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PROCESS CONTROL OF THE SAND WAVE MIGRATION IN BEIBU GULF OF THE SOUTH CHINA SEA*

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Abstract: Based on the environment characteristics of the Beibu Gulf of South China Sea, a quasi-three-dimensional physical model is built. By coupling the bottom boundary layer with the two-dimensional tidal current field near the seabed surface, the quasi-three-dimensional hydrodynamic numerical simulation is carried out. The sand wave migration process is dealt with by coupling the hydrodynamic model with the sediment transport model. The computational results are shown to be in good agreement with the observed data, which indicates that the quasi-three-dimensional physical model can be used to simulate the migration process for small scale sand waves. Then, based on measured data, the evolution of the sand wave migration is investigated. An effective formula is developed to predict the migration rate, in which not only the effects of the environment but also the features of sand waves are considered.

Key words: small scale sand wave, sand wave migration, quasi-three-dimensional physical model, numerical simulation, *in-situ* measurement

Introduction

The Beibu Gulf area southwest to the Hainan Island is frequented with highly active sand waves, where are many pipelines for transporting oil and gas. The sand wave migration may create dangerous states under an abominable marine environment[1,2]. The migration of sand waves causes the exposure of the pipeline in the scour areas, which may result in an environmental disaster. Several accidents of pipeline free span due to the sand wave migration were reported in Beibu Gulf. Therefore, it is very important to study the process of the sand wave migration.

The sand wave migration, including the migration direction and rate, involves many complicated issues. Its study is mostly limited to theoretical analyses and numerical calculations based on empirical formula. Hulscher[3] developed a model allowing for vertical circulation and described the initial evolution of the sand wave based on a horizontally averaged symmetrical tidal motion. In general, submarine sand waves are formed due to the ocean current transportation and the submarine sandy deposition. The steep slope points basically in the same direction as the preferential flow. Nemeth et al.[4] developed a model describing the formation and the migration of sand waves in the infinite medium based on a stability analysis, with which the initial evolution and the migration of sand waves may find an explanation and where the periodic water motion (M_2) is taken into account in combination with the steady part (M_0). Besio et al.[5] extended their model by including an M_4 tidal constituent and the effect of the suspended sediment transport in a linear analysis. These models are basically semi-empirical and mainly applied to the sand waves with a long wavelength, which may be called the large scale sand waves.

In the Beibu Gulf area, the average wavelength of the sand wave is about 30 m and the sand waves

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