Secular variations of M_2 tide, its resonant amplification, and the associated energy dissipation in a semi-enclosed sea connected to the East China Sea (Ariake Sea, Japan), 1980–2019.

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After 2000, decrease in M_2 tidal elevation amplitude have been obverved in and around a semi-enclosed shallow embayment connected to the eastern East China Sea, Ariake Sea. In this study, we present an updated analysis of the secular variation of M_2 tide in Ariake Sea by introducing the bottom friction and its nonlinearity, which have not been explicitly considered in the tidal studies of the Ariake Sea. Over the last five decades, M_2 tidal elevation amplitude has decreased at an average rate of ~−11 % century^{-1} both inside and outside of the sea. The result of the analysis indicated that linear bottom drag coefficient had decreased at ~−10 % century^{-1}, suggesting that if the quadratic bottom drag coefficient was unchanged, mean M_2 velocity in the sea also had decreased at the same rate. Comparing 1997 and 2015, when the lunar nodal factor for M_2 tide was nearly at its maximum, we found that the energy dissipation of M_2 tide decreased by ~11 % in 2015. The possible causes of these decreasing trends were changes in the frictional resonance properties of the sea and change in the incoming M_2 tide from the East China Sea.

Keywords: Changing tides, Ariake Sea, Bottom drag, Tidal energy dissipation

