Numerical Modeling of Sediment Transport along the South Coast of Qeshm Island

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Abstract;
In this project by using Delft3D software, the phenomenon of tides by using amplitude information of water level in the entire Persian Gulf and part of Oman Sea modeled to identify and predict the tide. Comparing the simulation results of tidal amplitude information from water level measurements in Souza and Bandar Lengeh stations indicating a very good fit of the model and demonstrated that the phenomenon of tides is predictable. The tide model set as base of sediment transport simulation. In this study, Badiee et al.`s Wave model output has analyzed Statistically in order to identify the dominant coastal waves and the characteristics of the waves height was classified according to their probability. Studies of analyzing waves And evaluation of the sediment grain size and sediment type, cause that desired coastline divided into three smaller regions because of different wave climates and diverse sediment grain sizes, So that every regions has its own wave climate, sediment grain size and sediment type and finally wave rose of each regions was drawn. Combined effects of tide and dominant waves investigated on the coastline sediment transport pattern. Results of sediment transport simulation indicates that dominant direction of sediment movement is from west to east and from Eastern side of the Qeshm Island to the West side, The intensity and velocity Variations of Long shore and cross shore sediment is reduced that Badiee et al.`s study confirm these results.
Online Submission Module.
Keywords: Qeshm Island Shore, Persian Gulf, Hydrodynamic, Sediment Transportation Pattern, Delf3D

1. Introduction

Qeshm Island with an area of nearly 1,500 square kilometers has the most of the beaches and shores among Islands of the Persian Gulf. This island, with extensive coast and high biodiversity, is one of the most important coastal areas in Iran. Because of Increasing industrial and urban expansion towards the coast, the beaches worthy of survival and stability is very important. The main objective of this study is dominant sediment transport modeling and its effect on the morphology along south coast of Qeshm Island and In fact this study is a continuation of Badiee et al. `s study [1]. To achieve this goal, first it is necessary to dominant influencing factors on Variations of coastal sediment have to be known and its value has to be calculated. Then combined effect of these phenomena should be studied on desired area. These factors include the phenomenon of tides and coastal waves, which is affected by wind and waves in deep water.

2. Numerical Modeling

The CFD method is convenient and time saving. In this project, Delft3D software is used in numerical modeling. First in order to identify and predict the tide, tides phenomenon is modeled by using amplitude information of water level due to the tide in the entire Persian Gulf and part of Oman Sea As form of a comprehensive model (fig.1).

Fig. 1. Studying area in tidal model (Persian Gulf comprehensive model)

Then for investigation of sediment transport pattern of Qeshm island south coastline, studies of analyzing waves And evaluation of the sediment grain size and sediment type, Indicated that desired coastline of Qeshm island has different wave climates and diverse sediment grain sizes. Therefore area of simulation on the coastline was divided into three smaller regions named M1, M2 and M3; So that every region has its own wave climate, sediment grain size and sediment type (fig.2).

Fig. 2. Studying area in sediment transport pattern modeling

2.1 Grid generation

After model design, dry boundary of model entered in Delft3D-RGFGRID and computational grid generated for both Persian Gulf comprehensive model and local coastline model in sediment transport pattern modeling. Also grid and domain study methods implemented and different computational grids generated with various quality and characteristics for ensuring from independency of simulation from computational grid. In computational grid generation, mesh density control is also applied in order to save computational power and time by having coarser grids at the boundaries of the domain and finer grids near area of interests and where the geometries are more complex. (fig.3).

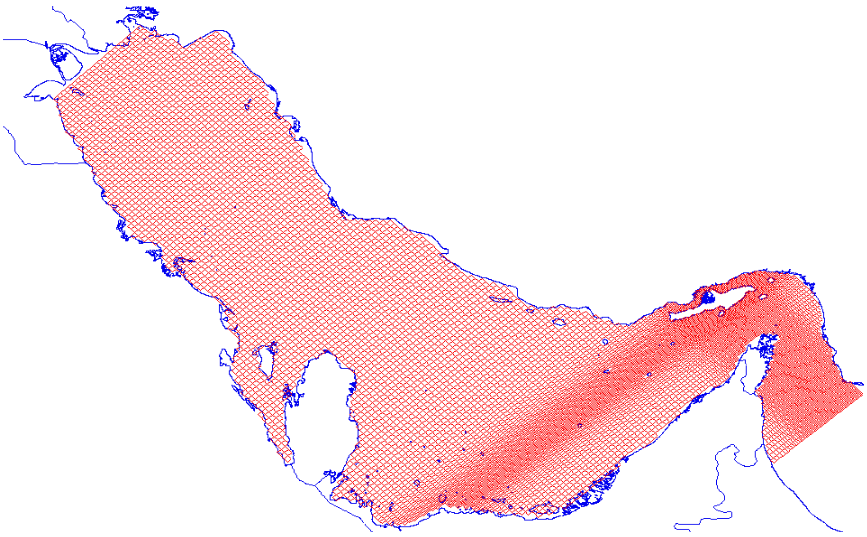

Fig. 3. Computational grid generated for Persian Gulf comprehensive model

In addition, to avoid generating any highly skew mesh, mesh control is also needed to ensure that the transition from fine to coarse mesh is smooth. After implementation of computational grid and domain study methods, mesh refinements done in five steps. The total number of cells in chosen computational grid is approximately 4.5 million. This is thought by the authors to be rough to give accurate results but proper to capture the characteristics of flow characteristics.

3. Results

Results of this article are classified in three major part consist of Persian Gulf comprehensive model results, Badiee et al. `S wave model Statist analyze results and results of sediment transport pattern modeling.

3.1 Persian Gulf comprehensive model

Calibration of tidal model is done with bed shaggy coefficient and numerical data are compared with field data [2] of water level variation. Comparing the simulation results of tidal amplitude information with water level measurement of Souza and Bandar Lengeh stations, indicating a very good accordance of the model and demonstrated that the phenomenon of tides is predictable (fig.4,5). Therefore, tidal model set as the base of sediment transport simulation.

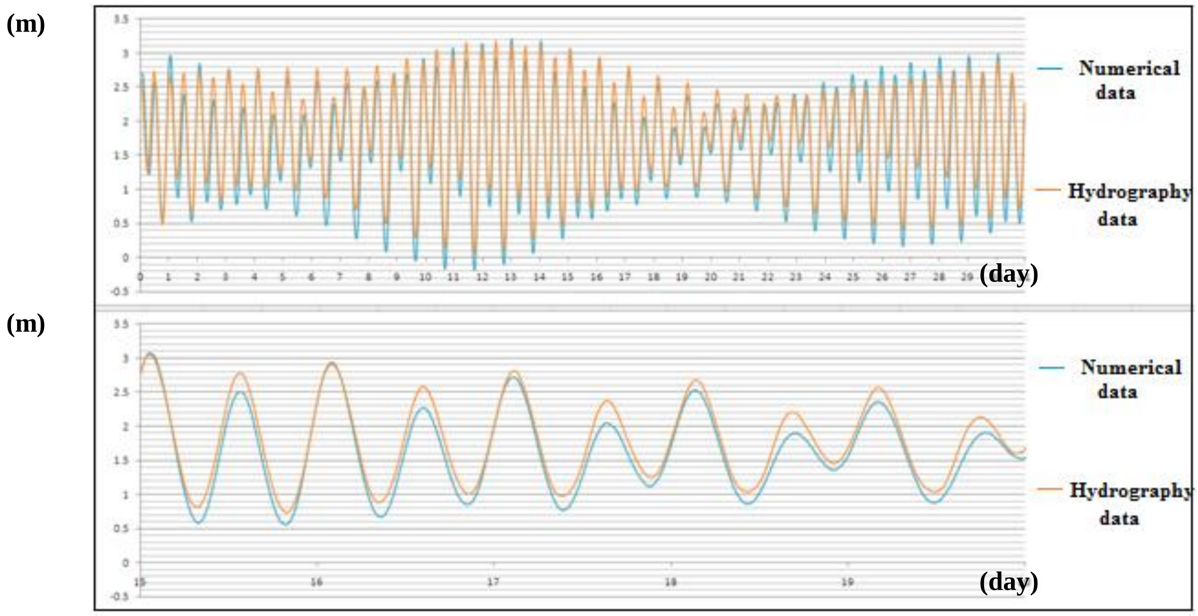

Fig. 4. Comparing numerical data with field measurements of tidal amplitude in Souza station

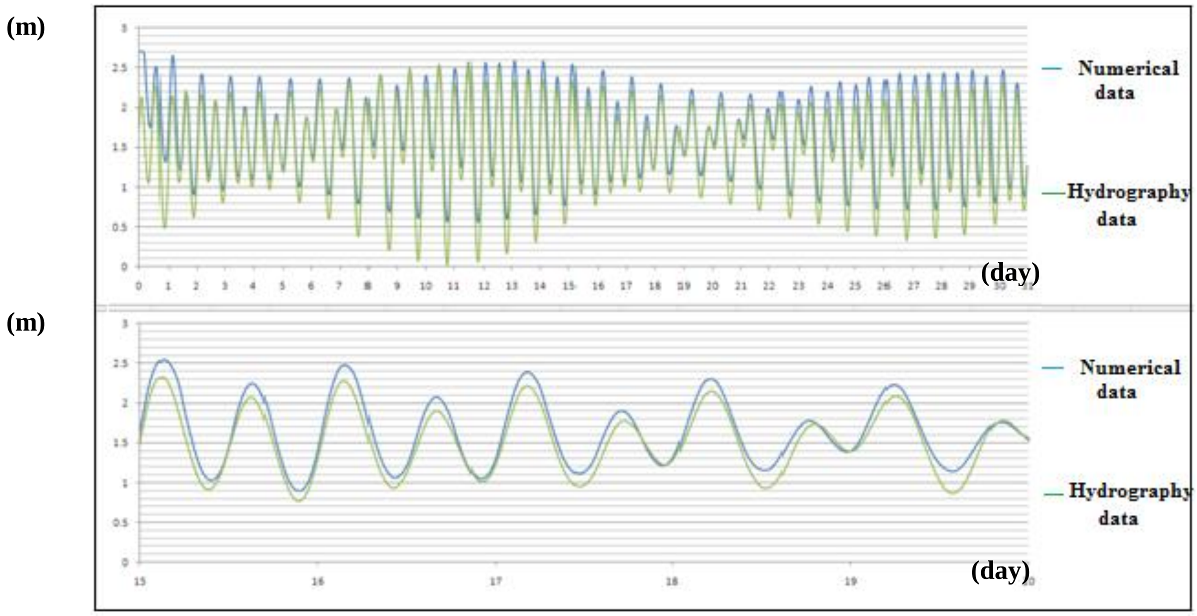

Fig. 5. Comparing numerical data with field measurements of tidal amplitude in Lengeh station

3.2 Wave model Statist analyze based on wind and deep water waves

Badiee et al.`s wave model used to continue the simulation. In order to identify the dominant coastal waves, Badiee et al.`s Wave model output for a period of 27 (1983-2009) years has analyzed Statistically And according to their characteristics such as waves height and Occurrence probability classified in M1,M2 and M3 area. Wave rose of each region drawn for M1, M2 and M3 area from right to left as illustrated in fig 6, 7 and 8.

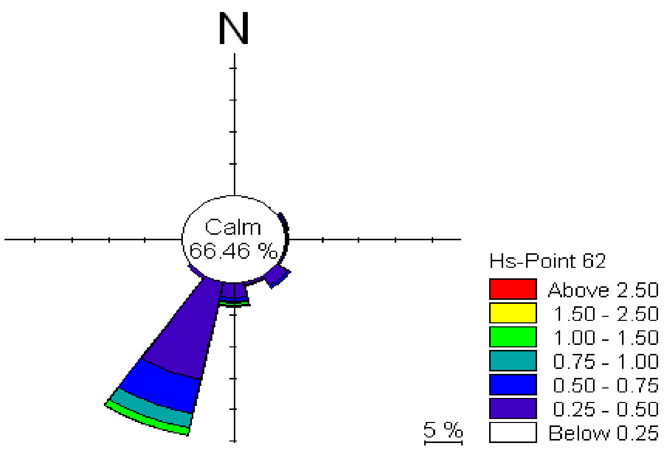

Fig. 6. Wave rose of M1 area

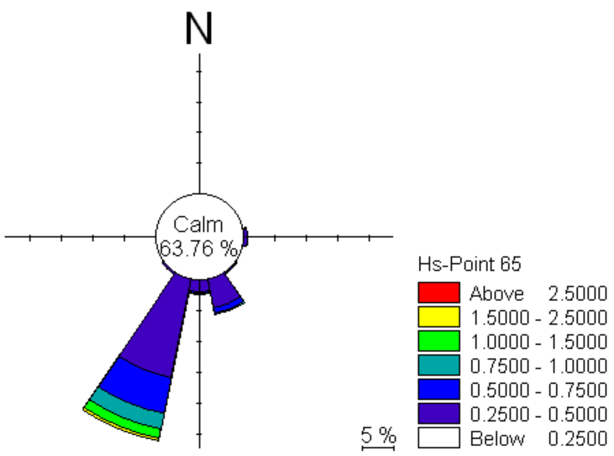

Fig 7. Wave rose of M2 area

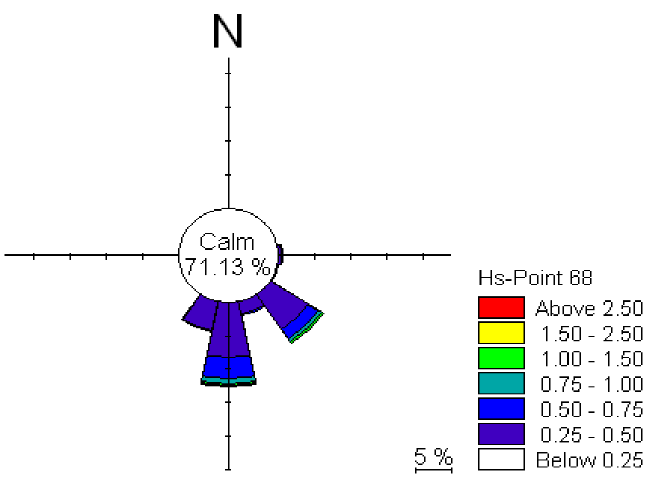

Fig 8. Wave rose of M3 area

3.3 Sediment transport pattern model

Results of sediment transport simulation, indicates that dominant direction of sediment movement is from west to east and from Eastern side of the Qeshm Island to the Western side, The intensity and velocity Variations of Long shore and cross shore sediment is reduced that Badiee et al.`s study confirm these results. Contours of variation in cross shore bed level due to sediment transport are illustrated in fig.9, fig.10 and fig.11. Contours show that rate of sedimentation and scour in M2 and M3 area are less than M1 area.

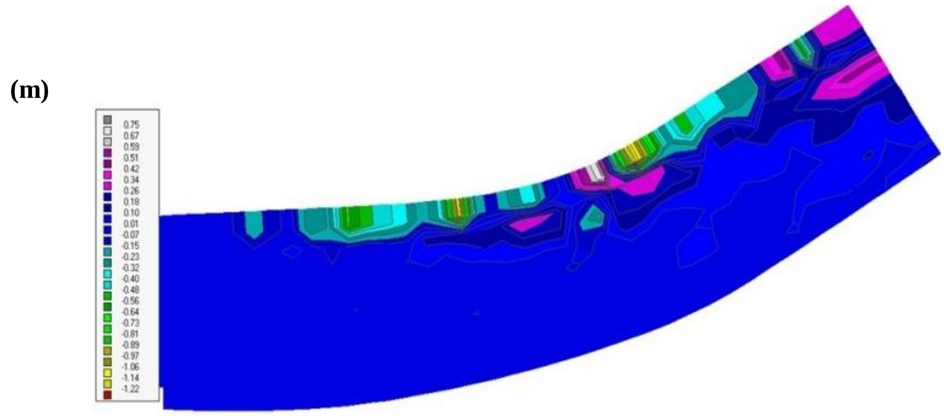

Fig. 9. Contour of variation in bed level due to sediment transport (M1 area**)**

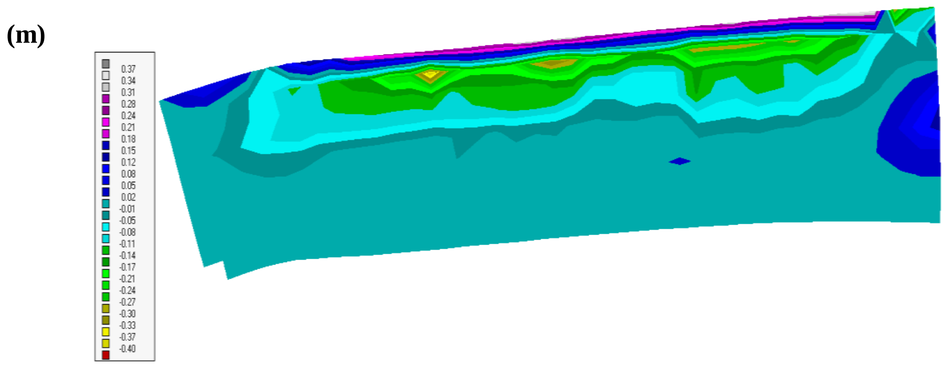

Fig. 10. Contour of variation in bed level due to sediment transport (M2 area)

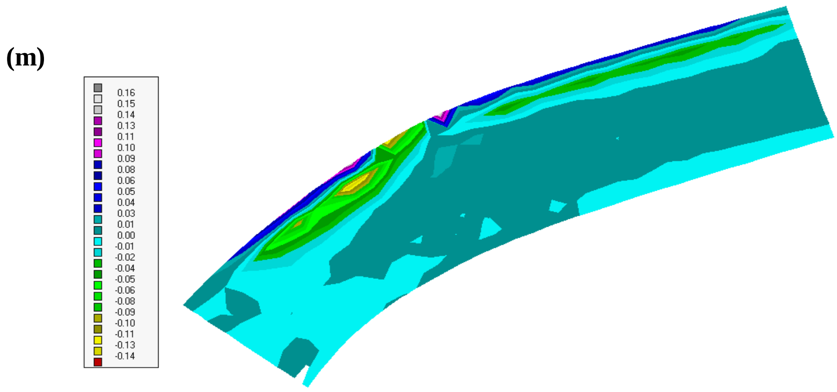

Fig. 11. Contour of variation in bed level due to sediment transport (M3 area)

Fig. 12. Shows a sample profile of bed level variation in one month period.

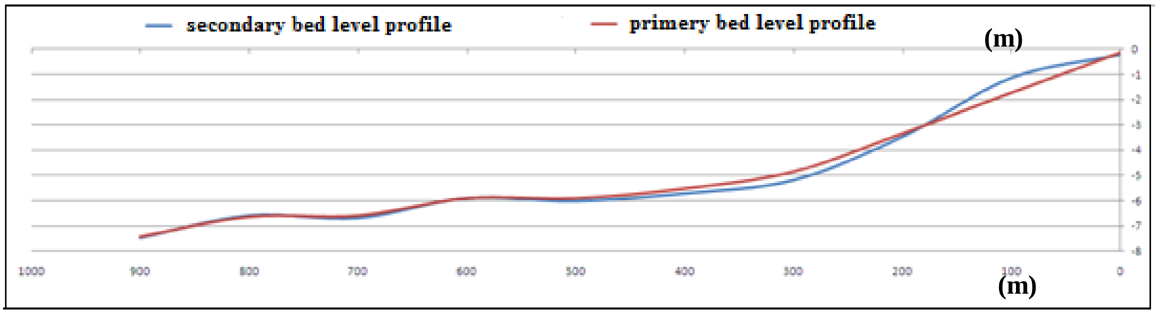

Fig. 12. Bed level variation in profile 4 of M1 area

4. Conclusions

Comparing the simulation results of the tides phenomenon in the entire Persian Gulf and part of Oman Sea with water level measurements information of Souza and Bandar Lengeh stations indicating a very good fit of the model and demonstrated that the phenomenon of tides is predictable. analyzing waves And evaluation of the sediment grain size and sediment type because of their different wave climates and diverse sediment grain sizes, the coastline divided into three smaller regions that every regions has different wave climate, sediment grain size and sediment type. Sediment transport pattern indicates that dominant direction of sediment movement is from west to east and intensity and velocity variations of long shore and cross shore sediment is reduced from Eastern side of the Qeshm Island to the West side.

References

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Author Profile

Mohammad Rahmanian received the B.S. degree in civil engineering from Hormozgan University in 2009 and received M.Sc. degree in Coastal Engineering from Hormozgan University in 2014.