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A Numerical Study of the Effects of Coastal Geometry on Storm Surges in the Bohai Sea

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Strom surges are not only determined by the atmospheric forcing, but also influenced by the geological factors of the affected areas, such as the coastal geometry and bathymetry. The coastline geometry changes evidently in many areas of China, especially in the Bohai Sea, where the geometry has changed dramatically both at the tip of the Yellow River Delta and in the vicinity of Caofeidian harbor area due to natural and anthropogenic factors. As the area of Yellow River Delta grows at a mean net accretion rate of 10.02 km2/a and the planning build-up area of Caofeidian industrial park will reach 310 km2 by 2030, the coastline of the Bohai Sea has changed dramatically these years. The storm surge in the changing Bohai Sea may have new characteristics due to the local changing of the geometry. To find out these new characteristics, the influence of the changes of coastal geometry on storm surges is primarily investigated by numerical methods. The coastal geometry of the Bohai Sea in 1976, 2010 and 2030 are involved as three coastal geometry scenarios in this study. A storm surge occurred in Oct. 2003 in the Bohai Sea is modeled based on three coastal geometry scenarios of the Bohai Sea. By analyzing the model results of these scenarios, it is found that the southwest part of the Bohai Sea, especially the top of the Bohai Bay and the Laizhou Bay, suffers the most series disaster of storm surge, and the main changes in the distribution of maximum surge elevation are located in the area south of the Yellow River esturay, where the maximum value of surge elevation is strengthened. By comparing the risk and vulnerability assessment of storm surge in Tanggu, Huanghua and Yangjiaogou, which are susceptible to storm surge in the Bohai Sea, the risk of storm surge in these places are all weakened by the development of the coastal geometry. Particularly in Yangjiaogou, though the maximum value keep almost the same in the three scenarios, the risk and vulnerability of storm surge is still weakened for the surge elevation during the process of water level rising is decreased by the evolvement of the Yellow River Delta.