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Temporal and spatial distribution of dissolved oxygen in the Pearl River Estuary and adjacent coastal waters

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Abstract

The Pearl River is one of the large rivers in the world and it discharges to the northern part of the South China Sea. There has been a concern about the deterioration of dissolved oxygen conditions in the Pearl River estuary and adjacent coastal waters. In this study, historical data on dissolved oxygen (DO) from 1980s, recent data from a summer cruise in 1999, and a 10-year time series in DO for 1990–2000 were used to examine spatial and temporal distribution of DO in the Pearl River estuary and adjacent coastal waters near Hong Kong. In the adjacent coastal waters, low oxygen waters $<4 \text{ mg l}^{-1}$ occurred in large areas during the summer of 1981, but DO rarely dropped to $<3 \text{ mg l}^{-1}$. In the Pearl River estuary, DO was $3.5\text{--}4 \text{ mg l}^{-1}$ in the eastern part, but was $>4 \text{ mg l}^{-1}$ in the western part in August 1984. In July 1999, DO was $<4 \text{ mg l}^{-1}$ in a near bottom 2 m layer in a large area of the estuary and was $<2.5 \text{ mg l}^{-1}$ in the

eastern section, just inside the entrance of the estuary. In the coastal waters adjacent to Hong Kong, DO was $>4 \text{ mg l}^{-1}$. The 9-year time series showed that DO decreased periodically in summer, but rarely dropped to $<3 \text{ mg l}^{-1}$. There was no apparent trend of decreasing DO between 1990 and 2000. Compared to August 1984, DO decreased significantly during the summer of 1999 in the Pearl River estuary, but large scale hypoxia ($<2 \text{ mg l}^{-1}$) was not observed. The spatial distribution of low oxygen waters may be controlled by estuarine circulation because DO was significantly correlated with salinity in the summers of 1981 and 1984. Furthermore, the spatial distribution of DO in the bottom layer was parallel to the topography of the bottom, indicating the importance of benthic consumption of DO in the sediment and the subsequent flux of low DO waters from the sediment-water interface resuspended by physical mixing. Relative to the high loading of nitrogen from the Pearl River, the present PO_4 concentration is still low. It is possible that the lack of large areas of hypoxia in the region may be linked to phosphorus limitation as shown in the previous study. Phosphorus may also be a limiting factor for bacterial decomposition which has a strong control on total oxygen consumption in the water column and sediments.



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Keywords

Pearl River estuary; Dissolved oxygen; Hypoxia; Phosphorus; Hong Kong

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