Chapter 1

Introductory Chapter: Introduction to Sea Level Rise and Coastal Infrastructure

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http://dx.doi.org/10.5772/intechopen.77193

1. Introduction

Sea level rise and coastal erosion had drawn an increasing awareness recently as the repercussion of increase of sea level and coastal erosion would reshape the earth system and induce to a tremendous loss in ecological as well as economic cost. Thus, the governments of various countries and cities are dedicated to meliorate the occurrence of these phenomena, or else all creations on the earth will suffer from catastrophe. Global warming is one of the crucial factors resulting in the increase of sea level and coastal erosion, and thus the countries have held different conferences, for example United Nations Climate Change Conference, which required the countries cooperating to lower the global temperature and hence the phenomena of the increase of sea level and coastal erosion can be alleviated. Remote sensing and geographic information systems (GIS) [1] are thoroughly adopted to monitor the dynamic change of the nature system such as coastal land use and land cover, sea level rise, and coastal infrastructure.

2. Sea level rise

Sea level generally refers to the mean sea level observed over a long period of time that the average of sea level is in between high tide and low tide, which is a dynamic level changing at various temporal and spatial scales. The average sea level refers to the mean height of the sea level over a month or a year that the fluctuations caused by tides, waves, wind, and air pressure are eliminated during certain period of time [2]. Wind is the most dominant agent changing the sea level by blowing wave. Low air pressure pulls up the sea level and vice versa. Tide is a combined product by the gravitation force of the Moon and the Sun, and different

places have different tide patterns and magnitude, for example, semidiurnal in Hong Kong. Besides, there are other factors that contribute to variation in longer time scale. The increase of the sea temperature that expands the water mass is known as thermal expansion, and there is a seasonal pattern of sea level change on Northern and Southern hemisphere, as Northern Hemisphere covers more land than Southern, and water is therefore stored as snow and ice during the Northern Hemisphere's winter that lower the sea level, vice versa for summer.

Apart from the nature effect, human input is one of the most factors resulting in sea level change. Starting from the Industrial Revolution, human activities have been increasing its power on the sea level change as greenhouse gases emitted from the burning of fossil fuels warms the global temperature which accelerates the melting of water stored in cryosphere. These melted ice return to the sea and increase the mass of the ocean. At the same time, the warming globe increases the sea temperature as water heating up the particles expands and the ocean mass increases, pushing the sea level up.

3. Coastal infrastructure

Coastal infrastructure is the natural and man-made buildings and infrastructures along the coastal area. In order to prevent the coastal erosion and rise in sea level, a number of urban infrastructures are built next to the shoreline, including seawalls, breakwaters, jetties, and groynes [3]. Seawall is made up of sand, granite, steel, geotextile, concrete, sandbags, and wood, which are used to minimize the effect of wave and the occurrence of coastal erosion along the coastal area. The materials of breakwater, jetties, and groynes are similar to seawall that breakwater aims to lower the strength of the wave so as to serve as a protection to harbors and marinas; jetties are adopted to minimize the current generated by wave; and groynes are built for reducing the delivery of sediment.

4. Coastal erosion

Coastal erosion is the shoreline, the verge of land embracing by sea, suffered from landward movement that the coastlines are intermittently altering the geomorphology resulted from natural or anthropogenic jeopardy. Those living in the coastal zone are threatened by coastal erosion that marginally below 70% of the cities with favorable economic development among the world are facing the challenge of coastal erosion and the average population of these kinds of cities is almost 60% [4], for example, the population in Australia, Mexico, the United States and China were in between 70 and 80%. That is, coastal erosion is a concern worldwide that immensely influences the economy, society, and environment. Coastal erosion management, therefore, should thoroughly be planned by the authorities and pertinent professions based on the geography, and the need of local inhabitants in order to minimize the disastrous effects brought by coastal erosion. The processes of coastal erosion mainly are corrosion, hydraulic action, attrition, and solution. There are several types of coastal erosion, including high momentum waves, weathering, bioerosion, and mass movement [5] that basically caused by the climate, waves, currents, rocks along the coastal areas, global increase of sea level, and

human interference, for example constructions of dams, extraction of sand, and tourism [6]. The phenomenon of coastal erosion is a worldwide issue adversely affected the countries being proximate to the sea, in particular, the areas teeming with inhabitants and biodiversity as they are threatened by the changing shape of coastline in case of no adequate adaptations and protections.

The process of corrosion is that the waves containing different types of materials are repeatedly dumped against the coastal and eventually results in erosion along the coastal [7]. Hydraulic action is that the moving water carries enormous of energy and they continuously collide to the cliff and the surface of rocks. For attrition, the waves involving materials crash the coastal and the materials ultimately are broken down into fragments and turn to be smoother over a certain period. Solution is the process that the rocks along the coastal zone involving the minerals chemically react with the sea water and hence the minerals are dissolved by this chemical action. After a period of time, the coastal zones suffer from erosion by dissolving the rocks [8]. The erosion process is mainly combined by these procedures.

5. Aims of this book

This book aims to examine the impact of sea level rise and coastal infrastructure on coastal erosion, coastal vegetation or environment, and coastal disasters from field measurements and remote sensing data using geographic information systems (GIS). The significance of this study is the integration between different aspects of sea level rise and coastal infrastructures with their impacts on coastal erosion and coastal disasters. Most of the work represented in this book is based on accurate in-situ observations.

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References

[1] Bouchahma M, Yan W, Ouessar M. Island coastline change detection based on image processing and remote sensing. Canadian Center of Science and Education. 2012;**5**:27-36

[2] Baede APM editor. Annex I glossary. In Climate Change 2007: The Physical Science Basis. In: Solomon S, Qin D, Manning M, Chen Z, Marquis M, Averyt KB, Tignor M, and Mille HL, editors. Contribution of working group I to the fourth assessment report of the inter governmental panel on climate change. Cambridge: Cambridge University Press; 2007. pp. 941-954

[3] Pinn EH, Mitchell K, Corkill J. The assemblages of groynes in relation to substratum age, aspect and microhabitat. Estuarine Coastal and Shelf Science. 2005;**62**:271-282

[4] Chen JY, Chen SL. Estuarine and coastal challenges in China. Chinese Journal of Oceanology and Limnology. June 2002;**20**(2):174-181

[5] Maglara M. Estimation of Exposure of Elafonisos Coast on Coastal Natural Hazards. Athens: Harokopion University, Department of Geography; 2011

[6] Doukakis E. Coastal vulnerability and risk parameters. European Water. 2005;**11**(12):3-7

[7] Van der Werf JJ, Donoghue TO, Buijsrogge RH, Kranenburg WM. Practical sand transport formula for non-breaking waves & currents. Coastal Engineering. 2013;**76**:26-42

[8] Callaghan DP, Wainwright D. The impact of various methods of wave transfers from deep water to nearshore when determining extreme beach erosion. Coastal Engineering Journal. 2013;**74**:50-58