

Physical structure and mixing processes in the inner part of Tokyo Bay

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Numerous physical processes are involved in coastal regions of freshwater influence, e.g., river plume dynamics, tidal mixing, internal waves. In the inner part of Tokyo bay, one of the regions of freshwater influence, strong stratification often appears resulting in hypoxia and blue tide, which significantly influences ecosystems. Although there have been numerous studies on physical structures in Tokyo bay, few studies have focused on mixing process in the inner part of the bay. In this study, we analyzed data from long term observations at the Chiba light beacon located at the inner part of Tokyo Bay to understand physical structures associated with mixing process. The observational data showed that hypoxia events occurred with appearances of high density water in the bottom layer. The ratio of the vertical density gradient and vertical shear, namely the Richardson number, well explains appearance of hypoxia events. The wind stress largely influenced vertical mixing, rather than tidal currents. We calculated modified versions of the horizontal Richardson number (R_x^{wt}) developed by Burchard [2009]. Bottom hypoxia events occurred when R_x^{wt} were over 2.1×10^{-3} of critical value of stable stratification. The horizontal physical structure can be used to explain the vertical physical structure. By comparing R_x^{wt} with zonal winds, R_x^{wt} was over approximately 2.1×10^{-3} when east wind below 5 m/s. This suggests that weak offshore winds promote the upwelling of bottom hypoxia water mass from offshore rather than mixing. Weak winds less than 5 m/s enhance stratification in the inner part of Tokyo bay.

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