STUDYING THE SHORELINE VARIATIONS BASED ON THE MONSOON SEASONALITY IN MIRISSA

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Introduction

Sri Lanka is an island consisting of a 1600 km long shoreline. The shoreline is the boundary between the ocean and the land. The coastal area of Sri Lanka provides a different range of natural resources and the most effective conditions for economic and social development. Coastal areas are threatened by natural and human activities and regular erosion. Some reasons such as unauthorized constructions, unplanned manmade barriers, changes in the rainfall, sea level rise, mean tidal range, mean wave height, coastal slope, and land use pattern shoreline were changed (Pusella, 2015). The major cause of changes in shoreline position in coastal zones is the accretion or erosion of sand. Coastal management needs to recognize how sand accretion and erosion are affected by monsoon seasonality and human impacts to implement the most effective coastal protection techniques. Shoreline change is named coastal erosion and it became a major problem in many regions of the world and is particularly important for countries in low-lying coastal areas such as the south coasts of Sri Lanka. As an example, in Weligama Bay in the south, about 175000 to 285000 m^2 of the coastal land area is lost due to erosion in the year (Lowry and Wickremeratne, 2012).

Mirissa is a small town on the south coast of Sri Lanka, located in the Matara District of the Southern Province. It is approximately 150 kilometres south of Colombo and is situated at an elevation of 4 meters above sea level. This area is in Sri Lanka with the Global Position System (GPS) coordinates of 5°56'53.7432" N and 80°28'17.7168"E. Mirissa Beach makes a popular tourist destination. Further, Mirissa coastal area consists of a fishery harbour and one of the island's main whale and dolphin viewing sites (Brinkhoff & Thomas, 2012). Mirissa area immensely helps to develop the economy of our country. However, improvement of this economic destination is not considered by the relevant authorities. This study mainly focuses on the detection of shoreline changes and geomorphological changes in Mirissa, on Sri Lanka's southern coast.

The shoreline time series were obtained using the "CoastSat" software. The toolkit uses Google Earth Engine's capabilities to quickly retrieve Landsat and Sentinel-2 photos cropped to any user-defined area of interest. With a precision of 10 m, separation was used to map the location of the shoreline (Vos, Splinter, Harley, Simmons, & Turner, 2019)). By using CoastSat a precise output can be gained for the small beach area. But using Sentinel -2 images, an accurate comparison can be obtained to the Landsat images. Determining the shoreline variation according to the

monsoon seasonality and identifying the geomorphological changes in Mirissa coastal area are specific objectives of this study.

Methodology & Experimental Design

Figure 1 below describes the methodology that has been used in this study. The steps represented in the workflow diagram were applied to the selected area to get the results.

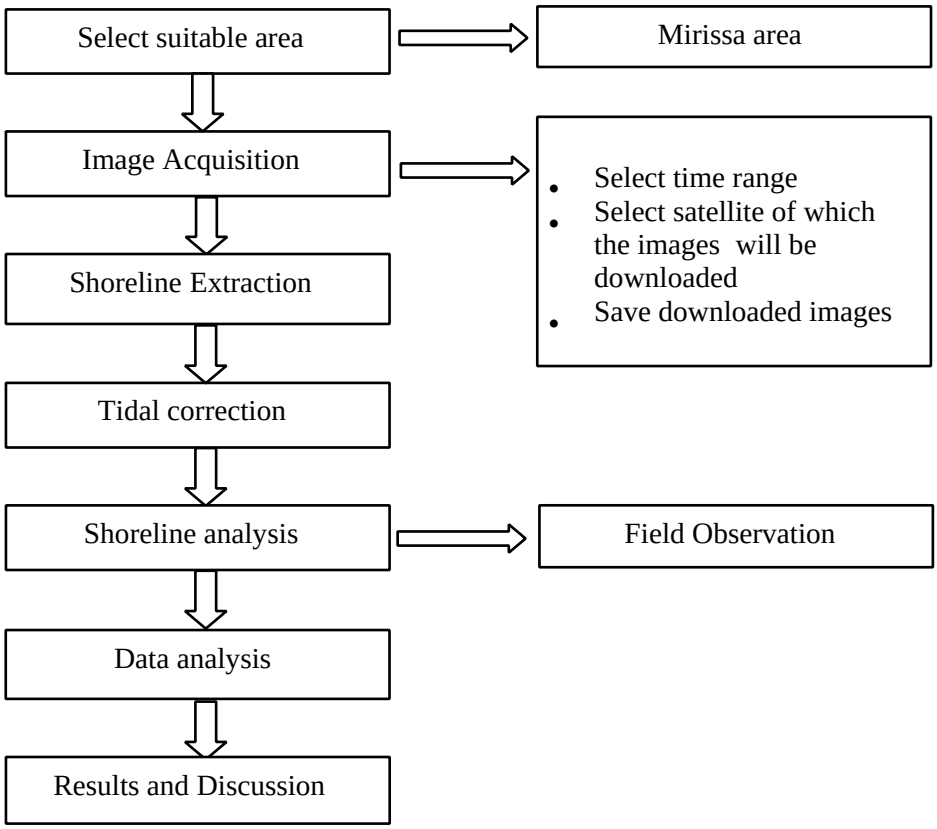

Figure 1: Workflow diagram

In Mirissa 2 km long shoreline was inserted into the 'CoastSat' software. After retrieving 286 photos and completing pre-processing and classification, 65 images were chosen for shoreline analysis and the retrieved shorelines at the location have been corrected for tidal effects. A graph was created for the analysis utilizing the "CoastSat" data and a time series of shoreline changes along each transect. Using the comparison of the shoreline retrieved by "CoastSat" with field survey data obtained using GNSS, the accuracy of the shoreline was verified. Also, for each transect location, the overall beach state in the Mirissa coastal zone was determined.

Results and Discussion

The beach was in three states, according to the data analysis: erosion, accretion, and steady state. Additionally, the majority of transect locations exhibit a similar beach state, which is favourable for the development of the tourism industry.

Figure 2: Shore normal transect locations

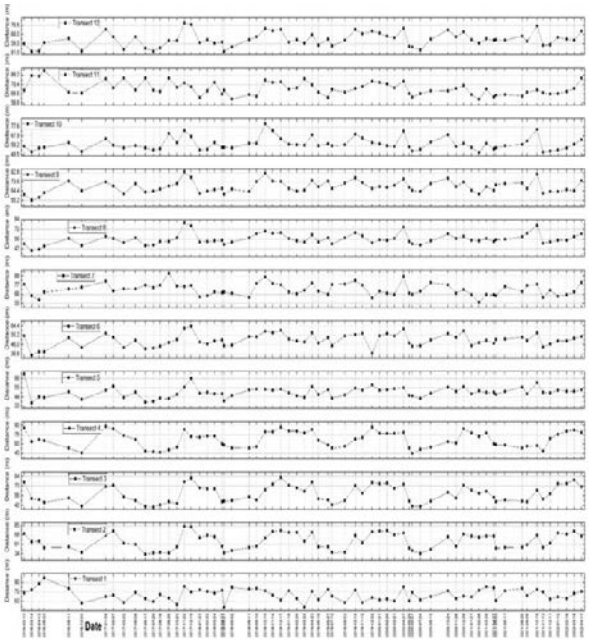

Figure 3: Transect based shoreline variation

The average horizontal shoreline difference (based on "CoastSat" and field measurements) was 7.899 ± 1 m, which is within the acceptable range. Therefore, satellite images acquired from the Google Earth Engine and "CoastSat" can be utilized to assess shoreline change detection very successfully with the proper tidal correction when there is a limitation of long-term field data in the area.

Table 1: Overall beach state

Transect No.	No: of Shorelines Extracted	Time Frame	Distance between the shorelines of the moving (OL) and following (YG) proceeding in meters		Overall-Beach State	Mean (m)	Standard Deviation
			Gain	Loss			
Transect_1	65	2016 - 2022	02		Steady State	70.68	09.17
Transect_ 2	65	2016 - 2022		04	Steady State	56.89	14.29
Transect_ 3	65	2016 - 2022		06	Steady State	58.84	12.08
Transect_ 4	65	2016 - 2022		07	Steady State	67.00	12.67
Transect_ 5	65	2016 - 2022		19	Erosion	49.75	06.25
Transect_6	65	2016 - 2022		00	Steady State	50.53	06.13
Transect_7	65	2016 - 2022	02		Steady State	71.61	07.11
Transect_8	65	2016 - 2022	14		Accretion	55.94	07.74
Transect_9	65	2016 - 2022	13		Accretion	68.76	05.75
Transec_10	65	2016 - 2022	06		Steady State	59.78	06.43
Transect_11	65	2016 - 2022	12		Accretion	74.28	06.87
Transect_12	65	2016 - 2022	11		Accretion	63.51	06.46

Conclusion

The constant state beach can be seen in many transect places in Mirissa depending on the general beach condition. For the beach state, values (loss or gain) less than 10 m are defined as steady-state values. The steady-state beach in Mirissa is due to fluctuations in monsoon seasonality, the orientation of the shoreline and the local wind pattern. Based on the seasonality of the monsoon, the general beach condition in Mirissa exhibits more than 10m of sand accretion and erosion. As a result, Mirissa Beach is ideal for leisure activities and the tourism sector. All monsoon seasons result in sand erosion and accumulation (southwest, northeast, 1st inter-monsoon, and 2nd inter-monsoon).

References

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