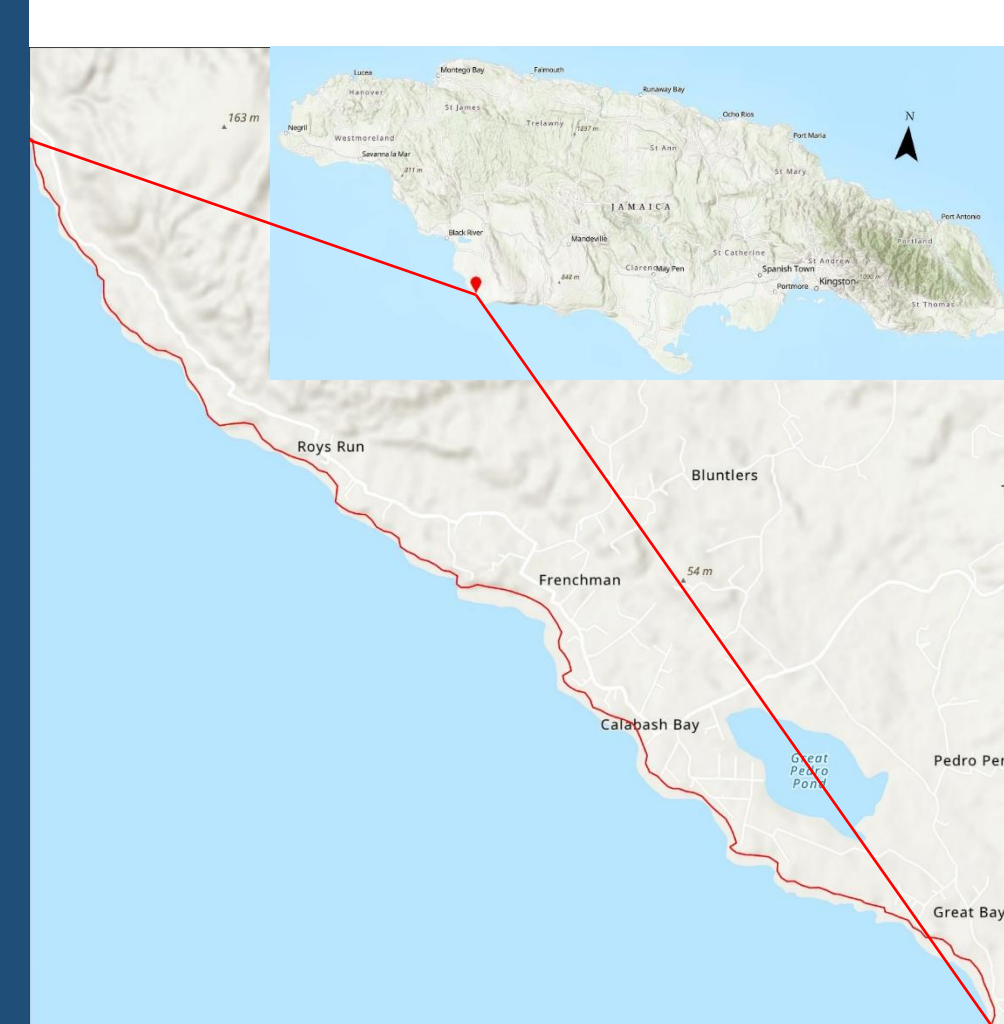


ABSTRACT

Anthropogenic climate change is causing sea level rise and shoreline changes that threaten the environment and economy of coastal communities in Caribbean Island nations. To assess this risk, this study quantifies shoreline changes at Treasure Beach in St. Elizabeth Parish on the south coast of Jamaica since Hurricane Ivan in September 2004. Over 11 km of shoreline are assessed with about half being sandy beaches ranging from <100 to 700 m in length with the remainder lined by rock headlands and beach rock outcrops. Multiple years of aerial photographs and satellite imagery are used along with field profiles to evaluate beach erosion and deposition trends at the seasonal, storm event, and decadal scales. Preliminary results indicated that beach widths vary annually and over 5–10-year periods. Shoreline changes along Treasure Beach at 50 m intervals averaged -0.5 m/yr (erosion) from 2013 to 2016. Maximum erosion rates of -5 m/yr were observed with maximum deposition rates of 2 m/yr. Both sand deposition and erosion occurred during storm events. However, by 2016 only about 40% of the sand beach length had recovered to its original location prior to Hurricane Ivan in 2004.

STUDY AREA



Jamaica is located west of Haiti and south of Cuba in the Caribbean Sea. Jamaica is the third largest island in the Caribbean. Billy Bay (1.55 km), Frenchmans Bay (1.0 km), Calabash Bay (2.1 km) and Pedro Bay (1.75 km) is located along Treasure Beach, the South coast of Jamaica in St. Elizabeth's Parish. Treasure Beach is a community-based tourist area that relies on their beaches for tourism.

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DISCUSSION & CONCLUSIONS

Water line recession (shoreline erosion) occurred at 80% of the 128 transects evaluated. On average, sandy beaches at Calabash, Frenchman's, and Billy Bays moved 2.6-3.3 m landward over 20 years (0.13-0.17 m/yr). Pedro Bay produced the highest erosion rates with an average beach loss of 7.8 m (0.39 m/yr). Calabash Bay experienced the largest reduction of beach width with an average narrowing of almost 5 m during the 20-year period. Pedro Bay lost 1.6 m of beach width on average, while there was no change at Frenchman's Bay (0.1 m gain) and a relatively large gain in beach width at Billy Bay (+4.8 m). In general, if beach migration rate is slower than a rising sea level, beaches get narrower (Martins and Pereira, 2014). However, beach width as measured here using vegetation lines can be influenced by several factors including rate of beach erosion, degree of over-wash during storms, vegetation recovery, and human manipulation. Future work will utilize additional years of higher resolution imagery and aerial photographs, assess the effects of errors on erosion estimates, and use field work to evaluate effects of geomorphic controls and human factors on beach widths and beach processes overall. The average error for rectified images used for 2021 is 2.6 m and the range of residuals for the images is 0.1 to 5.8. The average error for rectified images used for 2001 is 1.8 m and the range of residuals is 0.0 to 6.3. Previous survey of beach faces at Treasure Beach show that the maximum daily tidal range of 0.2-0.3 m in Jamaica could create water line movement of 1.7-2.7 m suggesting that errors due to tidal stage are typically <1.5 m.

METHODS

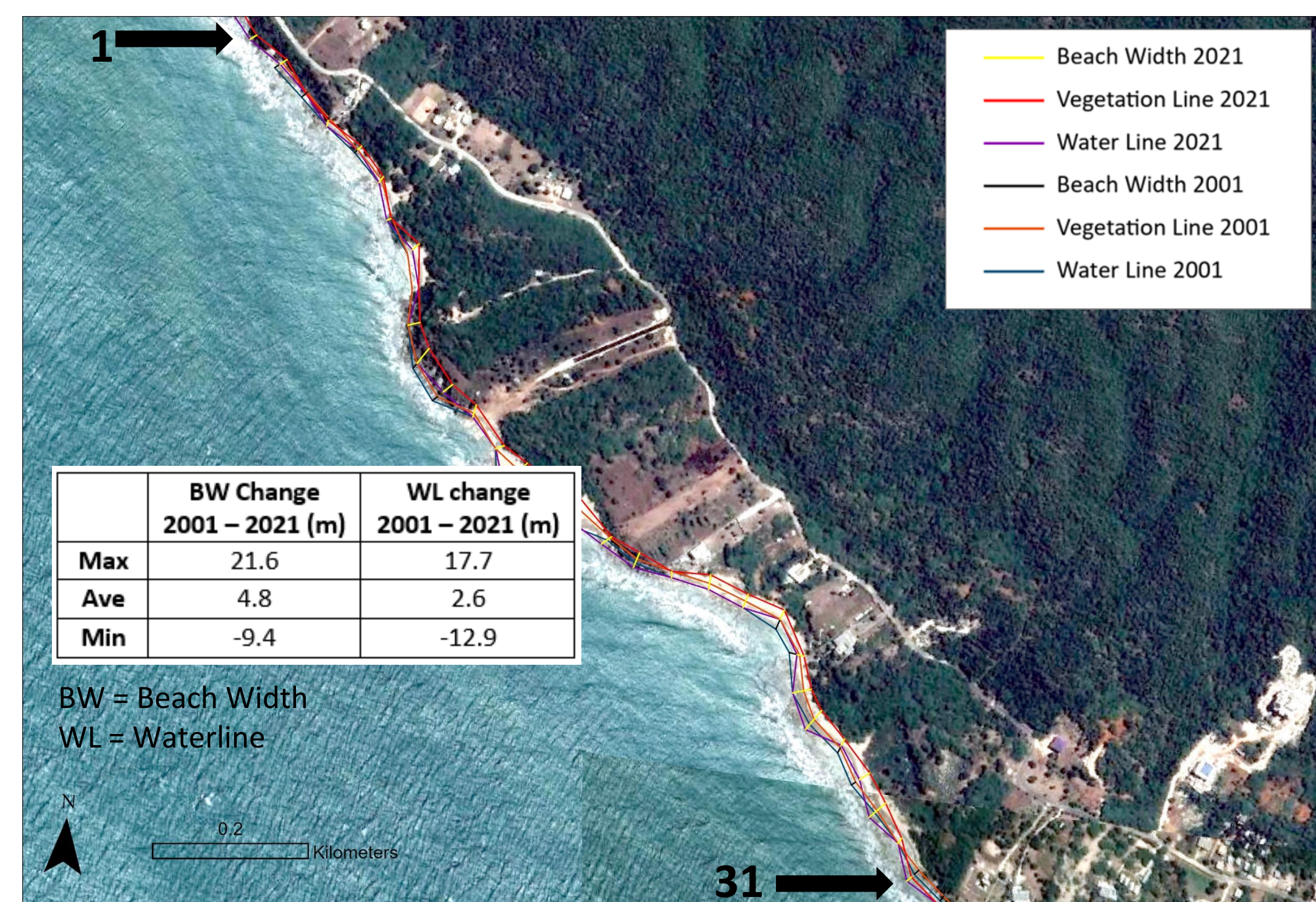
Changes in water and vegetation lines on satellite images were assessed at transects spaced perpendicular to the shoreline at 50 m intervals along sand beaches in Treasure Beach, Jamaica. Shoreline changes were quantified between 2001 and 2020 using changes in waterline location as an indicator of beach erosion or deposition and beach width as an indicator of area of sandy beach. Beach width was measured as the distance between the vegetation line and water line on each transect. The 20-year time period for this study includes the passage of the highly destructive Hurricane Ivan in 2004 and a global rise in sea level of over 5 cm. Rectification error for the 2021 image was 2.6 m and average errors for 2001 images were 1.8 m. Daily fluctuations in waterline location due to a maximum tidal range of 0.2-0.3 m was about 1.7-2.7 m (horizontally) based on previous beach slope measurements.

WORKS CITED

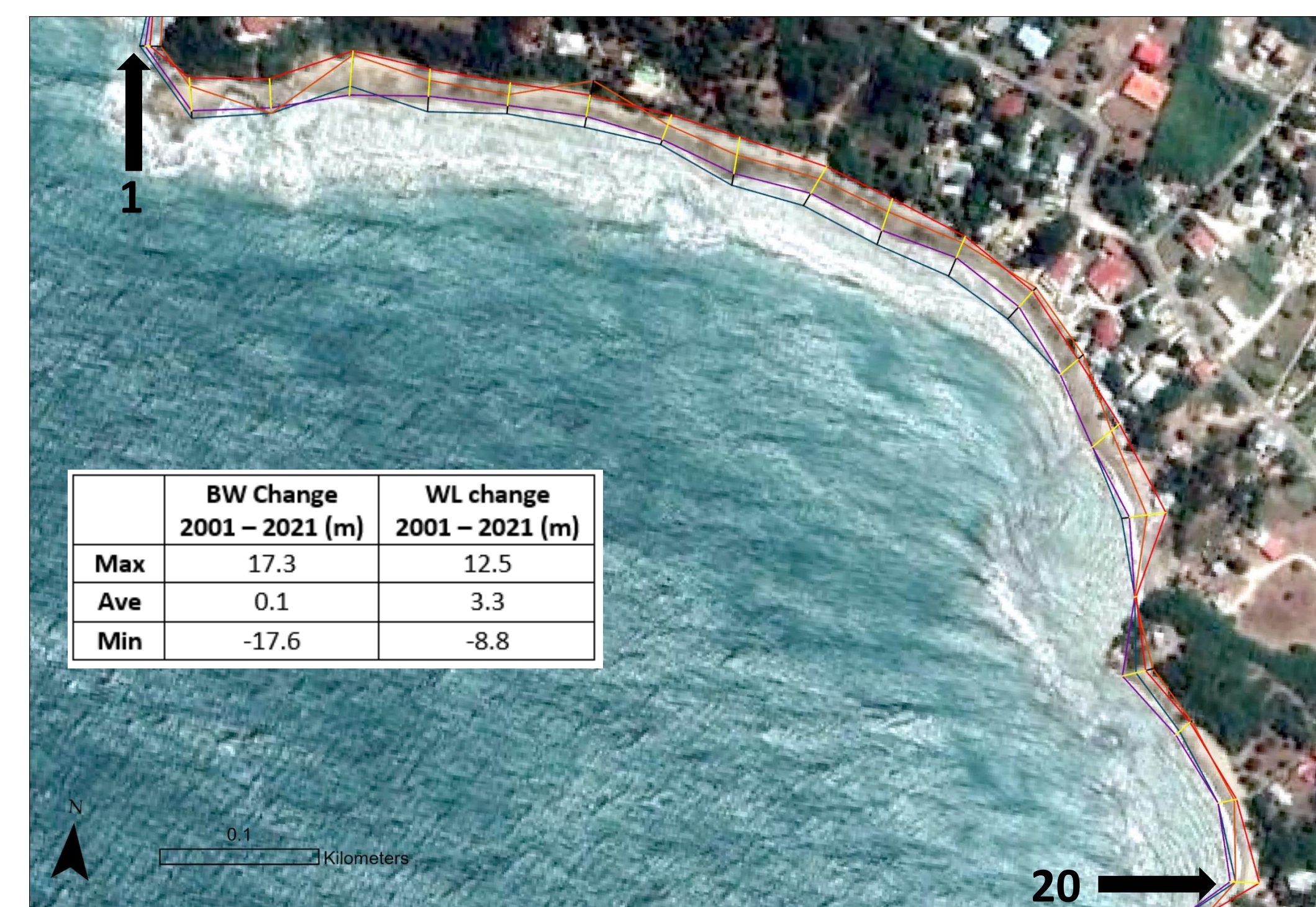
Martins, K. A., & Pereira, P. S. (2014). Coastal Erosion at Pau Amarelo Beach, Northeast of Brazil. *Journal of Coastal Research*, 71(10071), 17-23.

PRELIMINARY RESULTS

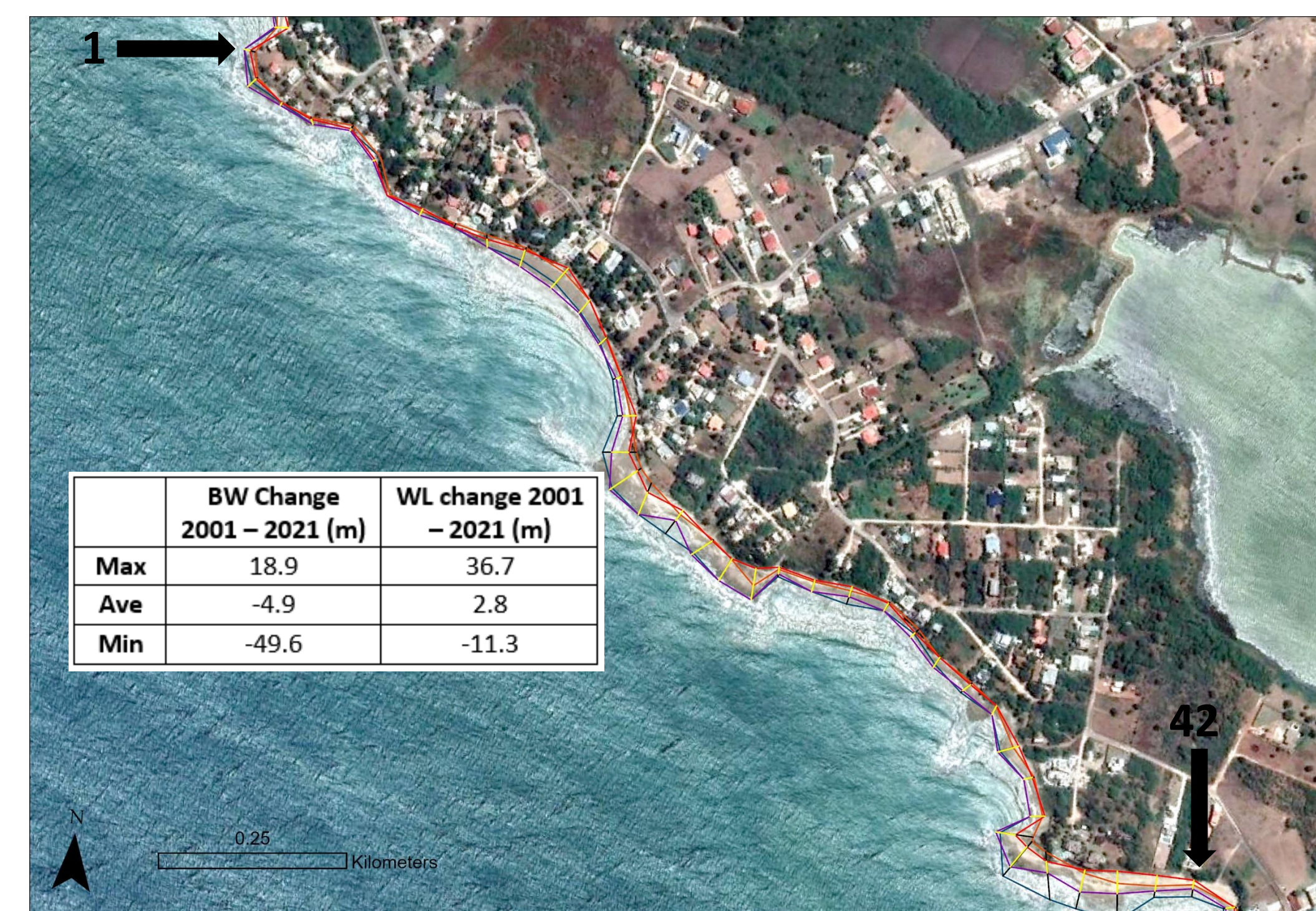
Billy Bay



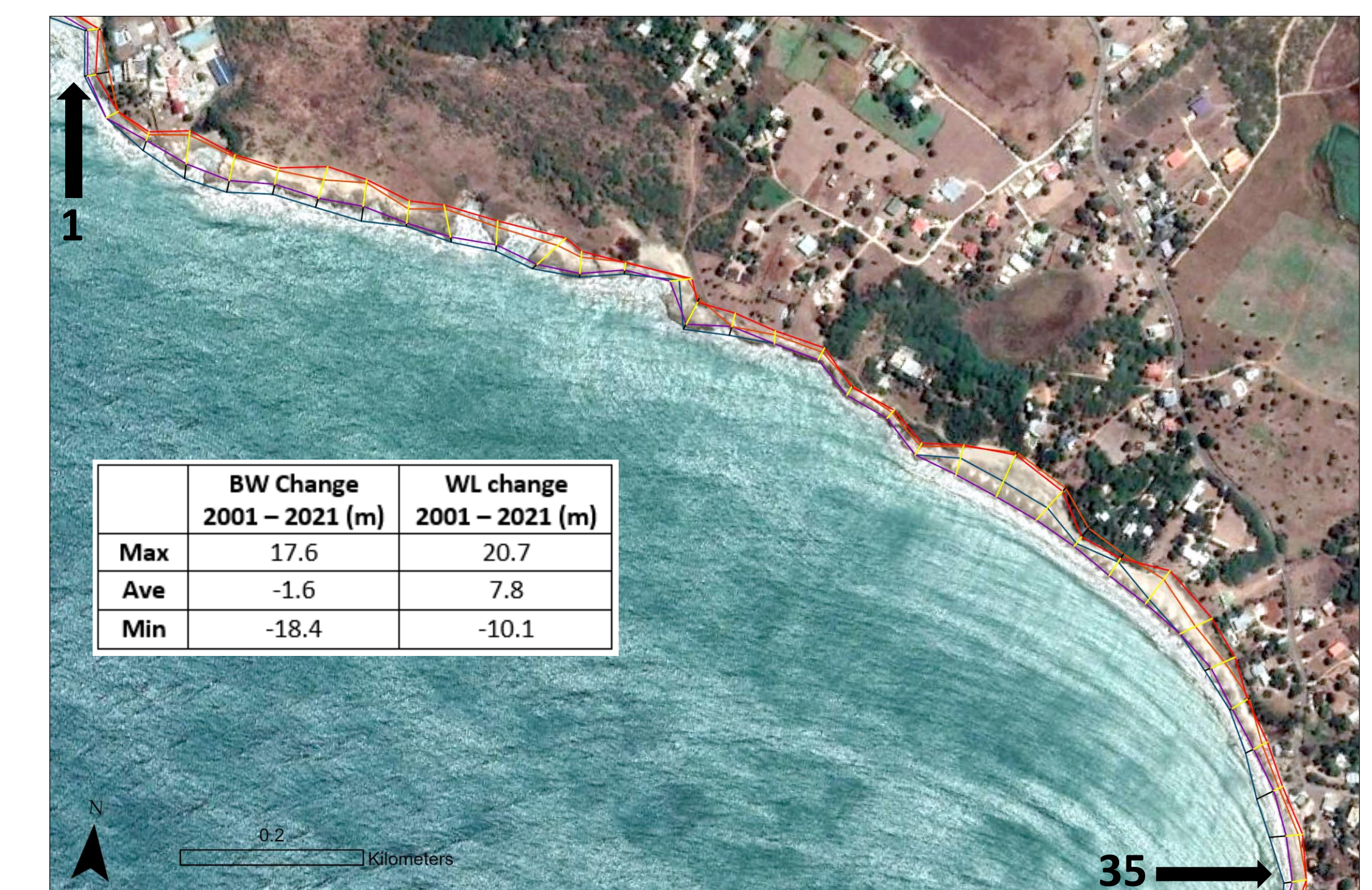
Frenchmans Bay



Calabash Bay



Pedro Bay



Beach Erosion and Deposition Trends for Treasure Beach

