



## Preface

Coasts exhibit a unique interface of land and seascapes and are characterized by multi-faceted interactions and probabilities. Coasts host ports and facilitate industrial and trade-related activities, and hence people migrate to coasts. In view of such a scenario, the increase in human population in coastal areas will be faster than in hinterland areas. These anthropogenic activities are shaping coastal landscapes and altering natural ecosystems. These developmental activities are likely to be adversely affected due to impacts of climate change such as sea-level rise, flooding, acidification, coastal erosion, eutrophication, algal blooms, etc. Hence, it is not only essential to carry out multi-disciplinary research to address these complex uncertainties, but also crucial to spread such knowledge in neighbourhood. In this context, International Symposium on ‘Advances in Coastal Research with Special Reference to Indo-Pacific (AdCoRe IP-2019)’ was organized by the Earth System Science Organisation – National Centre for Coastal Research (ESSO-NCCR), Chennai in collaboration with the Research and Information System for Developing Countries (RIS), New Delhi. Discussions were centered around how quality of life of coastal populace can be improved by applying knowledge of science and technology. The key focus of the symposium was to provide a platform to researchers from the Indo-Pacific region, so that they can exchange ideas and cooperate for advancing the blue economy.

The papers presented during this Symposium were peer-reviewed and finally 22 articles were selected and published as a Special Issue on ‘Advances in Coastal Research’ in the *Journal of Earth System Science* (JESS). These articles cover advances in coastal processes, coastal zone management, climate change, coral reef, living resources and pollution.

Coastal processes of erosion, deposition and sediment transport affect port and other developmental activities along the coast. The observations on coastal current are important for understanding the movement of sediments. The indigenously developed drifters based on the Global Navigation Satellite System (GNSS) were used to measure rip-currents along a beach on the east coast. The accuracies in position and location were also validated using dyes. The information that rip-currents are strong during post-monsoon season is very useful for ensuring the safety of beachgoers. HF radar-derived observed current data are useful for validating model simulations as well as assimilation in numerical models. Coastal currents along the East coast of India, simulated by the Nucleus European Modelling of Oceans (NEMO), which captured zonal currents better than meridional current, were validated using HF radar data. The assessment of the wave climate is essential for assessment of coastal erosion processes. Numerical simulations of wave transformation were carried out using DELFT3DWave along the Kerala coast (south-west coast of India) and validated using Wave Rider Buoy data. This approach was utilized to hindcast nearshore wave climate for last 40 years. The shoreline change and littoral drift were computed along the Karnataka coast using numerical LITPACK model. It was found that the net transport is towards north and reaches maximum magnitude between June and August. Tidal hydrodynamics was studied in the Gulf of Khambhat using HF radar data as well as simulated data. It was found that the flood tide dominates over ebb tide and the speed of tidal currents increase from south to north. The concentration and movement of suspended sediments provide vital information on erosion and deposition. Satellite data were used to derive suspended

sediment patterns and correlate the same with coastal erosion along the Kerala coast. The changes in shoreline were computed using topographical and satellite data on the Odisha coast. It was found that construction of engineering structures and cyclones are two major causes for changes on the Odisha coast. Kavaratti, one of the islands of Lakshadweep Islands, has been facing serious erosion. Based on extensive analysis and model simulations, it was found that submerged-geo-tubes would be the most effective shore protection measure.

Climate change and its impacts are of grave concern. The increasing extreme rainfall and resultant floods, and coral bleaching are two main issues that have been discussed. An App has been developed to collect field data on characteristics of flood such as water level and changes in water, duration having time, date, and location along with receipt of warning advisories, rescue, and relief measures, etc., to assess impact of flood in 2018 in Kerala. Such developments can help in mitigation efforts. Coral reefs are most susceptible to increase in temperature of sea, one of the major aspects of climate change. Octocoral communities in the Gulf of Mannar were investigated by field methods and scuba diving. It was observed that the corals did bleach during 2016 and also showed signs of resilience by 2018 and many corals had completely recovered. It was also observed in the Gulf of Mannar that proliferation of sponges occurred after 2016 bleaching event. It was also noticed that many fishes such as *Scarpus* spp. have started feeding on sponges. This observation is very important from the standpoint of adaptation of fishes to climate change. The blue carbon contribution by benthic fauna regarding climate change is of great interest. In a study carried out in the Arctic Kongsfjord, it was demonstrated that nematodes have the capability to sequester carbon.

Coastal and Marine Spatial Planning (CMSP) has been advocated for conserving coastal and marine ecosystems and to utilize living resources sustainably. The utility of CMSP has been demonstrated by developing a framework for the Odisha state to meet necessity of strengthening the institutional framework. In biologically rich rock pools on the Goa coast, it was shown that tides determine phytoplankton distribution, while location of rock pools influence nature of phytoplankton assemblage. The rock pools affected by mid-

and low-tide have elongated shaped diatoms, while high-tide dominated pools have spherical dinoflagellates. Cage aquaculture has been attracting a lot of attention recently. A case study to identify suitable areas for cage culture in a lagoon has been carried out on south-east coast. The suitability varies according to season and water depth was found to be major limiting factor in deciding sites. In another study conducted in open sea on south-east coast of India, it was found that congregation, density, and diversity of aggregated fish was much higher around sea cages than in common fishing ground. The investigations related to biodiversity around artificial coastal defense structures revealed that such structures facilitate higher species richness and diversity of epibenthos. The dimensions of such structures also influence species composition.

Coastal pollution, an accurate reflection of industrial and domestic discharges, have adverse consequences on coastal environment due to their accumulation, toxicity, and persistence. Remote sensing techniques have been used to assess water quality. The bulk inherent optical properties (IOP) of seawater provide information on constituents of water. The evaluation of Zhang's model revealed that this model retrieves IOPs with fewer errors compared to other models. Toxicity bioassays measure the direct impacts of contaminants on aquatic environment. It was demonstrated that sediment toxicity bioassay, fluorescein diacetate hydrolysis assay, using resident species of copepods can provide reliable risk assessment. The growing impact of metal toxicity illustrates the nutritional, ecological and environmental impacts. Heavy metal concentration in the Kochi estuary on the south-west coast of India, was found to be within limits and safe for human consumption. The possible impact of toxic metals on mangroves of the Sunderbans was investigated. It was observed that there is a correlation between photosynthetic pigments, antioxidant response and stressed enzymatic activity with increasing metal concentration. Biofilm formation is a strategy developed by microbes to survive and adapt to adverse environmental conditions. In a study in a Paradeep port, it was found that *Pseudomonas chengduensis*, bacterium can remove metals and can be utilized for remediation of heavy metals in contaminated environment.

I am sure that this special issue on 'Advances in Coastal Research' will be quite useful to scientists and coastal managers though there are still many

challenges and issues yet to be addressed. I would like to thank Dr M Rajeevan, then Secretary, Ministry of Earth Sciences, Govt. of India for his encouragement and guidance in conducting this Symposium. I am grateful to Prof. N V Chalapathi Rao, Chief Editor, for agreeing to publish selected papers of the Symposium as a Special Issue in JESS. The support in editing manuscripts provided by Dr M Dileepkumar and Dr C Gnanaseelan, Associate Editors, was very valuable. My sincere

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