

**PROPOSAL FOR A SCOR WORKING GROUP ON MARINE  
HYDRODYNAMIC AND SEDIMENT TRANSPORT MODEL PREDICTION**

**PERFORMANCE CRITERIA**

**1. Rationale**

Hydrodynamic numerical simulation of wave and current processes, and sediment transport, is now a well established tool, and becoming ever more available. Model simulations are applied to a wide range of problems such as tidal currents in estuaries and inlets, longshore sediment transport, beach morphodynamics, sediment transport in and out of harbours, pollution dispersion, shelf currents, wave modelling, tsunamis, etc.

Several model suites are available internationally, including the well known HR Wallingford (UK), DHI (DK), Delft Hydraulics (NL), and 3DD (Dr Kerry Black; AU/NZ) models, which are used both for research purposes and applications in the international literature, as well as for commercial applications.

Elsewhere many new models have been, and are continuing to be, developed within research institutions. These models are applied in a wide range of coastal marine, oceanographic and engineering situations. Models have a variable performance, depending, *inter alia*, upon the skill of the modeller in setting the boundary conditions, and quality of the data for model calibration and verification.

However there is no standard test or parameter to judge performance of the models, and indeed, sometimes outrageous claims are made by the authors that the model has been “calibrated”. Such was the case in a manuscript submitted for an international journal presenting simulation of a tidal model with suspended sediment transport in which the author claimed the model was calibrated, but when one peruses the ‘calibration’ carefully it is clear that the ostensibly ‘calibrated model’ has up to 80 cm/s variation from the model predicted compared to the field measured result. Some parts of the “calibration” show current flow is 180 degrees out of phase with the model simulation! Is this acceptable within the scientific modelling community?

In the late 1980s GESAMP undertook a review of the suitability of various coastal models [GESAMP Report 43 Coastal Modelling, 1991]. At that time the GESAMP Working Group reviewed aspects of model suitability for simulating coastal processes but did not identify any quality performance tests for the models. Later, an IAHR Working Group issued guidelines aimed at standardising the *reporting* of validation tests of models, but did not make recommendations about standardising the evaluation procedures themselves. [International Association for Hydraulic Research, “Guidelines for Documenting the Validity of Computational Modelling Software”, 1994]. Recently, a European Thematic Network QNET-CFD [www.qnet-cfd.net] has addressed the question of specifying standard benchmark test cases for certain classes of flow model. They considered industrial and aeronautical, as well as environmental, Computational Fluid Dynamic models, and

made recommendations about the most suitable classes of models as well as the need for validation tests.

However, to date there is no internationally recognised set of criteria or scores that a researcher can use as a measure of the quality of their numerical simulation. In the late 1990s HR Wallingford, [under the leadership of R. Soulsby, in a project funded by EC MAST – the European COAST3D project] undertook detailed instrumentation and detailed data sets off Teignmouth and Egmond to use as a basis to compare various numerical model simulations.

In a paper resulting from that project, Dr J. Sutherland (2001) makes the statement:

*“The question of how good a model is should be defined in a more quantitative manner than the usual ranking (poor, good, excellent) that is normally applied”*,

and points out that HR Wallingford has worked on this issue. Sutherland identifies 4 model performance statistics including the Brier Skill Score, The Relative Mean Absolute Error (RMAE), The Scatter Index, and the Wilmott et al.’s Indices of Agreement that can be used for model performance assessment. In the same volume, Van Rijn used the concept of evaluating model performance based upon the Relative Mean Absolute Error (RMAE) and the Brier Skill Score.

However, these measures have evidently not gained wide international acceptance. Accordingly the purpose of this proposed SCOR Working Group is to review the available performance measures and recommend performance assessments, measures, or scores that marine hydrodynamic and sediment transport modellers can apply and quote concerning the quality of their predictions relative to measurements of distributions of quantities such as wave height, current velocity, suspended sediment concentration, pollutant concentration or bed morphology.

## **2. Terms of Reference**

The purpose of this proposed Working Group is to bring together a group of experienced model users and model developers to:

- (i) review possible tests of various types (descriptive as well as statistical) that modellers might apply as a quality test of model performance;
- (ii) propose standard procedures and tests that model practitioners could/should apply to test the veracity of their model output; and
- (iii) assess whether it is possible to devise a “standard score” as a measure of model simulation performance.

## **3. Publication Output.**

It is proposed to produce a paper to be published in a leading international journal, perhaps as a Special Issue, specifying the appropriate model performance measures for coastal oceanographic hydrodynamic and sediment transport simulations .

#### **4. Proposed Membership**

Chair - Prof Terry Healy (New Zealand)

Co-Chair: Prof Richard Soulsby (Wallingford, UK)

Dr Kerry Black (International model developer) (Australia/NZ)

Dr Ida Broker (DHI model developer – Denmark)

Dr Leo van Rijn or Dr Dirk-Jan Walstra (Delft Hydraulics, Netherlands)

Gegar Presetya (Indonesia – tsunami modeller)

Prof Shu Gao (Nanjing University, China)

Dr Nick Kraus (USACE Waterways Experimental Station)

? A meteorologist : – weather forecast performance assessment

? A Time series statistician expert in marine field data analysis

#### **5. Proposed Meeting Schedule**

##### Meeting 1: 2006

Discussion and review. Refining of the terms of reference.

- Determine WG outputs: What can we achieve?
- Determination of publication outlet and type (Book? International Journal paper?/ Special Issue?)
- Individual contributions
- Co-option of additional associate members
- Timetable and time-lines
- Communication methods
- Agenda for next meeting

##### Meeting 2: 2007

Review of contributions

? Workshop with various models testing

#### **6. References**

GESAMP 1991, Coastal Modelling. GESAMP Reports and Studies No 43, 192 p.

HR Wallingford, 2001. COAST3D Final Volume of Summary Papers, Report TR 121, EC MAST project No MAS3-CT97-0086.

IAHR, 1994, Guidelines for Documenting the Validity of Computational Modelling Software

Sutherland J., Peet A.H. and Soulsby R.L., 2004. Evaluating the performance of morphological models. Coastal Engineering, 51, 917 – 939..

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Submitted jointly by Professors Terry Healy (NZ) and Richard Soulsby (UK) as a UK-NZ SCOR Working Group proposal.

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