Journal of Coastal Conservation (2020) 24:50
https://doi.org/10.1007/s11852-020-00768-2

# Spatio-temporal modelling of shoreline migration in Sagar Island, West Bengal, India

Ismail Mondal[1] · Sandeep Thakur[1] · Mukhiddin Juliev[2] · Jatisankar Bandyopadhyay[3] · Tarun Kumar De[1]

Received: 5 February 2019 / Revised: 13 July 2020 / Accepted: 21 July 2020


## Abstract

Sagar Island is a very popular pilgrimage destination located in the western part of Indian Sundarbans. This study employs Digital Shoreline Analysis System (DSAS) extension tool in ArcGIS platform to study and analyse the shoreline dynamics of Sagar Island by utilizing satellite images extending 40 years (1975–2015). 44 transects with 100 m spacing were laid and divided into six littoral cells (LCs). End Point Rate (EPR) and Linear Regression (LR) models were utilized to analyze the shoreline change patterns and also for predicting the future shoreline positions. It was observed that almost the entire southern portion of Sagar Island is susceptible to high rate of shoreline erosion. Most of the erosion occurred in Dhablat (LC 4 (a)) in the south eastern part at a rate of 11.695 ± 2.1 m/year. The mean shoreline change rate was also high in LC5 (±23.525 m/year). However, the overall shoreline change rate for the island was 4.94 m/year and uncertainty of total shoreline change rate was ±4.4 m/year. The study shows the usefulness of DSAS as a scientific tool for shoreline change studies and highlights state of erosion in the study area.

**Keywords** Shoreline · Erosion · Accretion · Endpoint rate · Linear regression · Remote sensing and GIS

## Introduction

Shorelines are very vibrant in nature and are defined as a definite boundary connecting land and water (Mondal et al., 2016; Pajak, Leatherman, 2002). Shoreline migration is as a major problem in deltaic regions all over the world and is of particular interest to the researchers (Crowell et al., 1991) as it is important to delineate how much area is accreted or eroded over time. The causes for coastline shifts are natural as well as some human induced (Marfai 2012; Mutaqin, 2017). Shoreline changes are caused by several factors, such as rising sea level, storm surges; small and extended periodic modifications affected by the hydrodynamic adjustment of the estuaries and sea (Mondal et al., 2016a), geomorphologic changes (e.g. Lisitzin, 1974; Cowell and Thom, 1994; Pugh, 1996, 2004; Paskoff and Clus-Auby, 2007; Pardo-Pascual et al., 2012; Thébaudeau et al., 2013). Erosion is the backward movement of land due to gradual reduction in sediments while the forward movement of land by gradual accumulation of sediments is called accretion (Bagli and Soille, 2003; Mills et al., 2005; Lavigne et al., 2016). Erosion is significant in most of the Sundarban region (Nandi, 2013) and has resulted in loss of inhabitable land, paddy field, mangroves and the natural resources of the region.

Erosion control is a very crucial aspect of coastal zone management and research on the predicting future shoreline positions form a prominent part of it. To determine the future shoreline positions using prediction models; accurate information of the past and present shoreline positions is needed. Some of the most common models which have been used to evaluate the shoreline positions with the help of historical datasets are End Point Rate (EPR), Linear Regression (LR), and Average of Rate (AOR). For long term shoreline position

✉ Ismail Mondal
ismailmondal58@gmail.com

Sandeep Thakur
sandeept.pu@gmail.com

Mukhiddin Juliev
mukhiddinjuliev@gmail.com

Jatisankar Bandyopadhyay
jatib@mail.vidyasagar.ac.in

Tarun Kumar De
tarunde@yahoo.co.in

[1] Department of Marine Science, University of Calcutta, Kolkata 700019, India

[2] EcoGIS Center, Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, Tashkent, Uzbekistan

[3] Department of Remote Sensing & GIS, Vidyasagar University, Midnapore, India

Published online: 29 July 2020