Current Characteristics and Their Forming Mechanism in Beilun Estuary

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ABSTRACT

Beilun River is the boundary river between China and Vietnam. Since the beginning of 1970s, its main channel of the entrance to the sea has been migrating, and therefore it is particularly urgent to study on Beilun Estuary. The evolution features of the estuary are analyzed from the respect of riverflow and marine dynamics. A three-dimensional hydrodynamic model of Beilun Estuary and its adjacent sea areas is set up to simulate and analyze the characteristics of tidal current field, showing that the current characters are different during flood and ebb tides, and have subtle vertical variations. It is found that the more layers the higher precision in the numerical calculations. Results can provide better understanding and reasonable scientific basis for the regulation, development and protection of Beilun Estuary.

KEY WORDS: Beilun Estuary; evolution analysis; three-dimensional mathematical model; tidal current characteristics.

INTRODUCTION

With rich natural resources, descendant geographical positions and a distribution of 80% of cities in the world, estuaries are the ideal places for human life and production as well as carrying out scientific researches. An estuary is a partially enclosed coastal body of water that is either permanently or periodically open to the sea and which receives at least periodic discharge from a river, while its salinity is typically less than that of natural sea water and varies temporally and spatially (Yan et al., 2000; Potter et al., 2010). Based on the interaction of the riverflow and the sea, estuaries are the most active regions where various dynamic factors are inter-permeated and inter-restricted (Qiu et al., 2003).

The connectivity between the catchment and the sea via a river provides estuaries with unique hydrodynamic characteristics. Tides and freshwater inflows are the two major external forcing mechanisms controlling estuarine processes, in which the tides lead to periodic seaward and landward transport and reduce the estuary stratification (Ji et al., 2007). The early related study was focused on the tidally averaged momentum balance and the estuarine circulation (Pritchard, 1956), and then a striking feature of the recent work has been shifting towards the influence of tidal variability and turbulence on estuarine dynamics (Uncles, 2002; Zhang, 2010), in which the aspects of intratidal vertical stratification (Geyer et al., 2000; Nepf and Geyer, 1996), salt and sediment transport as well as the estuarine morphology (Hu et al., 2009; Uncles, 2002) are paid much more attention.

Models and theoretical analysis as well as technical software have played significant roles in enhancing the research of the estuarine dynamic process, especially the numerical modeling which is an effective approach to simulate the process of currents, sediments, waves and salinities. The research and application of the three-dimensional estuarine hydrodynamic models are strengthening, particularly in the aspect of calculating efficiency and stability; such existing studies are mainly about the fresh and salt water mixing (Ji et al., 2007; Zheng et al., 2002), estuarine flow structure and morphological analysis (Xu and Wang, 2002; Zheng et al., 2005), tidal current motions and characteristics (Abualltayef et al., 2009; Olivares et al., 2009) and other estuarine hydrodynamic aspects.

Due to the special geographical location, the complex historical evolution process and rare measurement data, the researches on Beilun Estuary were few investigated from the hydrodynamic viewpoint. In this paper, in order to study the hydrodynamics of the estuary, the estuarine evolution characteristics are analyzed from the point of sediment movement influenced by riverflow and marine dynamics; a three-dimensional tidal current model is set up to simulate and analyze the characteristics of tidal current field.

STUDY AREA

Geographical location

As the boundary river between China and Vietnam, Beilun River rises in Bulong Mountain in the south of Shiwandashan Mountain of Guangxi Province, first joins the tributary Xilonghe River near Natong Town, then flows southeast and divide into two tributaries till the