Chapter 7
Modelling of Hydrodynamics and Sediment Transport at Pantai Tok Jembal, Kuala Terengganu Mengabang Telipot, Terengganu, using MIKE 21

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ABSTRACT

This study is mainly concerned with simulation of hydrodynamics behaviours and sediment transport characteristics at coastal areas. The field data of the coastal area at Mengabang Telipot recorded by Institute of Oceanography at University of Malaysia Terengganu for January and February of year 2009 have been integrated with two-dimensional modelling system, MIKE 21. A hydrodynamic module of MIKE 21 has been used to simulate the hydrodynamic flow of the study area and the output was integrated with the non-cohesive sediment transport module to model the sediment transport patterns, capacity, and bed level changes. The effect of wave-current interaction is included in the simulation. The model simulates the hydrodynamics satisfactorily with mean current velocity 0.15 ms^{-1} and 0.10 ms^{-1}, respectively, with maximum value up to 0.40 ms^{-1}. Simulated sediment transport pattern spreads eastward predominantly and suggest an average capacity below 400 m^3/yr/m. Initial rates of bed level changes vary between -0.01 m/day to 0.01 m/day. Outcome of the simulation is expected to be representative and give hydrodynamics and sediment logical information of the area.

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INTRODUCTION

Sediment transport plays an important role in coastline and morphology changes of coastal area. Meanwhile, coastal areas are of great economic significance to mankind. Accordingly, the knowledge of hydrodynamic is necessary in a variety of applications including design of coastal structures, sediment transport, coastal erosion and pollution transport studies (Moeini and Shahidi, 2007). A sustainable development of economic activities in coastal areas requires long term data regarding their environmental conditions. Being able to predict the coastal phenomena is necessary with regard to some coastal engineering problems and their accompanying solutions. This makes forecast of hydrodynamics, erosion, deposition and transport of sediment in coastal area of great interest. Apparently, the modelling of sediment transport with the hydrodynamics in coastal areas has great economic value (Liang, Li and Lee, 2007). Thus, modelling of hydrodynamic and sediment transport will be of major importance in future. Numerical simulation models will have a great potential when attempting to estimate development of coastal systems. These simulation models make it possible to estimate changes in hydrodynamic behavior and quantify the erosion, deposition and transport of sediment over a large area for a given period (Lumborg & Windelin, 2003). Based on research carried out by Mehta et al., (1989), Teisson, (1991), Mulder and Udink, (1991), and Toorman, (2001), numerical hydrodynamics and sediment transport models had been developed in recent decades since the middle of the 20th century (as cited in Lumborg & Pejrup, 2005), and commonly used to predict the hydrodynamic and morphodynamic response of low crested structures (Martinelli, Zanuttigh and Lamberti, 2006).

Among these models developed, the model suite developed by Danish Hydraulic Institute (DHI) had been widely used to carry out simulation of hydrodynamics, advection-dispersion, short waves, sediment transport, water quality, eutrophication and heavy metals (Hu et al., 2009). Research from Lumborg and Pejrup (2005) had point out that numerical hydrodynamic models can describe complete estuarine systems on timescale of years to decades provided with key parameters that measured from field data. Numerical modeling is a good and an effective approach for this job. Though the general situation of numerical simulation may seem quite clear, it remains to be a very complex problem on mechanics of multi-phase media (Amromin & Kovinskaya, 2003). There are many problems that arise when the coastal profile has to be studied and traditional approach is not able to handle the complexity of the problem in a holistic approach. Limited extend and the restriction of scales and sizes often boundary the studies of hydrodynamics flow processes in coastal area with physical model. Due to the complex hydrographical and sedimentological circumstances, it is difficult to investigate the overall sediment dynamics using methods like point measurements of current velocities and suspended sediment.

In this study, it was attempted to set up a numerical model to satisfactorily describe and model the hydrodynamic behavior and sediment transport characteristic at coastal area of Mengabang Telipot, Kuala Terengganu, using analytical and numerical modelling system over the period of January 2009 and February 2009. This study includes generation and analysis of data using 2-dimensional microcomputer based modeling system correspond to hydrodynamics behaviors and sediment transport characteristic at coastal area at Mengabang Telipot for the period of January 2009 and February 2009. The study was divided into two scopes where the hydrodynamics and sedimentological characteristic of the study area were presented at the end of this study. First, the model was setup by use a combination of field data and parameter derived from existing literature. The field data were retrieved from the historical gauged records at Institute of Oceanography, University of Malaysia Terengganu and parameters

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