Coastal and marine ecosystems, biology and ecology

Subsurface Chlorophyll Maximum In A Stratified Estuary

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Estuaries are formed around the river mouths, where lighter fresh water meets denser sea water. Many comparative studies have shown that production in estuaries is highest in marine systems, although there is a great deal of variety in mixing processes and salinity distributions. This study was conducted in the Yura Estuary, which is highly stratified because of the small tide, facing to the Sea of Japan. Seasonal and temporal variety of river discharge affects the dynamics in the estuary; the salt wedge intrudes into the bottom layer in summer when the river discharge is low. Consequent primary production is high in summer and a chlorophyll maximum is generated around the halocline, indicating that the salt wedge plays an important role in the ecosystem in the estuary. A hydrodynamic-ecosystem coupled model was developed to investigate the formation mechanism of a chlorophyll maximum in the subsurface layer in the Yura Estuary. The model results show that salinity and chlorophyll distributions agreed well with field observations. In addition to the seasonal variation, the salt wedge responds over short time scales according to the flood events, and consequent distribution of chlorophyll frequently changes. Marine diatoms grow using a plenty of nutrients from the river when the salt wedge is formed in the bottom layer. However, production around the halocline is not always higher than the other layers. Direct measurements of the primary production in the Yura River showed the highest production in the surface layer, supporting the model results. These results indicate that the retention of advected phytoplankton is important for formation of the chlorophyll maximum in the subsurface layer in the Yura Estuary.