

Three-Dimensional Numerical Simulation for the Yangshan Port Waters

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ABSTRACT

A three-dimensional numerical model FVCOM is applied and model results indicate obvious difference in the vertical direction of the current field in the Yangshan Port area. (1) In the Kezhu Hill waterway, flood current concentrates at the Kezhu Hill side, while the ebb current distributes more evenly, as far as the surface current is concerned, the bottom current is slightly anti-clockwise drift compared to the surface flow field. (2) In the port front area, residual current results show that ebb current dominates, especially at both sides, but at the east mouth, flood current of the bottom layer at left side shows its dominance, which makes aggregation and segregation of residual current locally.

KEY WORDS: Yangshan Port, tidal current, residual current, numerical simulation, FVCOM; aggregation; segregation.

INTRODUCTION

The Yangshan deep-water port, situated at the area of Qiqu Archipelago, is 30km southeast from Luchaogang, the southeast point of Shanghai mainland. The Qiqu Archipelago contains two island chain south and north which separately dominated by Dayangshan and Xiaoyangshan (Fig. 1). There are 69 islands distribute in this sea area with about 10.72 km² area. Between the two island chain is the port front domain, which seems narrow at east and wide at west. The east mouth (Dayangshan to Xiaojiaoyan) is about 1km wide while the west mouth (Dawugui to Xiaojiaoyan) is about 7.5km wide. The inner area is about 20km². Water depth in this area shows deep in the east and shallow in the west. The east mouth acts as a deep channel where the deepest point is over 80m. Though the water depth decrease from east to west, it's still normally greater than 10m at the west mouth, these conditions are great for building deep-water port. Nowadays, a grand scale deep water port has been constructed on the Xiaoyangshan island chain (shadows in Fig. 1), several big branches between islands in Xiaoyangshan chain have been blocked through reclamation works to build great amount of areas for docks simultaneously. A bridge and a sea dike road which connect the island Kezhushan with Janggongzhu in the south and Dawugui in the north, since then, the Xiaoyangshan chain as a whole can be linked to Shanghai mainland through the East Sea Bridge, a 38 km long cross-sea bridge

Water current in Yangshan deep-water port is complex, as for the Yangshan port management and maintenance, especially its further development, a careful and comprehensive evaluation of the hydrodynamic and transport characteristics of the local current system

is necessary. Rare field measurements of hydrology or geology had been carried out in this area until the government considered to build the deep-water port here in 1996, field observations of meteorology, hydrology, sediment, geology, etc. were emphasized and conducted. A series of field measurement have been completed since Oct 1996 and abundant data achieved varies from tidal, sea bed morphological to sediment concentration, wave, weather and so on. Based on these field data, specialized research for a better understanding of the beach development history and also a corresponding precised forecast then can be start. Methods varies, from compared with historic chart comparison, physical model experiment to remote sensing analysis. Chen, SL(2000) discovered the seabed was a little alluvial in the recent century, about 2.3cm annually, based on some chart. Wu, MY, Feng, YL, Yan, XX, Liu, GT, and Xu, JS(2002) and Wu, MY, Feng, YL, Yan, XX, Liu, GT, and Xu, JS(2003) studied the way of transportation of current and sediment around these two island chains through fixed-bed models. Yang, H, Xu, JS, and Hou, ZQ(2003) used remote sensing maps to analysis the suspended sediment movement. Xie, WH, Chen, SL, and Gu, GZ (2000) and Yan, XX(2000) summed up the main hydrodynamic characters of current and suspended sediment in the Qiqu Archipelago based the measured data.

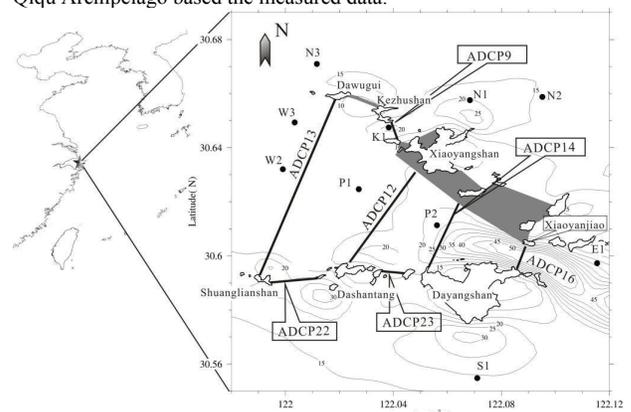


Fig. 1 Location of study area and current & flux profile stations

According to Zuo, SH, Zhang, NC, Li, P, and Yang, H (2009) and Yan, XX(2003), tidal in this area belong to non-normal semidiurnal tidal current, which dominated by M2 constituent, the tidal current is great. Based on the computed result of elliptic factors by quasi-harmonic