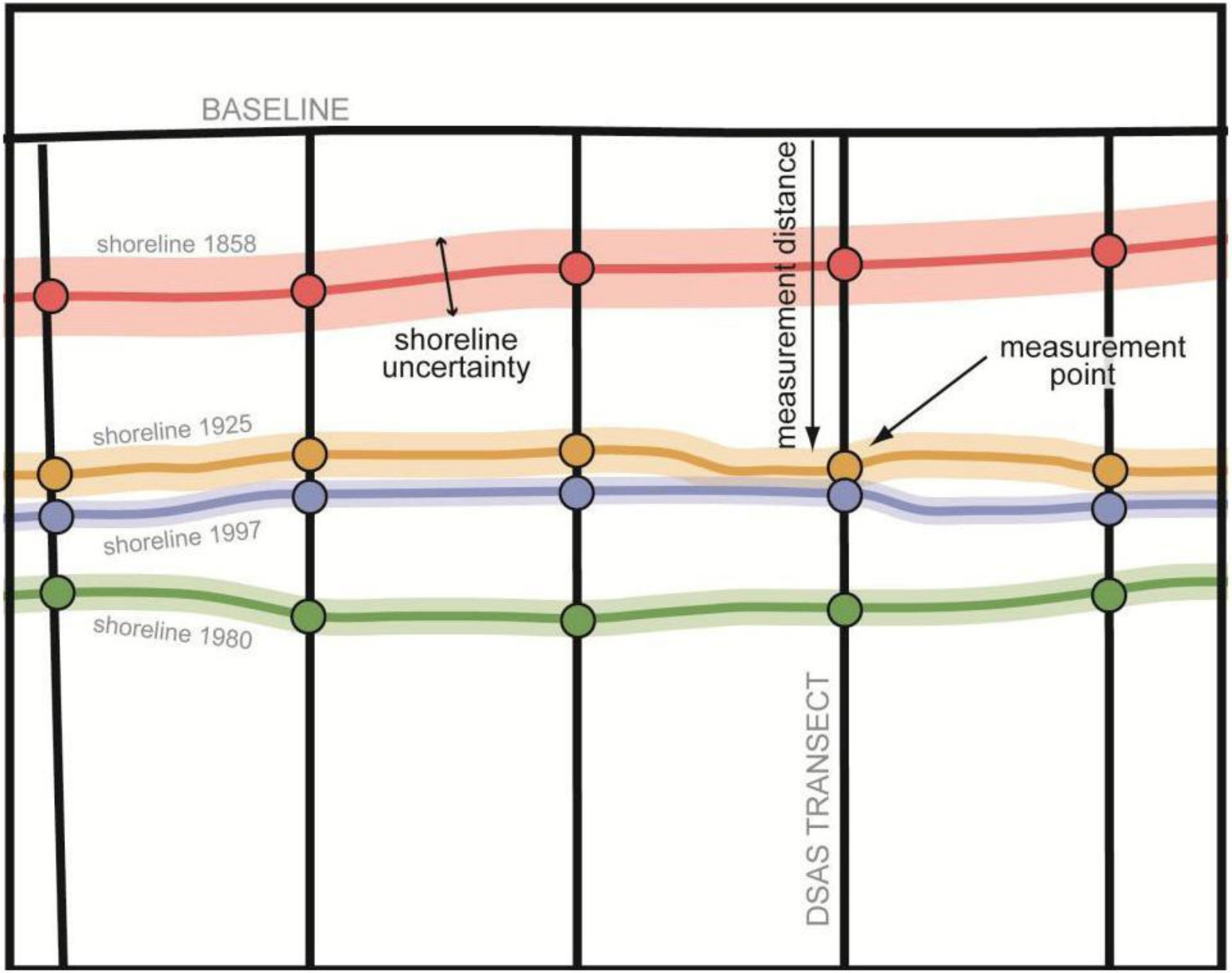
Nantucket



Regional Rates (m/yr):

- LT avg = -0.67 ± 0.08
- LT max = -6.8 ± 1.5
- ST avg = -0.79 ± 0.41
- ST max = -11.7 ± 10.8

Computing Change-Rate Statistics

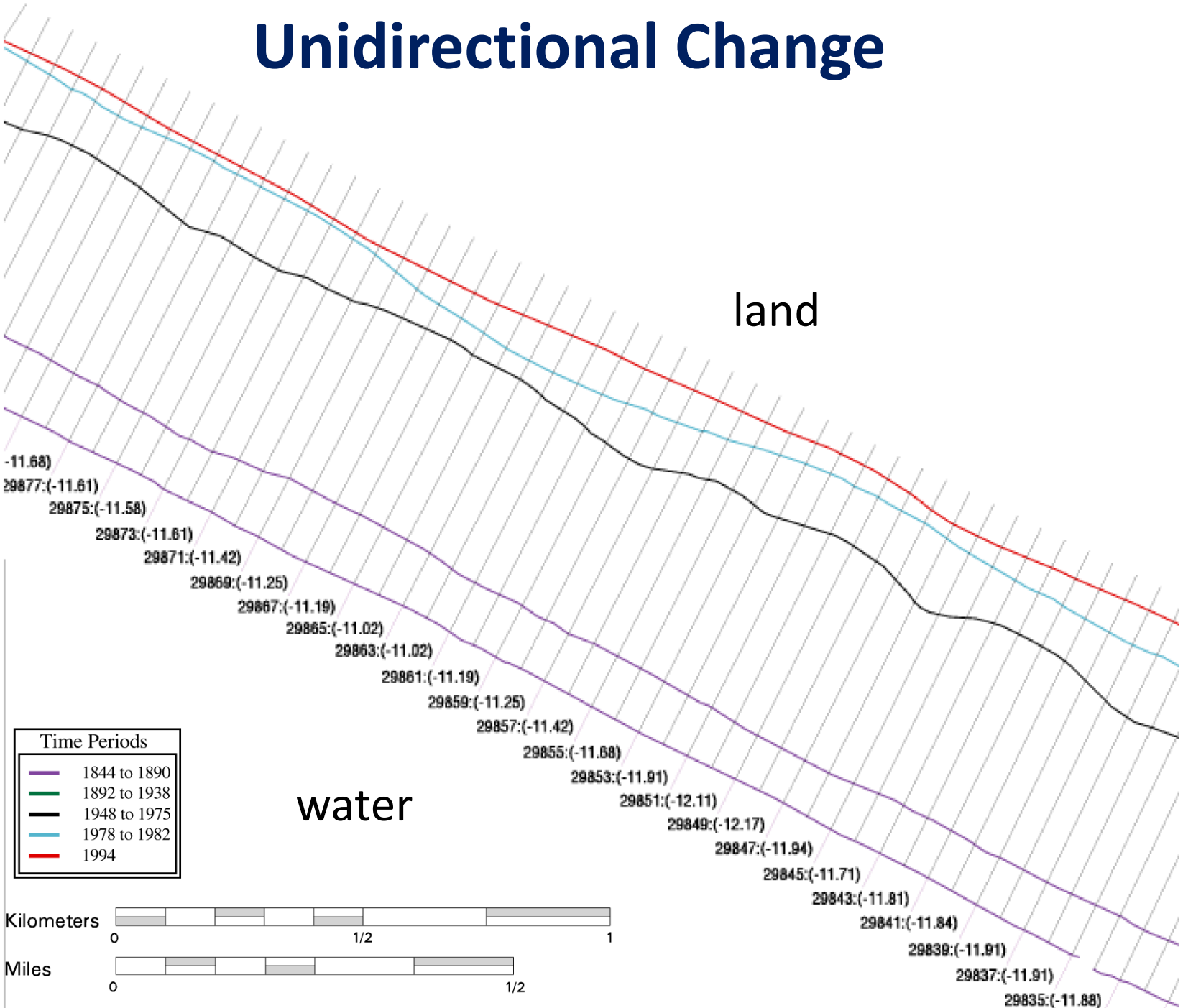


Caution: Measurement Uncertainty

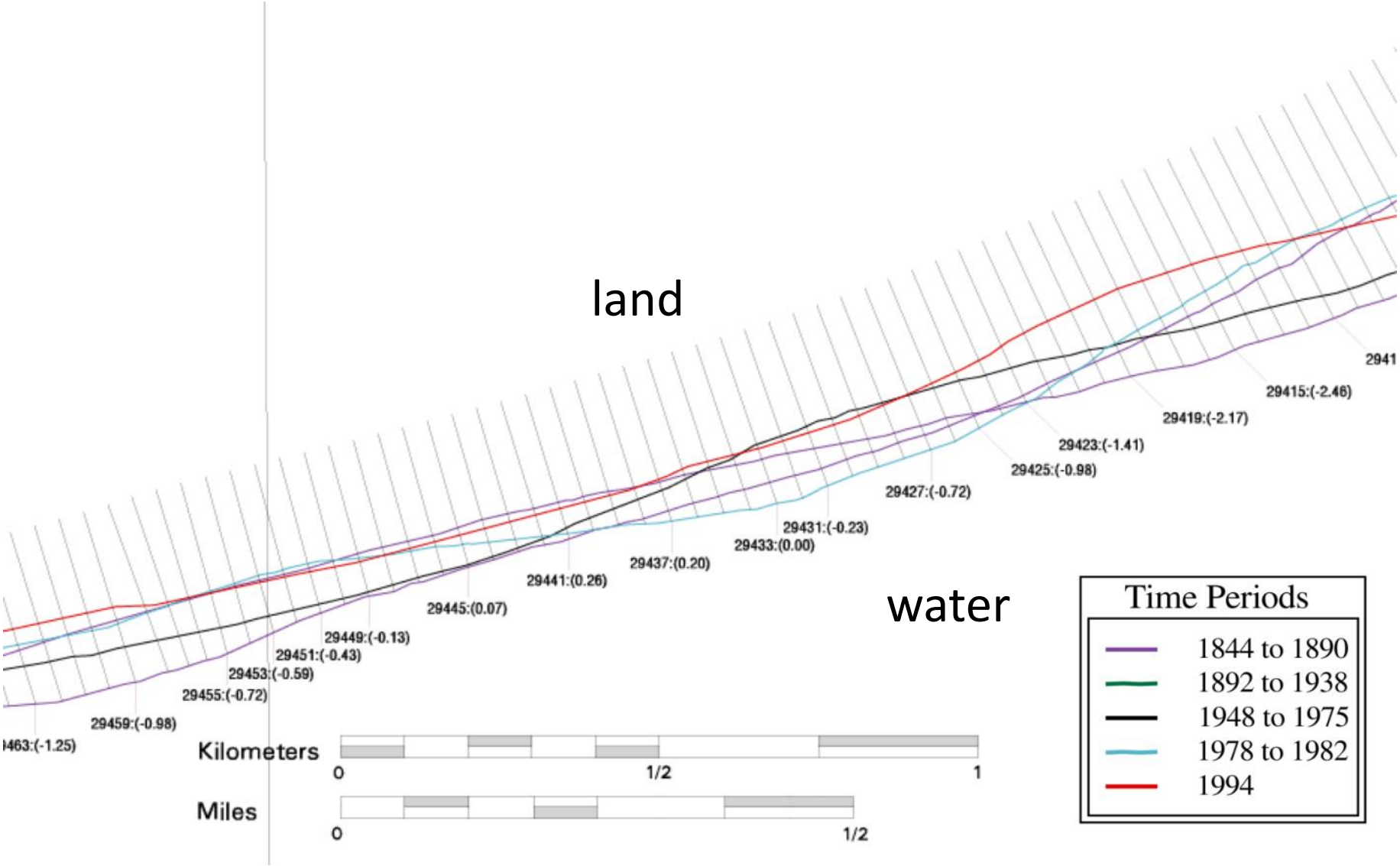
Measurement Uncertainty (meters)	T-sheets (1800s-1950s)	T-sheets (1960s-1980s)	Air photos (1970s-1994)	50 cm Orthophotos (2001)	15 cm Orthophotos (2008)	30 cm Orthophotos (2008-2009)	30 cm Orthophotos-distorted (2009)	Lidar (2000-2007)
Georeferencing (U_g)	4	4	-	-	-	-	-	-
Digitizing (U_d)	1	1	1	1	1	1	1	-
T-sheet survey (U_t)	10	3	-	-	-	-	-	-
Air Photo (U_a)	-	-	5	3	0.25	2.12	4.23	-
Uncertainty of the High Water Line (U_{pd})	4.3	4.3	4.3	4.3	4.3	4.3	4.3	-
Lidar total position Uncertainty (U_p)	-	-	-	-	-	-	-	1.27
Total shoreline position uncertainty (U_p) (m)	11.6	6.7	6.7	5.3	4.4	4.9	6.1	1.27

2001 project = 8.5 m uncertainty

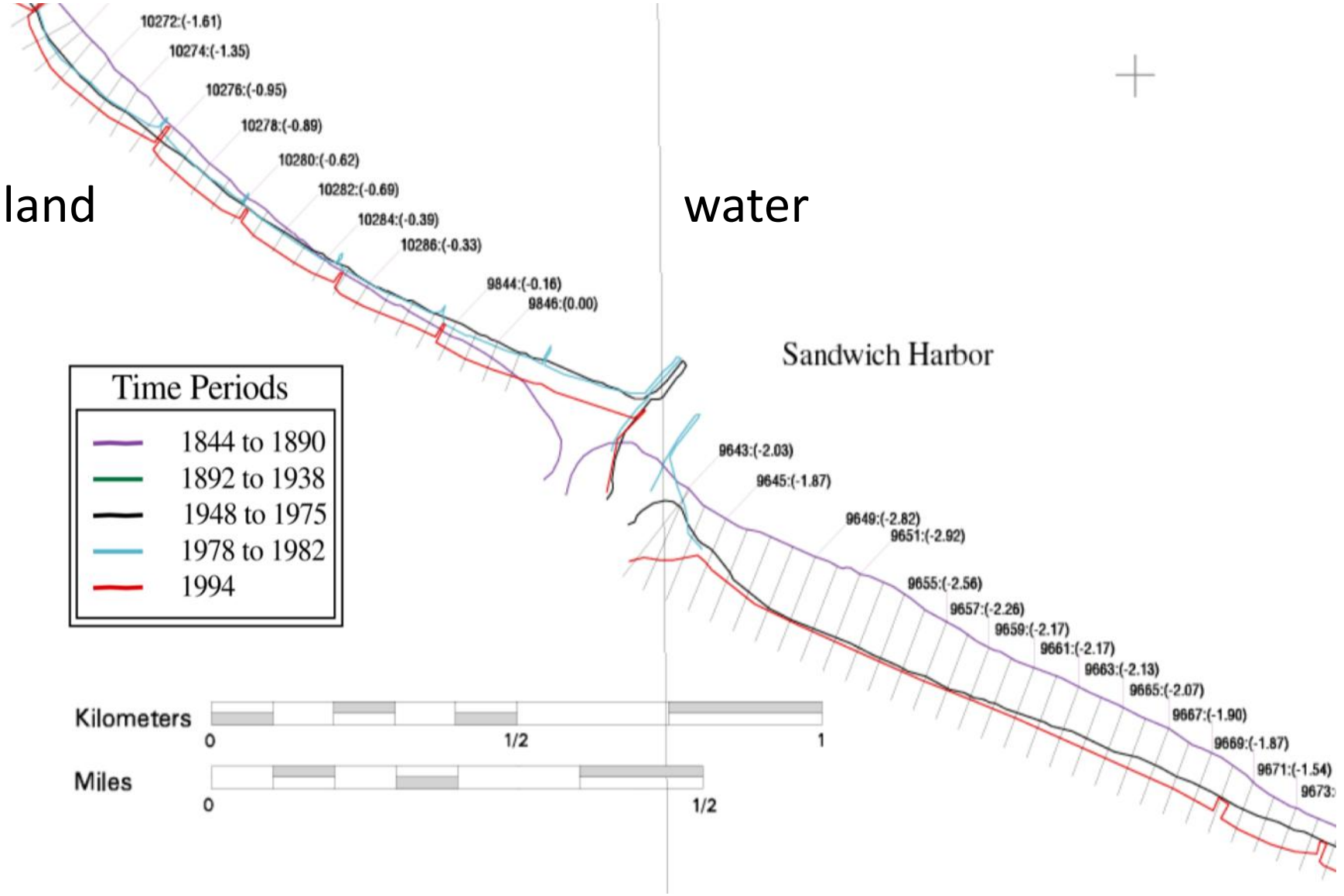
Unidirectional Change



Fluctuating Shoreline



Influence of Coastal Structures



Interpretation

- **Consider all available information:**
  - short-term & long-term shoreline change data
  - current site conditions
  - recent changes in shoreline uses
  - affects of human-induced alterations to natural shoreline processes

Availability

www.mass.gov/czm/hazards/shoreline_change/shorelinechangeproject.htm

Massachusetts Shoreline Change Project

To help make informed and responsible decisions, coastal managers, shorefront landowners, and potential property buyers need information on both current and historical shoreline trends, including reliable measurements of erosion and accretion rates in non-stable areas. The goal of the Massachusetts Office of Coastal Zone Management (CZM) Shoreline Change Project is to develop and distribute scientific data that will help inform local land use decisions.

CZM's Shoreline Change Project illustrates how the shoreline of Massachusetts has shifted between the mid-1800s and 1994. Five relative high water lines and change rates at 40-meter intervals along the ocean-facing shore have been determined using data from historical and modern sources. CZM has incorporated these shoreline change data into MORIS, the Massachusetts Ocean Resource Information System, which can be readily accessed by the public.

View the Shoreline Change Map: Please proceed to the Shoreline Change Fact Sheet, which explains the use and limitations of this project and leads to an online map with available shorelines, transects, and rates of change.

Shoreline Change Map

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