Sea Level Rise at East Asia Coasts based on Tide Gauge Analysis


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ABSTRACT

Sea level rise will bring very high impacts to coastal area, including increased coastal erosion, increased flooding risk, more extensive coastal inundation, changes in surface water quality and groundwater characteristics and potential loss of life. IPCC (2007) announced the global average rate is 1.7±0.5 mm/yr for the 20th century. However, this rate is highly non-uniform in the world ocean. The purpose of this study is to know the regional value in the East Asia area. Long-term and qualified records from fifty-eight tide stations collected by PSMSL are used in this study. The linear trend of the sea level changes by least square approach is applied. We confirm the high variation on the sea level rising rates in the study area. At China Bohai Sea, the sea level change is steady within the past few decades. However at the Yangtze River mouth, the rate is large. It is 6.2 mm/yr which is several times of the global average value. A turning trend of the sea level fluctuation is found at the tide stations in Taiwan Island. The average rate of sea level rise of all fifty-eight tide stations is 2.77 mm/yr for the East Asia area. This is 1.6 times higher than global average. In addition, we find the high rising rates happen at the band of Festoon Islands. This verifies the vertical land movement may contribute to some percentage to the sea level rise. To know the quantitative value of the sea level rise for coastal zone management, all causes should be take into account to have the equivalent value of sea level rise. However, to understand the component of sea level rise induced from global warming of the earth, the vertical land movement should be considered.

KEY WORDS: Sea level rise; tide gauge

INTRODUCTION

Sea-level rise is an increase in sea level. Multiple complex factors may influence this change. In most populated regions in the world, sea level is increasing at a rate of only a few millimeters per year (Church et al., 2004), even the expected accelerated future sea level rise is in average normally less than 1 cm/year. However, over time, this gradual developing process has a high potential to alter ecosystems and habitability in coastal regions and many cause bring very high impacts to humanity, particularly on coastal systems (Mcinnes et al., 2003). Such impacts include increased coastal erosion, higher storm-surge flooding, inhibition of primary production processes, more extensive coastal inundation, changes in surface water quality and groundwater characteristics, increased loss of property and coastal habitats, increased flood risk and potential loss of life, loss of nonmonetary cultural resources and values, impacts on agriculture and aquaculture through decline in soil and water quality, and loss of tourism, recreation, and transportation functions, especially for the river delta area or for island countries, such as Singapore and Taiwan in the East Asia Area. (Huang et al., 2004; Ng and Mendelsohn, 2005)

Global sea level has risen about 130 meters since the peak of the last ice age about 18000 years ago. Since 1900 the sea level has risen at 1 to 2 mm/yr; since 1993 satellite altimetry from TOPEX/Poseidon indicates a rate of rise of 3.1 ± 0.7 mm/yr. IPCC (2007) announced Fourth Assessment Report (AR4) showing that the average 20th century rate of sea-level rise is 1.7 ± 0.5 mm/yr. It also clearly indicated that the reasons for sea level rise have been due to thermal expansion, melting glaciers and ice caps and the polar ice sheets. State Oceanic Administration (SOA) of China announced the report of sea level rise situation at Chinese coasts, showing the average rate of sea level rise is 2.5 mm/yr in the past thirty years. The rate will increase to 3.2 mm/yr in the next ten years at Chinese coasts (SOA, 2008). Hong Kong Observatory (HKO) also announced the average rate of sea level rise around Hong Kong’s coasts is 2.3 mm/yr in the past fifty years (1954-2003) and it had been increased to 7 mm/yr since 1993 (Wong et al., 2003). From above reports, we found the rate of sea level rise is around 1.47 times than the global average rate at Chinese coasts. This identified clearly that non-uniform rate of sea level rise in the world’s ocean.

Future sea level rise, like the recent rise, is not expected to be globally uniform. Some regions show a sea-level rise substantially more than the global average, and others a sea level fall. To understand the local value of the sea level rise (or fall) is worthy to provide information for strategies development such as for the coastal zone management to against the natural impacts in the future. The purpose of this paper is to study the regional values of sea level rise at the East Asia coasts.

SEA LEVEL DATABASE

Tide measurement

A tide gauge is used to measure the sea level fluctuations. Since mechanical devices for recording sea level are still in use, but these are