IPReM

Greater Caribbean 2023

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JUNE 28th-30th, PANAMA

Science and technology for sustainablebeaches in a climate change scenario

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An overview of the geomorphological changes at Bonasse, Trinidad

Sandy Shorelines, IPReM Conference

28th-30th June 2023

Panama City, Panama

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Overview

- Introduction
- Site description
- Methodology
- Results
- Conclusion
- Recommendation

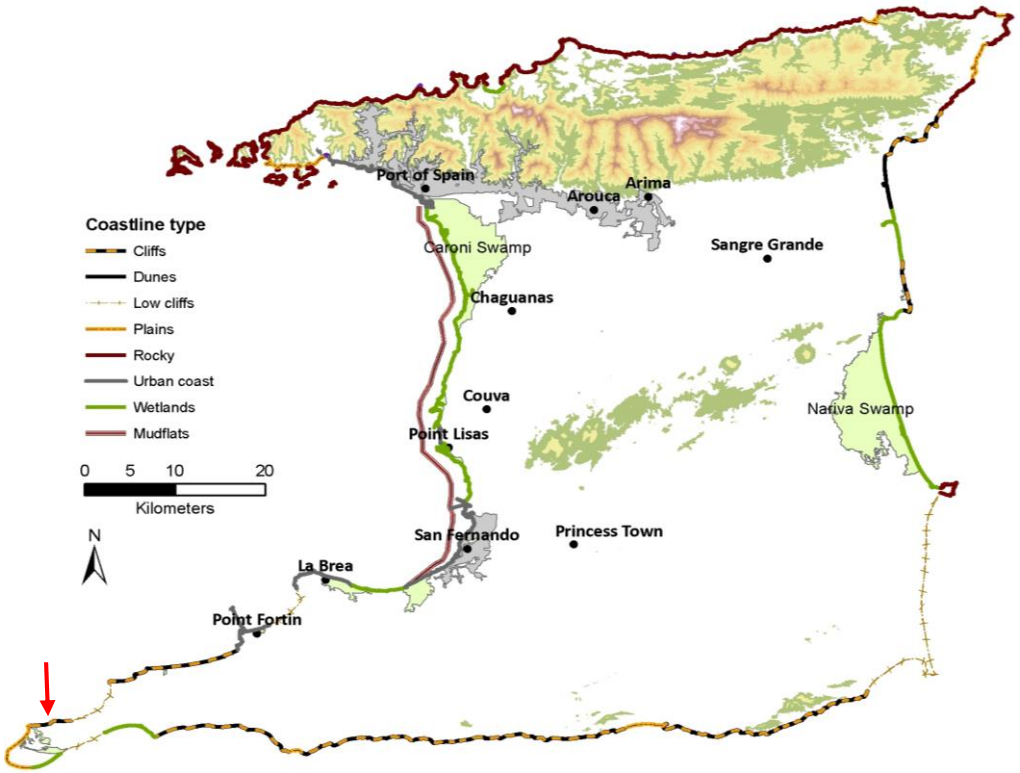
Introduction - Beaches

- Depositional features found along coasts
- Dynamic and respond to coastal processes (summer and winter)
- Beach sediment protects the coastline – reduces wave energy
- Buffer to erosion
- Damaged by nature and man (anthropogenic activity)

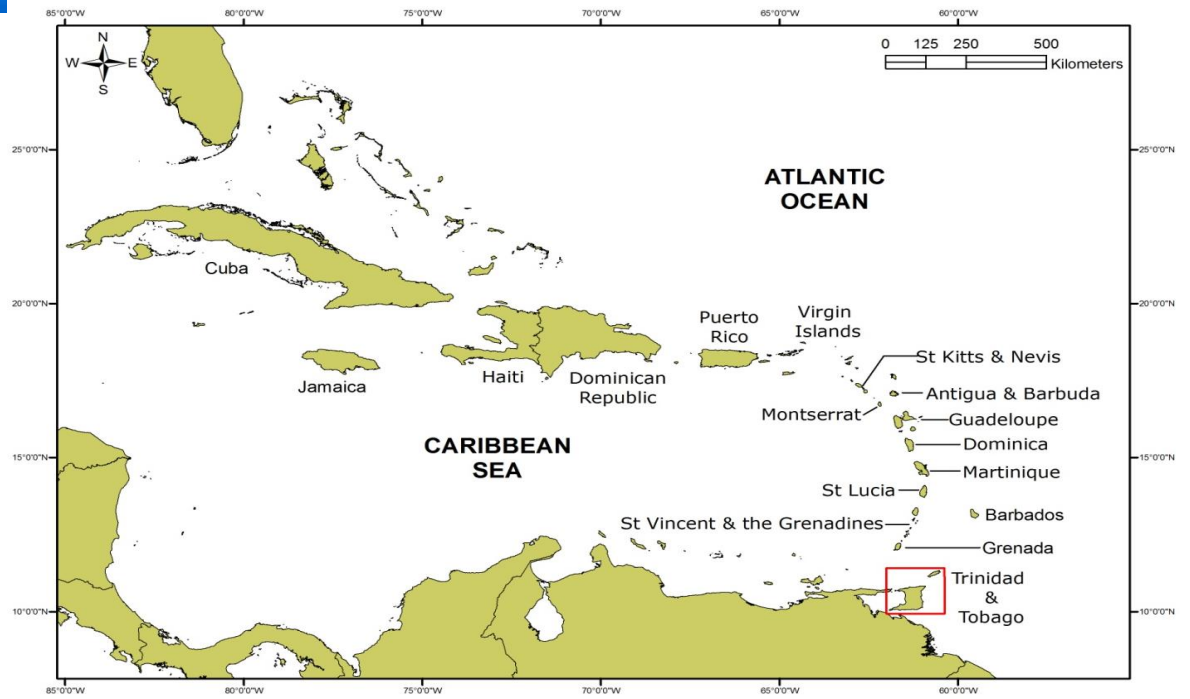
Introduction - Objectives

- To investigate coastal processes, beach changes & sediment composition of beaches and bays (Coastal Conservation Project)
- To determine coastal erosion and accretion rates
- To monitor the stability status and trends of beaches over time (Bonasse)

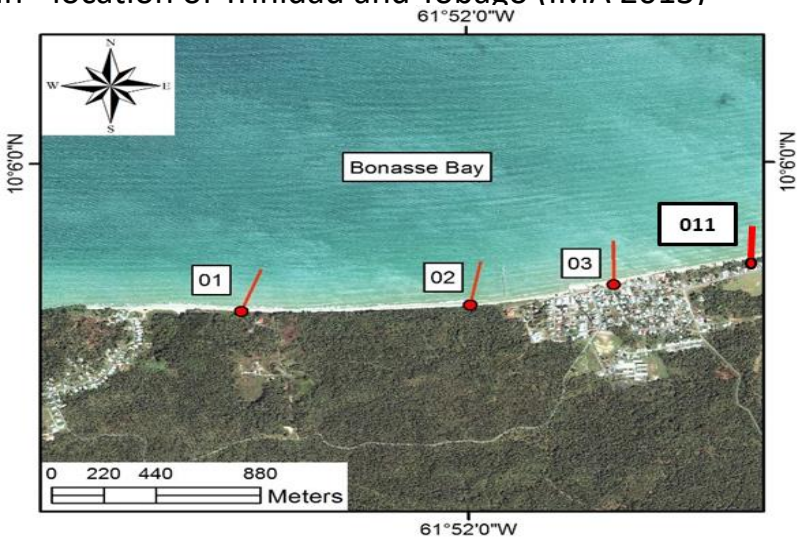
Site description
West coast, Trinidad



Coastal Classification Map of Trinidad (IMA 1983)

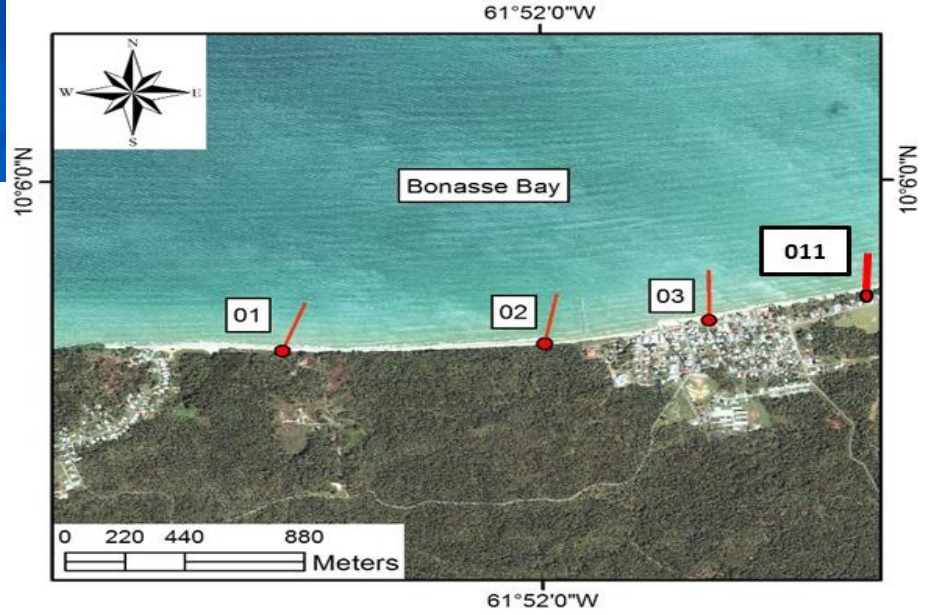


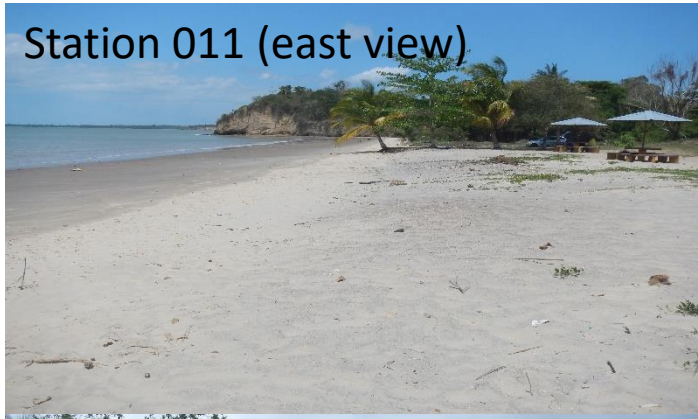
Map of the Caribbean - location of Trinidad and Tobago (IMA 2013)



Satellite imagery
(IKONOS 2007)
IMA benchmarks

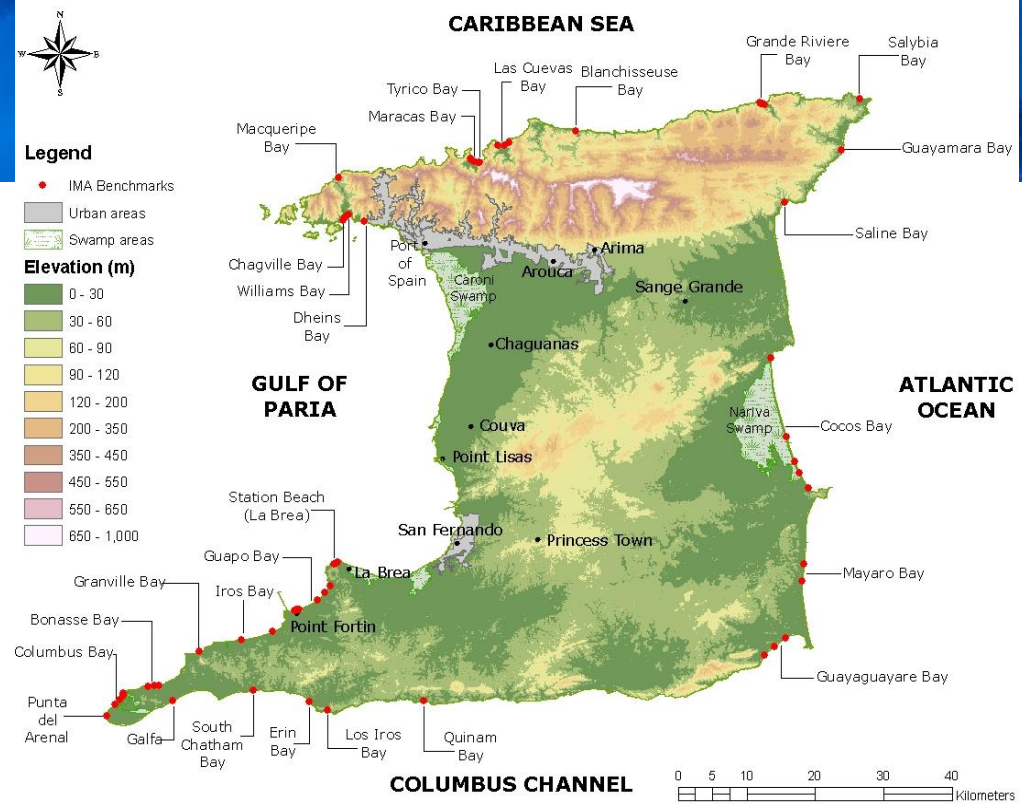
Site description
West coast, Trinidad



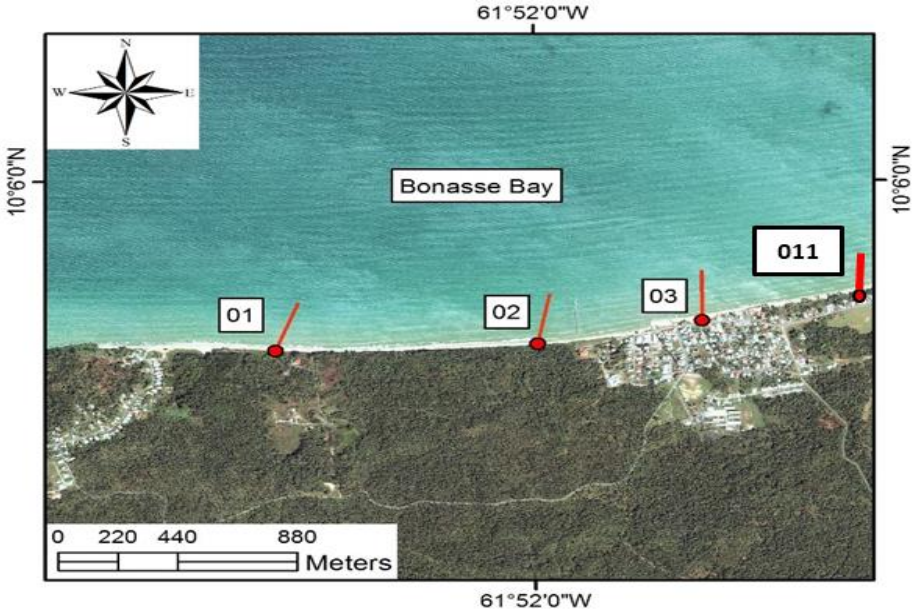


Methodology – data collection

- Littoral data - nearshore
  - (wind speed and direction, wave height, breaker height and direction, wave period, longshore current, beach orientation)
- Beach profiles
- Grain size
  - Wentworth (1922) classification
  - Folk and Ward (1957) parameters
  - D_{50}



Location of IMA Beach Monitoring Stations, Trinidad (IMA 2012)



Results – littoral data

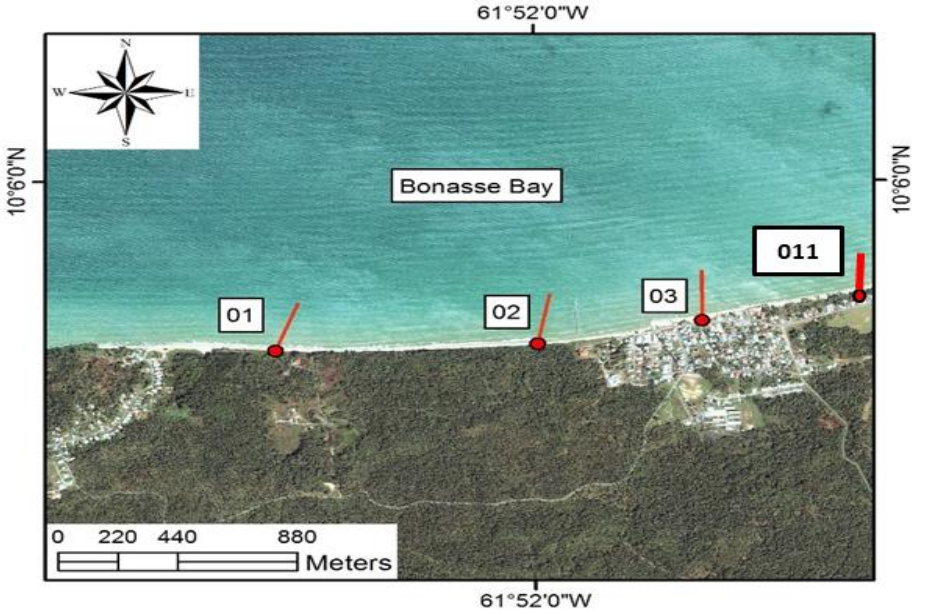
- Beach length – 5km

Table littoral data for Bonasse bay (2011-2018)

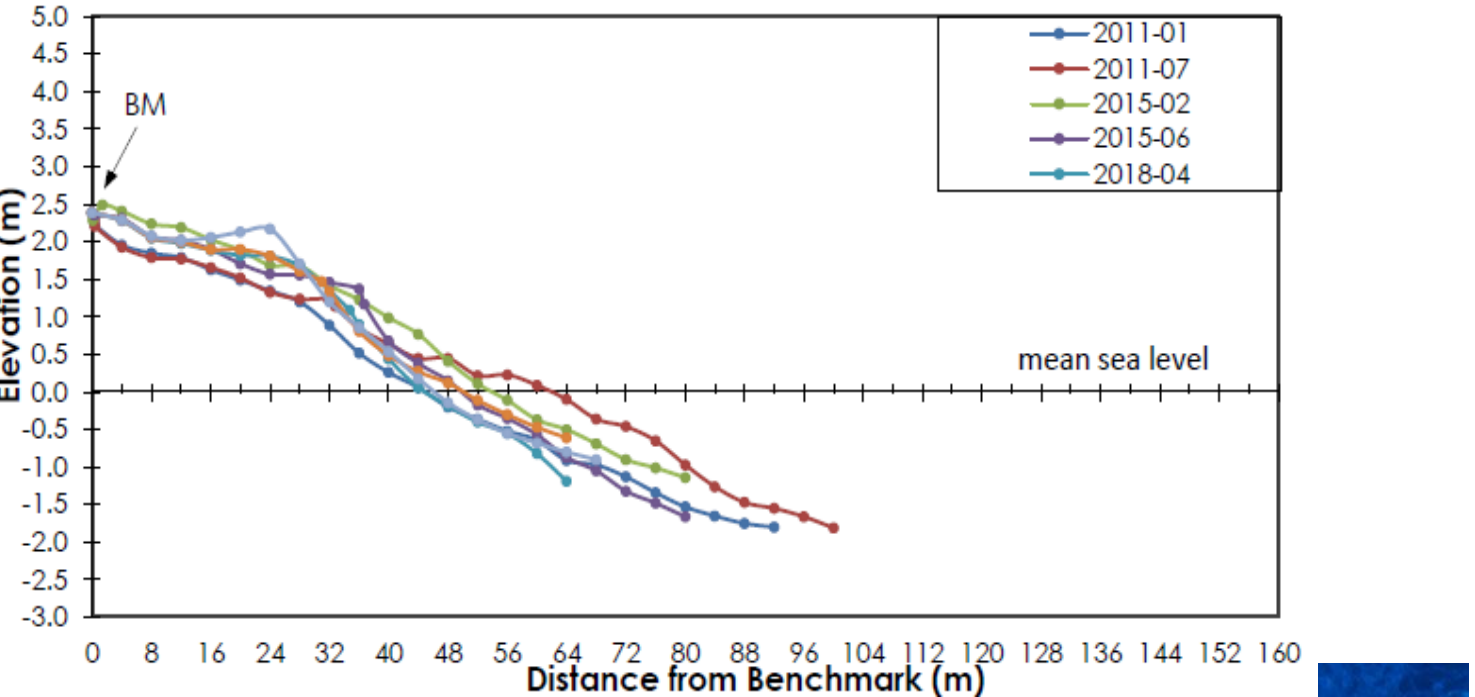
Beach/Bay	Station Location	Wind Speed (m/s)			Wind Direction	Significant Wave Height (m)				Breaker Height (m)			Breaker Period (s)			Longshore Current Speed (cm/s)			Current Direction
		Mean	Range	STD		Mean	Range	STD	Direction	Mean	Range	STD	Mean	Range	STD	Mean	Range	STD	
Bonasse Bay	1	1.53	0.0-2.2	0.8	E	0.28	0.2-0.35	0.05	WNW	0.33	0.25-0.40	0.07	6.8	5.1-7.8	1.08	9.3	4.7-16.3	3.81	W
	3	1.51	0.0-2.5	0.9	E	0.29	0.2-0.37	0.06	WNW	0.32	0.25-0.43	0.07	6.9	5.1-8.1	1.09	9.4	4.7-16.6	3.82	W
	011	1.49	0.0-2.1	0.8	E	0.27	0.2-0.34	0.05	WNW	0.30	0.25-0.41	0.06	6.7	5.0-8.0	1.06	9.2	4.7-16.5	3.80	W

Results – beach profiles

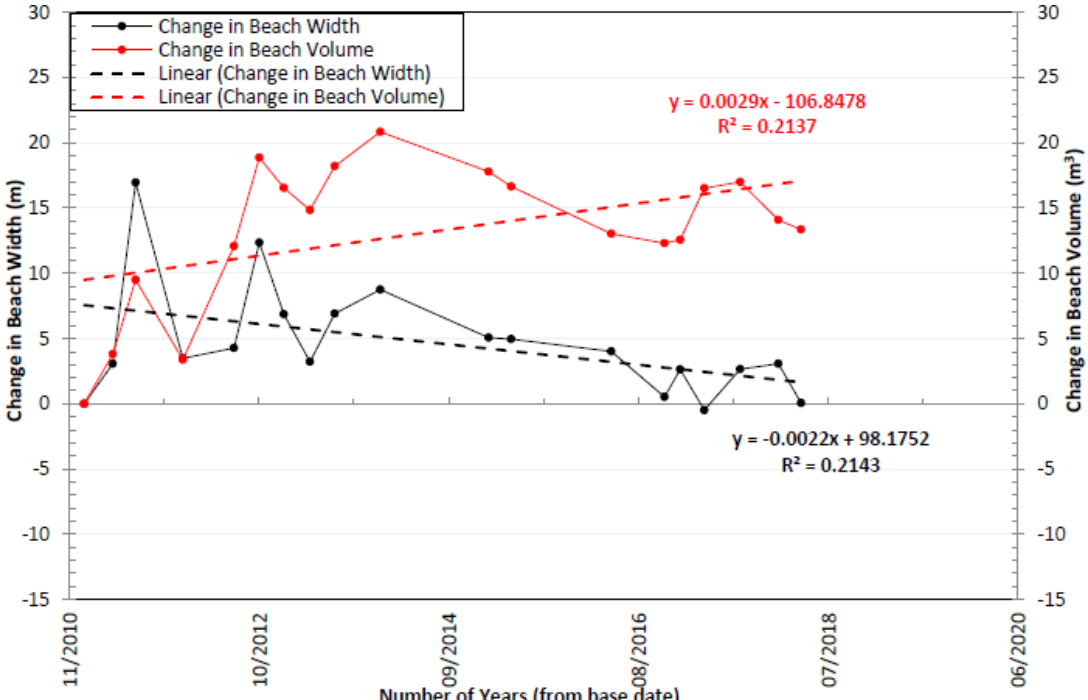
- Beach length – 5km



Bonasse Bay – Station 1 (2011-2018)

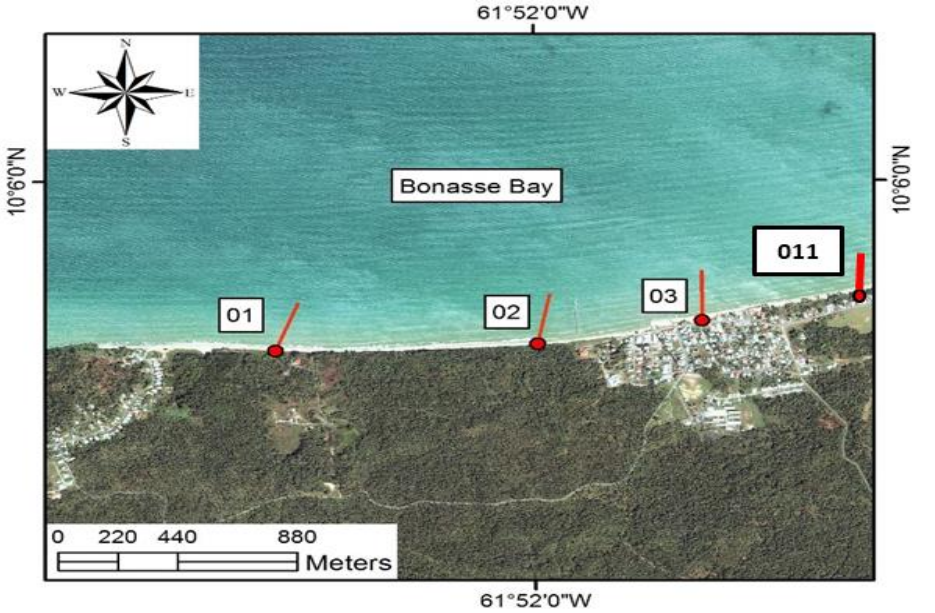


Bonasse Bay – Station 1
Changes in Beach Width and Beach Volume 2011 - 2018

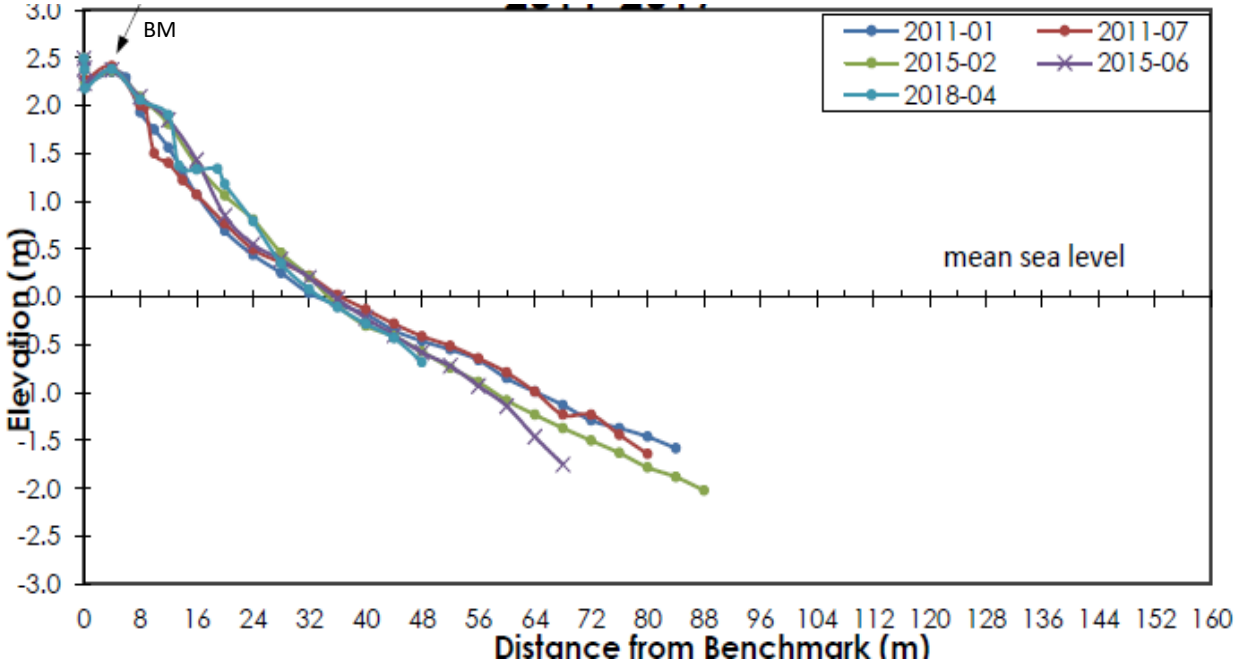


Results – beach profiles

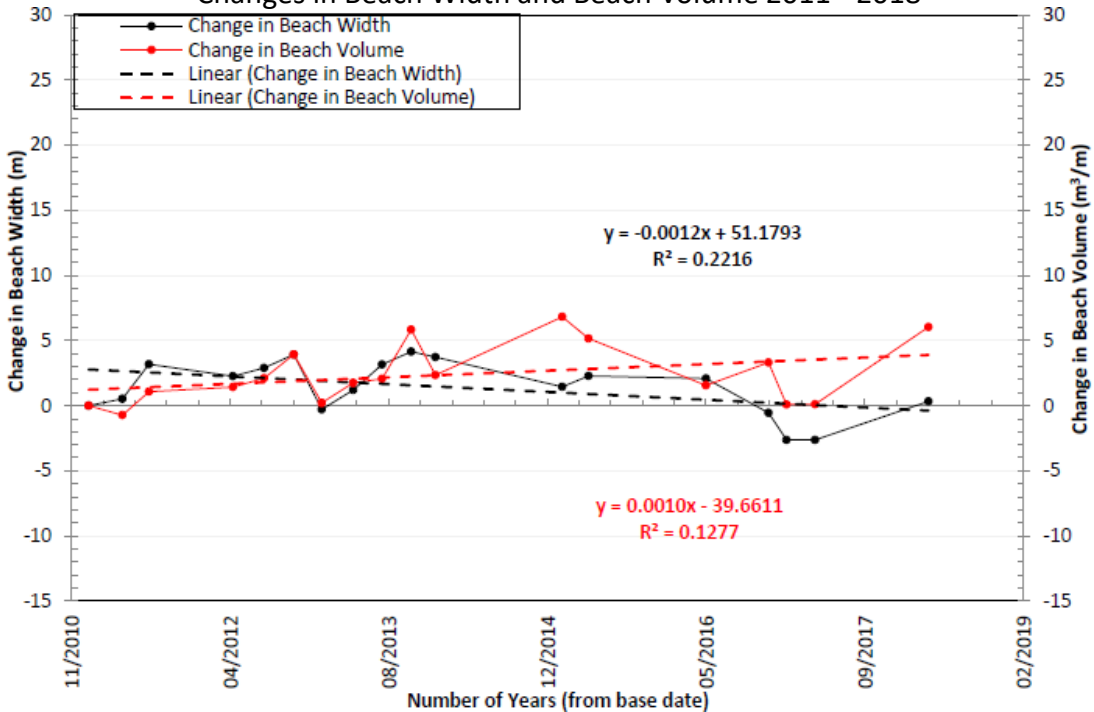
- Beach length – 5km

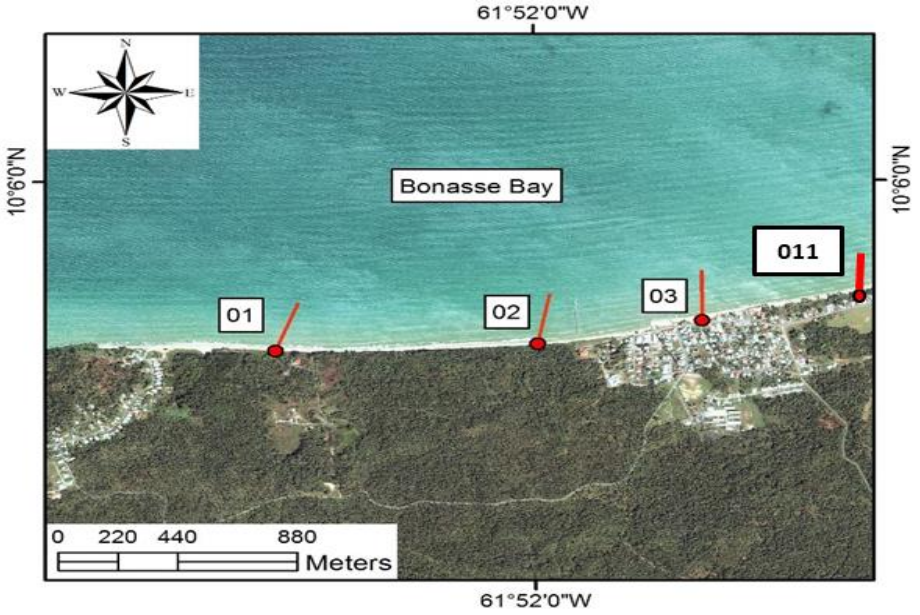


Bonasse Bay – Station 3 (2011-2018)



Bonasse Bay – Station 3
Changes in Beach Width and Beach Volume 2011 - 2018





Results – grain size

- Sampling period – 2013
- D_{50} – 0.22mm

Table – Grain size parameters for Bonasse bay, 2013

BEACH/BAY	STATION	SAMPLE LOCATION	GRAPHIC MEAN		MEDIAN		SORTING			SKEWNESS	KURTOSIS	PERCENTAGE COMPOSITION			CLASSIFICATION (FOLK & WARD)
			ϕ	mm	ϕ	mm	ϕ	mm	REMARKS			GRAVEL >2.0mm	SAND (0.0625 - 2.0 mm)	MUD < 0.0625mm	
Bonasse Bay	1	UB	2.24	0.20	2.23	0.20	0.19	0.86	Very well sorted	0.04	1.41	0.73	99.15	0.12	Slightly Gravelly SAND
		MB	2.02	0.23	2.00	0.24	0.52	0.68	Moderately well sorted	-0.12	1.93	1.48	98.35	0.17	Slightly Gravelly SAND
		LB	1.35	0.37	2.06	0.23	1.41	0.36	Poorly sorted	-0.54	0.63	8.99	90.33	0.68	Gravelly SAND
	3	UB	2.23	0.19	2.24	0.20	0.19	0.86	Very well sorted	0.03	1.41	0.73	99.15	0.12	Slightly Gravelly SAND
		MB	2.01	0.23	1.99	0.24	0.52	0.67	Moderately well sorted	-0.12	1.92	1.47	98.36	0.17	Slightly Gravelly SAND
		LB	1.33	0.36	2.05	0.23	1.40	0.35	Poorly sorted	-0.54	0.62	9.00	90.33	0.67	Gravelly SAND
	011	UB	2.22	0.18	2.23	0.19	0.17	0.85	Very well sorted	0.02	1.40	0.70	99.17	0.13	Slightly Gravelly SAND
		MB	2.00	0.22	1.97	0.22	0.50	0.66	Moderately well sorted	-0.11	1.90	1.45	98.37	0.18	Slightly Gravelly SAND
		LB	1.32	0.35	2.03	0.22	1.39	0.34	Poorly sorted	-0.52	0.61	8.97	90.35	0.68	Gravelly SAND

Results – erosion table

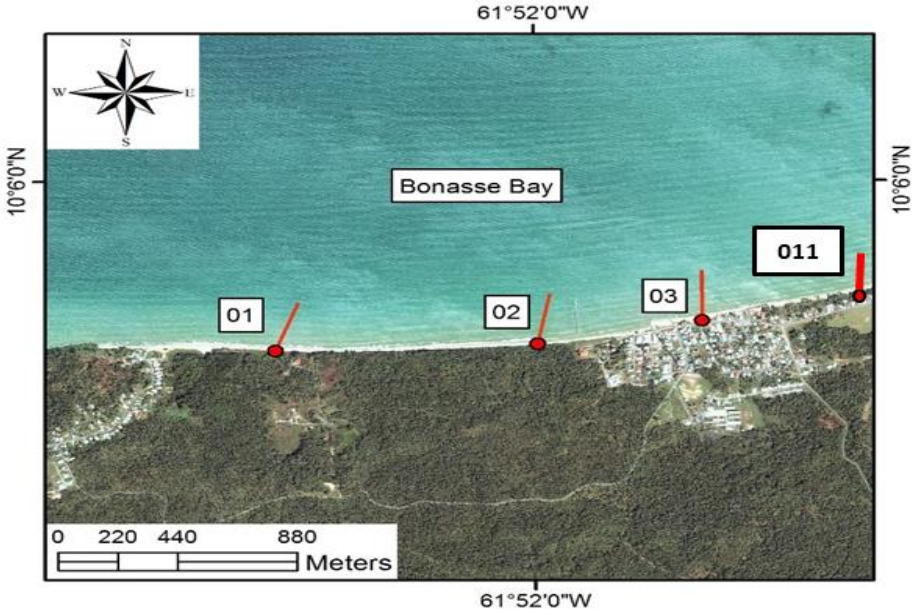
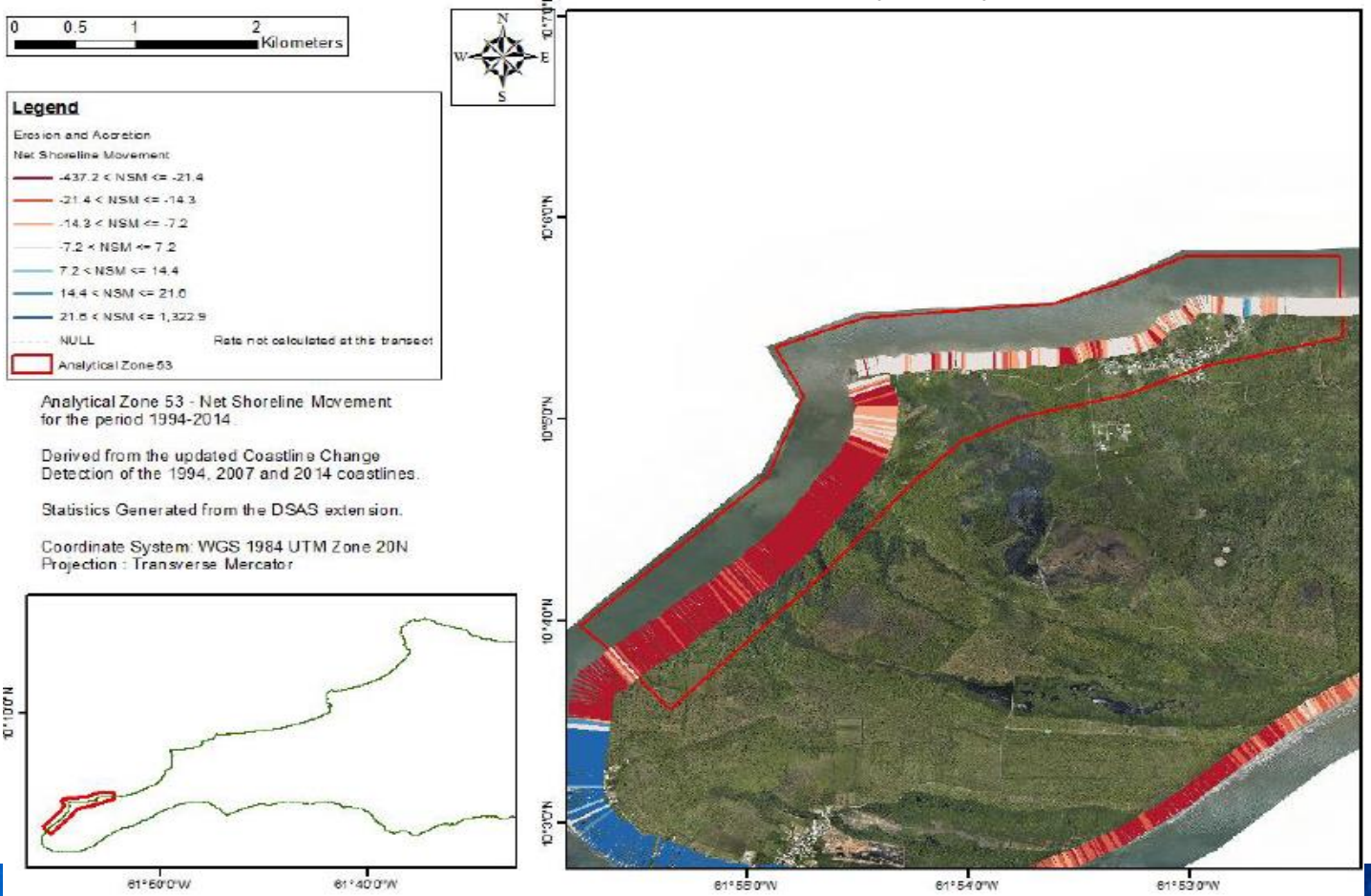


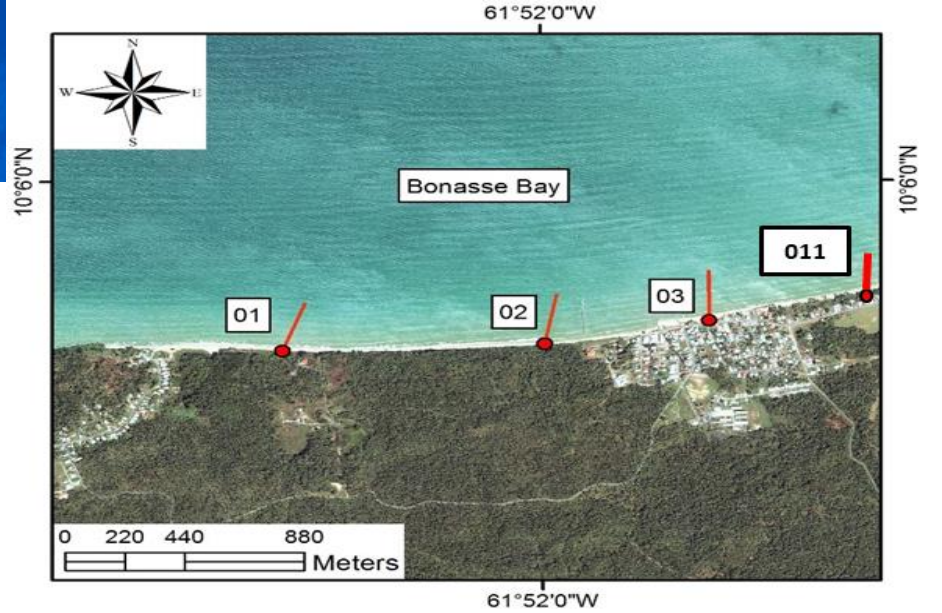
Table – Erosion rates for Bonasse bay, 2011-2018

Beach/Bay	IMAs Beach Monitoring Station Location	Shoreline Stability Status (+Net Annual Accretion (m); -Net Annual Erosion (m); DE Dynamic Equilibrium)							
		2011	2012	2013	2014	2015	2016	2017	2018
Bonasse	1	-0.02	0.00	-0.01	-0.02	-0.01	-0.01	0.00	-0.01
	2	-0.01	-0.01	-	-	-	-0.01	-	-
	3	-0.01	0.00	0.00	-0.01	0.00	0.00	-0.01	0.00
	011	DE	DE	DE	DE	DE	DE	DE	DE

Results – shoreline movement

Bonasse shoreline movement (DSAS)





Shoreline movement - Bonasse (DSAS) 1994-2014

Area (Bonasse)	Shoreline movement (mm)
Eastern	-21 to -437
Central	-7 to -14
Western	- 7 to +7

Conclusions

- Erosion at multiple areas along beach (DSAS)
- Increased beach profiles required to capture shoreline movement
- Beach is being narrowed
- Fine-grained sand

Recommendations

- Additional benchmarks required for monitoring shoreline
- Beach stabilization/nourishment (similar grain size)
- Dune creation (vegetated)

Acknowledgments

- KIOST
- KOICA
- ACS
- GAMMA
- GoRTT
- IMA

Thank you

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