HR Wallingford
Working with water

Cowes Harbour Model Review

Summary review of sediment transport modelling

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Contents

1. Main section heading

1.1. Background

Cowes Harbour Commission (CHC) is developing an improved set of hydrodynamic and sediment transport modelling tools to aid the management of Cowes Harbour and the surrounding areas. The tools are being developed by ABPmer. Cowes Harbour Commissioners (CHC) has requested HR Wallingford to undertake an independent review of the modelling studies. The purpose of the review is to provide confidence in the application and findings of the modelling which is being used to inform the management and development of the harbour.

In total three modelling activities required review:

- Regional tidal flow model;
- Local tidal flow model;
- Sediment transport model.

An earlier review was undertaken with regard to the first two activities (HR Wallingford, 2015). This report focuses on the last of these three modelling activities: the sediment transport model. For this review the interaction between HR Wallingford and ABPmer has been more iterative, including a workshop meeting held between ABPmer, HR Wallingford, Cowes Harbour Commission and Dr. Rob Nunny. As a result the review presented here takes the form of a summary of the various discussions held.

1.2. Objectives and scope of review

The objectives of this iterative review were to:

- Evaluate whether the model is “fit-for-purpose” for identifying the effects on sediment transport to development within Cowes Harbour;
- Identify any shortcomings of the sediment transport modelling;
- Make recommendations to address any identified shortcomings of the modelling or to improve the description of the modelling activities undertaken.

The review focused on the document,

Cowes Local Model, Sediment transport model calibration and validation, ABPmer Report R.2591, Version 1.0, 17 March 2015.

Supporting information for this report was obtained from the review of sedimentation in the Outer Harbour and the local flow modelling report (ABPmer, 2015a, 2015b). Following initial feedback and discussion of the above report, further supporting information was made available by Dr. Rob Nunny at the workshop.

2. Review Process

The review process took the following form:

- An initial review of the ABPmer report and provision of general and detailed comments to ABPmer;
- Consideration of the HR Wallingford comments and reply by ABPmer;
- Appraisal of the ABPmer replies by HR Wallingford leading to a list of further comments;
- A second set of replies by ABPmer;
- A workshop meeting to discuss the remaining issues held on 9 May 2016 at ABPmer Offices in Southampton with ABPmer, Cowes Harbour Commission, HR Wallingford and Dr. Rob Nunny present;
- Preparation of a summary (this report) of the issues considered and the conclusions of the review process.

3. Topics considered in the review

The review process considered the following topics:

- The modelling approach and procedure;
- The selection of representative sediment properties;
- The recently collected data on sediment type within the Harbour – which has shown that the sediment is significantly muddier than the characterisation of Harbour sediment in the previous 2007-2009 studies – and the consequences of this finding;
- The analysis of the rate of deposition in the Harbour, including observed deposition (through differences in surveys) and dredging records;
- The predicted and observed distribution of deposition within the Harbour;
- The predicted and observed suspended sediment concentration within the Harbour;
- The extent of variability between the two sources of observed suspended sediment concentration data;
- The significance of sand transport into the Harbour;
- The reliability of the model for predicting the effects of development (breakwater construction and dredging) with the Harbour.

As well as these more major topics, detailed comments were made available to ABPmer on every aspect of the report.

4. Conclusions of the Review

The modelling approach and procedure

The model study uses Mike21 FM MT which is a well-respected model. The general methodology applied to the study is appropriate. The method essentially uses the Solent as a boundary condition for the supply of fine sediment to the Harbour. A nominal wave condition, together with tidal currents, is used to provide a typical boundary condition for suspended sediment concentrations and this is a reasonable method of approach for the purposes of the study.

The selection of representative sediment properties

Whilst in general the sediment properties used in the modelling appear to be appropriate, it was noted that the value of the bed sediment density used in the model was too low (based on literature and general experience) and that use of a higher value of bed density would actually improve the performance of the model. Observations made by Dr Rob Nunny in the Harbour also supported this conclusion. ABPmer agreed to make this adjustment in their final report.

The recently collected data on sediment type within the Harbour

As part of the studies associated with the model development and investigation of the potential effects of development within the Harbour, a large number of grab samples of bed sediment have been obtained and analysed for particle size distribution. This is to be commended. The bed sampling has indicated that the Harbour is significantly muddier than was understood for the previous Cowes modelling studies in 2007-2009. This result is important for the conceptual understanding of the Harbour sediment transport.

Analysis of the observed rate of deposition in the Harbour

The observed rate of deposition in the harbour is a combination both of survey changes and of the volume of dredging that has been undertaken. Both of these have some uncertainty involved. Surveys, for instance, have some measurement error and maintenance (and capital) dredging occurs episodically in different areas of the Harbour. The action of ferries, which cause erosion and re-distribution of sediment, and bed levelling within the harbour, which also re-distributes sediment, further complicate the assessment of the rate of sediment accumulation within the Harbour which the model is then required to reproduce. Given these complications. It is considered that ABPmer have satisfactorily derived the overall rates of sediment deposition, and hence calibration targets, for the periods prior to, during and after breakwater construction. However, it is noted that there is more uncertainty in the estimate of the current rate of accumulation (post-breakwater) because it is based on a short (6 month) comparison of surveys.

The predicted distribution of deposition within the Harbour

The model was found to satisfactorily predict the distribution and magnitude of accumulating sediment with the Harbour (subject to the comment about the density of bed sediment made above) as identified by the analysis of the survey data and dredging records.

The predicted and observed suspended sediment concentration within the Harbour

There are two sources of suspended sediment measurements within the Harbour: a more recent set of measurements by Ambios undertaken for the present project and an earlier set undertaken by Titan in 2005. The review discussed the relationship and differences between these two sets of data – which, on the basis of the data shown in the ABPmer report, appeared to be noticeably different – and the fact that there are *apparent* tidal variations in the observed data (particularly the Ambios data) which are not produced in the model. Further evidence on this matter was discussed at the Workshop by Dr Rob Nunny (*pers.comm.* 9 May 2016) who said that his detailed analysis of these two data sets had shown that they matched quite well. Moreover, he stated that the suspended sediment data, when averaged over an hour or a few hours aligned much more closely to the predicted model results. The report detailing this result was not available at the time of writing but this finding by Nunny allows us to conclude that the model is reproducing the main features of the sediment transport well, even if the detailed shorter time-scale variation is not reproduced, thereby providing confidence in the model as a tool for predicting the effects of development.

The significance of sand transport into the Harbour

For the present studies ABPmer included some sand transport modelling. This modelling indicated that, when taken in the context of the (as now determined) much muddier nature of the Harbour, the extent of sand transport into the Harbour is not large.

The reliability of the model for predicting the effects of development within the Harbour

On the basis of the evidence presented by ABPmer and subsequent discussions with ABPmer, Dr Rob Nunny and The Cowes Harbour Commission, we are satisfied that the sediment transport model developed by ABPmer is fit for purpose for predicting the effects on this transport of development within the Harbour.

5. References

ABPmer (2015a) Cowes Harbour Commission, English Channel Regional Model Calibration, ABPmer Report R.2492, September 2015.

ABPmer (2015b) Cowes Harbour Commission, Cowes Local Model Calibration, ABPmer Report R.2517, October 2015.

HR Wallingford (2015) Cowes Harbour Model Review Cowes Harbour Model Review, HR Wallingford Report DDM7603-RT01-R1-00, November 2015.

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