Modeling the Distribution and Origin of Pollutant in North Zhejiang Coastal Areas

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ABSTRACT

Fishery resources decreased dramatically in North Zhejiang coastal area. It is crucial to picture the pollutant distribution character, to analyze the pollution developing tendency and to identify the pollution origin so as to take effective management measures to reduce the decreasing trend. Coupled with the field monitoring data, a three dimensional mass transport model has been proposed. The concentration distributions of nutrients and COD have been simulated. The results showed that eutrophication was the main environmental problem at most of the area especially where the runoff impact is significant. We also found that the effluence from Changjiang and other rivers is another important pollutant origin, and it accounts for about 85 percent. It is suggested that point source control is important; to carry out integrated coastal management may be a more powerful approach for coastal environment protection.

KEY WORDS: Nutrient concentration; numerical model; north Zhejiang coastal area; pollutant transport; boundary sources

INTRODUCTION

Nearly 60% of the world’s population live within 60 km from coastline and use the coastal resources directly or indirectly for their livelihood. The multifarious demands on the coastal zone has already resulted in overexploitation of marine resources and marked degradation of coastal habitats and environment. Industrial and urban pollution including sewage, solid waste and chemical discharges combined with unplanned construction activities and land reclamation have resulted in appreciable and measurable changes to coastal environment in many countries (Zheng, 2003, 2004; Even, 2007; Kim, 2009). Such changes pose problems for environmental management in both developed and developing countries. Besides, natural calamities including floods, storms, and other episodic events affect the utilization of resources and complicate the management problem. In addition to the current problems of coastal pollution, habitat degradation, coastal erosion, harmful algal blooms must be added to the threat of global climatic change. Coastal pollution can have readily apparent and immediate impacts, such as oil spills, the closure of beaches, or fish mortality due to toxic contaminants. This type of pollution can be very serious but it is usually short term. The effects of chronic pollution, such as excess nutrients and persistent toxic contaminants can be subtle, leading to long-term effects.

The same as other coastal areas, with the development of coastal industries, marine aquaculture and other human activities, environmental problem have been a serious issue in North Zhejiang Coastal Area. Geng (1991) predicted the pollutant of oily wastewater by finite element method. Cao (1994) analyzed the pollutant transport characteristics with currents. Improved ECOM model has been applied to simulate the tidal current characters (Zhang, 2005). It is nutrient rich in this area with high Chl-a concentration and high primary production rates. However, are human activities along the coastline of North Zhejiang the only reason for degradation of coastal environment? There is no quantitative analysis about this problem. The great influence from Changjiang Diluted Water should be considered when discussing the pollutant distribution of North Zhejiang Coastal area. In summer, the Diluted Water propagates across the shelf because of the combined effect of high discharge and the prevailing southerly wind. During this time, the diluted water covers most of the northern part of East China Sea. In winter, the diluted water flows southward along the Chinese coastline in a narrow band because of the low river discharge and the prevailing northeast wind. Qiantan also has the same impact to this area. We take the diluted water as a boundary source of North Zhejiang Coastal Area. The contribution of the rivers for North Zhejiang Coastal Area has been discussed by the model results.

This paper will focus on developing a numerical mass transport model in North Zhejiang Coastal Area to identify the spatial distribution of water quality components and the effluence from rivers. The paper is organized as follows. In section 2, the study area is described. In section 3, the model is given. In section 4, model results are provided and discussed. Finally, conclusions are summarized.

STUDY AREAS

North Zhejiang Coastal Area is at the north of East China Sea (Fig.1). About 3061 islands located in Zhejiang coastal area which account for 43.97% of total islands in China. The existence of numerous islands leads to complex watercourse and water depth; what’s more, diffraction and reflection phenomena occur when tidal waves reach this area. There is also extensive water exchange between East China Sea and the Kuroshio Current, which increase the complexity of the hydrodynamics.