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SPECIAL TOPIC ON REGIONAL CLIMATE CHANGE IMPACTS AND ADAPTATION

A Review of Assessment and Adaptation Strategy to Climate Change Impacts on the Coastal Areas in South China

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Abstract

This paper reviews assessment of climate change impacts on economy, society and ecological environment in the coastal areas of South China based on published literatures; it also proposes suitable adaptation strategies and countermeasures. Review shows that climate change has resulted in sea level rise in the coastal areas of South China, increasing the occurrence and intensity of storm surges, aggravating the influence of saltwater intrusion, coastal erosion, urban drainage and flood control, threatening the coastal facility and infrastructures, inundating lowland areas, offsetting mudflat silting, and degrading mangroves and coral reef ecosystem. Therefore, in order to reduce the adverse effects of climate change and to support the sustainable development in the coastal areas of South China, it is critical to improve the monitoring and early warning system, enhance prevention criteria, fortify coastal protection engineering, strengthen salt tide prevention, and reinforce the ecological restoration and protection.

Keywords: climate change; sea level rise; coastal areas; impact assessment; adaptation strategy

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1 Introduction

South China (3°30′–26°24′N, 104°26′–120°05′E) is located at the southern end of Eurasian continent and faces the South China Sea, consisting of Guangdong, Guangxi and Hainan provinces. Along the over 7,000 km coastlines, there are abundant resources, dense population, huge economic output, and countless national strategic facilities in South China, making it one of the most vulnerable areas to climate change in the Chinese coastal areas [*ECSCNARCC*, 2011].

The IPCC Fourth Assessment Report (AR4) [*IPCC*, 2007a] shows that global climate has undergone a significant warming change: observations demonstrate that the global mean temperature has in-

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creased 0.74°C during the past century (1906–2005), and the warming has even accelerated at 0.13° per decade during recent 50 years. Climate warming makes terrestrial ice/glacier melt and seawater thermally expand, resulting in global sea level rise. The global mean sea level has risen at an average rate of 1.8 mm per year since 1961. Climate change and sea level rise have brought out and will continue to bring out a series of adverse effects on environmental evolution and socio-economic development in coastal regions [*IPCC*, 2007b].

Different regions have different warming rates and sea level rise rates [*Fu et al.*, 2003; *Dong et al.*, 2010]. Under the context of global warming, air temperature in South China increases significantly as well with a rate of 0.16°C per decade during the beriod 1961–2010 [*Du et al.*, 2013]. Climate change accelerates regional sea level rise, exacerbates storm surge and coastal erosions, diminishes the function of flooding-prevention engineering and port infrastructures, aggravates the difficulty of coastal urban flooding drainage and preventions, and deteriorates qualities of water resource and coastal ecosystem. Therefore, it is of significance to assess impacts of climate change on the coastal areas in South China, thus putting up suitable adaptation strategies and countermeasures for regional disaster prevention and mitigation, utilization of natural resources, ecology and environment protection, and sustainable development.

2 Climate change impacts on the coastal area in South China

2.1 *Sea level rise*

In the last 30 years, the mean sea level in the South China Sea, within Guangdong, Guangxi and Hainan provinces, has an increase rate of 2.6 mm per year, similar to the national level but higher than the global level (1.8 mm per year), mostly due to the impacts of global warming and coastal land subsidence. In the next 30 years, the sea level in the South China Sea is projected to be one of the fastest increasing areas worldwide, rising 78–130 mm relative to 2010 for the entire area, and 84–149 mm for Guangdong province, 78–116 mm for Guangxi province, and 85–132 mm for Hainan province, respectively [*SOAPRC*, 2011].

2.2 *More and intensified storm surges*

The coastal area in South China is one of severe areas of storm surges in the nation. Sea level rise and enhancing intensity of tropical cyclones [*Du et al.*, 2013] lift up the base water level of storm surges, resulting in higher peak level of storm surges and increasing coastal water depth, and further intensify the wave force of storm surges and aggravate coastal risk. The peak level of storm surges has risen by 0.76 m at Zhanjiang Port in Guangdong province since the 1960s. Percentage of strong tide ($\geqslant$ 2 m above the local mean sea level) was 4.8% in the 1950s, 7.6% in the 1960s, 10.6% in the 1970s, and 11.8% in the 1980s [*Huang et al.*, 2000]. The frequencies of strong storm surges during 1996–2005 were 2.5 times as that of 1949–1995 in the coastal areas of Guangdong [*Chang et al.*, 2008]. If sea level rises by 30 cm, the return period of severe tide disaster ($\geqslant$ 1 m above the local warning level) would shorten 50%–60%. If sea level rises by 1 m, the present constraining water level at the Chiwan tide gauge station in the Pearl River Estuary, which is designed for the highest tide water level of a 100-year return period, will be lower than that of a 10-year return period, and the highest tide water level for a 50-year return period will be higher than the local standard designed for the maximum highest water level [*Huang et al.*, 2000].

2.3 *Severe saltwater intrusion*

Saltwater is a phenomenon that the water in the lower course of a river in an estuary becomes salty when the river freshwater discharge is low in a dry season (typically in winter) and sea water moves upstream, usually worsened by the tide-flowing. Due to sea level rise and climate warming, the tide level increases; together with increase of precipitation temporal variability and decrease of freshwater discharge, the saltwater intrusion in the Pearl River Estuary is worsening. Saltwater has occurred 9 times in winter since 1989 in the Pearl River Estuary, with 10–15 km farther and 15–20 d earlier. Five of them were severe, three in