SENSITIVITY OF COASTAL MORPHOLOGY TO CLIMATIC VARIABLES

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The shoreline monitoring program along the Village of East Hampton shoreline has been in operation for over 40 years with measurements taken, on average, every seven weeks (Figure 1). This makes it one of the longest, continuously active beach observation programs in the country. The beach width measured periodically at two stations in the Village of East Hampton, NY, Main Beach and Georgica Beach, between 1979 and 2020 exhibit similar multi-year trends (Figure 2).

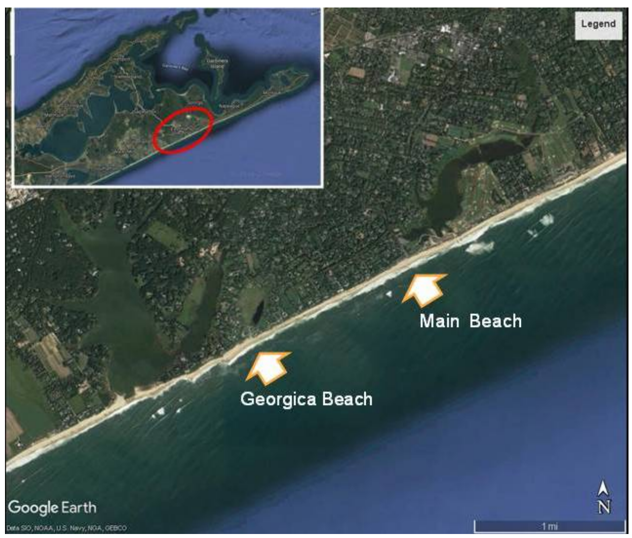

Figure 1. Study locations in East Hampton, NY

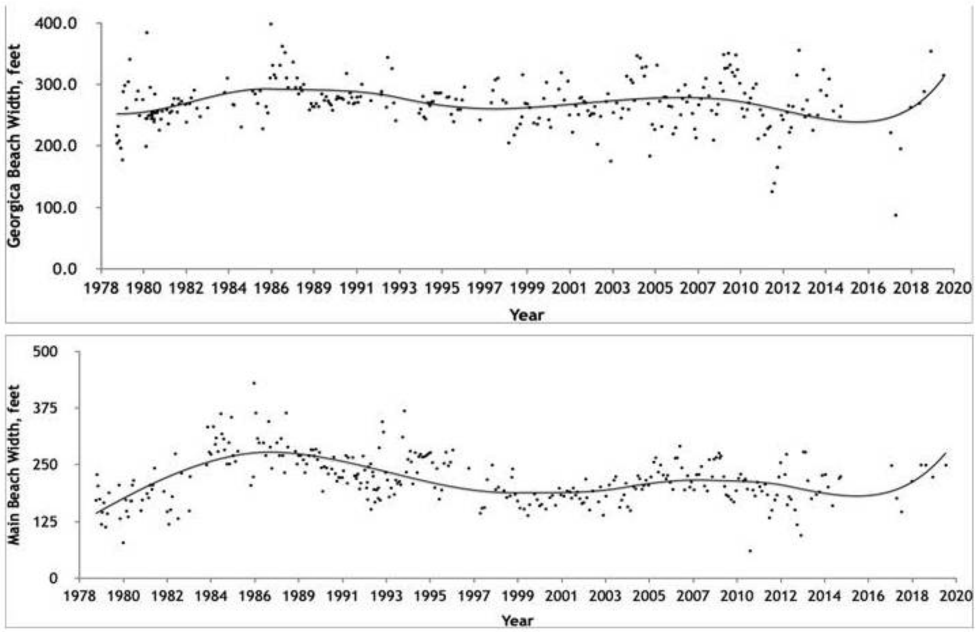

Figure 2. Long-term record of beach width Main and Georgica beaches, Village of East Hampton[1]

Based on the timescale of these multi-year trends we investigated possible climate variables that may be responsible for the observed variations. A shoreline erosion index (Barnard et al. 2015) was calculated as

$$S = (\langle y_{min} \rangle - y_{min}) / |\langle y_{min} \rangle|$$

Where y_{min} is the minimum annual shoreline position and $\langle y_{min} \rangle$ represents the mean of this quantity over the entire 40 year record. The difference is divided by the absolute value of $\langle y_{min} \rangle$. Positive values of the anomaly, s, correspond to the percentage of the erosion anomaly larger than the mean. The annual erosion index at Main Beach seemed to be inversely related to the index of the North Atlantic Oscillation (NAO). An increase in storminess has been documented during a downward trend of the NAO, which would lead to an increase in beach erosion (Luo et al. 2011). During a downward trend of the NAO, there was an upward trend in shoreline erosion index (Figure 3).

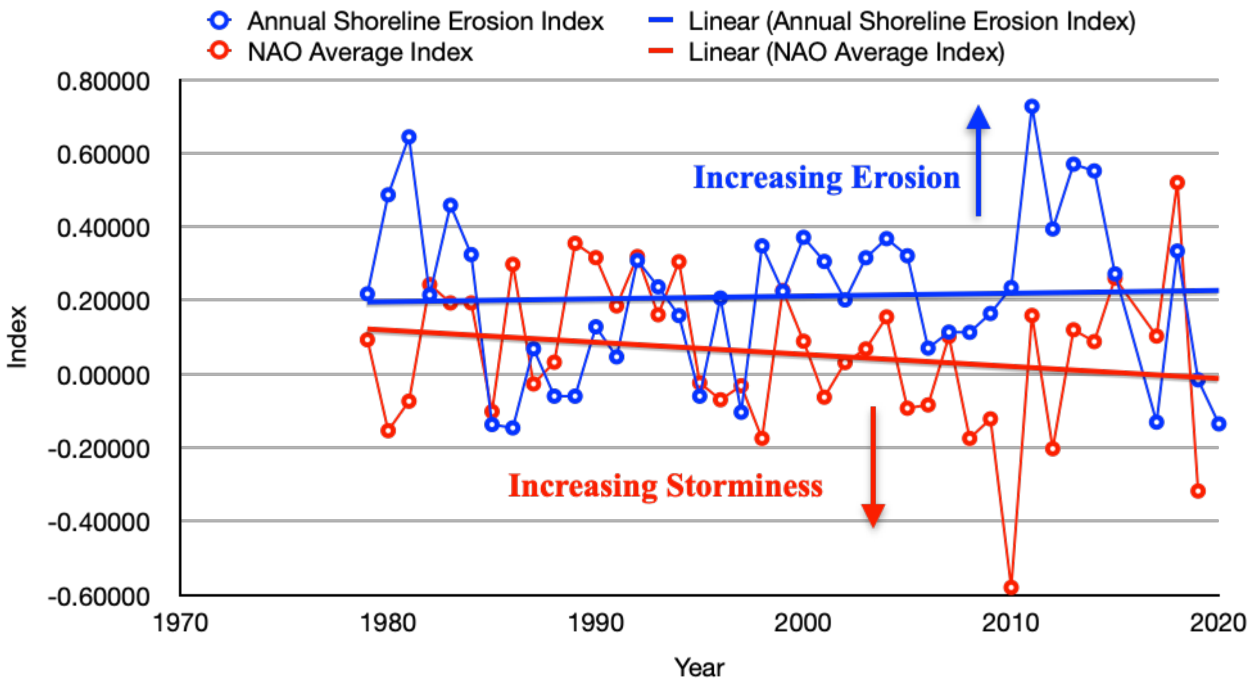

Figure 3. A downward trend of the NAO index (red line) corresponds to an upward trend in shoreline erosion index (blue line).

Although the pattern of changes in beach width at Georgica Beach is similar to that at Main Beach, (Figure 1) Georgica Beach displayed the influence of groins to its west (Figure 4). It is well documented that the primary sediment transport component is directed alongshore from east to west, although local reversals have been recorded (Kana 1995; Rosati, Gravens, and Smith, 1999) due to variation in wave direction and storm-influence. This suggests that the net westerly longshore transport tends to accumulate on the eastward side of the groins at Georgica causing larger beach widths, but depletes the beach at Georgica during reversals (Bokuniewicz 2004). It is crucial to examine the role of winds parallel to the shoreline to determine the influence of onshore and offshore sand transport, as well as, net longshore drift. Future research is intended to examine possible connections with the magnitude and position of the Azores High and Icelandic Low.

Figure 6. Georgica Pond groins in October, 1998 showing westward drift. Groins are 500 ft (152 m) apart.

Figure 4. Example of an easterly longshore drift accumulating sediment on the eastward side of the groins at Georgica Beach (Bokuniewicz 2004).

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[1] Over the years, stations were reset, relocated or lost, especially in the period between 1981 and 1994 at Main Beach and between 1981 and 1997 at Georgica. Beach widths were adjusted to be comparable to the current stations by the landward shifts in position and correlation to each nearby, overlapping station.