Chapter 1

Introduction to Coastal and Marine Environment Concepts and Significances

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1. Introduction

Oceanography is the investigation of features found in coastal water. It extends from shallow estuaries to deep oceans, everywhere sea water can be found. This involves a broad scope of issues, beginning with the physical aspects of coastal dynamics and coastal sedimentation to the seafloor's geology and ecosystems comprised by marine life. Consequently, the study of the ocean is always a challenging and intriguing process when considering its size and global expanse. Features of oceans are complex and challenge for human beings to comprehend. All life and climatic changes depend on ocean dynamic fluctuations. There is no doubt that oceans are important to life on this planet. It is not easy to understand oceans because there are many factors which control their features. Scientists cannot study these factors individually as this will deliver imperfect information. For example, the chemical components of water shape the nature of which organisms inhabit the ocean. Consecutively, marine organisms supply deposits to shape the ocean floor's geology.

2. Subdisciplines of oceanography

There are four major sub-disciplines of oceanography. These broader subjects are (i)marine chemistry, (ii) marine geology, (iii) marine biology and (iv) physical oceanography.

2.1. Marine chemistry

This is the examination of oceanic chemistry. With regard to this, the ocean contains practically all the element which exist in the periodic table. Therefore, the dynamic changes of these

chemical elements can be studied within the Earth's oceans. Scientists study the dynamic cycling of these elements in both oceans and adjacent land. In addition, scientists identify advanced cycles - known as a biogeochemical cycles, the cycling of substances or substance turnover. These are considered routes by which a chemical substances interchanges in the biosphere (i.e., biotic and lithosphere), atmosphere and hydrosphere (i.e., abiotic partitions of the Earth [3]).

The term "biogeochemical" expresses the involvement of biological, geological and chemical factors in ocean studies. For instance, the distribution of carbon, oxygen, nitrogen, phosphorus, calcium and water, etc., within the physical and biological system – this is known as a biogeochemical cycle [3].

2.2. Marine geology

Marine geology studies the early and recent structure of the ocean floor. It also explores the heritage of the dynamic changes and the development of underwater features within the landscape. Marine geology correspondingly investigates the chemical and physical properties of ocean floor sediments and rocks. In addition, it implies geochemical, geophysical, sedimentological and paleontological examination of the ocean floor and coastal zones. Thus, marine geology has extremely robust bonds to physical oceanography (e.g., alongshore currents which are induced because the oblique wave propagation can cause sediment transport along coastal waters [9]).

The study of the ocean floor is a corner stone to predicate the Earth's climate changes. The investigation of climate and weather patterns over hundreds of millions of years is a study known as paleoclimatology - under ocean floor sediments can be collected using resolution drills taking sediment-core samples[7, 9].

2.3. Marine biology

Marine biology investigates exactly how every one of the sub-fields of oceanography operate either discretely or simultaneously to affect the circulation of animals and marine plants along with what purpose marine organisms perform relative to their environment. Marine biology additionally emphasizes the way species fit with conservational fluctuations (e.g., increased water temperature, artificial and natural instabilities, and pollution). A natural turbulence can be caused by the explosion of an underwater volcano or a hurricane, whilst an oil spill and overfishing represent an artificial disturbance [9, 11].

Marine biotechnology is a new technology which is expanding the opportunity to investigate in which way marine resources can be expended to develop medical industry, ecological inventions, and food technology.

2.4. Physical oceanography

Physical oceanography models the dynamic relationship between the ocean's physical properties, the atmosphere, and the coast and seafloor. The ocean's physical properties include

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temperature, salinity, and density variations. The ocean's dynamic components are waves, current, and tides. Physical oceanographers additionally investigate the manner by which the ocean interacts with the Earth's atmosphere to generate climate and weather systems [2, 7, 12].

Under this circumstance, physical oceanography theories and models must extremely be instigated to investigate the mystery of flight MH370 [1, 17]. The observational procedures which are taught to undergraduates of physical oceanography do not work in this case. Indeed, standard and modified models are required to verify the information from the *Inmarsat* satellite. In fact, there are many researchers who just use physical oceanography models and do not really understand how the models operate. Physical oceanography scientists who have been correctly trained have deep background knowledge of physics, mathematics, numerical analysis, finite element models, and modelling and can verify information delivered by any source [6]. To date, some marine institutes with a low quality of physical oceanography research are unable to explain, scientifically, how flight MH370 vanished in the southern Indian Ocean. It is believed that researchers are not even able to solve the 1-D mathematical coastal water flow equation! In addition, these researchers are blind users of software, and in situ ocean observations in the water territories without perfect understanding of the principle theories. Ocean data observations do not represent the end work of scientists - they need to go beyond in situ data collection by developing models and solving boundary condition problems.

For instance, the turbulent water flow throughout the southern top of Africa - known as the Agulhas Current - is a portion of a superior "ocean conveyor belt" which distributes the water across the globe. The Agulhas Current is based on currents, wind, and water density changes. Scientists have defined a new finding, named the Agulhas leakage. This represents the increments of water flow from the southern Indian Ocean into the Atlantic Ocean. It may well be that flight MH370 debris moved to the Atlantic Ocean through the Agulhas leakage [7, 8].

Modern physical oceanography studies predict that the ocean conveyor belt will be slow down, something which could cause dramatic changes to weather and climate patterns, and consequently sea level rise due to the melting of ice caps. This melting could reduce the salinity of ocean water and change its biogeochemical matrix.

3. The significance of oceanography and coastal studies

The main question which can of course be raised is why ocean and coastal studies are important to our lives? This book covers some significant aspects of coastal studies. There are countless benefits to be gained from coastal studies which may represent solutions to many economic crises around the world. Due to the huge coverage of the oceans, which are approximately 70% of the Earth's surface, the ocean plays a tremendous role for transportation, natural resources, weather and climate, biodiversity, and the economy[2, 8].

3.1. Transportation

Cities which are located on the coast and have harbors always have great benefits, however, they are exposed to pollution from time to time [2, 7].

3.2. Natural resources

The ocean floor is rich in oil and natural gases - not only for benthic organisms. The ocean floor and continental shelf contains numerous minerals. However, 50% of nations cannot discover the wealth of resources stored in their continental shelves and ocean floors [2, 8, 11].

3.3. Weather and climate

The oceans interact in tandem with the atmosphere and influence worldwide climate and weather. Whilst the air circulates over the warm ocean, it escalates because of warming. When it cools, the condensation induces precipitation. For instance, the Gulf Stream, synchronized withwarm air flowing toward northern Europe, makes winters tolerable [5, 12, 16].

3.4. Biodiversity

A wide number of discrete species of organisms have an extraordinary biodiversity due to the existence of salt marshes, coral reefs, estuaries, seagrass beds, and mangrove [15]. The brackish water of estuaries is key for fish and others marine organisms. Furthermore, coral reefs sustain, along with estuaries, approximately 75% of living marine organisms and fish. With this regard, reefs and estuaries represent shelter for fish because of the accumulation of food and nutrients both required for feeding and nursing [14]. Moreover, birds reside along the sandy shores which represent a source of food – e.g., burrowing worms and fiddler crabs [4, 5, 8, 11, 13].

3.5. Economy

The significance of the ocean cannot be deliberated easily. Economic income is a function of shipping, marine biomedical products, fish industries, and oil and gas mining. Furthermore, beautiful beaches and islands are a corner stone for income as they attract a large number of tourists. In general coastal studies are important to policy makers, allowing them to minimize the effects of marine pollution to ecologically sensitive zones along the shorelines. Hence, pollution-free zones will attract more tourists and boost national economies [8].

3.6. Coastal engineering

Coastal engineers also required information about ocean and coastal dynamics before handing out offshore construction contracts. Furthermore, coastal studies can sustain shoreline changes and assist decision-makers in understanding the mechanisms of sediment transport in order to avoid erosion and sedimentation problems. In addition, information about salinity and temperature can be used to avoid the problem of corrosion to ships, pipelines, and coastal structures containing iron [3, 8].

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4. Outline of this book

This book examines the impact of physical oceanography parameters on several applications which range from mercury circulation, corrosion due to salinity, and coastal sedimentation to monitoring the coastal environment using geographical information systems (GIS) and remote sensing. Furthermore, the marine ecology study in this book covers a broad spectrum of clues about the physico-chemical properties of coastal waters. The significance of this study is the integration between different aspects of oceanography with wind monsoon pattern changes. Consequently, salinity and phytoplankton are the main factors that impact zooplankton growth and proliferation [10,11]. Most of the work represented in this book is based on accurate in-situ observationIndeed, the British National Antarctic Expedition which is known as the *Discovery Expedition* spent three years cruising across the world's oceans documenting significant ground information regarding biology, zoology, geology, meteorology, and magnetism. Furthermore, the expedition discovered the existence of the only snow-free Antarctic valleys.

This book contains 16 chapters, as follows:

Chapter 2 [Geological Evolution of Coastal and Marine Environments off the Campania Continental Shelf Through Marine Geological Mapping - The Example of the Cilento Promontory]. This chapter presents the geological evolution of coastal and marine environments offshore the Cilento Promontory, Italy, through marine geological mapping.

Chapter 3 [Engineering Tools for the Estimation of Dredging- Induced Sediment Resuspension and Coastal Environmental Management]. This chapter introduces predictive techniques used to estimate the suspended solid concentration arising from dredges with different mechanisms of sediment release and assesses the spatial and temporal variability of the resulting plume in estuarine and coastal areas.

Chapter 4 [Neo-tectonic Movement in the Pearl River Delta (PRD) Region of China and Its Effects on the Coastal Sedimentary Environment]. This chapter presents the Late Quaternary neo-tectonic movement in the Pearl River Delta (PRD) region of China and its effects on the coastal sedimentary environment. Furthermore, it discusses the evolution of the PRD formation and its controlling factors on the coastal sedimentary environment.

Chapter 5 [Review of Mercury Circulation Changes in the Coastal Zone of Southern Baltic Sea]. This chapter reviews how a surge in mercury concentration in marine organisms is not always linked to an increased inflow of anthropogenic mercury, directly influenced by humans, but may also be related to climate change occurring in a given area, the type of catchment, as well as to the predominance of either marine or terrestrial air masses.

Chapter 6 [Computatonal Analysis of System and Design Parameters of Electrodeposition for Marine Applications]. This chapter investigates marine corrosion in coastal water. In addition, it also addresses factors which induce marine corrosion.

Chapter 7 [Fabrication and Properties of Zinc Composite Coatingsfor Mitigation of Corrosion in Coastal and Marine Zone.] This chapter shows how electrodeposited zinc composite coatings have high potential to serve as protective films against corrosion for components and pieces that are made of mild steel in coastal and marine environments.

Chapter 8 [Dynamic Characterization of Open-ended Pipe Piles in Marine Environment]. This chapter introduces experimental investigations used to study dynamically characterized open-ended pipe piles in the marine environment.

Chapter 9 [Relationship between Bulk Metal Concentration and Bioavailability in Tropic Estuarine Sediments]. This chapter investigates the abundance, distribution, and bioavailability of major and trace elements in the surface sediments of the Cai River estuary, Russia.

Chapter 10 [Stable Isotope Techniques to Address Coastal Marine Pollution]. This chapter explores stable isotopes of carbon ($\delta^{13}C$), sulfur ($\delta^{34}S$), oxygen ($\delta^{18}O$), hydrogen ($\delta^{2}H$), nitrogen ($\delta^{15}N$), and a radioactive isotope of hydrogen (tritium) in order to study coastal pollution. This is new approach is compared to classic methods, such as heavy metals.

Chapter 11 [Investigation of Po-210 and Heavy Metal Concentration in Seafood Due to Coal Burning – Case Study in Malaysia]. This chapter investigates the level of Po-210 and heavy metals in marine organisms from the coastal area of Kapar and makes comparisons with other places around the world.

Chapter 12 [Atmospheric Pollution Causes Deterioration of Sweeteners of Treats and Decreases Competitiveness in the Food Industry of Coastal Baja California, Mexico]. This chapter presents the impact of atmospheric pollution on the food industry along the coastal zone of Mexico.

Chapter 13 [Depositional Environment of Phosphorites of the Sonrai Basin, Lalitpur District, Uttar Pradesh, India]. This chapters evaluates the governing factors involved during the process of phosphorite formation, and deposition. In addition, it investigates the marine mineralogy and chemistry of the various rocks.

Chapter 14 [Management of Marine Protected Zones – Case Study of Bahrain, Arabian Gulf]. This chapter explores the ecological and legal contexts of marine protected areas (MPAs) in Bahrain, and evaluates their effectiveness.

Chapter 15 [Monitoring the Coastal Environment Using Remote Sensing and GIS Techniques]. This is only the chapter in this book which involves remote sensing and GIS techniques in order to monitor the coastal environment.

Chapter 16 [Human History of Maritime Exploitation and Adaptation Process to Coastal and Marine Environments – A View from the Case of Wallacea and the Pacific]. This chapter investigates the historical maritime exploitation and adaption of the environmental coastal zone.

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