Seasonal variation in hypoxia and its behavior in the Upper Gulf of Thailand

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Upper Gulf of Thailand (UGoT) faced to Bangkok of capital city of Thailand is one of the important coastal areas because of high fishery production. Recently, enormous organic matters and nutrients are supplied from land area through 4 large rivers. As the result, eutrophication, red tide, and hypoxia occur and marine environment in the UGoT becomes worse. In fact, cultured mass mortality of shellfishes happens every year at aquaculture farm in the eastern part of UGoT. Regardless of the circumstance, dissolved oxygen (DO) distribution and its seasonal variation are unclear due to limitation of observed data there. In the present study, we have conducted 7 times field survey from 2014 August to 2015 June at stations covered whole UGoT. It is found from our observation that hypoxia occurs from June to November and DO concentration in the bottom layer is less than 1 mg/l. As for distribution of hypoxia, hypoxia happens in the central part of bay head in June and then expands to northeastern part of the bay head. The hypoxia occurs in the half of UGoT in September and distributes in the northwestern part of the bay head. It is noteworthy that location of hypoxia changes from eastern side to western side of bay head through June to November. Since UGoT locates in tropical region, density stratification is formed by fresh water supply from rivers. Therefore, it is expected that distribution of hypoxia relates to that of surface salinity. However, we cannot see such relation. On the other hand, oxygen consumption rate in the water correlates surface chlorophyll-a concentration. Although we have compared DO concentration in the bottom layer with intensity of stratification, oxygen consumption rate, surface chlorophyll-a, and so on, we could not explain the movement of hypoxia area from east to west.
When location of hypoxia changes from east to west, monsoon direction also changes from southwest to northeast monsoon. It is expected that circulation in the UGoT is varied by variation in wind field and low DO water mass transports to the other area. We develop a 3-dimensional numerical model to reproduce current fields during our observation period. In the model, we consider tidal, density-driven, and wind-driven currents applying tidal variation at open boundary, river discharge from 4 large rivers, and wind and net heat flux at sea surface. The model well reproduces tide and distribution of water temperature and salinity. From the results of the model, it is found that bottom circulation changes when hypoxia area in eastern part of the bay head moves to west. We are developing lower trophic ecosystem model with 5 compartments, nutrient, phytoplankton, zooplankton, detritus, and DO. At the presentation, we will explain generation mechanism and cause of movement of hypoxia from the results of the coupled physical-ecosystem model.

Keywords: Hypoxia, Tropical region

