



Applicability of a numerical model to predict vertical distribution of suspended sediment concentration along the depth in Dithmarschen Bight

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A three dimensional numerical model of Delft3d-flow was developed to simulate the current velocity and sediment transport of Piep tidal channel system. This channel system is part of Dithmarschen Bight located in the German North Sea coast. It consists of two main channel namely Norderpiep, and Süderpiep. These two channels conjunct together to form Piep channel near the land on tidal flat.

The source of the required field data for this study was those collected under “Prediction of Medium Term Coastal Morphodynamics”, known as the PROMORPH project. It was executed during the period May 1999 to June 2002. Those measured data used for calibration and validation of the model were current velocity and suspended sediment concentration (SSC). Current velocities were collected using ADCP devise. Suspended sediment concentration data was prepared by converting the measured values of light transmission. These data was collected using transmissometer. On the basis of some in situ mechanical sampler data an equation was developed to convert light transmission to the SSC. Field data were carried out at several stations along the width of three cross sections from the surface to the bottom, taking into account the limitations.

To verify the performance of the calibrated model, its results were compared with the field data. The comparison between the modeled and measured current velocity shows an accuracy of about 0.2 m/s.

Factor of two of measured SSC were used to evaluate the performance of the model regarding these values. Some dissimilarity was found between the modeled SSC and those of the field data. To verify the cause of this dissimilarity, two comparing procedures were carried out. First the evolution of the vertical profile of the SSC from the model and those from the field were prepared and compared. In another procedure the snapshot of distribution of SSC at each cross section during different phases of a tidal cycle were prepared using the model results and compared with those derived from the field.

It was found that the predicted SSC values are in good agreement with the field data during the periods of flood phase and low slack water. However, spatial dissimilarities are observed in the distribution of the SSC, during the periods of high slack water and the ebb phase. It was also found that the model could not simulate the peak SSC during the ebb current at Piep cross section which is located near the land. An insufficient supply of sediment from the tidal flat area in the model was considered to be responsible. several parameters and/or factors found to be responsible among them the usage of constant settling velocity and also constant erosion rate. The input of different values of the critical bed shear stress for erosion for the tidal flat areas and the tidal channel eastward of the cross section did improve the model results.