

Analysis of Shoreline Change in Connecticut 100 Years of Erosion and Accretion

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Funding by NOAA/National Sea Grant

Overall caveats:

Shorelines are continuously moving in response to natural processes and human activities.

- Cyclic and non-cyclic processes change the shoreline position from daily and seasonal effects (wind/waves/storms), to changes in sea level over a century to thousands of years.
- Beaches can be nourished/graded and shorelines can be filled, developed, and armored.

The results reflect a cumulative summary of the natural and man-made processes affecting the shoreline for the time period analyzed.

We have addressed areas of obvious or large-scale development on a limited basis when considering portions of the results (i.e., the pace of change.) Specifically areas in Bridgeport, New Haven, the Thames River, and selected portions of Fairfield County.



Project Background...

National Assessment of Shoreline Change: Historical Shoreline Change along the New England and Mid-Atlantic Coasts



Open-File Report 2010-1118

U.S. Department of the Interior
U.S. Geological Survey

USGS – 2010 Shoreline Change Study

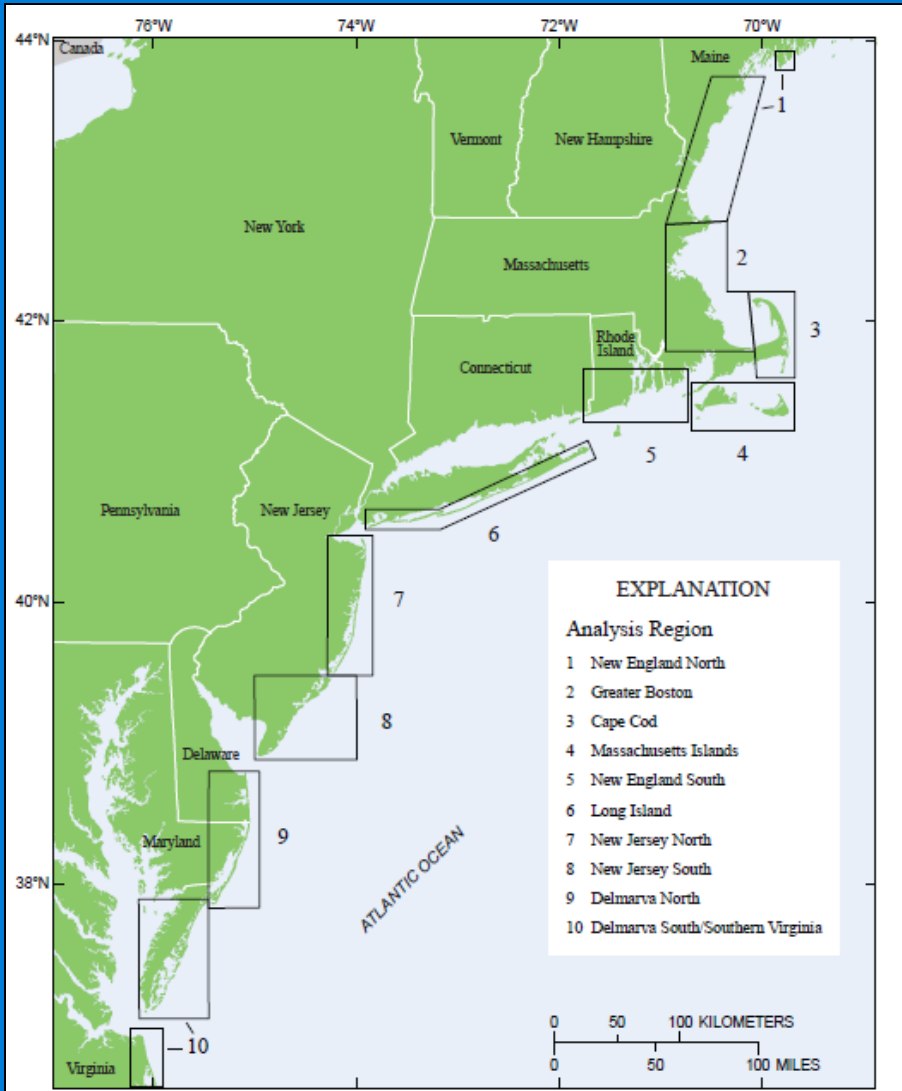


Figure 1. Index map of New England and the Mid-Atlantic showing the 10 analysis regions used in this study.

Project Background...

USGS – 2010 Shoreline Change Study

Why CT was not done and why we took it on:

Mid-Atlantic Coasts

- Long Island Sound is a comparatively low-energy system vs. Atlantic seaboard so recent efforts by USGS to assess shoreline change have ignored it

** National Assessment of Shoreline Change – New England Mid-Atlantic Coasts 2010. OFR 2010-1118*

- Existing information is either sparse, anecdotal (personal observations/institutional memory,) or dated (1980 CAM Planning Report 29)

- Several recent stated or implied needs
 - recommendations from CT Legislative Shoreline Taskforce;
 - assorted questions from various state & local regulatory/planning groups

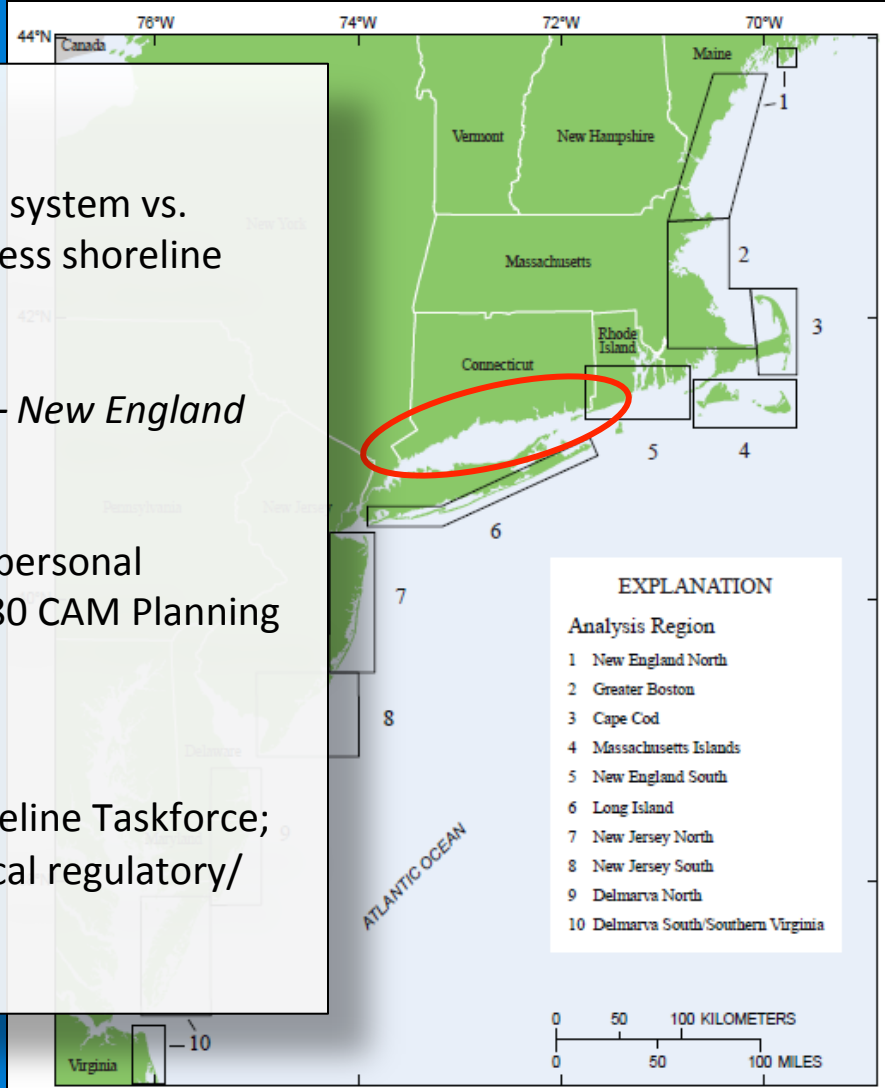


Figure 1. Index map of New England and the Mid-Atlantic showing the 10 analysis regions used in this study.

Need “Standard” Shoreline Between the Years

Not using dune or storm line for this project

Our Sources and Shoreline Definitions:

1) Office of Coast Survey/NOAA T-Sheets (Topographic Survey Sheets):

Mean High Water (MHW): By definition = average of two daily high water lines. On T-sheets from the Atlantic coast, it’s interpreted by trained topographers using the physical appearance of the beach (usually a line from the preceding high water limit).

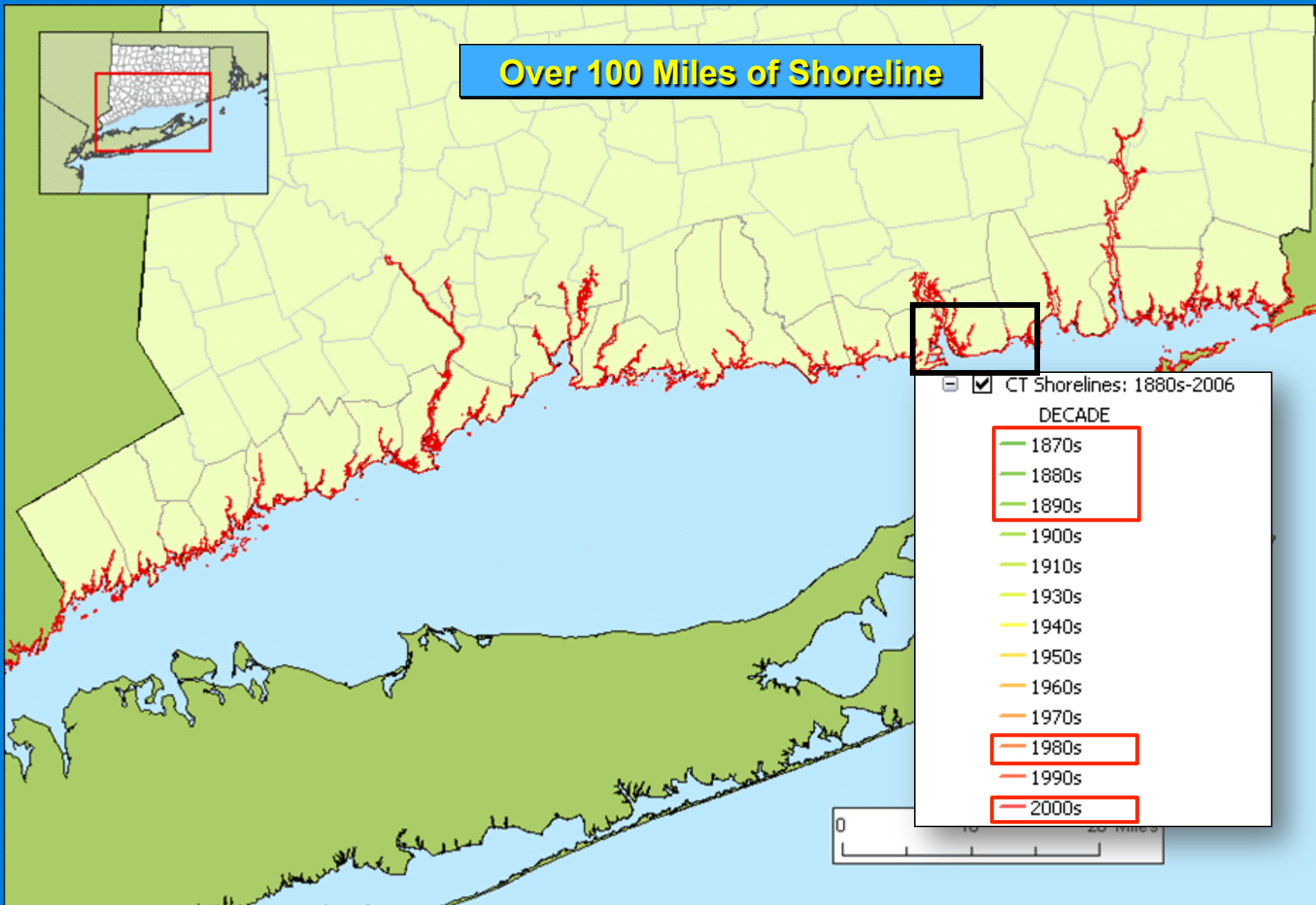
From “Shore & Sea Boundaries” Vol 2 by Aaron Shalowitz

2) USGS 1:24K Topographic Quad Sheets:

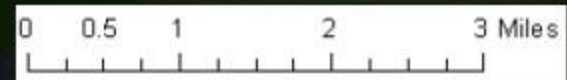
Wet/Dry Line: Per USGS recommendation, shorelines from standard USGS Topographic Maps were also used. These are best described as the “wet/dry line” or the intersection of land and water as interpreted from the source material - typically aerial photos. Since the wet/dry line and MHW may not be exactly the same, we have to adjust the uncertainty (“+/-”) in the analysis when using features derived from this source.

(hurricane)

Over 100 Miles of Shoreline

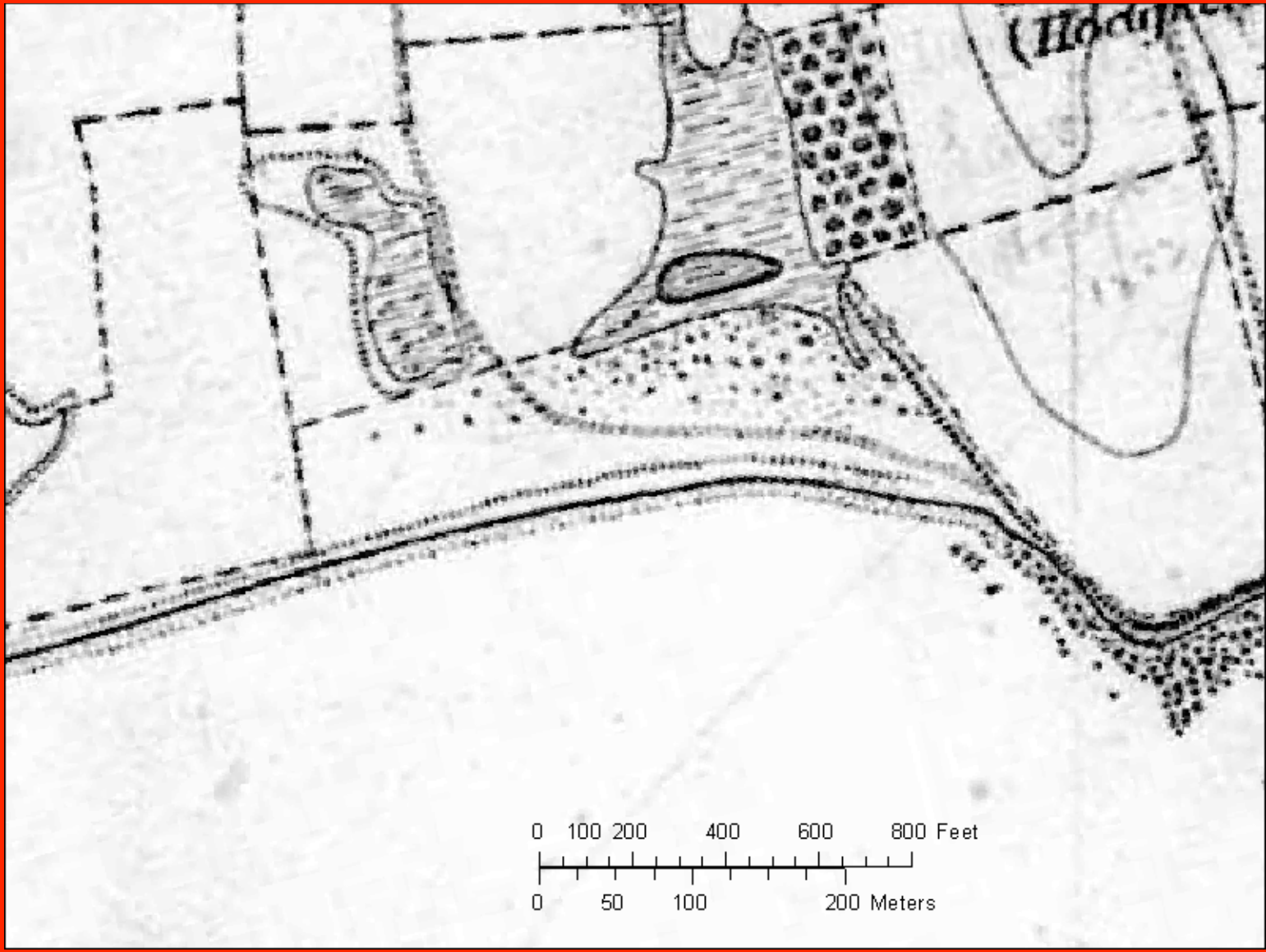


1880 T-Sheet Surveys



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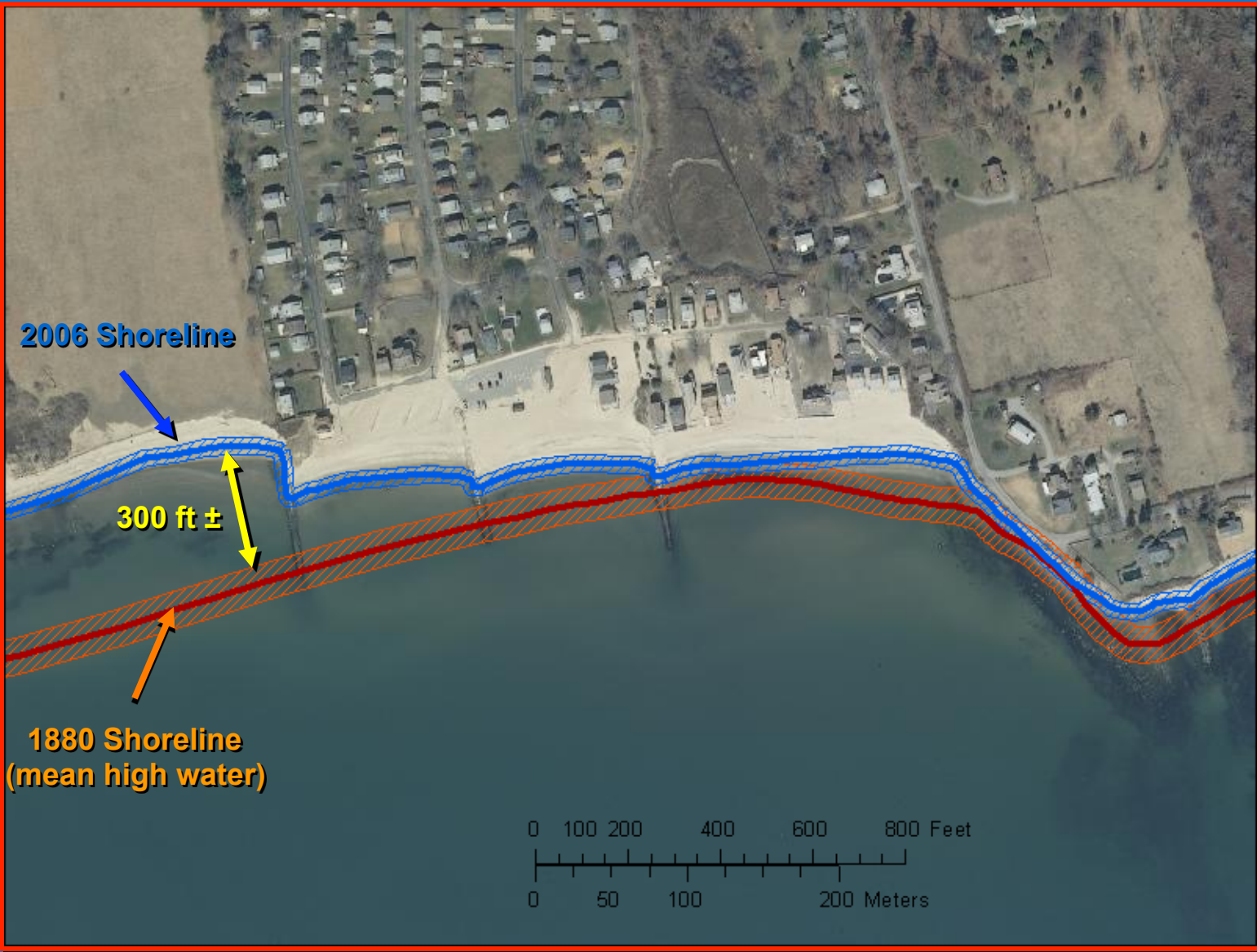
1880 T-Sheet Surveys



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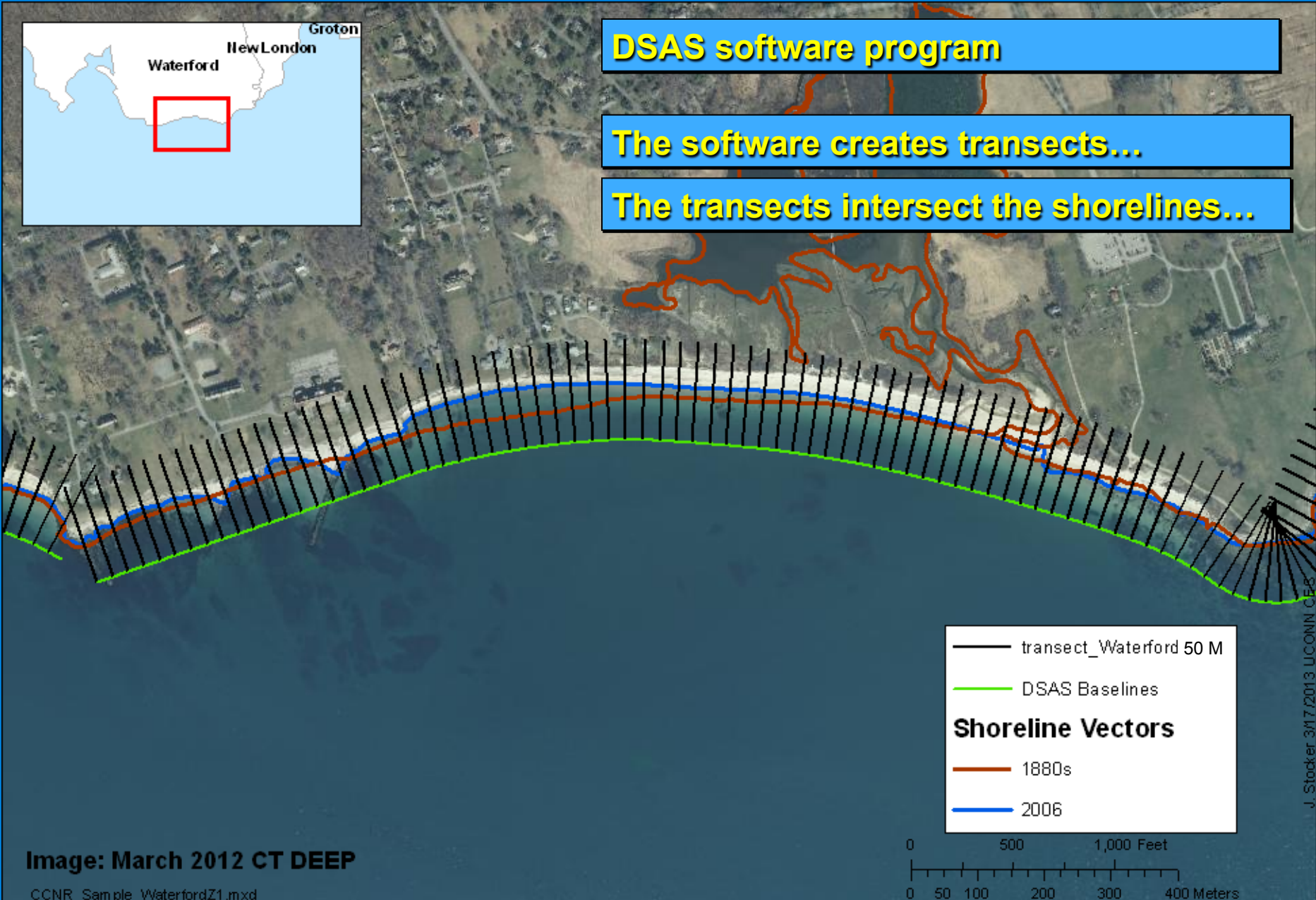




DSAS software program

The software creates transects...

The transects intersect the shorelines...



- transect_Waterford 50 M
- DSAS Baselines

Shoreline Vectors

- 1880s
- 2006

Image: March 2012 CT DEEP

CCNR_Sample_WaterfordZ1.mxd

J. Stocker 3/17/2013 UCONN CERS

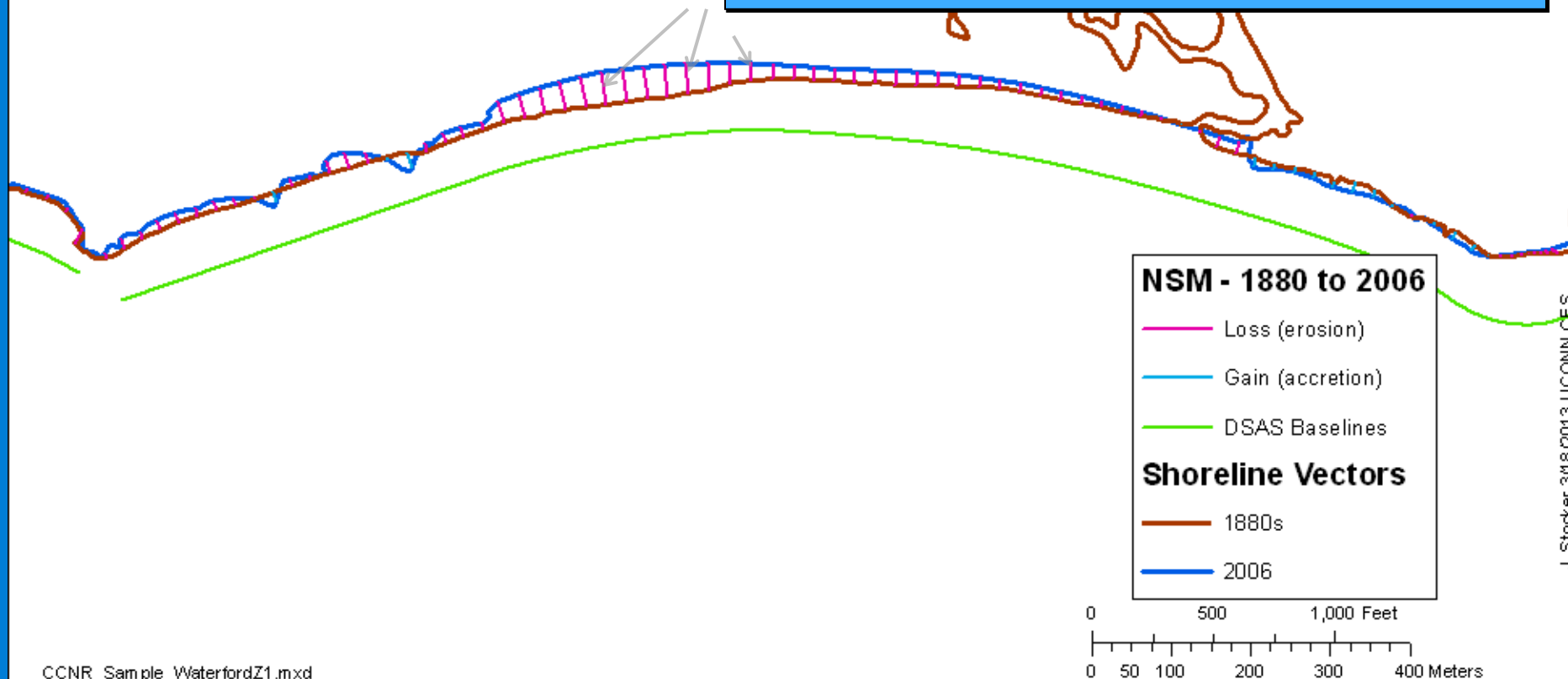


DSAS software program

The software creates transects...

The transects intersect the shorelines...

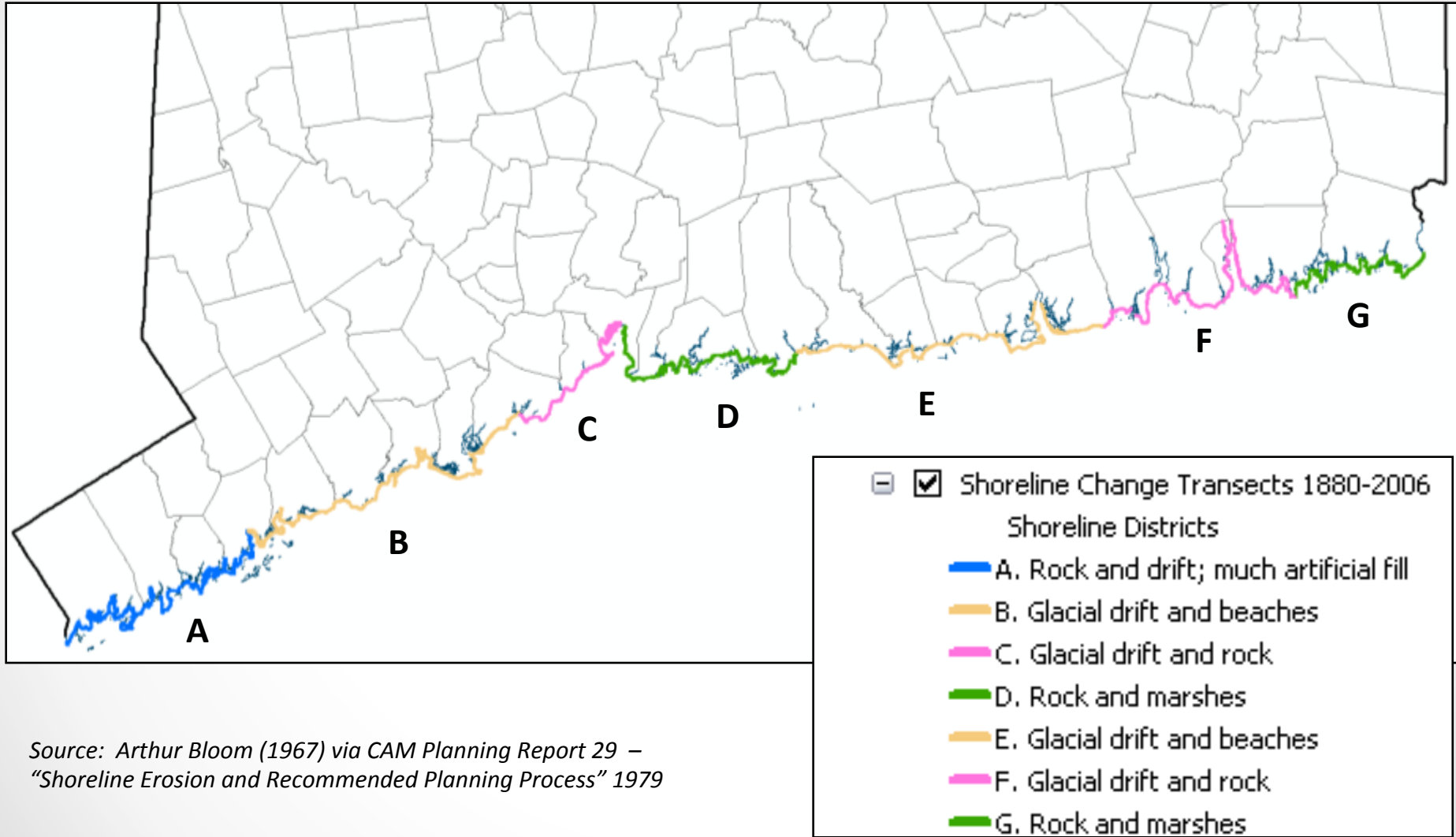
Output: Shoreline change measurements linked to and stored within each transect



CCNR_Sample_WaterfordZ1.mxd

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CT coastal towns & geologically similar areas:



Source: Arthur Bloom (1967) via CAM Planning Report 29 –
 “Shoreline Erosion and Recommended Planning Process” 1979

Assess and quantify change across CT using two primary categories:

“How much has the shoreline changed?” (How far has it moved?)

“How fast has the shoreline changed?” (At what rate is it moving?)

For each category we also consider:

- the long term change (i.e., using all the shoreline data from 1880s – 2006)
- the “short” term change (i.e., using just shoreline data from 1983 – 2006)

The results are presented (either spatially or via tables/charts:)

- for a series of individual points along the coast;
- for points grouped by coastal towns
- for points grouped by areas of the coast that are geologically similar.

“How much has the shoreline changed?”

- *Net Shoreline Movement*: looking at all the shorelines in a given time frame, it's the distance between oldest & newest shorelines.

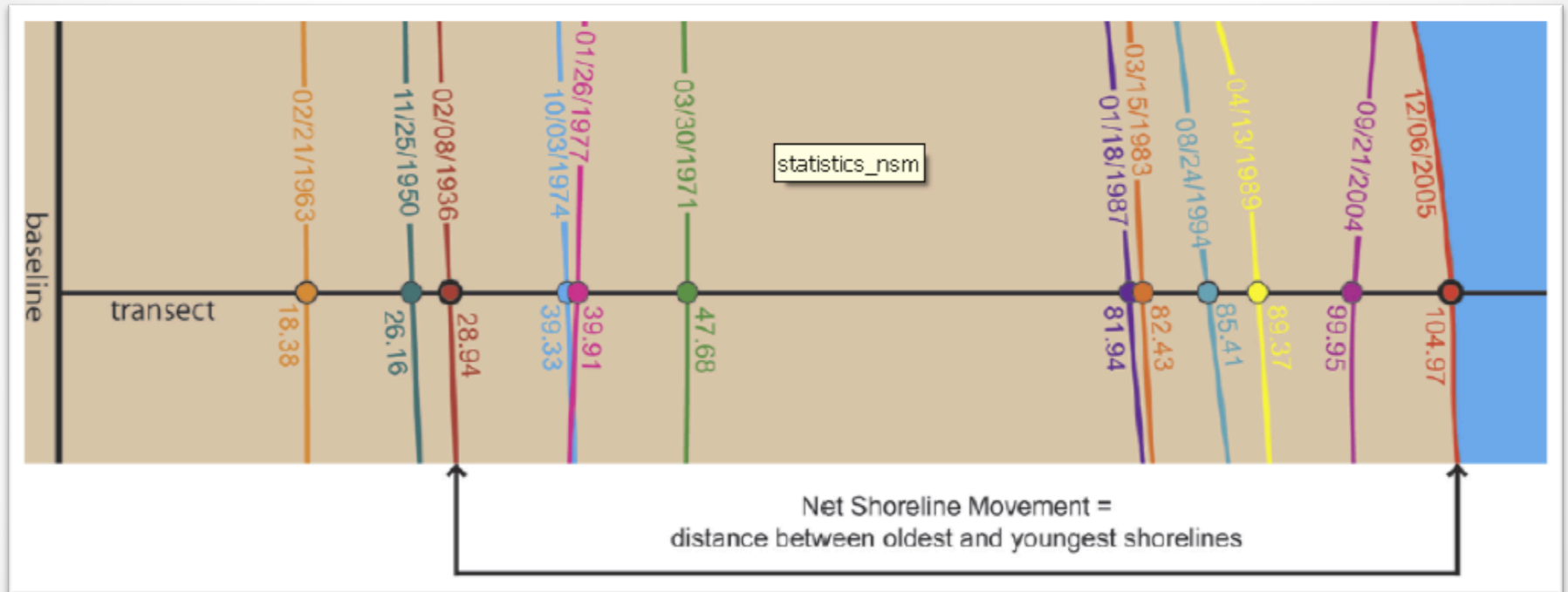
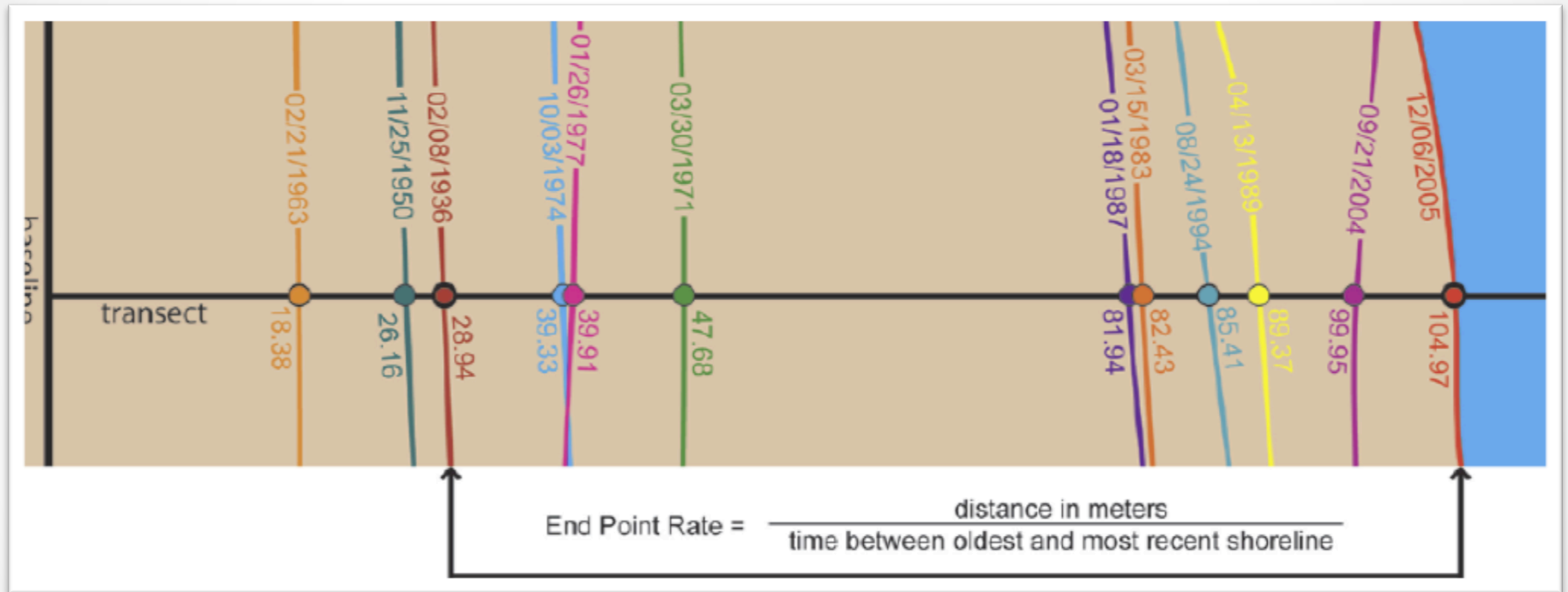


Photo credit - Thieler, E.R., Himmelstoss, E.A., Zichichi, J.L., and Ergul, Ayhan, 2009, Digital Shoreline Analysis System (DSAS) version 4.0— An ArcGIS extension for calculating shoreline change: U.S. Geological Survey Open-File Report 2008-1278.

“How fast has the shoreline changed?”

a. *End Point Rate*: Net Shoreline Movement divided by the time elapsed.

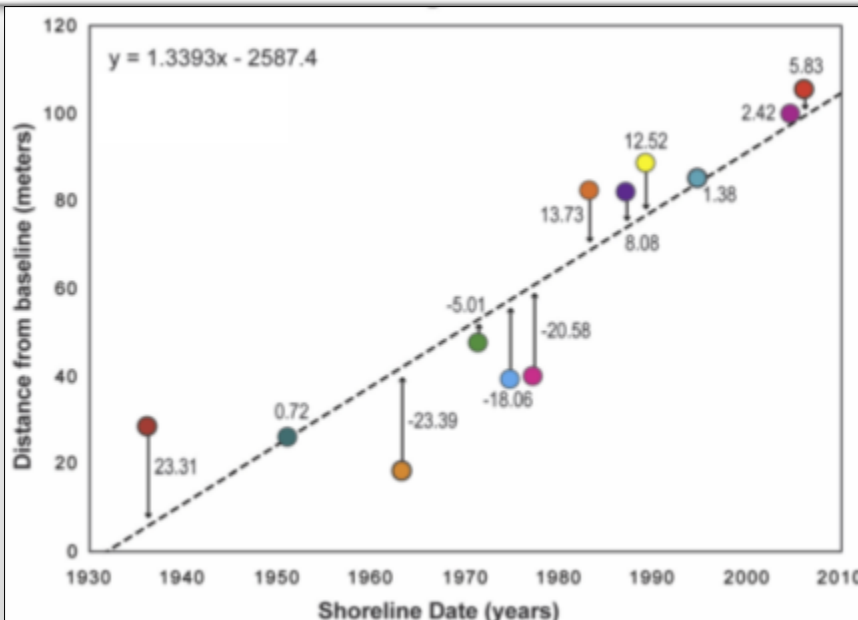
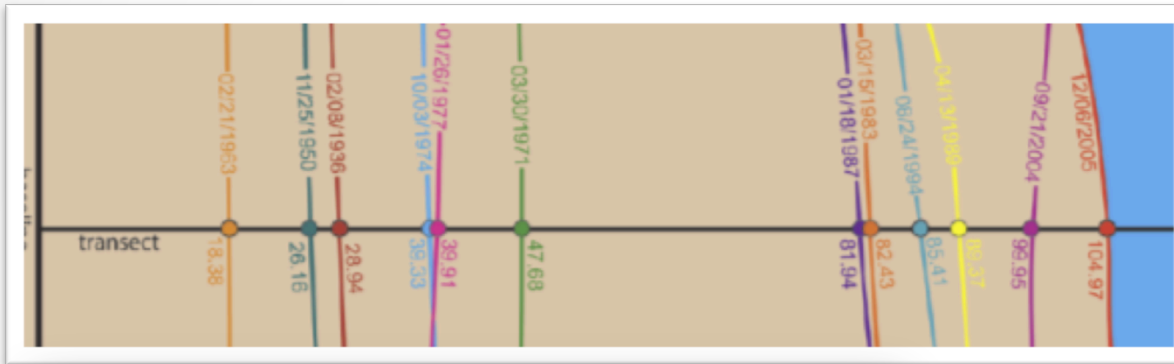


- if the Net Shoreline Movement was 76 meter and the timespan was 69 years, the end point rate is 1.1 meters per year (76 meters/69 years)

Photo credit - Thieler, E.R., Himmelstoss, E.A., Zichichi, J.L., and Ergul, Ayhan, 2009, Digital Shoreline Analysis System (DSAS) version 4.0— An ArcGIS extension for calculating shoreline change: U.S. Geological Survey Open-File Report 2008-1278.

“How fast has the shoreline changed?”

b. *Linear Regression Rate*: uses shoreline locations to “fit” a line that approximates the trend of the data. The line’s orientation and how well it fits is used calculate a rate and say how confident we are about it. (Confidence is user defined.)

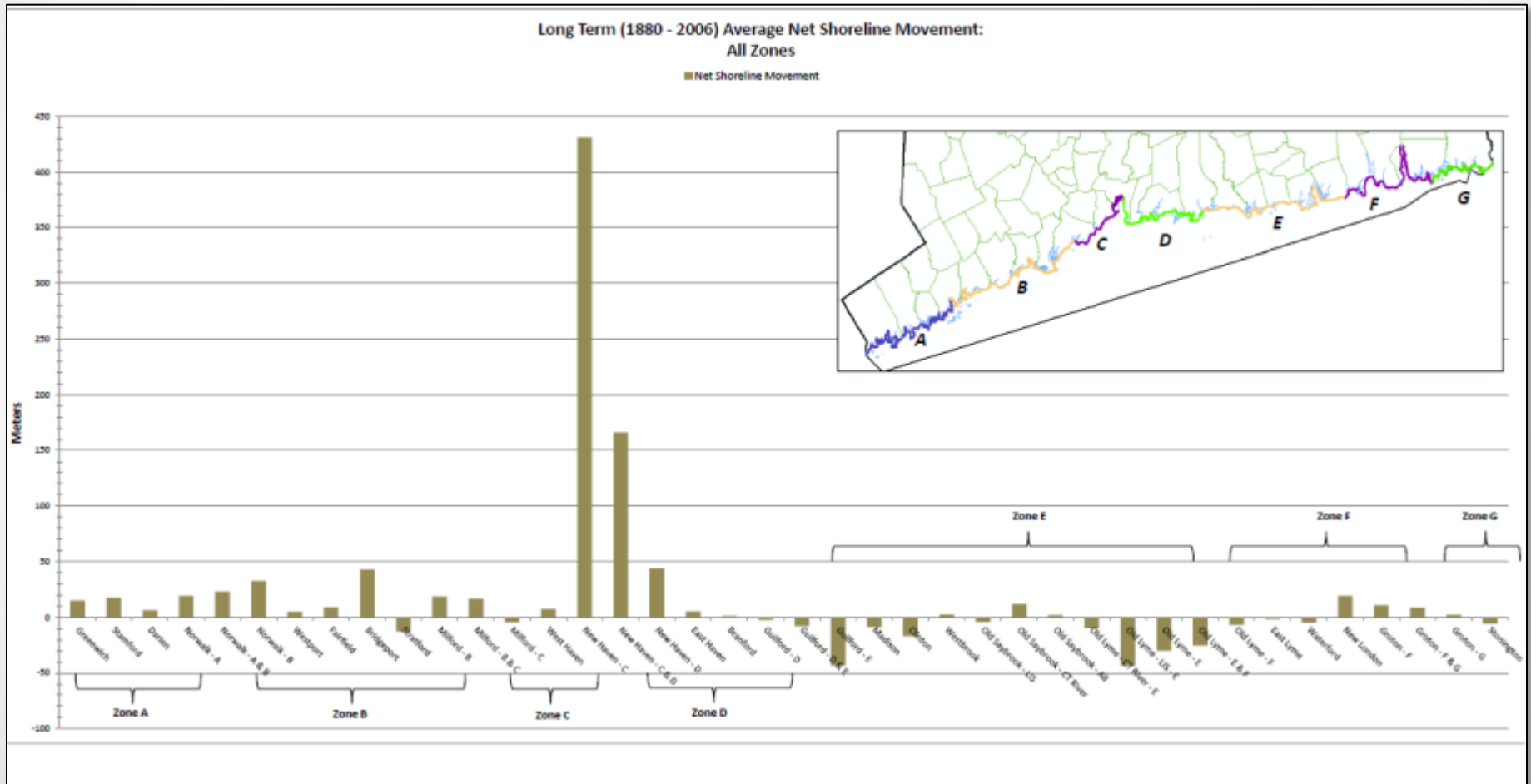


- Slope of dashed line = rate
- Offsets from the data points to the line are used to assess confidence

Photo credit - Thielor, E.R., Himmelstoss, E.A., Zichichi, J.L., and Ergul, Ayhan, 2009, Digital Shoreline Analysis System (DSAS) version 4.0 — An ArcGIS extension for calculating shoreline change: U.S. Geological Survey Open-File Report 2008-1278.

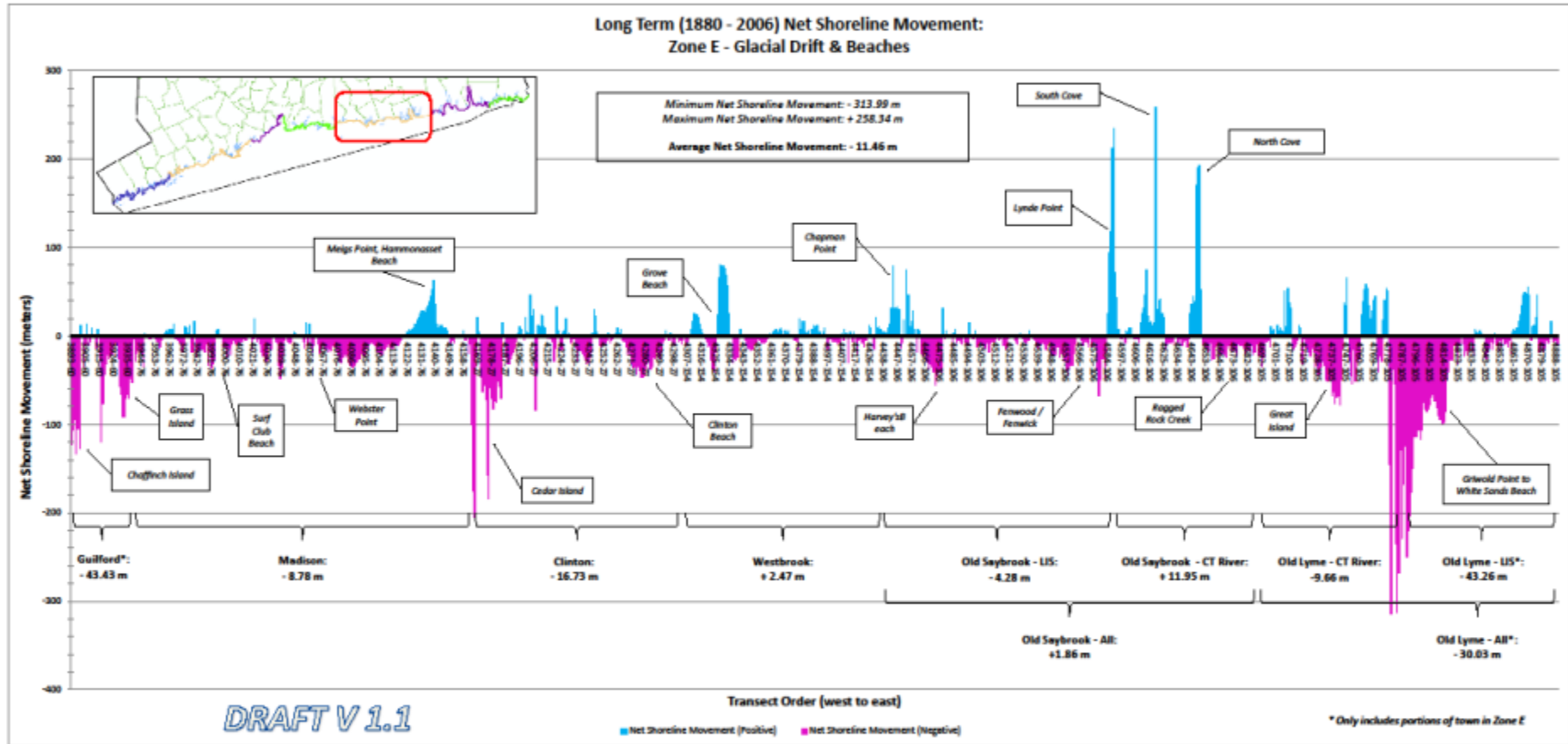
Example Output: Charts

How much has the shoreline changed over the long term (averaged by town)



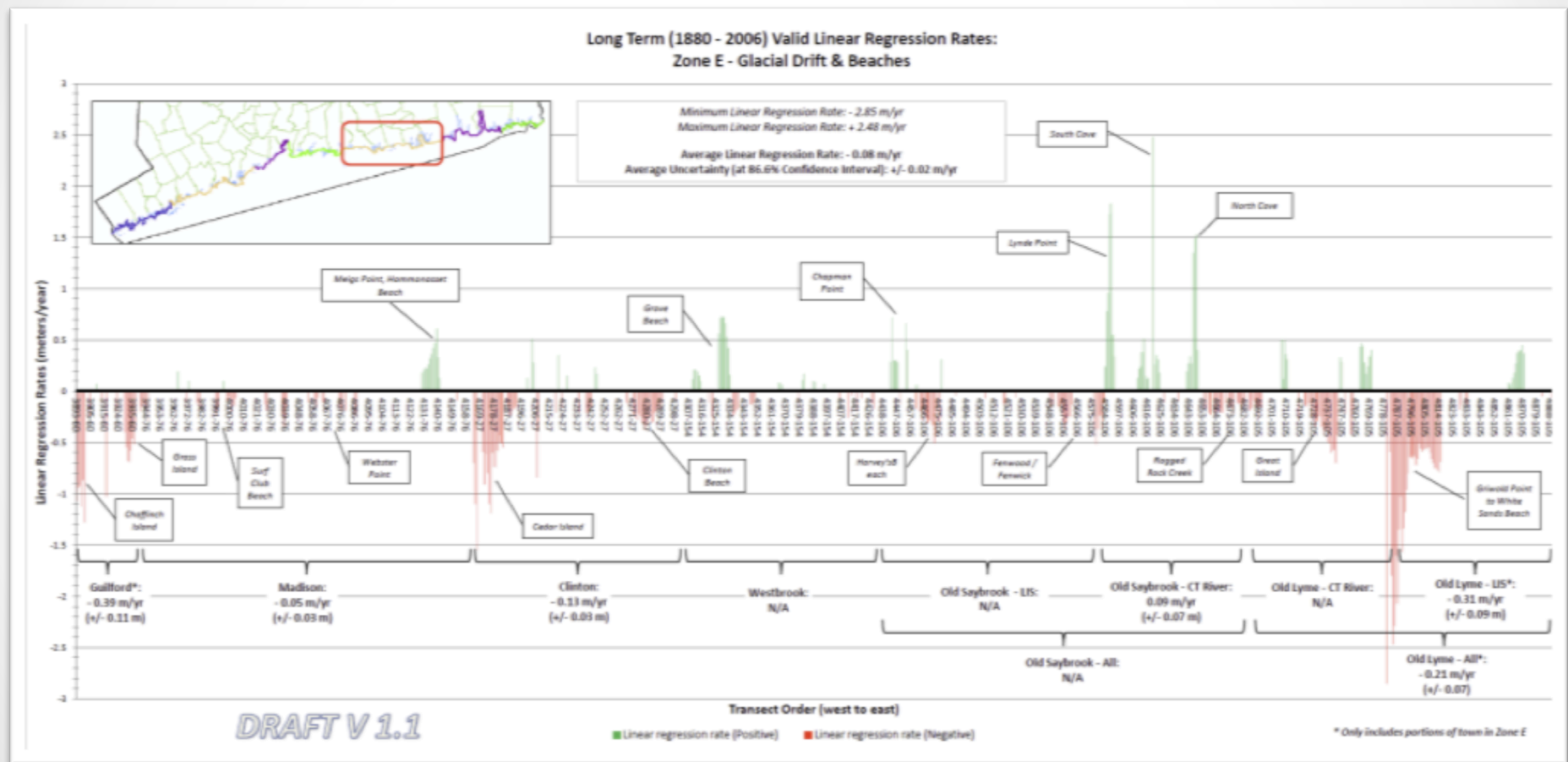
Example Output: Charts

How much has the shoreline changed (in a specific geological area)

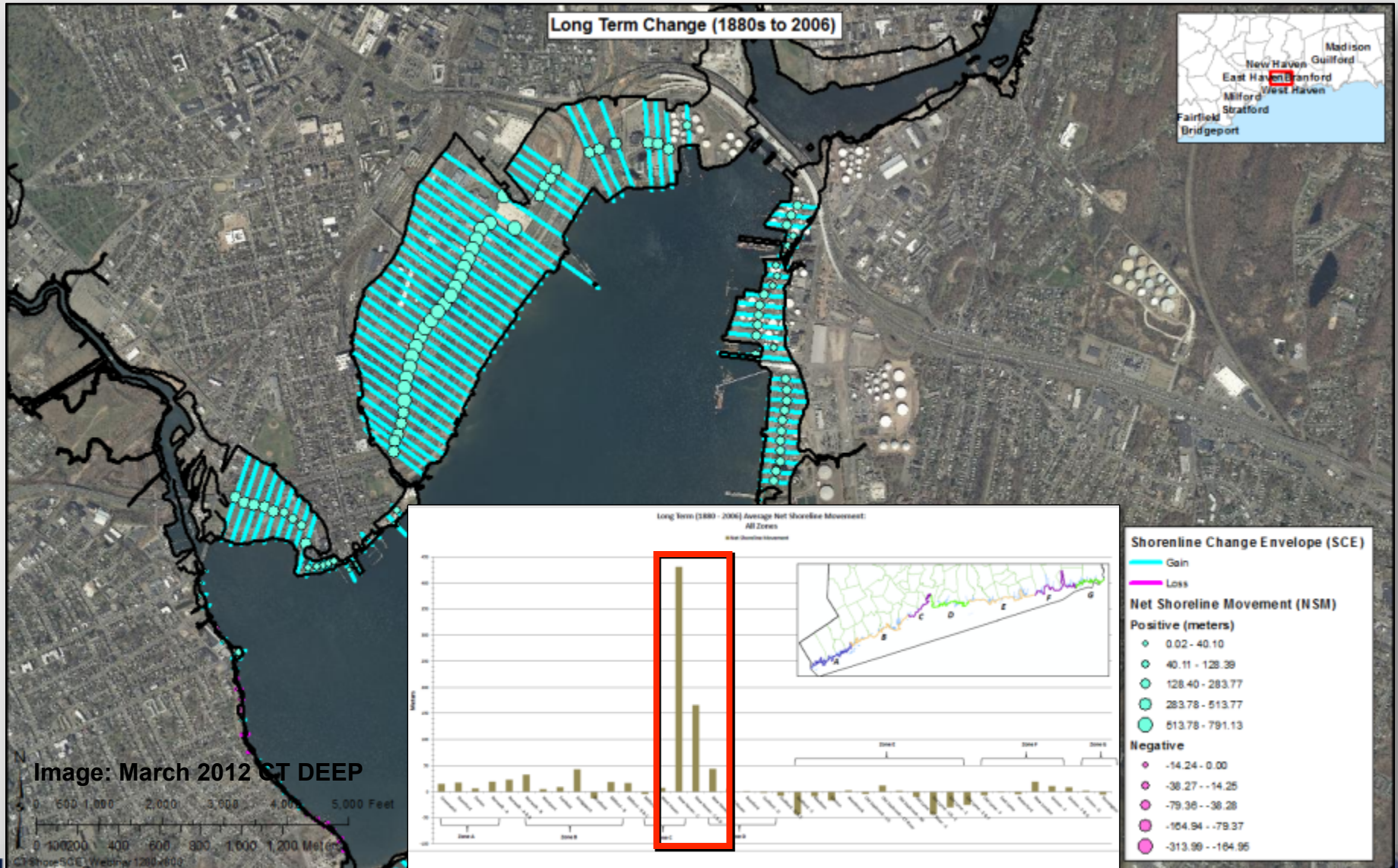


Example Output: Charts

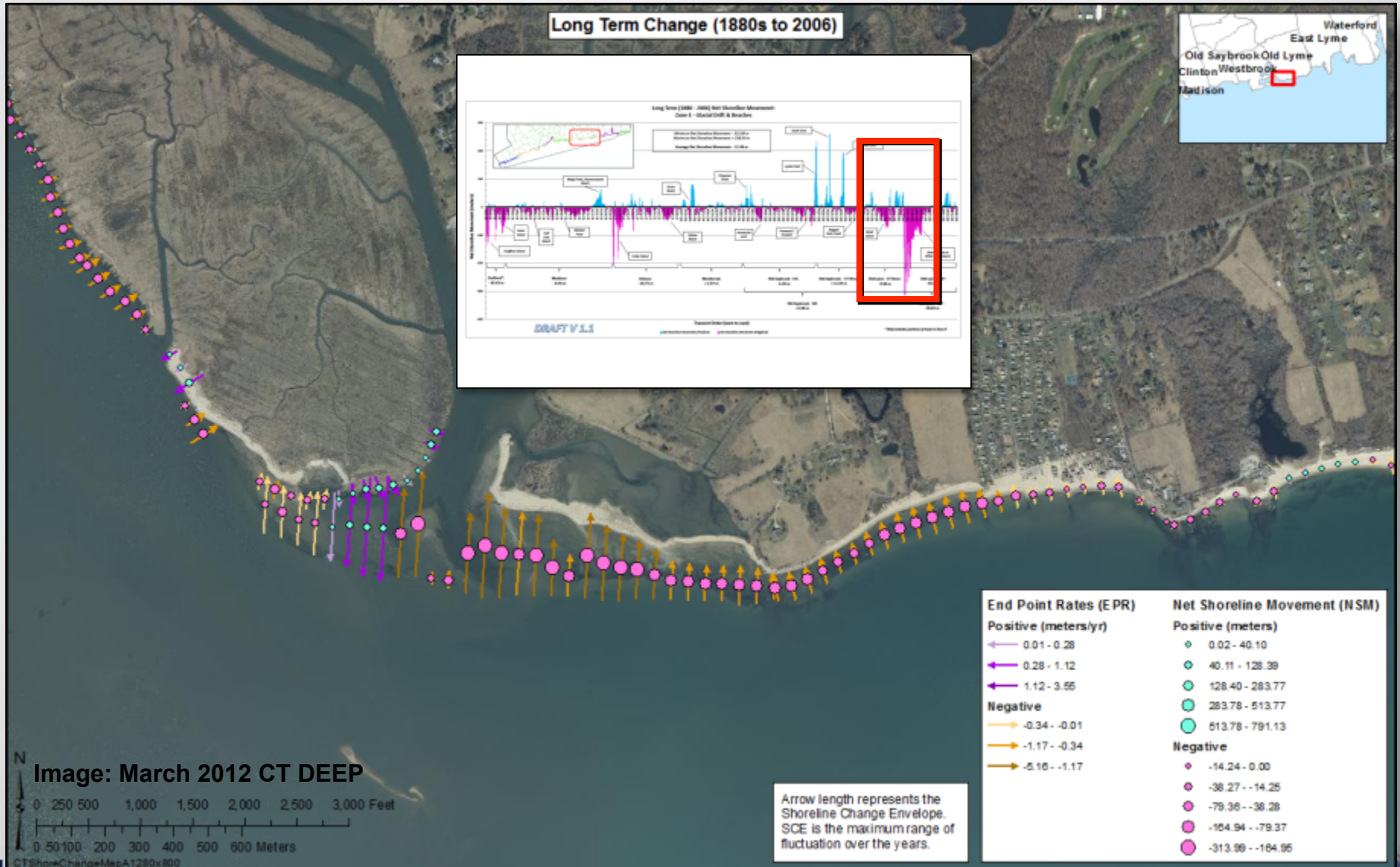
How fast has the shoreline changed (in a specific geological area)



Example Output: Geospatial Data - Urban Area Fill Material (New Haven) Shoreline Change Envelope (SCE) and Net Shoreline Movement (NSM)



Example Output: Geospatial Data (Old Lyme/Griswold Point) End Point Rates and Net Shoreline Movement



Disclaimer*:

Shoreline change data presented here may differ from that found in other sources, any differences do not necessarily indicate other data sources are inaccurate.

When considering other sources of shoreline change, discrepancies are to be expected considering the many possible ways of determining shoreline positions and rates of change, and the inherent uncertainty in calculating these rates.

The results from this analysis represent shoreline movement under past conditions and are not intended for use in predicting future shoreline positions or future rates of shoreline change.

** Adapted and amended from Hapke, C.J., Himmelstoss, E.A., Kratzmann, M., List, J.H., and Thieler, E.R., 2010, National Assessment of Shoreline Change; historical shoreline change along the New England and Mid-Atlantic coasts: U.S. Geological Survey Open-File Report 2010-1118, 57 p.*



Suggested Best Practice Guidelines (non-exhaustive:)

The materials presented **can** be reasonably used to:

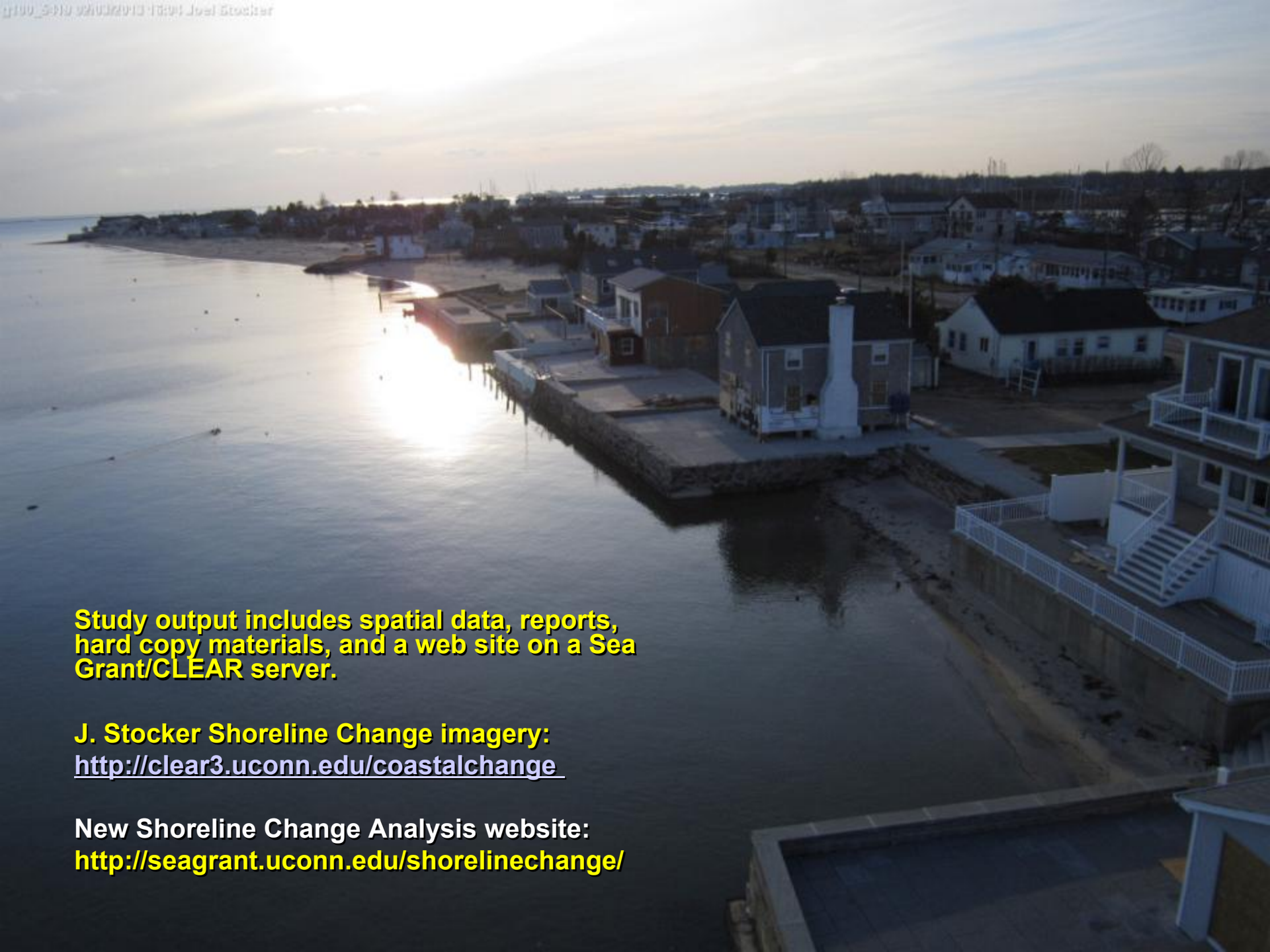
- *identify areas that have historically exhibited erosion or accretion trends;*
- *identify areas that have shown a “trend reversal” from the long term to the short term (either changing from erosion to accretion or vice-versa);*
- *generally assess the speed or magnitude of change;*
- *support or direct research investigations or planning purposes*

The materials presented **should not** be used to:

- *solely differentiate/explain the cause of change;*
- *state with absolute certainty the magnitude or speed of change at a given location;*
- *predict future rates and/or amount of change;*
- *develop engineering or design plans**

** Without a review of the underlying data*





Study output includes spatial data, reports, hard copy materials, and a web site on a Sea Grant/CLEAR server.

J. Stocker Shoreline Change imagery:
<http://clear3.uconn.edu/coastalchange>

New Shoreline Change Analysis website:
<http://seagrant.uconn.edu/shorelinechange/>