

Tidal changes in the Tokyo Bay during the last 10,000 years estimated from a numerical model

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Many major inner bays in Japan such as Tokyo Bay, Ise Bay south of Nagoya City and Osaka Bay have experienced a specific pattern of morphological changes during the Holocene: a rapid expansion of bay areas during the early Holocene due to the inundation of incised valleys in accord to the postglacial sea-level rise, which was followed by a gradual progradation of shorelines as a result of sediment depositions more apparent during mid- to late-Holocene when the sea level was stable or fallen by several meters. The current study estimated tidal changes taken place during the last 10ka in Tokyo Bay, where most of the modern bay area exposed subaerially during the earliest Holocene while the length of the bay axis extended up to about twice as large as the modern setting during the mid-Holocene. The estimation has been undertaken by compiling a series of paleobathymetry (every 1ka from 10kaBP to 4kaBP) using various sources and by conducting numerical experiments. It was found that the maximum tidal level at the head of the bay may have increased by 52%-93% compared to the present value during the maximum transgression period (7kaBP). The increase in the tidal prism during the transgressive stage have given rise to a significant increase in the tidal current strength at the mouth of the bay. During the early Holocene, strong tidal currents were also observed at around the modern head of the bay, which might be correlated to the coarse sediments observed at the base of the Holocene layer in this area. These features could be explained qualitatively by employing a simple resonance theory with two parameters, i.e., the water depth and the length of the bay.

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