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Project Plans for "Testing and evaluation of short term morphological models 2000"

conceptual approaches and details of the methods to be applied

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conceptual approaches and details of the methods to be applied

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CLIENT: Rijksinstituut voor Kust en Zee | RIKZ

TITLE: Project Plans for "Testing and evaluation of short term morphological models 2000", conceptual approaches and details of the methods to be applied

ABSTRACT:

The planning for the project “Testing and evaluation of short term morphological models 2000”, including the conceptual approaches and details of the methods to be applied, will be described in the first report. This project is carried out within the framework of the “Generiek Kust Onderzoek” agreement between WL | Delft Hydraulics and RIKZ - Rijkswaterstaat. This report is the first product as defined in our proposal (letter 31 March 2000, ref. MCM2139/Z2897/fb). Furthermore, a CD-rom has also been included which represents the second product. The content of the CD-rom will be explained in Chapter 4.

Within the present project five separate sub-projects have been defined. For each of these sub-projects a project plan has to be submitted to RIKZ for approval. Before the actual project execution the individual project plans have to be approved by RIKZ. This procedure has been chosen due to the unique character of the project and to ensure that RIKZ is closely involved and is able to influence the suggested approaches at an early stage of the project.

REFERENCES: Opdracht RKZ-825 (brief 8 mei 2000, ref. RIKZ/OS/2000/05703)

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KEYWORDS

- Argus, Video, morphology, sand transport, numerical models, Unibest-TC, Delft3D-MOR

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1 Introduction

The planning for the project “Testing and evaluation of short term morphological models 2000”, including the conceptual approaches and details of the methods to be applied, will be described in the first report. This project is carried out within the framework of the “Generiek Kust Onderzoek” agreement between WL | Delft Hydraulics and RIKZ - Rijkswaterstaat. This report is the first product as defined in our proposal (letter 31 March 2000, ref. MCM2139/Z2897/fb). Furthermore, a CD-rom has also been included which represents the second product. The content of the CD-rom will be explained in Chapter 6.

Within the present project four separate sub-projects have been defined. For each of these sub-projects a project plan has to be submitted to RIKZ for approval. Before the actual project execution the individual project plans have to be approved by RIKZ. This procedure has been chosen due to the unique character of the project and to ensure that RIKZ is closely involved and is able to influence the suggested approaches at an early stage of the project.

Below each of the sub-projects are described briefly. Note that the sub-project that defines the benchmarking databases has been split up according to the models (i.e. Unibest-TC and Delft3D) for which they are constructed.

Sub-project I: Evaluation of field data Egmond 1998 (Chapter 2)
In this sub-project the Egmond field data obtained within the EU-project Coast3D in combination with possible foreshore nourishment data are analysed. This analysis is aimed at identifying the applicability of DH’s morphological profile model (Unibest-TC) and morphological area model (Delft3D-MOR). Furthermore, an attempt will be made to establish which data is can be used to validate and calibrate the numerical models. The ARGUS video monitoring technique is also used. One of the aims of this sub-project is to explore and identify the possibilities of coupling the more traditional (in situ) measuring techniques (high temporal detail, but low spatial resolution and quantitative results) and the ARGUS technique (high spatial resolution, but qualitative results).

Sub-project II: User guide Unibest-TC (Chapter 3)
The user guide is aimed at assisting Unibest-TC users in setting up a morphological model. It will cover all aspects of morphological (profile) modelling with Unibest-TC. In general the following topics will be addressed: good modelling practice, boundary schematisations, how to interpret model results and an accurate description of model input parameters.

Sub-project III: Benchmarking database for Unibest-TC (Chapter 4)
In this sub-project a number of benchmark tests is collected. Attention is focussed on the characterisation of the various tests (e.g. field and laboratory), how to organise the database and to set-up a system in which the model can be tested automatically for a wide range of model settings.

Sub-project IV: Benchmarking database for Delft3D (Chapter 5)
This sub-project is mainly aimed at identifying interesting data sets. The datasets from the Coast3D project and the dedicated Delft3D models that have been constructed will be collected. In the present set-up this project does not aim at providing automated testing facilities.

Sub-project V: Statistical analysis tools (described in Chapter 4)
The evaluation of a model concept or improvements is always a difficult task. In many publications qualifications as "excellent" and "good" for a model performance are common without any objective justification. In an effort to arrive at an objective evaluation of model performances, a sub-project has been defined in which a statistical analysis tool (SAT) is developed to evaluate the Unibest-TC model. This tool is developed primarily to evaluate the Unibest-TC model performance in the benchmark tests. In the user guide for Unibest-TC the statistical analysis tool will be used and described.

In the following chapters the conceptual approaches and details of the methods to be applied for each of the sub-projects are included. The statistical analysis tool is described in combination with the benchmarking database for Unibest-TC in Chapter 4.
2 Evaluation of field data Egmond 1998

2.1 Introduction

Field measurements of hydrodynamic and morphodynamic parameters have been carried out in the tidal surf zone of Egmond beach (The Netherlands) during the periods April-May 1998 (Egmond-Pilot) and October-November 1998 (Egmond-Main) within the European COAST3D project. The Egmond site is located in the central part of the Dutch North Sea coast and consists of a sandy beach (about 0.3 mm sand). The local morphology is 2.5 dimensional exhibiting two longshore bars intersected by local rip channels; the bars are aligned parallel to the shore most of the time, but crestic bar forms do also occur occasionally. The tidal range varies between 1.4 m (neap) and 2 m (spring). The tidal peak currents in the offshore zone are about 0.5 m/s; the flood current to the north is slightly larger than the ebb current to the south. The offshore wave boundary conditions are based on information from a directional wave rider.

Apart from in-situ point measurements such as wave height, current velocity and sediment concentration, the COAST3D site has been monitored with the Argus video technique. The advantage of such video techniques over more classical (in situ) measuring methods is that it is relatively easy to obtain data over extended periods of time, even during extreme storm conditions when the application (or continuation) of in situ measurement techniques is often impossible. Furthermore, the spatial resolution is much better than could ever be achieved with conventional methods. A disadvantage of the Argus technique is its (present) inability of providing reliable quantitative data. The Argus video technique is well suited for a continuous monitoring of the qualitative behaviour of a system, whereas in situ measurements can provide reliable quantitative data at a limited number of locations.

2.2 Objectives

The objectives of the present sub-project are:
1. to get a better understanding of the hydrodynamics and morphodynamics in the surf zone at the Egmond site on the time scale of days to 1 year,
2. to produce a database of hydrodynamics and morphodynamics for evaluation of mathematical models (UNIBEST-TC and DELFT3D),
3. to investigate the applicability of the Unibest-TC and Delft3D model,
4. to assess the possibilities of combining the Argus technique with the Coast3D field data (a number of existing analyses tool for the analysis of Argus video data will be evaluated, it is not the aim to develop or improve these analyses techniques).
2.3 Approach

2.3.1 In Situ measurements

For the in situ measurements the following approach will be used:

- Inventory of the available data based on data reports and databases produced by the COAST3D project:
  - overview of data report and databases,
  - overview of physical parameters stored in databases,
  - presentation of relevant data in two summary tables and plan views of measurement stations.

- Overview of analysis results of the available hydrodynamic data of both field campaigns focusing on the most important physical parameters used in the mathematical models:
  - variation ranges of the offshore wave conditions using data from the DIWAR buoy and other offshore stations (offshore boundary conditions of models),
  - relative wave height (ratio of wave height and depth) of the high and low frequency waves at each station and in relation to offshore conditions to identify the maximum wave height of the high frequency during breaking conditions and the importance of the low frequency waves,
  - the asymmetry of the near-bed peak orbital velocities as a function of relative wave height to identify the non-linear effects of the wave motion in shallow water and the effect of wave breaking on the velocity asymmetry,
  - the magnitude of the cross-shore and longshore current velocities (including overview of errors involved) at each station in relation to the relative wave height to identify the effect of breaking waves on the wave-induced currents.

- Overview of the analysis results of available sand transport data and bed form data of both field campaigns:
  - definitions of transport components,
  - clustering of sand concentration profiles, velocity profiles and transport data (including variation ranges) in groups of peak onshore orbital velocity (six groups),
  - presentation of transport components (including variation ranges) as a function of peak orbital velocity to identify the relative importance of the various transport components in relation to the bed form characteristics.

- Overview of the analysis results of the available morphodynamic data of the Egmond-main campaigns:
  - presentation of longshore-averaged cross-shore bed level profiles (mean profiles and variation ranges),
  - determination of significant morphological changes,
  - identification of pre, storm and post storm events to be used for model simulation runs.

- Preparation of data (per event) in Excel files to be used as input for model validation runs:
  - for comparison of measured and computed wave height along profile,
  - for comparison of measured and computed velocity asymmetries along profile,
for comparison of measured and computed current velocities along profile,
for comparison of measured and computed sand transport and bed level changes along profile.

- Based on the data analysis described above the relevance of the various data is investigated for:
  1. direct applicability for use in models (as boundary conditions or as comparison with model results)
  2. the contribution to understand the morphological system at the Coast3D Egmond site.

- Based on the data analysis the applicability of the Unibest-TC and Delft3D models is evaluated (e.g. identification of important physical processes that are not included in the models).

2.3.2 Argus-images

A zoom camera has been used mounted on a 45 m high measuring tower located South of the COAST3D site. This camera captured the following images on a hourly basis:
- a snapshot,
- a time exposure over 10 minutes (sample frequency 1 Hz),
- a variance images over 10 minutes (sample frequency 1 Hz).

With existing analysis tool the water line and the locations of the highest wave breaking intensities can be derived. The latter can be used to monitor the development of the breaker bars. For a comprehensive discussion of the Argus system is referred to Aarninkhof (1999).

For the current project, the Argus technique will be used to monitor the evolution of the breaker bars.

By analysing time series, the evolution of these parameters is captured. Results will be compared with independently obtained bathymetric data. Within the framework of this project, the added value of the Argus technique in monitoring the dynamics of the breaker bars will be evaluated and compared to the results of in situ measurements (WESP surveys) and breaking wave heights from tripods. It will also be indicated how a combination of Argus images and in situ measurements may strengthen each other and can be deployed efficiently during future measurement campaigns. For example, data gaps in ‘classical’ series may be interpolated using Argus images.

Unfortunately, the field of view of the COAST3D camera is not optimal. Although a zoom camera was used, the image resolution is limited due to the considerable distance of the camera tower from the measuring site. Furthermore, the weather was often rainy, which reduces the sharpness of the images. Therefore, also images from the nearby Jan van Speyk Argus site may also be used in the analysis.

The results will be presented in a document including tables and figures.
3 User Guide Unibest-TC

3.1 Introduction

The user guide for Unibest-TC will provide a general framework which helps a novice user to apply the Unibest-TC model sensibly. The existing user manual (WL | Delft Hydraulics, 1999) and technical reference manual (Bosboom et al., 1997) are very general and detailed, respectively. From many users there is a need of having a user guide which is on an intermediate level which provides detail where necessary (e.g. model parameters description) and gives general guidelines when setting up the model (e.g. boundary schematisation). In the next section a general content description is given which will act as the project plan for the next phase of the project. Where applicable also the relations with other sub-projects are indicated.

3.2 Content description

This section contains a general content description of the user guide which will act as the method of approach for the next phase of the project. The description is given on chapter level, for each chapter a brief description is given of the subjects that will be included. Where applicable a short list is given of items that will be included/described in the user guide. At the end of each chapter the treated subject is made concrete with an example.

Ch1. Good Modelling Practice
This chapter will give a general introduction to the user guide. It will be written as an executive summary and should give a clear and compact overview of the discussed items. It will give a general description of the various items that are discussed and the interaction between them. Special attention will be given to the overall process of a project in which numerical modelling plays an important part. Often there is not a clear distinction between the different phases. In fact, most projects follow an iterative approach in which many of the phases (e.g. boundary schematisations, calibration, validation and interpretation) are repeated a number of times. The present chapter will attempt to describe this modelling process in general terms.

Ch2. Boundary/Area Schematisations
This chapter will give a detailed description of the required schematisations of the model input. It will describe both hydrodynamic boundary schematisations (e.g. wave height, vertical tide) and bottom profile schematisations. It will emphasise that before any schematisation can be made one has to have a basic physical understanding of the area of interest.

Some of the items that will be discussed are summarised below:
- relevance of a conceptual models,
- possible chronology effects (Hinton and Aarninkhof, 1998),
• methods for constructing cross-shore profiles (longshore averaging vs. simulating more profiles),
• sensitivity analysis.

Ch3. Model description
This chapter is focussed on a comprehensive description of the many model input parameters of Unibest-TC. To that end, a conceptual description is given of the model, viz.: overall model consists of several sub-modules which describe the main constituents that govern the cross-shore morphology in the surf zone. To give the user a good insight in the effects and impacts of the input parameters, these will be grouped according to the physics that they aim to describe.

The detailed description of the model parameters comprises:
• default values and valid ranges (where applicable according to coastal characteristics),
• relation to physical process (strong relation with benchmarking database),
• how well is it established (confirmed with references),
• sensitivity of the model predictions for variations in input parameter,
• relevance of parameter for calibration purposes (will be extended in the next chapter).

Ch4. Calibration
A calibration is the next step after having prepared the required schematisations. In this phase the model is tuned to find an optimal agreement with measurements. In the present chapter advise is given of how to perform a calibration of Unibest-TC. In general two phases can be distinguished during such a calibration: in the first phase the hydrodynamic modules (e.g. wave heights, undertow) are calibrated, followed by the calibration on the morphological profile development.

The following items will be discussed:
• general order in which parameters should be investigated (strong relation with previous chapter),
• sensitivity analysis,
• which spatial resolution and time step should be applied (relation with Chapter 2),
• in which order should the various sub-models be calibrated,
• approach to be followed when there is only a limited amount of data available,
• how to interpret results (strong relation with interpretation methods, Chapter 6),
• identification of deviations which can be improved by tuning the model,
• identification of deviations which are the result of the process descriptions in the model (and which can therefore not be improved by tuning the model).

Ch5. Validation / Determination of predictive capabilities
After the calibration in which the model has been tuned to give an optimal representation of the investigated area, a validation is required to investigate the applicability and predictive capability of the model for the problem under investigation. During this phase the model settings as derived in the calibration are used to make model predictions which can be verified with measurements. In general there will be a temporal division between the calibration and the validation (e.g. calibration of model on profiles from 1990 to 1995 and validation on profiles from 1995 to 2000). However, sometimes a spatial division is made
due to lack of data (e.g. calibrate the model for Noordwijk and apply it in Egmond). Both approaches will be discussed.

Determination of the predictive capabilities is one of the key aspects of a validation. This predictive capability can be derived based on the implemented physical processes. However, it is not always clear what the validity ranges of the implemented theories are. Furthermore, the effects of (non-linear) interactions between the various included processes is even more difficult to assess. Usually, the predictive capability for a certain application is derived from an interpretation of the results of the present validation or from a previous study in the same or comparable application.

In summary, the following items will be treated:
- division between calibration and validation (temporal vs. spatial),
- predictive capability based on validation (e.g. agreement with measurements, sensitivity of predictions to small modifications in input),
- predictive capability based on implemented theory (which type of forcing is applied, which phenomena have to be predicted),
- incorporation of results from the benchmarking database.

Ch6. Interpretation of model results
This chapter will contain a description of the various methods to interpret the Unibest-TC model results. Often, the interpretation of model results is only based on a visual inspection. This may be sufficient during some phases of a project (e.g. parts of the calibration), but only general qualifications can be derived which are often subjective as well. It is important to derive quantitative qualifications which can be verified objectively (e.g. volume changes in a certain part of the bottom profile). The development and implementation of various model performance indicators (MPI's), which are applied when evaluating the model based on a direct comparison with measurements, are developed/colllected in a separate sub-project and are not treated here in great detail. In stead, an overview is given of specific interpretation methods for various types of model results. It is expected that results from Sub-projects III and V (benchmarking database for Unibest-TC, and the statistical analysis tool) can be used here as well.

Interpretation methods that will be included are:
- volume changes in certain parts of the bottom profile (horizontal and vertical subdivision),
- migration of breaker bars,
- generation of breaker bars,
- prediction of coastline.

The interpretation methods listed above will also be included in the final version of the Statistical Analysis Tool (SAT). The present chapter will also contain a describe the operation of the final version of the SAT.

The above list is not aimed at giving a complete description. It is anticipated that results from the benchmarking database for Unibest-TC will also play an important role in providing general guidelines.
4 Benchmarking database for Unibest-TC

4.1 Introduction

This chapter describes the method of approach for the benchmarking database for Unibest-TC. It will summarise the datasets which can be included in the database. The suggested data structure is also described, based on which it is possible to define some of the standard tasks involved in the execution and processing of data. These task will be automated to a large extend and some of the preliminary versions will be explained briefly. After giving a general description of the statistical analysis tool, this chapter is concluded with some considerations and suggestions on version management and updating procedures.

4.2 Overview and description of datasets

The datasets that will be incorporated in the database should enable a complete qualification of the accuracy of the description of the implemented physical processes and the accuracy and reliability of the final results: the predicted profile development and the computed longshore sediment transport. The final evaluation should be performed on prototype profiles with a prediction range of years. In the table shown below a number of datasets have been selected that can be included in a first version of the database. The majority of the data sets have been selected on their applicability to enable the testing of the hydrodynamic physical processes. The final version of the benchmarking database will also contain datasets which enable long term simulations specifically aimed at representing the morphological profile development relevant for coastal zone management.
<table>
<thead>
<tr>
<th>Code</th>
<th>Lab of Field</th>
<th>Waves and set-up</th>
<th>Currents (2DV)</th>
<th>Currents (3D)</th>
<th>Concentration and Transport</th>
<th>Bottom changes</th>
</tr>
</thead>
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<tr>
<td>Battjes en Janssen (1978)</td>
<td>BJ78</td>
<td>Lab</td>
<td>Hrms eta</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Hotta en Mizuguchi</td>
<td>Hotmiz</td>
<td>Field</td>
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</tr>
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<td>Ebersole and Hughes</td>
<td>Duck85</td>
<td>Field</td>
<td>Hrms</td>
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<tr>
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<td>Lab</td>
<td>Hrms</td>
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<tr>
<td>Stive (1985)</td>
<td>Stive85</td>
<td>Lab</td>
<td>Hrms eta Qb</td>
<td></td>
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<tr>
<td>Arcilla et al., Roelvink en Reniers</td>
<td>LIP11D</td>
<td>Lab</td>
<td>Hrms eta Qb</td>
<td>u(z) urms guss guls</td>
<td>c(z) Stotx</td>
<td>z(x,t)</td>
</tr>
<tr>
<td>Reniers</td>
<td>Reniers</td>
<td>Lab</td>
<td>Hrms eta</td>
<td>u,v urms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boers</td>
<td>Boers</td>
<td>Lab</td>
<td>Hrms eta Qb</td>
<td>u(z) urms guss guls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coast3D</td>
<td>Egmond Teignmouth</td>
<td>Field</td>
<td>Hrms dir</td>
<td>u,v urms guss guls</td>
<td>c(z)</td>
<td>z(x,t)</td>
</tr>
<tr>
<td>Egmond</td>
<td>Egmond</td>
<td>Field</td>
<td></td>
<td></td>
<td></td>
<td>z(x,t)</td>
</tr>
</tbody>
</table>

Of these datasets a number of cases will be selected and will be described in a standardised way. The selected cases will be included in the database according to the formats and structure described below. Furthermore, a basic input file for Unibest-TC will be constructed for each case.
4.3 Data structure of datasets

The data structure is aimed at facilitating a simple and transparent comparison between measurements and model predictions. The database is sub-divided in separate data sets, in which a number of cases are defined. The LIP11D experiment is a good example of this approach. Under the LIP11D directory a number of case directories are present in which for each case all the applicable measurement data is collected. Data is stored in ASCII-files according to the very simple and transparent TEKAL-format. Each data file contains only one physical parameter. The TEKAL-format comprises one data block with two columns, the first column contains the x, z or t and the second column the parameter values. The file names are standardised:

- `<param>`.tek for f(x) (not time dependent)
- `<param>`Xxxx.tek for f(z) or f(t) at location xxx
- `<param>`Ttt.tek for f(x) at time ttt

The data for the model runs is located under the case directory. In the example shown above the directory “vl” contains all the Unibest-TC input files and Unibest-TC will also be executed at this location. The model output will be reformatted so that the model data has exactly the same data structure and file name convention as the measurement data. Only the temporal and spatial coverage of the model output is obviously more dense compared to the measurement data. The utility programs that will be used are “rdfs” and “rdvert” which are located in “work/debug”. Form the model directory (e.g. “vl”) it is now very easy to visually compare measured and computed data. In the suggested set-up, we intend to use the MATLAB program to perform this task (code included on CD-ROM). A preliminary version has been constructed of which some results can be found in Figures 1 to 3.

In the model directory the Statistical Analysis Tool (SAT) can be used to investigate the model performance for the required parameters. The SAT interpolates the calculated values to the measurement locations or time points and performs a number of statistical operations and saves the results to file. For Case 1A of the LIP11D test the results of a preliminary exercise are shown below. The number of statistically operation will be extended in the next phase of the project.
### 4.4 Description of software utilities

As the data structure now has been defined it is possible to identify a number of standard tasks which should be repeated for each new model version or sensitivity run that is carried out:

For each dataset and/or case:

1. Copying of underlying model directory to new directory with new version number
2. Modification of run parameters (keywords)
3. Automatic execution of simulation
4. Converting of result files (“mpl” en “ver” files) to TEKAL files
5. Plotting of all parameters of simulation and measurement
6. Execution of SAT
7. Creation of pairs of measurements and model results for the creation of scatter plots

For each dataset:

1. Collection and plotting of scatter data
2. Averaging of statistical parameters per output parameter
3. Determination of weighted mark

Over all datasets:

1. Collection and plotting of scatter data
2. Averaging of statistical parameters per output parameter
3. Determination of weighted mark

For the practical execution of these tasks some FORTRAN and MATLAB routines will be developed. For a number of these task some preliminary versions have already been constructed to test the adopted concepts. On the CD-ROM the code and executables of these routines are included.
4.5 Description of performance present Unibest-TC version

The performance of the present Unibest-TC version will be described with detailed plots (f(x), f(z) and f(t)). Furthermore, the statistical analysis tool will be applied to give an objective evaluation of the performance (see also next section). Where applicable, explanations will be given for observed deviations from the measurements which can be used as a starting point for improving the model. The sensitivity of the model to the main model input parameters will be shown and recommendations will be made.

4.6 Statistical analysis tool (SAT)

The statistical analysis tool (SAT) will be an intrinsic part of the benchmark database. In summary it will consist of the following parts:

1. Visual inspection of results and comparison with measurements per variable, f(x), f(t) or f(z), per case.
2. Visual inspection with scatter plots per variable, over all datasets, per dataset and per case.
3. Statistical parameters per variable, per case, dataset or over all datasets.

In the present preliminary implementation the visual inspection has been implemented and the following statistical parameters have been implemented:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>bias</td>
<td>systematic error</td>
<td>( \frac{1}{N} \sum_{i=1}^{N} (f_{\text{comp},i} - f_{\text{meas},i}) )</td>
</tr>
<tr>
<td>rms</td>
<td>standard deviation of the error</td>
<td>( \sqrt{\frac{1}{N} \sum_{i=1}^{N} (f_{\text{comp},i} - f_{\text{meas},i})^2} )</td>
</tr>
<tr>
<td>rel. bias</td>
<td>systematic error rel. to the mean</td>
<td>( \sum_{i=1}^{N} (f_{\text{comp},i} - f_{\text{meas},i}) / \sum_{i=1}^{N} f_{\text{meas},i} )</td>
</tr>
<tr>
<td>rel. rms</td>
<td>standard deviation rel. to the mean</td>
<td>( \sqrt{\frac{1}{N} \sum_{i=1}^{N} (f_{\text{comp},i} - f_{\text{meas},i})^2 / \left( \frac{1}{N} \sum_{i=1}^{N} f_{\text{meas},i} \right)^2} )</td>
</tr>
<tr>
<td>bias/f(1)</td>
<td>systematic error rel. to the start or boundary value</td>
<td>( \frac{1}{N-1} \sum_{i=2}^{N} (f_{\text{comp},i} - f_{\text{meas},i}) / f_{\text{meas},1} )</td>
</tr>
<tr>
<td>rms/f(1)</td>
<td>standard deviation rel. to the start or boundary value</td>
<td>( \sqrt{\frac{1}{N-1} \sum_{i=2}^{N} (f_{\text{comp},i} - f_{\text{meas},i})^2 / f_{\text{meas},1}^2} )</td>
</tr>
</tbody>
</table>

Especially the quantitative evaluation of predicted spatial distributions of parameters which give a reasonable qualitative agreement (skill indexes) still have to be selected and/or developed.
4.7 Version management and updating procedures

The database will also be identified by a version number. It is suggested to use double numbering system in which the date of creation of the new version is also included: e.g. 21092000.1.45. The sub-numbers (45) should be used to identify small modification to the database (e.g. small modifications to the included data sets or analysis tools). The main version number (1) should only be modified when a new data set is added. These are just some of the general ideas, in the next phase of the project this will be worked out in greater detail.

Special attention will be given to the creation of transparent updating procedures. The main aim is to keep the system as open as possible. The updating procedure will cover the following subjects:
• how to give new version numbers,
• how to include a new data set,
• how to modify existing data sets (deleting, correcting or adding data),
• how to update analysis tools,
• storage and management of the database.

4.8 Recommendations

An intrinsic part of the benchmarking database will be document which summarises the present state of implementation, and based on that conclusions and recommendations which prioritise future improvements.
5 Benchmarking database for Delft3D-MOR

5.1 Introduction

As Delft3D-MOR consists of four separate modules (WAVE, FLOW, TRAN and BOTT) ideally a benchmark database would consist of four subsets against which each of the modules can be tested. However, this lies not in the scope of the present study. Here the aim is to identify and characterise a limited number of datasets which can be used to evaluate Delft3D-MOR as a complete system. Some benchmarking databases are already available for the individual sub-modules (e.g. there is an extensive benchmarking database available for SWAN, which is part of Delft3D-WAVE). Recently, the Coast3D-project has provided detailed field data for Egmond and Teignmouth (UK) which can be used to evaluate Delft3D-MOR.

5.2 Coast3D-data

The data obtained from field campaigns carried out within the framework of the Coast3D-project in Egmond and Teignmouth will be included in the benchmarking database. Furthermore, the Delft3D-models that have been set-up (e.g. grids, bathymetries, boundary conditions, etc.) will be collected as well. The available data will be stored and organised according to the data structure of the benchmarking database of Unibest-TC.

5.3 Inventory of other datasets

Within WL | Delft Hydraulics many data sets are used for benchmark testing when upgrading Delft3D-MOR. These datasets are available but have not formally been combined and described. Within the limited scope of this sub-project these datasets will be identified and where possible collected and also added to the benchmarking database.

5.4 Recommendations

An intrinsic part of the benchmarking database will be document which summarises the present state of implementation, and based on that conclusions and recommendations which prioritize future improvements.
6 Content description of CD-Rom

6.1 Introduction

This chapter gives a description of the CD-ROM which is included with this report. The CD-ROM contains a preliminary set-up for the benchmarking database for Unibest-TC. Furthermore, executables and code (Fortran and Matlab) for a number of utilities are also included. Here only a description of the content of the CD-ROM is given, for a description of the included software and data is referred to Chapter 4.

*Note that some of the utilities may not work correctly. The data and utilities are included for demonstration purposes only and can not yet be used as generic tools. The Matlab routines contain some calls to customised toolboxes that are not included on the CD-ROM.*

6.2 Overview of included data

<table>
<thead>
<tr>
<th>Directory/File names</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATABASE</td>
<td>Actual database</td>
</tr>
<tr>
<td>MATLAB</td>
<td>Matlab routines for postprocessing</td>
</tr>
<tr>
<td>readme.txt</td>
<td>Summary of CD-ROM content</td>
</tr>
</tbody>
</table>