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Editorial: Coastal environmental and ecological data analysis

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Editorial on the Research Topic
Coastal environmental and ecological data analysis

The coastal seas are one of the most important areas of the ocean and land. Approximately 3 billion people – about half of the world's population – live within 60 km of the coastline. At the same time, a total of 14 of the world's 17 largest cities are located along coasts (Brown and Hausner, 2017). Pervasive environmental pollution and occurrence of natural disasters in the coastal waters result in serious environmental and ecological problems. Eutrophication, hypoxia, and other adverse effects caused by anthropogenic activities are recognized as growing problems in many estuaries and coastal areas around the world. Hence, implementing regular monitoring programs is paramount to help understand the spatial and temporal variations of coastal water quality, with the purpose to prevent and mitigate marine pollution.

Long-term ecological monitoring networks have been established in coastal areas to evaluate eutrophication and other environmental problems like harmful algal blooms (HABs), heavy metal pollution and their biomagnifications, etc, and this measurement of hydro-chemical variables and biological indicators in the coastal environment will aid better understanding of aquatic environment. These monitoring programs produce huge datasets, and it becomes really difficult to extract latent meaningful information from these datasets. To extract the latent meaningful information, chemometrics, multivariate statistical analysis and different biotic indices for biodiversity data are used. It may include factor analysis, cluster analysis, discriminant analysis, self-organizing maps, artificial neural network, canonical correspondence analysis, redundancy analysis and many biotic indices (Wu and Wang, 2007; Wu et al., 2009a; Wu et al., 2009b; Wu et al., 2010; Dong et al., 2010a; Dong et al., 2010b; Wu et al., 2011; Wu et al., 2012a; Wu et al., 2012b; Wu et al., 2012c; Ling et al., 2014; Wu et al., 2015a; Wu et al., 2015b; Wu et al., 2016; Wu et al., 2020). These methods identify the spatial and temporal variation of water quality in coastal waters and help to elucidate the processes involved in it. The multivariate statistical analysis identifies different

patterns in the datasets and provides meaningful underlying information which would be rather difficult just seeing the raw data or using traditional statistics techniques.

The aim of this Research Topic is to explore the recently used or newly developed methodologies involving chemometrics, multivariate analysis or biotic indices, with an emphasis on Land-Ocean Interactions in the Coastal Zone, to solve the environmental and ecological problems.

Multivariate statistical analysis

The multiple ecosystemic services of the coastal zone are at risk owing to the development of human activities and the occurrence of natural extreme events. Firstly, coastal environment and ecosystems receive the excessive fluxes of waste water discharges and residues that promote eutrophication, ocean acidification, hypoxia, HABs, heavy metal pollution and their biomagnifications, etc. Secondly, the occurrence of extreme events such as storms and typhoon in the coastal zones is increasing. Thirdly, relevant coastal carbon sinks, such as to mangrove, seagrass and coral reefs are under stronge pressure due to global change. These changes also support the need to measure hydro-chemical variables and biological indicators. Analysis of variance (ANOVA-one way) showed significant ($p < 0.05$) spatial variation for depth, slope, seawater current, salinity, chlorophyll-a, benthic density, and diversity of coral reef in the southeast coast of India. The geographical information system (GIS) based model output showed space allocation for artificial reef deployment; that will help to conserve the fish stock and support the fishermen in the coastal regions (Jha et al.). Statistical analysis including principal component analysis, combined with the subterranean estuary dynamic variation, indicated that dissolved organic carbon (DOC), salinity, and ammonium concentrations along the sediment depths was related with the vertical community distribution of the Nitrospira species in Daya Bay, South China Sea (Sun et al.). Jiulong River estuary of Chian was subdivided into three subregions, including the upper (Area I), middle (Area II), and lower reaches (Area III) of the estuary. The diversity patterns of phytoplankton were shown to vary at different scales, in different seasons and in different indices in Jiulong River estuary. It is noteworthy that the significant roles that nutrients and nutrient ratios played in shaping phytoplankton diversity patterns and the nutrient balance were characterized by excess nitrogen (N) and silicon (Si) and limited phosphorus (P), which could potentially cause diatom blooms (Ge et al.). Based on canonical correspondence analysis, it was deduced that the variations of the community structure and potential functions of microbes in expanding marine hypoxic area in Bohai Sea could be influenced by depth, $NO2–$ concentration and DO availability (Guo et al.). Non-metric multidimensional scaling and an analysis of similarities revealed significant seasonal and spatial differences among macroinvertebrate assemblages in Hainan, China (Li et al.). Multivariate analysis revealed that the dynamics of phytoplankton alpha-diversity and algal pollution indices was influenced by environmental conditions (e.g., nutrients) particularly by trophic states changes (Inyang et al.). Cluster analysis revealed that composition of the macroalgae consumed by eight fish species from Xisha Islands,China, was always grouped together (Wu et al.). The Amundsen Sea was divided into nine bioregions by cluster analysis in the Antarctic (Feng et al.). A self-organizing map analysis using the environmental data revealed that the spatiotemporal variations in salinity and nutrient concentrations differed significantly between the two lagoon systems in two contrasting temperate coastal lagoons of Korea. Canonical correlation analysis highlighted that the POM properties differed according to physicochemical factors in two contrasting temperate coastal lagoons of Korea (Lee et al.). Multivariate tool indicated that except near-shore sites, there is a good seawater quality at Thanjavur in the southeast coast of India (Jha et al.). Temporal changes in faunal assemblages were evidenced through multivariate technique in the intertidal region of South Andaman Islands (Sahu et al.)

Data mining and ecosystem modelling

Studies using big data methods are alsoi included in this special issue. Loop analysis revealed that the heaviest feedback loops are the interactions among benthos, zooplankton, and phytoplankton; and the predator-prey negative interaction strength between zooplankton and phytoplankton dominated the stability of an artificial reef, whether in summer or autumn in the Bohai Sea (Li et al.). The maximum gross primary producti-on and community respiration occurred in the estuarine plume of the Guangdong-Hong Kong-Macao Greater Bay Areain summer, while in winter the more active metabolisms of plankton community occurred in the Daya Bay by principal component analysis (Zhang et al.). Wth a model on the basis of the nonlinear impact of environmental regulation on coastal marine environmental pollution, the level of environmental regulation and the degree of coastal marine pollution in 46 coastal prefecture-level cities in China from 2004 to 2016 was identified in the coastal prefecture-level cities ofChina (Ma et al.). In subtropical waters of Hong Kong, it was found that some omnivorous infauna shifted from a mainly carnivorous diet at the unpolluted site to a largely herbivorous diet at the organically polluted site by standard deviation of nearest neighbour distance (Xu et al.). The first (second) warming peak is warmer than the second (first) one for super (other) El Niño composite in the South China Sea (Xiao et al.). Chen et al. used mixing model and concluded that atmospheric deposition contributes to the nitrate pool in water and that the impact of atmospheric deposition on the whole Beibu Gulf is relatively consistent.

The ecological distribution profiles of the nirS, nosZ I, and nosZ II gene communities varied with water depth, and denitrification genes in shallow-sea and deep-sea sediments differed in their sensitivity to environmental factors in the South China Sea (Xiang et al.). The estimates of the resuspended fraction of the proportion of resuspended particles in total suspended matter showed a substantial uncertainty of 50% in summer, likely owing to the potential errors of model parameter estimation and the influence of other unexplored biophysical processes such as biological degradation, upwelling, and monsoons, combined a simplified ecosystem model and vertical mixing model (Guo et al.). Island ecosystem conditions were influenced by both natural and anthropogenic factors as well as area size, population, and gross domestic product (GDP) in the 42 typical, representative islands

within China's coastal regions (Ma et al.). The data reduction potentials and explanatory value of these methods are showcased and important atmospheric variables affecting the chlorophyll-a concentration are identified in the Dutch Wadden Sea (Mészáros et al.).

Seasonal variations in the concentration of heavy metals were found in both seawater and sediment from Qinzhou Bay, as a result of seasonal hydrological change, biological activity, and human influence (Lao et al.). The combined assessment results of enrichment factor, contaminated factor and the percentages of acid soluble fraction indicated that surface sediments of Zhanjiang Bay were generally contaminated by Cd and Zn,and that their concentrations may pose medium to high risk to the environment (Zhou et al.). CO_2 emission from mangrove deforestation and N_2O emission from shrimp aquaculture in coastal aeras may offset the efforts of coastal wetlands conservation and restoration in the Hainan province of China (Zhao et al.). Mangrove plants could take up and accumulate PBDEs; and although BDE-209 is less toxic than other congeners, it is more difficult to be removed by mangrove systems (Wang et al.). Biogeochemical processes have little impact on nitrate dual isotopes under heavy nitrogen pollution, and isotopes are an ideal proxy for tracing nitrogen sources in Beibu Gulf, China (Cai et al.). There were many sources of organic matter in the bay, including inputs of soil, algae, and sewage. Influenced by freshwater input, dissolved organic matter decreased from the upper to the outer zone in Zhanjiang Bay (Zhong et al.). The combination of the untargeted FT-ICR MS approach and optical techniques could be valuable for studying the DOM sources and transformation in large river estuarine systems along the Yangtze River Estuary-to-East China Sea Continuum (Sun et al.). The source of the particulate organic carbon is overwhelmingly the mariculture, averagely accounting for 42.7% in the flood season and 52.6% in the dry season, mainly in the form of microalgae in Zhangjiang Estuary (Yan et al.).

Contribution and perspectives

In this special issue, we introduce the Research Topic "*Coastal Environmental and Ecological Data Analysis*" to analyze the structure and functioning of diverse coastal ecosystems around global, adressing topics related with water quality, mangrove, coral reef and CO_2 emissions. Experimental data for mining is important in the law and theory of the science. Outputs of these big database can improve the knowledge of us. In the 29 papers, the special issue provides a better understanding of the data monitoring, data analysis, and data integration. Thus, the knowledge of this special issue is by no means a closed chapter. In particular, we hope for significant insights from the novel big data, which can provide a high level of scientific, administrative and financial integration of coastal environmental and ecological sciences.

Author contributions

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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