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| Title: | Survey of the need for experimental facilities including a Journal and dissertations evaluation. | | |
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| June 2003 | | | |
| Number of pages | : | | |
| Keywords (3-5) | : | Facility, Facilities | |
| DC-Publication-number | : | DC1-314-1 | |
| Institute Publication-number (optional) | : | | |
| Report Type | : | <input type="checkbox"/> | Intermediary report or study |
| | : | <input checked="" type="checkbox"/> | Final project report |
| DUP-publication Type | : | <input checked="" type="checkbox"/> | DUP Standard |
| | : | <input type="checkbox"/> | DUP-Science |

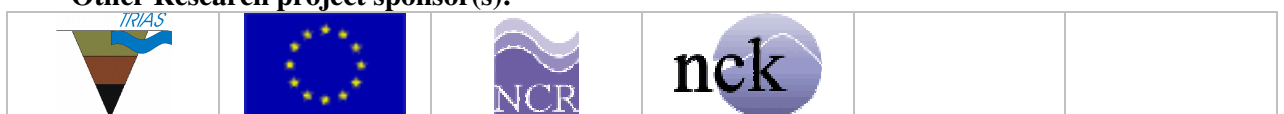
Acknowledgement

This research has been sponsored by the Dutch Government through the ICES-2 program, [Delft University of Technology and WLDelft Hydraulics](#). The research is part of the Research program of Delft Cluster.

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Abstract

Survey of the need for experimental facilities including a Journal and dissertations evaluation.

In this project, the role of experimental facilities in coastal and river engineering research was evaluated. Two main activities were undertaken: a survey of journal papers and (Dutch) dissertations over the past 10 years, and a pilot experiment to investigate the feasibility of 3D morphological experiments given the present state-of-the-art of models and facilities.

The literature evaluations show that measurements still play an important role in publications in international journals. Field measurements referred to in the evaluated papers are most often used to calibrate and/or validate numerical models. Laboratory measurements are often used to investigate basic processes, as for example in sediment transport processes. Experimental research with the goal to further develop the insight in processes is often used more than once.

The pilot experiment shows that it is feasible to carry out useful morphological experiments in a 3D wave-current facility. Stable conditions were generated in an interesting regime with dominantly suspended transport and reasonable ripple sizes (approx. 1 cm height, 5-10 cm length). The test with a detached offshore breakwater has been analysed thoroughly and turned into a dataset for model validation, which will be available to interested research

Efforts to improve the status of experimental research in Delft should focus on using the existing facilities more, rather than building new ones. If there is not enough enthusiasm for using the present facilities, it is unlikely that this will improve with new, even more costly ones.

From a research point of view, there is a good potential for a combined 3D wave-current basin with a longer set of paddles and good facilities for current generation and sand traps. Such a facility however is only feasible with a substantial new injection of funding that includes money for carrying out a testing programme.

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|-------------------|---------------------------------------------------------------------------------------------------------|-------------------|-----------------|
| PROJECT NAME: | Survey of the need for experimental facilities including a Journal and dissertations evaluation. | PROJECT CODE: | 03.01.04 |
| BASEPROJECT NAME: | System knowledge and response | BASEPROJECT CODE: | 03.01 |
| THEME NAME: | Coast and River | THEME CODE: | 03 |

Executive Summary

Survey of the need for experimental facilities including a Journal and dissertations evaluation.

Introduction

In recent years there has been much discussion on the role of experimental facilities in coastal and river engineering research. Experimental research appears to be under severe pressure. Numerical models seem to take over the role of scale model research. Carrying out field measurements in combination with remote sensing techniques offers fast increasing possibilities for (numerical) model validation.

Because of the high costs of experimental research the threshold of carrying it out is high; therefore the capacity of the facilities is not used enough, which makes them even more expensive. In some cases there is a clear downward spiral, where the capabilities to do good experimental research threatens to sink below an acceptable minimum level.

In various ways efforts are undertaken to improve the financial picture around the experimental facilities. However, these efforts are hampered by the difficulty of showing what kind of facilities are needed, from a scientific point of view and seen from the market.

In this project, the role of experimental facilities in coastal and river engineering research was evaluated. Two main activities were undertaken: a survey of journal papers and (Dutch) dissertations over the past 10 years, and a pilot experiment to investigate the feasibility of 3D morphological experiments given the present state-of-the-art of models and facilities.

Journal and dissertations evaluation

The goal of this study was to investigate the importance of experimental research as shown by papers in internationally important scientific journals. This was done by counting the number of papers in these journals which make use of experimental research data, including an attempt to indicate the importance of such research for the papers that are investigated. The same analysis was carried out for Dutch dissertations.

The evaluations presented in the report show that measurements still play an important role in publications in international journals. Field measurements referred to in the evaluated papers are most often used to calibrate and/or validate numerical models. Laboratory measurements are often used to investigate basic processes, as for example in sediment transport processes. Often, the papers are used to present the experimental results and the implications for theoretical or numerical models.

From the analysis it has become clear that experimental research with the goal to further develop the insight in processes is often used more than once. In other words, good experiments are of use for long time spans.

No evidence is found that the demand for experimental research is decreasing. In fact, the combination of an increasing number of papers presented for publication, in combination with a quite stable percentage of papers where use is made of both experimental and field research indicated that the demand for experimental research shows in fact a slight *increase*.

Despite that, the use of self-performed measurements decreases in the (Dutch) dissertations reviewed. This does not mean that the demand for field and laboratory measurements is decreasing, but more likely that the budgets for such investigations are insufficient.

Morphological pilot experiment

As the subject of the pilot experiment we chose the morphological development and trapping capacity of a groyne on a longshore uniform beach, and compared that with a detached offshore breakwater of limited length, situated the same distance from the shore as the tip of the groyne.

The beach was approx. 33 m long and 14 m wide. It made an angle of 20 degrees with the mean direction of the incoming waves. 110 Micron sand was used. Waves were multidirectional with a directional distribution with a standard deviation of 15 degrees. Peak wave period was 2 s and significant wave heights of 10 and 15 cm were applied. A recirculation flow of approx. 125 l/s was applied for the 10 cm waves and approx. 200 l/s for the 15 cm waves. These conditions were chosen on the basis of preliminary simulations with a 3D flow model.

During the tests measurements were taken of flow velocities (6 electromagnetic current meters, wave heights (6 gauges) and sediment concentration (suction tubes). Circulation patterns were observed using video camera and small pieces of paper.

The bathymetry was mainly measured by video observation during the lowering of the water level, which was a cheap way of measuring and accurate enough for the purpose of the pilot experiment. Additionally, traditional levelling was applied in areas that were difficult to observe by video, i.e. in the shadow area of the breakwater.

The pilot experiment shows that it is feasible to carry out useful morphological experiments in a 3D wave-current facility. Stable conditions were generated in an interesting regime with dominantly suspended transport and reasonable ripple sizes (approx. 1 cm height, 5-10 cm length). The test with the groyne shows credible results which are in some aspects different from traditional profile/line models but are in line with more sophisticated models.

Predictive runs with a 3D morphodynamic model (Lesser et al., 2000) (look in Ref.) were proven to be qualitatively correct although significant quantitative differences occur. Since all relevant processes can be measured in the same model, the comparison between computer model and physical model will give a good opportunity for validation and improvement of computer models.

The test with the detached offshore breakwater has been analysed thoroughly and turned into a dataset for model validation, which will be available to interested researchers.

For a wider range of conditions and types of structures with a wider impact a facility with a longer set of wave paddles is needed. To allow the study of additional effects of tidal currents, the current recirculation should be an order of magnitude stronger. For longer running experimental programmes, an efficient sediment supply system and a more sophisticated sand trapping and pumping system are required.

Conclusions

The main conclusion from this study is that physical modelling is very much alive and offers great potential for detailed research of processes and for model validation. Contrary to earlier findings, meaningful morphodynamic experiments can be carried out in 3D wave basins, given the much improved wave generation techniques and the possibility of 'compound' modelling, using a numerical model to interpret the physical model results and to scale the results up to the real world.

Efforts to improve the status of experimental research in Delft should focus on using the existing facilities more, rather than building new ones. If there is not enough enthusiasm for using the present facilities, it is unlikely that this will improve with new, even more costly ones.

The dismantling of the Sand Flume at DH is a serious loss to the capabilities in Europe. Given the importance of predicting the development of dunes, the potential breaking up of armoured layers and other such questions during extreme discharge events, and given the effects of these phenomena on the assessment of risk levels in the Netherlands, this does not seem to be an acceptable situation.

From a research point of view, there is a good potential for a combined 3D wave-current basin with a longer set of paddles and good facilities for current generation and sand traps. Such a facility however is

only feasible with a substantial new injection of funding that includes money for carrying out a testing programme.

Recommendations

The present combination of the facilities at DH and the Fluid Mechanics Laboratory at DUT offers a good range of modern facilities. Simply for reasons of space there is no other feasible option than this combination. The threshold for doing fundamental research in the DH facilities should be lowered by obtaining support from external funding agencies like NWO, or by introducing arrangements where students can use facilities with the minimum support by DH staff required to run tests safely, much as it is done at DUT.

After the successful pilot experiment in the Vinjé basin we recommend to carry out a number of further morphological experiments to investigate specific processes:

- Current-induced scour near structures (3D)
- Wave-induced currents over a bar or a submerged breakwater, with recirculating flow to simulate part of a 3D situation; such situations are very relevant for construction phases of works like Palm Island, Maasvlakte-2 (2DV tests)
- 3D morphological tests of offshore breakwaters, submerged breakwaters, in a closed basin.

We recommend to carry out a number of such tests at DUT first, using the mono-directional wave basin, the 3D current facility and the wave flume, and to follow the 3D tests up with multidirectional tests in the Vinjé basin.

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| PROJECT NAAM: | Survey of the need for experimental facilities including a Journal and dissertations evaluation. | PROJECT CODE: | 03.01.04 |
| BASISPROJECT NAAM: | System knowledge and response | BASISPROJECT CODE: | 03.01 |
| THEMA NAAM: | Coast and River | THEMA CODE: | 03 |

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| Survey of the need for experimental facilities including a Journal and Dissertations evaluation | Z2825 Delft Cluster | June 2003 |
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Survey of the need for experimental facilities including a Journal and Dissertations evaluation

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June, 2003

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I Introduction

I.1 Background

In recent years there has been much discussion on the role of experimental facilities in coastal and river engineering research. Experimental research appears to be under severe pressure. Numerical models seem to take over the role of scale model research. Carrying out field measurements in combination with remote sensing techniques offers fast increasing possibilities for (numerical) model validation.

Because of the high costs of experimental research the threshold of carrying it out is high; therefore the capacity of the facilities is not used enough, which makes them even more expensive. In some cases there is a clear downward spiral, where the capabilities to do good experimental research threatens to sink below an acceptable minimum level.

In various ways efforts are undertaken to improve the financial picture around the experimental facilities, see for instance lit. [1]. However, these efforts are hampered by the difficulty of showing what kind of facilities are needed, from a scientific point of view and seen from the market. The report of Commissie van Bennekom, lit. [2] underlines this point.

The author of this report believes that there still is a unique role for experimental facilities, beside that of numerical models and field research. A number of these facilities can be maintained and developed in the Netherlands, in a cost-effective way, while for others co-operation with institutes abroad must be sought.

The most important role of experimental facilities is in the research of processes and the improvement of process models. Here the boundary conditions need to be controllable and reproducible, and the phenomena involved need to be measured accurately and in detail.

I.2 Objectives of the project

The objectives of the project are to investigate:

- What, seen from the consultancy market and the models applied there, are the biggest gaps in knowledge and know-how, in the field of hydrodynamics, sediment transport, bottom behavior and morphology;
- Which type of facilities are critical to the research of these aspects;
- Are these facilities available in Europe, of sufficient quality and sufficiently accessible;
- Is the level of expertise required a reason for developing and/or maintaining the facilities in the Netherlands;
- How and where can these facilities be developed/ maintained;
- What kind of pilot experiments must be carried out to get a better indication of the feasibility of certain facilities?

The project has focused mainly on the hydrodynamics, sediment transport and morphodynamics of coasts, estuaries and rivers. The use of facilities for the research on hydraulic structures is considered in less detail.

Regarding the pilot experiments, a substantial part of this project has consisted of actually carrying out a morphological experiment in an existing 3D wave basin.

1.3 Framework of the project

This project is part of the Delft Cluster Theme 3: Coast and River, basic project plan 1: system knowledge. In this basic project fundamental research is carried out into the morphodynamics of coasts and rivers, which must lead to an increase of knowledge in these areas and an improvement of models that can be used to predict the effects of large-scale works.

The research strategy that is followed is one, where in a balanced way attention is paid to the following development stages:

- identification of processes by means of field research;
- detailed analysis in laboratory facilities;
- development and validation of numerical models;
- integral verification of these models through laboratory research;
- field validation using point measurements, soundings and remote-sensing data.

The role of experimental research relative to numerical models and field research is summarized in the table below:

| Method | Application | Problems |
|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Numerical models | <ul style="list-style-type: none"> • Investigating processes and formulations • Describing present situation • Predicting autonomous development • Predicting effects of works | <ul style="list-style-type: none"> • Predictability • Completeness • Accuracy • Representing history in bottom • Complex reality |
| Field research | <ul style="list-style-type: none"> • Investigating trends • Identifying dominant processes • Validation and calibration of numerical models | <ul style="list-style-type: none"> • Availability of long time-series • Trend breaches • Spatial covered • Reproducibility • Multiple influences |
| Experimental research in facilities | <ul style="list-style-type: none"> • Local project-related problems and measures • Process research (acquiring fundamental insight) • Improvement of process modelling (parameter variation) • Integral model verification | <ul style="list-style-type: none"> • Scale effects • Model effects • Representing history in bottom |

2 Inventory of role of experimental facilities in publications

2.1 Introduction

The goal of this study was to investigate the importance of experimental research as shown by papers in internationally important scientific journals. This was done by counting the number of papers in these journals which make use of experimental research data, including an attempt to indicate the importance of such research for the papers that are investigated.

Also a number of (Dutch) dissertations have been investigated, for the same purpose. The outcome of this dissertation investigation, concerning the ratio of carried out or used experimental research, reflects the Dutch situation.

The findings of the study are reported in Appendix 1. Below, the main conclusions are summarised.

2.2 Main conclusions

The evaluations presented in the report in Appendix 1 show that measurements still play an important role in publications in international journals. Field measurements referred to in the evaluated papers are most often used to calibrate and/or validate numerical models. Laboratory measurements are often used to investigate basic processes, as for example in sediment transport processes. Often, the papers are used to present the experimental results and the implications for theoretical or numerical models.

From the analysis it has become clear that experimental research with the goal to further develop the insight in processes is often used more than once. For example, within the publications reviewed, 4 times reference is made to the experiments by Beji and Battjes (1993). Other examples include Guy *et al.* (1966, 3 times), Bagnold (1946), Kamphuis (1975), Day (1977), Jensen *et al.* (1989), Cox *et al.* (1991), Okayasu and Katayama (1992), Roelvink and Stive (1989) and Sleath (1990), all twice. In other words, good experiments are of use for long time spans.

No evidence is found that the demand for experimental research is decreasing. In fact, the combination of an increasing number of papers presented for publication, in combination with a quite stable percentage of papers where use is made of both experimental and field research indicated that the demand for experimental research shows in fact a slight *increase*.

Despite that, the use of self-performed measurements decreases in the (Dutch) dissertations reviewed. This does not mean that the demand for field and laboratory measurements is decreasing, but more likely that the budgets for such investigations are insufficient.

3 Setup, results and conclusions 3D morphological pilot experiment

3.1 Introduction

One of the most uncertain aspects in the analysis of future requirements of facilities is the need for a 3D wave-current facility in which, apart from hydrodynamic tests, also morphological tests can be carried out.

Morphological tests in a 3D basin have hardly been carried out at WL| delft hydraulics since the early '80s. This was mainly due to a couple of problems that occurred in doing such tests:

- spurious waves due to first-order wave generation led to bottom disturbances which were often of the same order as the features under study;
- due to scale effects (e.g. relatively large ripples) the results were hard to translate to prototype.

Regarding the first point the wave generation techniques have been improved to such an extent that disturbances are much smaller. The second point is addressed by changing the role of the experiments: no longer as a direct scale representation of reality, but rather as one of the tools in a composite modelling methodology: a controlled part of reality is used to validate computer models. The latter are then used to make predictions on a prototype scale. The strong need for datasets to verify the recent 2DH or 3D morphological models is illustrated by the fact that some very old datasets, i.e. Keta Lagoon, Delft Hydraulics (1982) and Roelvink et al., (1994); groyne tests by Hulsbergen et al. (1978) are still used internationally, for lack of an alternative. (vermeld deze publ. in Ref.)

In order to assess the present situation with regard to morphological experimenting in a 3D basin, a limited pilot experiment was carried out in the multidirectional wave basin at WL | delft hydraulics (DH).

3.2 Goal of pilot experiment

The purpose of the pilot experiment is to evaluate whether, at the present state-of-art, datasets can be generated that can be used to validate numerical morphological models. To do these experiments a number of requirements must be met:

- A clear distinction between areas affected by boundary disturbances, relatively undisturbed areas and the area of interest, where significant changes occur, i.e. near some structure.
- No spurious circulations, seiching or secondary waves.
- Simultaneous observation of the relevant process parameters such as wave heights, orbital velocities, velocity verticals, concentration; regular observation of bed forms and bed changes.

These requirements were tested in the existing multidirectional wave basin, which was equipped with a limited flow circulation capacity, strong enough to recirculate the surfzone current.

3.3 Set-up of the experiment

As the subject of the experiment we chose the morphological development and trapping capacity of a groyne on a longshore uniform beach, and compared that with a detached offshore breakwater of limited length, situated the same distance from the shore as the tip of the groyne.

The beach was approx. 33 m long and 14 m wide. It made an angle of 20 degrees with the mean direction of the incoming waves. 110 Micron sand was used. Waves were multidirectional with a directional distribution with a standard deviation of 15 degrees. Peak wave period was 2 s and significant wave heights of 10 and 15 cm were applied. A recirculation flow of approx. 125 l/s was applied for the 10 cm waves and approx. 200 l/s for the 15 cm waves. These conditions were chosen on the basis of preliminary simulations with a 3D flow model.

During the tests measurements were taken of flow velocities (6 electromagnetic current meters, wave heights (6 gauges) and sediment concentration (suction tubes). Circulation patterns were observed using video camera and small pieces of paper.

The bathymetry was mainly measured by video observation during the lowering of the water level, which was a cheap way of measuring and accurate enough for the purpose of the pilot experiment. Additionally, traditional levelling was applied in areas that were difficult to observe by video, i.e. in the shadow area of the breakwater.

Figure 1 shows a photograph of the model basin during the start of the detached offshore breakwater test.

The experimental set-up and the comparison with the morphodynamic model Delft3D is described in more detail in the paper by Roelvink et al. (2002) attached as Appendix 2 to this report.



Figure 1 View of the detached offshore breakwater test with measurement tripods, beam with fixed instruments. Inflow is at the far end.

3.4 Main results

During calibration tests without structures it turned out to be very well possible to obtain a stable longshore current over an almost perfectly straight beach. The required sediment supply was found to be in the order of 1 m³/hour, which was supplied by hand. With this supply, the beach remained very stable over many hours of wave action.

The groyne led to some limited initial adjustment of the beach line and initially some accretion downstream of the tip of the groyne. Subsequently, practically all sand transported along the beach was bypassed around the groyne and disappeared in the sandtrap downstream. The groyne thus had very little effect on the longshore transport. This finding is similar to preliminary computations with a 3D morphological model and appears to be related to the fact that the waves do most of the stirring of the sand while the longshore current merely transports the material. Obviously, this is very much against what conventional profile/line models would predict and deserves further study.

The detached offshore breakwater test showed considerably larger bed level changes, as a shallow underwater tombolo formed. A comparison between the modelled final bathymetry (Figure 2, right) and the results from the video analysis merged with levelling results (left) shows a good qualitative agreement.

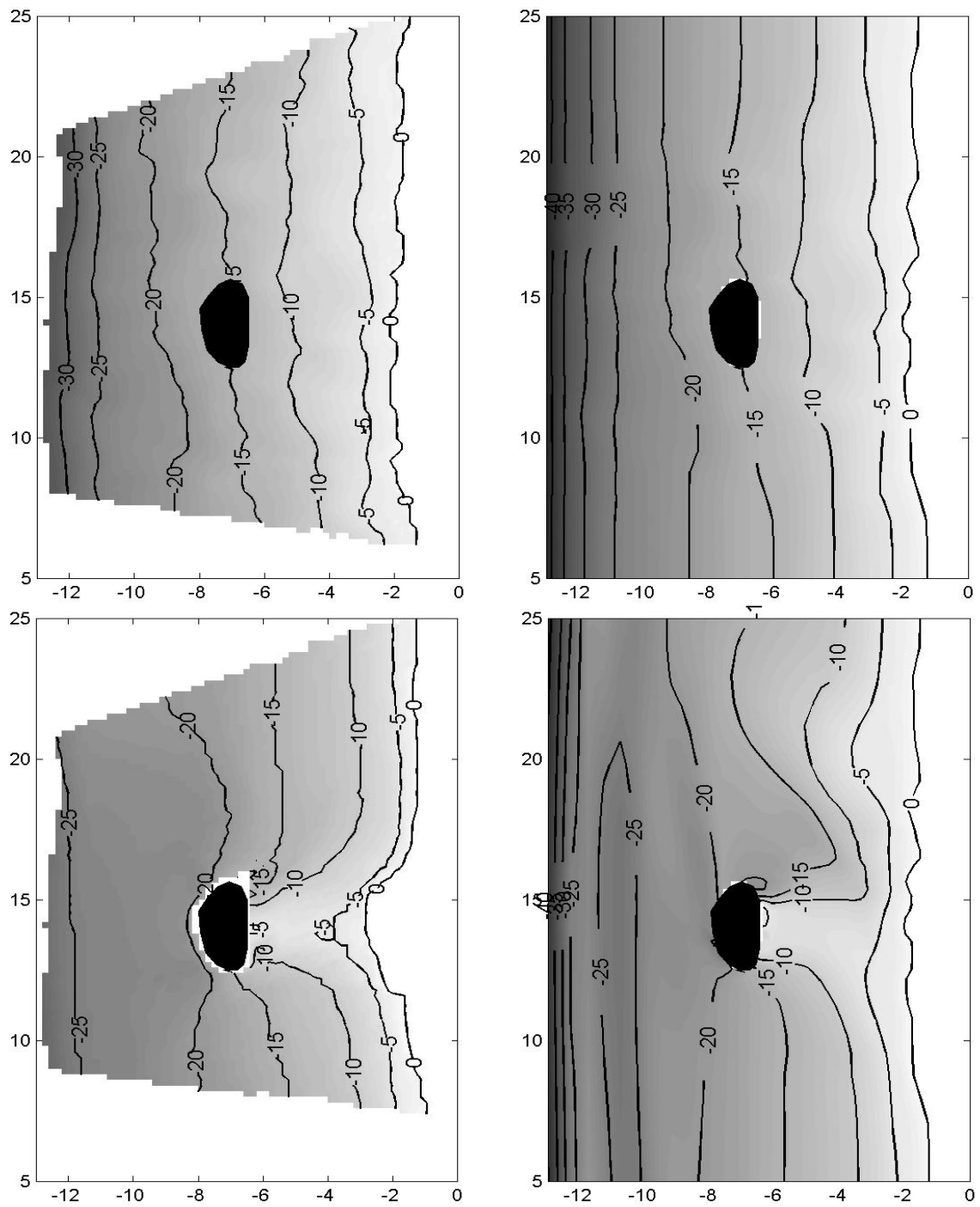


Figure 2 Observed (left) and computed (right) initial bathymetry (top) and final bathymetry (bottom); bottom heights in cm, distances in m.

3.5 Conclusions

The pilot experiment shows that it is feasible to carry out useful morphological experiments in a 3D wave-current facility. Stable conditions were generated in an interesting regime with dominantly suspended transport and reasonable ripple sizes (approx. 1 cm height, 5-10 cm length). The test with the groyne shows credible results which are in some aspects different from traditional profile/line models but are in line with more sophisticated models.

Predictive runs with a 3D morphodynamic model (Lesser et al., 2000) (ook in Ref.) were proven to be qualitatively correct although significant quantitative differences occur. Since all relevant processes can be measured in the same model, the comparison between computer model and physical model will give a good opportunity for validation and improvement of computer models.

The test with the detached offshore breakwater has been analysed thoroughly and turned into a dataset for model validation, which will be available to interested researchers.

For a wider range of conditions and types of structures with a wider impact a facility with a longer set of wave paddles is needed. To allow the study of additional effects of tidal currents, the current recirculation should be an order of magnitude stronger.

For longer running experimental programmes, an efficient sediment supply system and a more sophisticated sand trapping and pumping system are required.

4 Summary of findings

4.1 Overview of gaps in knowledge and know-how relevant to morphological problems

Based on a review of research and consultancy projects at Delft University of Technology (DUT) and Delft Hydraulics (DH) over the past 5 years, we have selected the following high-priority topics related to morphological problems:

| | |
|--------------------|-----------------------------------------------------------------------------------------------------------|
| Hydrodynamics | Large-scale turbulence; prediction of large horizontal vortices near structures and bathymetric gradients |
| | Non-hydrostatic flows in lakes, estuaries, harbours, near local structures |
| | 3D, time-varying flows in surfzones |
| | Nonlinear properties of waves in the nearshore |
| | Turbulence damping and density currents induced by suspended sediment |
| | Vegetation effects |
| Sediment transport | Ripples, dunes and roughness as function of hydrodynamics and sediment composition |
| | Effects of increased turbulence on transport |
| | Intra-wave transport mechanisms |
| | Erosion and sedimentation of mud and sand/mud mixtures as function of current, waves, sediment properties |
| | Biological effects on mud strength |
| | Flocculation, settling and consolidation of mud |
| | |
| Morphology | Behaviour of bends and bifurcations due to graded sediment |
| | Horizontal and vertical sorting processes |
| | Nearshore bars and rip circulation systems |
| | Effects of hard and soft coastal protection measures |
| | Channel/shoal interactions |
| | Interactions between morphology and vegetation |
| | |

4.2 Availability of facilities to study these processes

4.2.1 Large-scale turbulence; prediction of large horizontal vortices near structures and bathymetric gradients

These phenomena are studied in small-scale table models or larger-scale models such as are available at DUT. Sophisticated measuring equipment is needed to record turbulence characteristics at sufficiently small scales.

4.2.2 Non-hydrostatic flows in lakes, estuaries, harbours, near local structures

Local flows around structures can be studied in existing facilities at DUT and DH, which range from simple flumes to the Tidal Flume, in which a combination of tidal and salinity driven currents can be simulated (e.g. current-deflecting wall of Deurgancksdok, Antwerp).

4.2.3 3D, time-varying flows in surfzones

These flows (surf beats, edge waves, shear waves) can be studied in wave flumes such as the Scheldegoot at DH and the Speurwerkgoet at DUT, for 2DV situations, and the 3D Vinjé basin at DH. The length of the paddle section is a limitation for shear waves to develop and the existing capabilities of generating longshore currents are ad-hoc and could be much improved.

4.2.4 Nonlinear properties of waves in the nearshore

These can be studied in the existing wave flumes and 3D basin. A typical scale of 1:40 is no major obstacle, as Reynolds numbers will generally be high enough.

4.2.5 Turbulence damping and density currents induced by suspended sediment

These effects could be studied in the Tidal Flume, but such experiments have not been carried out yet.

4.2.6 Vegetation effects

The effects of vegetation on current profiles and wave attenuation can be investigated in the existing wave/current flumes at DH and DUT.

4.2.7 Ripples, dunes and roughness as function of hydrodynamics and sediment composition

These studies require a sophisticated sand flume, which is not available in the Netherlands at present. Good facilities exist in the US and Germany, among others. The larger-scale bed forms can be detected in the field, but this only provides occasional snapshots and no information on vertical sorting processes.

4.2.8 Effects of increased turbulence on transport

The current-induced scour near structures is poorly understood and modelled, largely due to lack of insight on the increased pick-up of sediment due to local turbulence. Accepting some scale effects, this could be investigated in the large current basin at DUT or in flumes.

4.2.9 Intra-wave transport mechanisms

These mechanisms can only be studied sensibly in large-scale facilities such as the Large Oscillating Water Tunnel (LOWT) at DH, the Delta Flume or the GWK in Hanover. With the concentration of DH in Delft completed, it must be feared that complex detailed process measurements in the Delta Flume will be difficult to execute; the GWK has a permanent staff and is well equipped. The effects of pressure gradients and vertical velocities cannot be studied in the LOWT.

4.2.10 Erosion and sedimentation of mud and sand/mud mixtures as function of current, waves, sediment properties

Some effects can be studied in the existing flumes at DH and DUT; in the ripple regime, serious scale effects are likely to occur, and large-scale facilities must be preferred. Gaps in the knowledge about the erosion rates of such mixtures are a major obstacle in predictions of morphological change in estuaries.

4.2.11 Biological effects on mud strength

There is not enough expertise to carry out such tests in Delft; co-operation with institutes such as NIOO and NIOZ may provide the necessary data.

4.2.12 Flocculation, settling and consolidation of mud

There are very good facilities at DUT and DH to study mud processes, such as the new Settling (??) Column at DUT.

4.2.13 Behaviour of bends and bifurcations due to graded sediment

This requires large-scale model facilities which are not presently available in the Netherlands; there are excellent facilities in Germany (Bundesanstalt für Wasserbau) and a long-term programme of carrying out tests in these facilities. There is no support in the Netherlands for this kind of long-term, costly research.

4.2.14 Horizontal and vertical sorting processes

Improvement of understanding and modelling of these processes, which play a crucial role in understanding river dynamics, requires a good sand flume. Regrettably, such a facility is no longer available, and this kind of research can only be carried out in facilities abroad.

4.2.15 Nearshore bars and rip circulations systems

The morphological study of such systems in the existing 3D wave basins in Europe is likely to suffer from serious scale effects. A direct parametric study trying to link the morphology to incident wave conditions and beach parameters is therefore not possible. However, meaningful datasets for validation of numerical models could be generated, provided the models can handle the small scales in the physical model. Overcoming the scale effects by enlarging the basin would lead to unrealistic dimensions.

In this domain, the advance of ARGUS video techniques and in situ measurement techniques make it more and more feasible to study such processes in the field, in enough detail. A remaining problem will be the complexity of the forcing conditions.

4.2.16 Effects of hard and soft coastal protection measures

As in the previous example, very useful datasets can be generated in existing 3D facilities, to test numerical models' capability to predict effects of protection measures. The advantage here is that there usually is a strong signal due to the measure, which is easy to isolate from possible model effects. The pilot experiment in the Vinjé basin clearly shows the feasibility of such studies. However, the costs of carrying out such tests in the Netherlands are considerable, especially when the tests have to be run over longer time periods. Well-equipped laboratories in low-wages countries could be a serious alternative, in combination with a co-operative agreement to carry out test series and a commitment to provide technical support.

4.2.17 Channel/shoal interactions

These need to be studied in large area models, which can be run over long periods. At present, such facilities are not available in the Netherlands; the same argument as above points towards setting up long-term relationships with institutes abroad.

4.2.18 Interactions between morphology and vegetation

Facilities for testing such interactions are available at DH and DUT; the Tidal Flume and the wave/current flumes can be used to study such effects, in addition to field measurements.

4.3 Are these facilities available in Europe, of sufficient quality and sufficiently accessible?

An overview of the available facilities in Europe has been gathered in the framework of the EU-HYDRALAB programme, ref. [3], [4]. The main conclusions from that project were

that a first priority is to make better use of existing facilities rather than build bigger new ones.

The dismantling of the Sand Flume at DH is a serious loss to the capabilities in Europe, though there are large facilities at the Bundesanstalt für Wasserbau; these are however meant primarily for research on German waterways. Given the importance of predicting the development of dunes, the potential breaking up of armoured layers and other such questions during extreme discharge events, and given the effects of these phenomena on the assessment of risk levels in the Netherlands, this does not seem to be an acceptable situation.

For coastal morphology, large-scale flumes are available (still?) in the Delta Flume, and in the GWK in Hanover; the latter is much longer and fully covered, and has a more permanent staff.

The Vinjé basin in its present state can be used for limited 3D tests of morphological changes, and other European facilities are not much better equipped; the wave generation in Delft is superior. The main problem lies with the costs and the time associated with carrying out morphological tests, while there is little doubt that such tests are needed for generating datasets for validation of morphological models.

4.4 Is the level of expertise required a reason for developing and/or maintaining the facilities in the Netherlands?

There is a strong experimental expertise at DH and DUT on the subjects of:

- mud processes
- dredging processes
- density currents
- wave generation
- 2DV and 3D testing of hydraulic structures
- 2DV morphological testing
- turbulence measurements.

While much of this expertise is also available abroad, Delft still has a good concentration of expertise which gives it an advantage in the high-end market.

Morphological modelling in 3D basins is relatively labour-intensive and requires relatively much low-skilled labour. Carrying out such experiments in low-wage countries with a good support would be a good alternative. However, methods and measurement techniques should preferably be developed in Delft, in limited-scale experiments.

4.5 How and where can these facilities be developed/maintained?

The present combination of the facilities at DH and the Fluid Mechanics Laboratory at DUT offers a good range of modern facilities. Simply for reasons of space there is no other feasible option than this combination. The threshold for doing fundamental research in the DH facilities should be lowered by obtaining support from external funding agencies like NWO, or by introducing arrangements where students can use facilities with the minimum support by DH staff required to run tests safely, much as it is done at DUT.

4.6 What kind of pilot experiments must be carried out to get a better indication of the feasibility of certain facilities?

After the successful pilot experiment in the Vinjé basin we recommend to carry out a number of further morphological experiments to investigate specific processes:

- Current-induced scour near structures (3D)
- Wave-induced currents over a bar or a submerged breakwater, with recirculating flow to simulate part of a 3D situation; such situations are very relevant for construction phases of works like Palm Island, Maasvlakte-2 (2DV tests)
- 3D morphological tests of offshore breakwaters, submerged breakwaters, in a closed basin.

We recommend to carry out a number of such tests at DUT first, using the mono-directional wave basin, the 3D current facility and the wave flume, and to follow the 3D tests up with multidirectional tests in the Vinjé basin.

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5 Conclusions

The main conclusion from this study is that physical modelling is very much alive and offers great potential for detailed research of processes and for model validation.

Contrary to earlier findings, meaningful morphodynamic experiments can be carried out in 3D wave basins, given the much improved wave generation techniques and the possibility of ‘compound’ modelling, using a numerical model to interpret the physical model results and to scale the results up to the real world.

Efforts to improve the status of experimental research in Delft should focus on using the existing facilities more, rather than building new ones. If there is not enough enthusiasm for using the present facilities, it is unlikely that this will improve with new, even more costly ones.

The dismantling of the Sand Flume at DH is a serious loss to the capabilities in Europe. Given the importance of predicting the development of dunes, the potential breaking up of armoured layers and other such questions during extreme discharge events, and given the effects of these phenomena on the assessment of risk levels in the Netherlands, this does not seem to be an acceptable situation.

From a research point of view, there is a good potential for a combined 3D wave-current basin with a longer set of paddles and good facilities for current generation and sand traps. Such a facility however is only feasible with a substantial new injection of funding that includes money for carrying out a testing programme.

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A Appendix

Journal and Dissertations evaluation

**Christiaan Jacobs
Chris Stolker**

June, 2003

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I Introduction

I.1 Background

In recent years, a nearly endless discussion has been (and still is) going on the role of experimental facilities in Coastal and River engineering research. From the discussion it is clear that experimental research is under strong pressure. Numerical modelling seems to be able to replace (some of the features) of scale-model research. Field measurements in combination with remote sensing might offer sufficient opportunities for model validation.

High expenses are thought to be connected to experimental research. New research is reduced, which causes a decreasing use of experimental facilities; this makes research even more expensive. This downward trend might cause that the possibilities to do proper experimental research could diminish below acceptable levels.

Several attempts are being made to improve the financial background of experimental facilities. These attempts, however, show how difficult it is to show the necessity of experimental facilities in the Netherlands, both from scientific and from economic points of view.

The most important role of experimental facilities nowadays is to study basic processes and to improve process based modelling. Boundary conditions need to be verifiable and reproducible and processes have to be measured in detail and accurately.

The goal of this report is to investigate the importance of experimental research as shown by papers in internationally important scientific journals. This is done by counting the number of papers in these journals which make use of experimental research data, including an attempt to indicate the importance of such research for the papers that are investigated.

Also a number of (Dutch) dissertations have been investigated, for the same purpose. The outcome of this dissertation investigation, concerning the ratio of carried out or used experimental research, reflects the Dutch situation.

I.2 Framework

This report is part of the research done within the framework of Delft Cluster, a co-operation between five technological institutes in Delft: GeoDelft, IHE Delft, TNO, Delft University of Technology and WL | Delft Hydraulics.

The research concerning the different Journals was carried out by ir. C.E.J. Jacobs (Delft University of Technology). The dissertations were examined by ir. C. Stolker and dr.ir. Suryadi.

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The evaluation of the need of experimental research facilities is part of the theme 'Kust en Rivier' (Coast and River). The project number is 03.01.04

I.3 Structure of the report

In Chapter 2 of this report, information is given about the scope of the investigated journals and dissertations. Chapter 3 gives the analysis of the different journals and the concerned dissertations. Finally, in Chapter 4 some conclusions and recommendations are given.

2 Scientific Journals

2.1 Introduction

This chapter gives some background information on the investigated journals and dissertations.

In total three different journals have been investigated to evaluate the use of experimental research facilities within the papers in these journals. These are *Coastal Engineering* (by Elsevier Science) (Paragraph 2.2), the *Journal of Hydraulic Engineering* (by the American Society of Civil Engineers, ASCE) (Paragraph 2.3) and the *Journal of Waterway, Port, Coastal, and Ocean Engineering* (by the ASCE) (Paragraph 2.4).

Besides in journals, experimental research can be found in dissertations. Therefore 65 dissertations have been reviewed to investigate the ratio of use of experimental facilities or experimental data. The dissertations were chosen on the criterion that the research was carried out within Dutch (research) institutions. Therefore mainly Dutch authors are taken into account. Background information concerning the dissertations can be found in Paragraph 2.5.

2.2 Coastal Engineering

2.2.1 Scope

Coastal Engineering is an international journal for Coastal, Harbour and Offshore Engineers, published bimonthly by Elsevier Science, Amsterdam. *Coastal Engineering* is intended as an international medium for engineers working in the field of marine and coastal technology. Combining practical application with modern technological and scientific achievements it publishes fundamental studies as well as case histories on the following aspects of coastal, harbour and offshore engineering: studies on waves and currents; coastal morphology; estuary hydraulics; harbour and offshore structures. Mathematical and physical models as well as constructional aspects and environmental problems relating to these items are included. (Information copied from cover of publication.)

2.2.2 Editorial Board

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E.W. Bijker, Maassluis, The Netherlands,

Advisory Editorial Board:

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A. Brampton, Wallingford, UK

R.A. Dalrymple, Newark, DE, USA

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 J.W. Kamphuis, Delft, The Netherlands
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 M. Mathiesen, Trondheim, Norway
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 H. Oumeraci, Braunschweig, Germany
 M.J.F. Stive, Delft, The Netherlands
 I.A. Svendsen, Newark, DE, USA
 D.H. Swart, Pretoria, South Africa
 J. van de Graaff, Delft, The Netherlands
 J.J. van de Kreeke, Miami, FL, USA
 A. Watanabe, Tokyo, Japan
 I. Young, Adelaide, Australia

2.2.3 Issues

The issues investigated in this report include the years 1995, 1998 and 1999, all volumes.

2.3 Journal of Hydraulic Engineering

2.3.1 Scope

The *Journal of Hydraulic Engineering* is an international journal, published monthly by the American Society of Civil Engineers, ASCE. The journal aims to be a central forum for the dissemination of original work. This journal describes the analyses and solutions of problems in hydraulic engineering, hydrology, and water resources. Contributors emphasise concepts, methods, techniques, and results that advance knowledge, or are suitable for general application and use in the hydraulic engineering profession. Technical papers, notes, and professional discussions highlight hydraulic engineering issues ranging from short-term fluctuations in ground water to momentum models of non-uniform channel-bend flow. On occasion, the results of any technical, economic, or social facet of the use and conservation of water as a natural resource are published. (Information copied from internet page of publication).

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2.3.2 Editorial Board

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Cliff A. Pugh, U.S. Bureau of Reclamation
Wolfgang Rodi, University of Karlsruhe

2.3.3 Issues

The issues investigated in this report include the year 1999, all volumes.

2.4 Journal of Waterway, Port, Coastal, and Ocean Engineering

2.4.1 Scope

The *Journal of Waterway, Port, Coastal, and Ocean Engineering* is an international journal, published bimonthly by the American Society of Civil Engineers, ASCE. The journal aims to present a timely collection of papers in engineering research and practice concerned with dredging, floods, ice, pollution, sediment transport, and tidal wave action that affect shorelines, waterways, and harbours. Peer-reviewed papers detail the development and operation of ports, harbours, and offshore facilities, as well as deep ocean engineering and shore protection and enhancement. Additional issues encompassed by the journal's scope include the regulation and stabilisation of rivers and the economics of beach nourishment. (Information copied from internet page of publication).

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2.4.2 Editorial Board

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Zeki Demirebileky, Coastal Engineering Research Center

Editorial Board:

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Ronald Riggs, University of Hawaii at Manoa
Hongbo Xu, Shell Development Company
Harry H. Yeh, University of Washington
Solomon Yim, Oregon State University

2.4.3 Issues

The issues investigated in this report include the year 1999, all volumes.

2.5 Dissertations

At last, a total of 65 dissertations were examined, with subjects in the field of River- and Coastal engineering. The subjects of the dissertations vary from waves, morphology, water management to revetments. The reviewed dissertations originate from 1986 to 2000. Appendix A shows the evaluated dissertations, sorted by the author's last name. Mainly Dutch authors fill the list.

Figure 2.1 shows the evaluated dissertations as a function of time. The years 1992 - 1999 dominate when looking to the number of dissertations. The year 1997 provides the highest number of dissertations evaluated: 9.

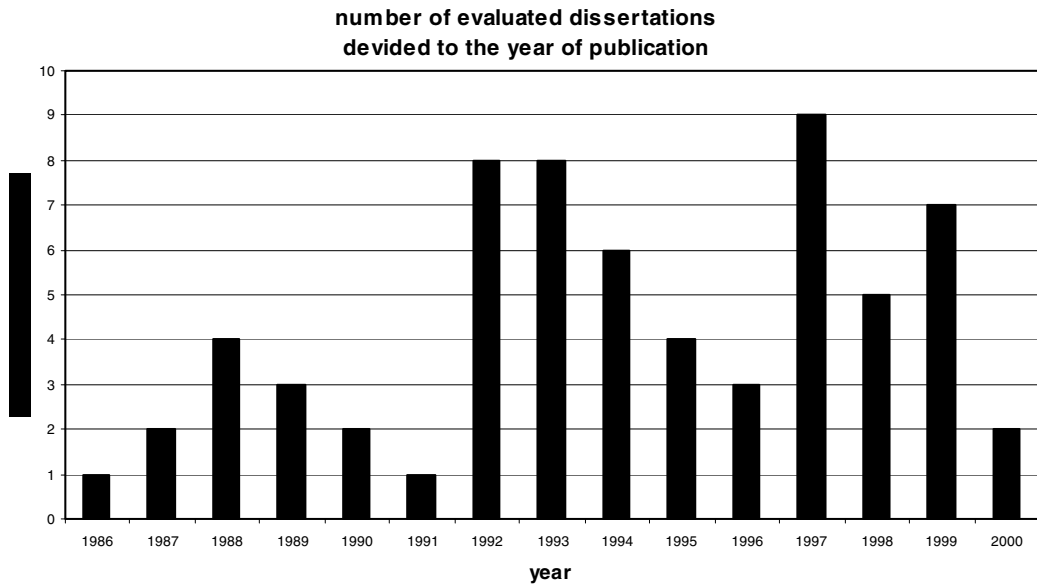


Figure 2.1 Number of evaluated dissertations divided to the year of publication

In order to provide a more straightforward evaluation, the evaluation of the dissertations has been set up within a Microsoft Access Database. The layout of this database is shown in Figure 2.2.

artikel

Artikel ID:

Initialen 1e auteur: 2e auteur: 3e auteur:

Achternaam 1e auteur: 2e auteur: 3e auteur:

Titel:

Maand, Jaar:

tijdschrift/boek/congresrapport:

Uitgever:

pagina(s):

Gebiedstrefwoord:

Materiaaltrefwoord:

Modeltrefwoord:

aantal model experimenten speciaal voor dit onderzoek:

aantal gebruikte reeds bestaande modelexperimenten:

aantal veld metingen speciaal voor dit onderzoek:

aantal gebruikte reeds bestaande veldmetingen:

Relevantie van modelexperimenten:

Relevantie van veldmetingen:

enige gegevens / Summary

Erosion of cohesive banks is incorporated in a two-dimensional depth-averaged model for river morphology. Bank erosion is modelled by a time-average description of a sequence of mass failures induced by toe erosion. The model was based on the conservation of mass and momentum of small volumes of water and sediment, whereas the predictions of river bank migration span long periods of time.

Record: of 65

Figure 2 Example of the layout of the Access database User interface

3 Analysis

3.1 Introduction

On the following pages, an overview is given of the analysis performed on the different journals, papers and dissertations published. After describing the method used for evaluation, the results for each journal are given. For *Coastal Engineering*, three years have been evaluated (Paragraph 3.3). For the *Journal of Hydraulic Engineering* and the *Journal of Waterway, Port, Coastal, and Ocean Engineering* one year of each have been evaluated (see respectively Paragraph 3.4 and 3.5).

The last paragraph (Paragraph 3.6) describes the evaluation of the 65 dissertations.

3.2 Method

3.2.1 Evaluation method

The papers and dissertations analysed for this report have been scanned for the use of experimental data sets, meaning both from field measurements and from measurements in laboratory facilities such as flumes. The analysis included not only a mere counting of the papers with such use and without, but included an attempt to indicate the importance of the used data as well. In Table 1, an overview of the indices used in this analysis is given. A short description is given here:

- 0 *irrelevant*: Papers and dissertations marked by this index did not include the use of data sets at all, nor from field measurements, or laboratory experiments.
- 1 *minor relevance*: Papers and dissertations marked by this index made some use of measurements, but did not include a thorough analysis of some kind. These papers can include for example those that use field measurements as a setting for model calculations.
- 2 *some relevance*: Papers and dissertations marked by this index made use of measurements, being from either field and laboratory measurements or one of them. The paper included only a small amount of analysis of the data used. An example could be a paper with an illustration where use has being made of measured data.
- 3 *relevant*: Papers and dissertations marked by this index made use of measurements, which were partly analysed as well. These papers include the ones in which use is made of measured data to calibrate and validate numerical models.
- 4 *large relevance*: Papers and dissertations marked by this index would be non-existent without the measured data used in them, but do not give a thorough description of the methods used for measuring. This can for example mean the formulation of formulae, based on measurements in a laboratory flume.
- 5 *extremely relevant*: As the previous index, but here an extensive description is given of the measuring methods and procedures. These papers and dissertations include those written to present new measurements.

Table 1 Indices used for analysis

| index | description |
|-------|---------------------------------------------|
| 0 | irrelevant |
| 1 | minor relevance |
| 2 | some relevance |
| 3 | relevant |
| 4 | large relevance |
| 5 | extremely relevant (describes test-results) |

The journals are evaluated per publication year (calendar year). This has been done to achieve clear borders for the number of papers for each journal to be evaluated, but also to make it possible to indicate developments in time if occurring.

To indicate the importance of field and laboratory tests for the different journals, average values of the indices given per paper have been calculated. Three types of averages per year are given:

- 1 *Overall importance*: the average of the highest indices per paper for one year of papers per journal. For example: in a paper, both experimental laboratory research and field measurements are used. For that specific paper, it occurred that experimental research was of some relevance (index 2), whereas the field measurements were presented in this paper (index 5). The highest index found is 5, which means that this specific paper contributes a 5 to the overall average.
- 2 *Laboratory importance*: the average of the indices for use of laboratory measurements for one year of papers per journal. Only the papers with reference to laboratory measurements are taken into account.
- 3 *Field importance*: the average of the indices for use of field measurements for one year of papers per journal. Only the papers with reference to field measurements are taken into account.

For each calendar year of a journal, the indices are summarised in a bar graph. For each index, three bars are given: one bar for the highest indices per paper (black bar), one bar for the indices for papers with reference to laboratory experiments (grey bar) and one bar for the indices for papers with reference to field measurements (white bar). The graph below gives an example.

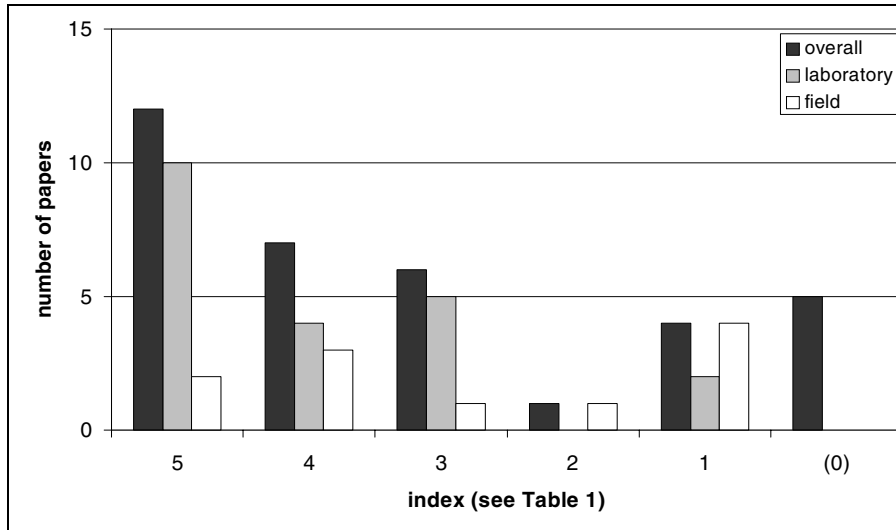


Figure 3.1 Bar graph indices for Coastal Engineering 1995

3.2.2 Paper characteristics

In the appendices, for each studied paper a few characteristics are given. After information on the journal where the paper can be found (including volume number, date and pages), the title of the paper is given, followed by the author(s). If keywords are found in connection to the paper, these are given next. The abstract, which is copied from the internet pages of the journals, is printed. Note that symbols used in the abstract might be lost in the process of copying the abstract from the internet pages.

The last part of the overview of the characteristics consists of the number of data sets found in the paper (being the number of field or laboratory measurements, old or new data sets), the relevance as described in Paragraph 3.2.1 and finally remarks if the author of this report wishes to give some. The following figure gives an example of the overview of characteristics for a paper found in *Coastal Engineering*.

Coastal Engineering
Volume 37, no. 3-4, 08/1999, pages 513-527

Shallow water bathymetry derived from an analysis of X-band marine radar images of waves
by Paul S. Bell

Keywords: Shallow water; Bathymetry; X-Band

Abstract:
Image sequences of surface gravity waves are readily produced by standard marine X-band radars. These image sequences contain a great deal of information regarding wave parameters and their variation over an area. By approaching the analysis of such data, using image analysis techniques, it is possible to map the variations in wave behaviour in a shallow water area. Wave celerity and direction can be mapped, and inversion algorithms based on linear wave theory used to infer the underlying bathymetry. Knowledge of the period of the waves is necessary for the analysis, and this can also be calculated from the radar data, although there is some discrepancy between the figures derived from radar data and from an offshore S4DW instrument. These discrepancies are investigated, and the results presented. Three days of data from the Holderness II deployment during 1995 have been analysed, and estimates of the bathymetry produced. The calculated depths show a mean water level comparable to that read off an Admiralty chart for the area, and a tidal signal is also clearly superimposed on the data, giving confidence in the water depths derived using this technique. © 1999 Elsevier Science B.V. All rights reserved.
Note: the abstract is not corrected on spelling!

| | old | new | total | relevance |
|---------------------------------------|-----|-----|-------|-----------|
| data sets from laboratory experiments | 0 | 0 | 0 | 0 |
| data sets from field measurements | 1 | 0 | 1 | 4 |

Remarks:
special on Monitoring current and wave variability in coastal seas

Figure 3.1 Example of the overview of characteristics for a paper found in Coastal Engineering

3.2.3 Note of Evaluation

The authors of this report wish to stress that the analysis performed for this report is partly subjective. The use of the indices could be otherwise interpreted. However, a number of papers were analysed by others, leaving no large differences in the outcome of the evaluation.

3.3 Evaluation of Coastal Engineering

3.3.1 Introduction

From *Coastal Engineering*, three different years were analysed. The following paragraphs give a short overview of the result of this analysis.

All papers published in *Coastal Engineering* are related to research in the coastal zone, ranging from pure wave research to research on sediment transport processes, from research on a small part of processes to research on complete models to compute coastal changes.

3.3.2 Year: 1995

Year 1995 of *Coastal Engineering* consists of in total 35 papers, divided in 3 volumes, in total 5 editions.

In 60% of the papers, use is made of the results of measurements in laboratory facilities (21 papers). In 31% of the papers, field measurements are being used (11 papers), whereas 14% of the papers has no reference to measurements (5 papers). In total, reference is made to 75 data sets from measurements, 57 from laboratory measurements and 18 from field measurements. In 12 papers (34%), new laboratory measurements are used. In 6 papers (17%), new field measurements are used.

The average importance of the measurements for these papers is computed as explained in Paragraph 3.2.1. The *overall importance* of measurements is approximately 3.20. The *laboratory importance* is approximately 3.95, whereas the *field importance* is approximately 2.82. Figure 3.3 gives an indication of the importance of measurements for these papers.

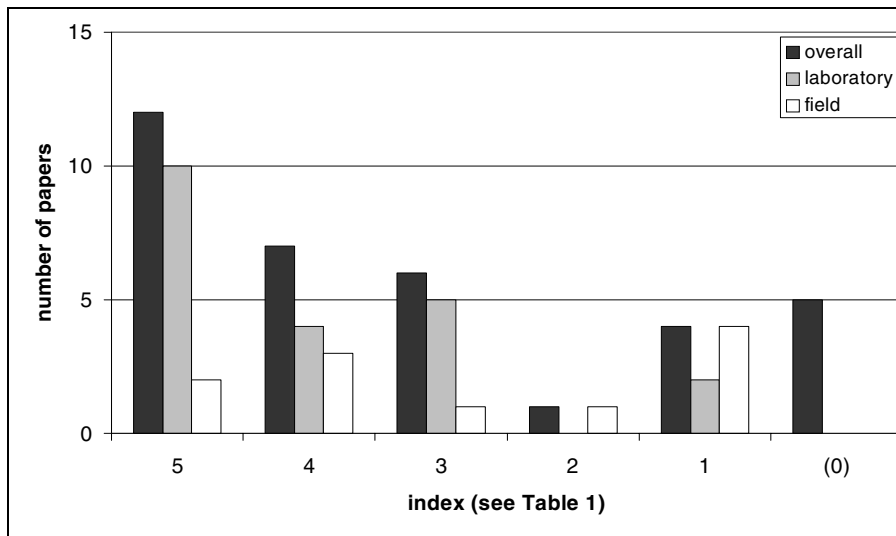


Figure 3.3 Bar graph indices for Coastal Engineering 1995

3.3.3 Year: 1998

Year 1998 of *Coastal Engineering* consists of in total 37 papers, divided in 3 volumes, in total 7 editions. One edition is a special issue dedicated to the subject *New instrumentation in Coastal Engineering*.

In 35% of the papers, use is made of the results of measurements in laboratory facilities (13 papers). In 41% of the papers, field measurements are being used (15 papers), whereas 27% of the papers has no reference to measurements (10 papers). In total, reference is made to 65 data sets from measurements, 31 from laboratory measurements and 34 from field measurements. In 9 papers (24%), new laboratory measurements are used. In 12 papers (32%), new field measurements are used.

The average importance of the measurements for these papers is computed as explained in Paragraph 3.2.1. The *overall importance* of measurements is approximately 2.97. The *laboratory importance* is approximately 4.46, whereas the *field importance* is approximately 3.73. Figure 3.4 gives an indication of the importance of measurements for these papers.

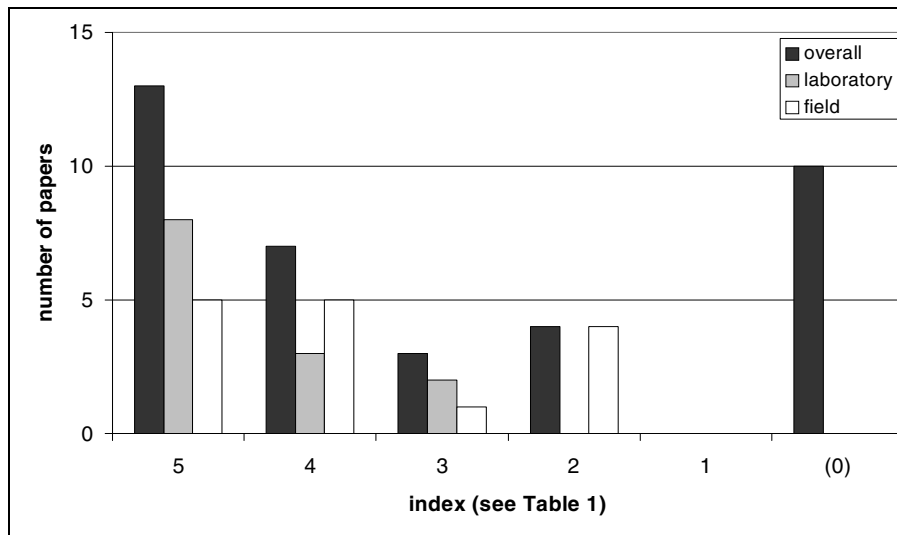


Figure 3.4 Bar graph indices for Coastal Engineering 1998

3.3.4 Year: 1999

Year 1999 of *Coastal Engineering* consists of in total 52 papers, divided in 3 volumes, in total 11 editions. One edition is a special issue dedicated to the subject Monitoring current and wave variability in coastal seas.

In 33% of the papers, use is made of the results of measurements in laboratory facilities (17 papers). In 60% of the papers, field measurements are being used (31 papers), whereas 15% of the papers has no reference to measurements (8 papers). In total, reference is made to 117 data sets from measurements, 49 from laboratory measurements and 68 from field measurements. In 5 papers (10%), new laboratory measurements are used. In 9 papers (17%), new field measurements are used.

The average importance of the measurements for these papers is computed as explained in Paragraph 3.2.1. The *overall importance* of measurements is approximately 2.96. The *laboratory importance* is approximately 3.54, whereas the *field importance* is approximately 3.37. Figure 3.5 gives an indication of the importance of measurements for these papers.

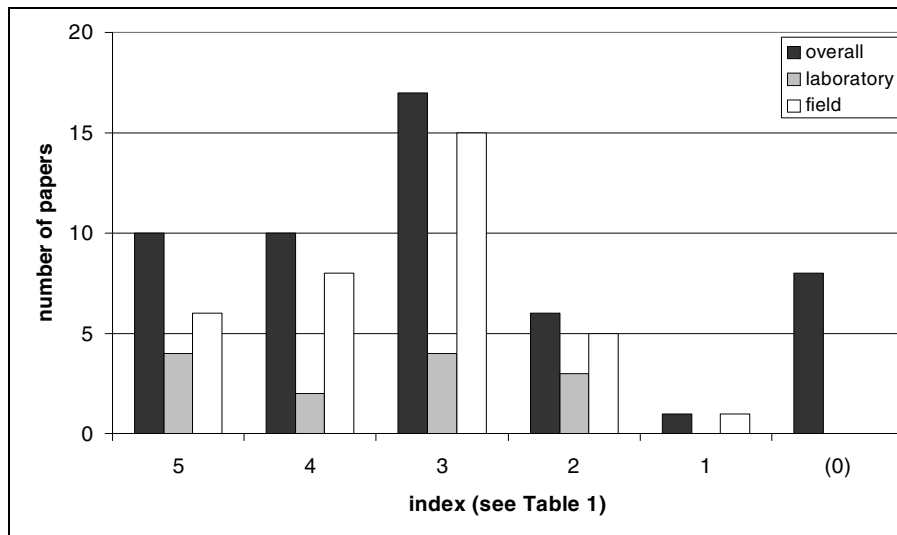


Figure 3.5 Bar graph indices for Coastal Engineering 1999

3.4 Evaluation of Journal of Hydraulic Engineering

3.4.1 Introduction

From the *Journal of Hydraulic Engineering*, one year, 1999, is analysed. In the following paragraph, an overview of the results is given.

Papers in the *Journal of Hydraulic Engineering* are not always related to coastal or river engineering. Also subjects as sewerage systems and pipe systems for example are included. For the analysis, no distinction has been made between these non-coast or river related papers and those that are related to coastal or river engineering, as the first only account for a small part of the total number of papers.

3.4.2 Year: 1999

Year 1999 of *Journal of Hydraulic Engineering* consists of in total 104 papers, divided in a total number of 12 editions. One edition, No. 3 (March 1999), with in total 9 papers, is not included in the analysis. This leads to a total number of 95 papers that have been evaluated for this report.

In 62% of the papers, use is made of the results of measurements in laboratory facilities (59 papers). In 29% of the papers, field measurements are being used (28 papers), whereas 14% of the papers has no reference to measurements (13 papers). In total, reference is made to 167 data sets from measurements, 101 from laboratory measurements and 66 from field measurements. In 35 papers (37%), new laboratory measurements are used. In 7 papers (7%), new field measurements are used.

The average importance of the measurements for these papers is computed as explained in Paragraph 3.2.1. The *overall importance* of measurements is approximately 3.24. The *laboratory importance* is approximately 4.05, whereas the *field importance* is approximately 3.00. Figure 3.6 gives an indication of the importance of measurements for these papers.

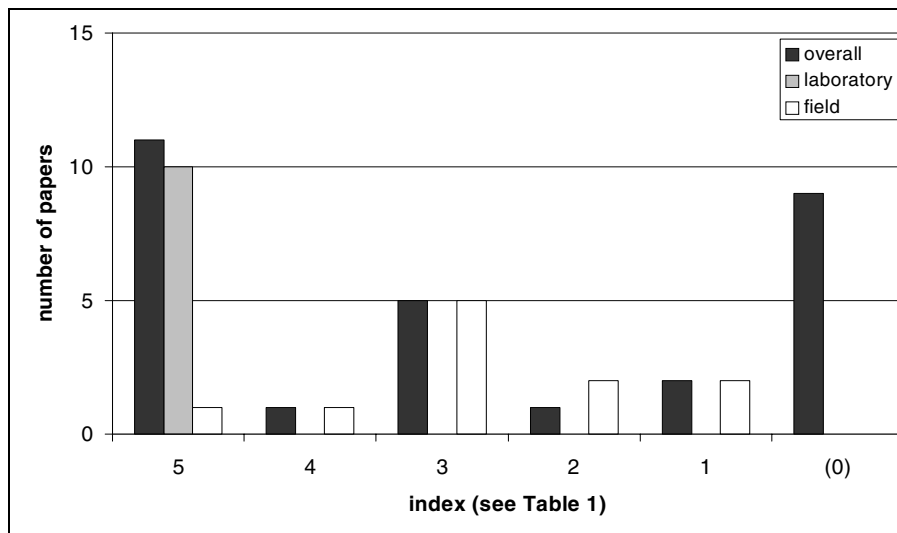


Figure 3.6 Bar graph indices for the Journal of Hydraulic Engineering 1999

3.5 Evaluation of Journal of Waterway, Port, Coastal, and Ocean Engineering

3.5.1 Introduction

From the *Journal of Waterway, Port, Coastal, and Ocean Engineering*, one year, 1999, is analysed. In the following paragraph, an overview of the results is given.

Papers in the *Journal of Waterway, Port, Coastal, and Ocean Engineering* are related to research in the engineering fields mentioned in the title of the journal. Also papers with no direct relation to coastal or river engineering research are included in the evaluation. Examples of these papers are amongst others a paper on

the costs of environmental dredging and a paper on wave force on offshore platforms.

3.5.2 Year: 1999

Year 1999 of *Journal of Waterway, Port, Coastal, and Ocean Engineering* consists of in total 35 papers, divided in a total number of 6 editions. One edition, No. 6 (November/December 1999), with in total 6 papers, is not included in the analysis. This leads to a total number of 29 papers that have been evaluated for this report.

In 34% of the papers, use is made of the results of measurements in laboratory facilities (10 papers). In 38% of the papers, field measurements are being used (11 papers), whereas 31% of the papers has no reference to measurements (9 papers). In total, reference is made to 29 data sets from measurements, 14 from laboratory measurements and 15 from field measurements. In 10 papers (34%), new laboratory measurements are used. In 5 papers (17%), new field measurements are used.

The average importance of the measurements for these papers is computed as explained in Paragraph 3.2.1. The *overall importance* of measurements is approximately 2.69. The *laboratory importance* is 5.00, meaning that all papers which refer to experimental laboratory research are used to present the results of such research. The *field importance* is approximately 2.73. Figure 3.7 gives an indication of the importance of measurements for these papers.

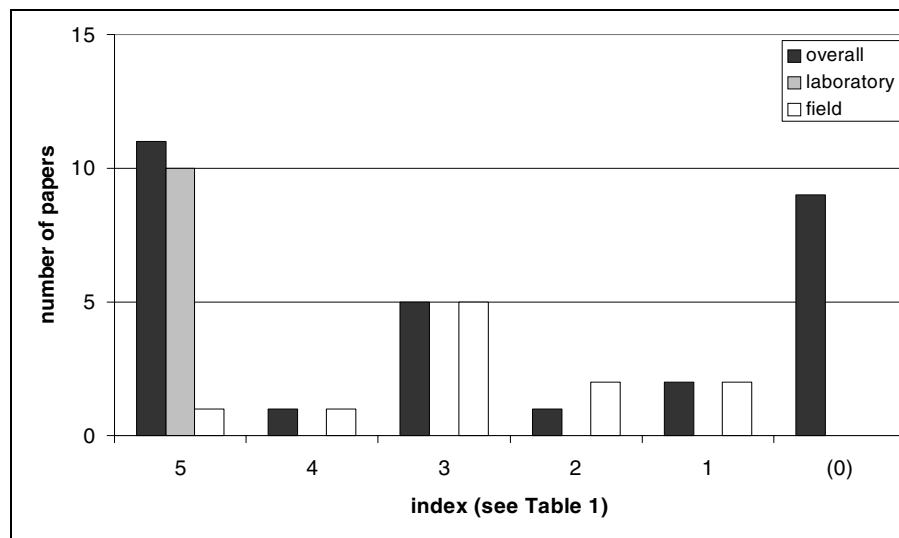


Figure 3.7 Bar graph indices for the Journal of Waterway, Port, Coastal, and Ocean Engineering 1999

3.6 Evaluation of Dutch dissertations

3.6.1 Introduction

The following paragraph presents the evaluation of the dissertations, mainly from Dutch authors. The research dissertations can all be assigned to the fields of River

and Coastal engineering, but the topic of construction engineering was left out of the evaluated dissertations.

The dissertations cover a time period of 15 years (1986 - 2000).

3.6.2 Evaluation

Of all of the concerned dissertations 63% makes in a certain extent use of laboratory results (41 dissertations) and 72 % uses in a certain extent field data (47 dissertations), while 9% of all of the dissertations do not use field or model data at all (6 dissertations).

20% of the dissertations describe specific new laboratory results (13 dissertations), while in 14% of the dissertations field measurements were carried out (9 dissertations).

43% of all the dissertations uses laboratory measurements from others, or from earlier research (28 dissertations), while 58% of the dissertations use (old) field measurements (38 dissertations).

All of the above mentioned percentages can be derived from Figure 3.8.

The overall importance of both the laboratory and field measurements is 3.5 meaning that laboratory and field measurements are used from others, or from previous measurements, but are not carried out for the specific dissertation.

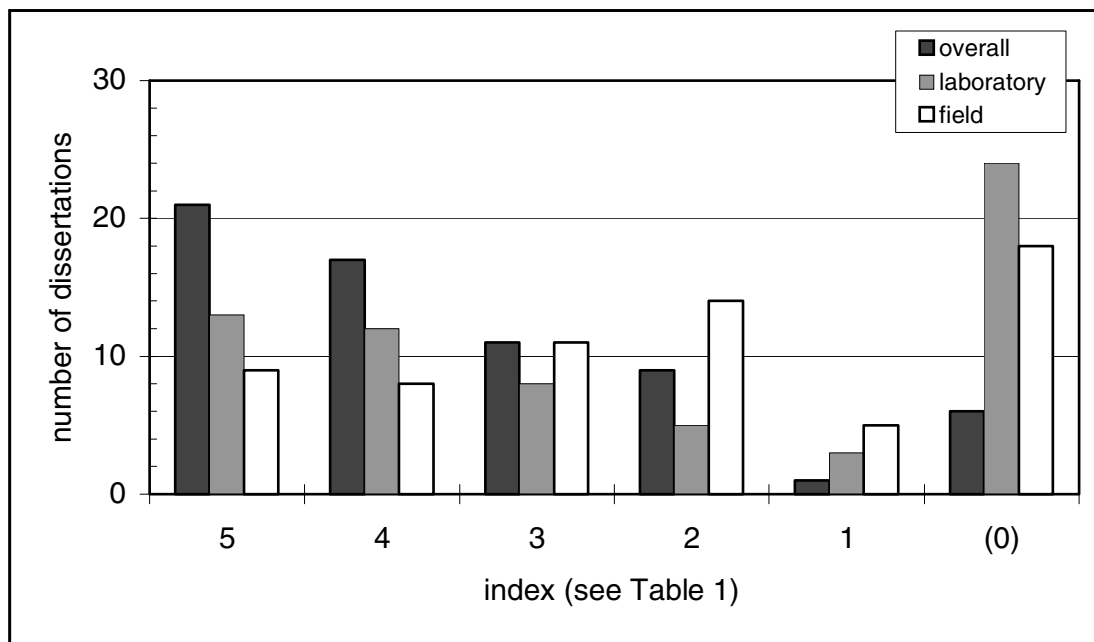


Figure 3.8 Bar graph indices for the 65 evaluated dissertations

In order to examine if the ‘extremely relevance’ (the dissertations that describe the field measurements or the model investigations itself) of the dissertations during the recent years, the number of dissertations with the score 5 (extreme relevance)

has been plotted in a graph as a function of time. The result can be found in Figure 3.9.

On the basis of this graph it can not be concluded that the number of dissertations describing its own field measurements or scale model investigations increases in time. The impression arises that the field measurements and scale model investigations mere for the dissertations research is decreasing, which results in the impression that often is reverted to previous carried out model investigations and field measurements.



Figure 3.9 Number of dissertations with the score extremely relevant (describes the test-results) per year

4 Discussion and conclusions

4.1 Discussion

In the previous chapter, an overview is given of the results of the evaluation of the journals. In Table 2, the results are shortly summarised.

| | year | number of papers | number of papers / dissertations with: | | | average index of papers with | | |
|---------------------------------------------------|-------------|------------------|----------------------------------------|------------------------|------------------------|------------------------------|--------------------|---------------|
| | | | new lab. measurements | new field measurements | no measurements at all | lab. measurements | field measurements | overall index |
| <i>Coastal Eng.</i> | 1995 | 35 | 21 | 11 | 5 | 3.95 | 2.82 | 3.20 |
| <i>Coastal Eng.</i> | 1998 | 37 | 13 | 15 | 10 | 4.46 | 3.73 | 2.97 |
| <i>Coastal Eng.</i> | 1999 | 52 | 17 | 31 | 8 | 3.54 | 3.37 | 2.96 |
| <i>J. of Hydraulic Eng.</i> | 1999 | 95 | 59 | 28 | 13 | 4.05 | 3.00 | 3.24 |
| <i>J. of Waterw., Port, Coast. & Oc. Eng.</i> | 1999 | 29 | 10 | 11 | 9 | 5.00 | 2.73 | 2.69 |
| <i>Dutch dissertations</i> | 1986 - 2000 | 65 | 13 | 9 | 6 | 3.30 | 3.40 | 2.10 |

Table 2: Summary of evaluation results.

From the comparison of the evaluation of the different papers, the following can be concluded:

- The total number of papers increases through the years. From *Coastal Engineering*, three years of publication have been evaluated. The number of papers in 1995 was 35, whereas in 1999, 52 papers were included in the journal. Also for the other journals, this increase can be seen from the tables of content from the (not evaluated) years of publication.
- The use of measurements in papers does not decrease. Despite the increasing use of numerical models to investigate processes, the use of measurements (both from field and laboratory experiments) does not decrease. In combination with the increasing number of papers, this means that the demand for measurements is in fact *increasing*. Also the use of 'own' measurements (first reported) is increasing. (?????)
- In more than half of the total number of papers and dissertations reference is made to measurements. For all evaluated journals, in less than 20% (???) no use at all is made of measurements, as can be seen from Table 2. For the dissertations this number is less than 10%. (???)
- The use of field measurements differs from the use of laboratory measurements. As can be seen from the average index for the papers (see Paragraph 3.2.1 for information on these indices), the average value for papers with reference to laboratory measurements is higher compared to the average value for papers with reference to field measurements. Laboratory measurements are often presented for the first time in papers, whereas field measurements are more often used as illustration or to calibrate and/or

validate numerical models. This is especially true for the *Journal of Waterway, Port, Coastal, and Ocean Engineering*, where in 1999, only new measurements were presented in the papers.

- There seems to be an increase in the use of field measurements for journals. In the three evaluated years of *Coastal Engineering*, the use of field measurements increases from 31% (1995) to 60% (1999). However, it has to be noted that this increase can be explained by the Special Issue on Wave Monitoring in 1999. If these papers are not taken into account, no clear trend is visible.
- The use of self performed measurements for the dissertations does not seem to increase.
- More laboratory than field measurements are used for dissertations.

4.2 Conclusions

The evaluations presented in this report show that still a lot of measurements are used for publication in international journals. Field measurements referred to in the evaluated papers are most often used to calibrate and/or validate numerical models. Laboratory measurements are often used to investigate basic processes, as for example in sediment transport processes. Often, the papers are used to present the experimental results and the implications for theoretical or numerical models.

From the analysis it has become clear that experimental research with the goal to further develop the insight in processes is often used more than once. For example, 4 times reference is made to the experiments by Beji and Battjes (1993). Other examples include Guy *et al.* (1966, 3 times), Bagnold (1946), Kamphuis (1975), Day (1977), Jensen *et al.* (1989), Cox *et al.* (1991), Okayasu and Katayama (1992), Roelvink and Stive (invullen?) and Sleath (invullen?), all twice. In other words, good experiments are of use for long time spans.

No evidence is found that the demand for experimental research is decreasing. In fact, the combination of an increasing number of papers presented for publication, in combination with a quite stable percentage of papers where use is made of both experimental and field research indicated that the demand for experimental research shows in fact a slight *increase*. Despite that, the use of self performed measurements decreases when talking about dissertations. This does not mean that the demand for field and laboratory measurements is decreasing, but more likely that the finances for the achievement of such an investigation are decreasing.

Investigated Dissertations

| <i>Author</i> | | <i>Year</i> | <i>Title dissertation</i> |
|----------------|----------------|-------------|-------------------------------------------------------------------------------------------------------------------|
| <i>A</i> | | | |
| Al Salem | A.A. | 1993 | Sediment transport in oscillatory boundary layers under sheet-flow conditions |
| Arens | S.M. | 1994 | Aeolian processes in the Dutch foredunes |
| Asselman | N.E.M. | 1997 | Suspended sediment in the river Rhine |
| <i>B</i> | | | |
| Boer | M.M. | 1999 | Assessment of dryland degradation |
| Booij | K. | 1989 | Exchange of solutes between sediment and water |
| Brinke | W.B.M. ten | 1993 | The impact of biological factors on the deposition of fine-grained sediment in the Oosterschelde, the Netherlands |
| Broeze | J. | 1993 | Numerical modelling of non-linear free surface waves with a 3D panel method |
| Brummelhuis | P.G.J ten | 1992 | Parameter estimation in tidal models with uncertain boundary conditions |
| <i>D</i> | | | |
| Dingemans | M.W. | 1994 | Water wave propagation over uneven bottoms |
| Dohmen-Janssen | M. | 1999 | Grain size influence on sediment transport in oscillatory sheet flow |
| <i>E</i> | | | |
| Eldeberky | Y. | 1996 | Non linear transformation of wave spectra in the nearshore zone |
| <i>G</i> | | | |
| Gelder | P.H.A.J.M. van | 2000 | Statistical methods for the risk-based design of civil structures |
| Gent | M.R.A. van | 1995 | Wave interaction with permeable coastal structures |
| Gijsbers | P.J A. | 2000 | Decision support for the management of shared water resources |
| Graaff | J. van de | 1988 | Sediment concentration due to wave action |
| Groen | K.P. | 1997 | Pesticide leaching in polders |
| Groeneweg | J. | 1999 | Wave-current interactions in a generalized Lagrangian mean formulation |

| <i>Author</i> | <i>Year</i> | <i>Title dissertation</i> |
|---------------|---------------|----------------------------------------------------------------------------------------------------------|
| <i>H</i> | | |
| Heemels | M.W. | 1999 Computer simulations of colloidal suspensions using an improved lattice-Boltzmann scheme |
| Hoffmans | G.J.C.M. | 1992 Two dimensional modelling of local-scour holes |
| Hulscher | S. | 1996 Formation and migration of large scale, rhythmic sea-bed patterns: a stability approach |
| <i>J</i> | | |
| Jin | X.Y. | 1993 Quasi three dimensional numerical modelling of flow and dispersion in shallow water |
| <i>K</i> | | |
| Kroon | A. | 1994 Sediment transport and morphodynamics of the beach and nearshore zone near Egmond, the Netherlands |
| <i>L</i> | | |
| Leeuwen | P.J. van | 1992 Low frequency wave generation due to breaking wind waves |
| Lobrecht | A.H. | 1997 Dynamic water system control, Design and operation of regional water resources systems |
| <i>M</i> | | |
| Mastenbroek | C. | 1996 Wind wave interaction |
| Meene | J.W.H. van de | 1994 The shoreface-connected ridges along the central Dutch coast |
| Meer | J.W. van der | 1988 Rock slopes and gravel beaches under wave attack |
| Mendez | N.J. | 1998 Sediment transport in irrigation canals |
| Minns | A.W. | 1998 Artificial neural networks as subsymbolic process |
| Mosselman | E. | 1992 Mathematical modelling of morphological processes in rivers with erodible cohesive banks |
| <i>N</i> | | |
| Nelen | A.J.M. | 1992 Optimized control of urban drainage systems |
| Nieuwkamer | R.L.J | 1995 Decision support for river management |
| <i>P</i> | | |
| Peerbolte | E.B. | 1993 Sea level rise and safety |
| <i>R</i> | | |
| Reniers | A. | 1999 Longshore current dynamics |
| Ribberink | J.S. | 1987 Mathematical modelling of one-dimensional morphological changes in rivers with non-uniform sediment |
| Rijn | L.C. van | 1987 Mathematical modelling of morphological processes in the case of suspended sediment transport |

Author

Year Title dissertation

| | | | |
|----------|-----------|------|------------------------------------------------------------------------------------------------|
| Ris | R.C. | 1997 | Spectral modelling of wind waves in coastal area |
| Roelvink | J.A. | 1993 | Surf beat and its effect on cross-shore profiles |
| Roo | A.P.J. de | 1993 | Modelling surface runoff and soil erosion in catchments using geographical information systems |
| Ruessink | B.G. | 1998 | Infragravity waves in a dissipative multiple bar system |

S

| | | | |
|------------|----------------|------|--------------------------------------------------------------------------------------------------|
| Schielen | R.M.J. | 1995 | Nonlinear stability analysis and pattern formation in morphological models |
| Schultz | E. | 1992 | invullen |
| Schuurman | W. | 1991 | A model to study the hydraulic performance of controlled irrigation canals |
| Schuurmans | J. | 1997 | Control of water levels in open-channels |
| Sha | L.P. | 1990 | Sedimentological studies of the ebb-tidal deltas along the West Frisian Islands, the Netherlands |
| Sieben | J. | 1997 | Modelling of hydraulics and morphology in mountain rivers |
| Sloff | C.J. | 1997 | Sedimentation in reservoirs |
| Spek | A.J.F. van der | 1994 | Large-scale evolution of Holocene tidal basins in the Netherlands |
| Steezel | H.J. | 1993 | Cross-shore transport during storm surges |
| Stive | M.J.F. | 1988 | Cross-shore flow in waves breaking on a beach |

T

| | | | |
|--------|------|------|-----------------------------------------------------------------|
| Talmon | A.M. | 1992 | Bed topography of river bends with suspended sediment transport |
| Tolman | H.L. | 1990 | Wind wave propagation in tidal seas |

V

| | | | |
|---------------|------------|------|----------------------------------------------------------------------|
| van der Molen | J. | 1997 | Tides in a salt-marsh (Great Marshes, Barnstable, Cape Cod, USA) |
| Vellinga | P. | 1986 | Beach and dune erosion during storm surges |
| Verlaan | P.A.J. | 1998 | Mixing of marine and fluvial particles in the Scheldt estuary |
| Visser | P.J. | 1998 | Breach growth in sand dikes |
| Vooren | M. van der | 1994 | Application of hierarchical control theory to wave-data assimilation |

W

| | | | |
|-------|------------|------|------------------------------------------------------------------|
| Wal | D. van der | 1999 | Aeolian transport of nourishment sand in beach-dune environments |
| Wang | Z.B. | 1989 | Mathematical modelling of morphological processes in estuaries |
| Weber | S.L. | 1989 | Surface gravity waves and turbulent bottom friction |

Author

Year Title dissertation

| | | | |
|------------|--------|------|---------------------------------------------------------------------------------------------|
| Winterwerp | H. | 1999 | On the dynamics of high-concentrated mud suspensions |
| Wolf | F.C.J. | 1997 | Hydrodynamics, sediment transport and daily morphological development of a bar-beach system |

Z

| | | | |
|-------------|--|------|------------------------------------------------------------------------------------|
| Zhiwen Chen | | 1992 | Sediment concentration and sediment transport due to action of waves and a current |
| Zhou H.M. | | 1995 | Towards an operational risk assessment in flood alleviation |

B General Appendix: Delft Cluster Research Programme Information

This publication is a result of the Delft Cluster research-program 1999-2002 (ICES-KIS-II), that consists of 7 research themes:

► Soil and structures, ► Risks due to flooding, ► Coast and river , ► Urban infrastructure, ► Subsurface management, ► Integrated water resources management, ► Knowledge management.

This publication is part of:

| | | | | |
|---------------------------------|---|--------------------------------------------------------------------------------------------------|---------------------------------------|------------|
| Research Theme | : | Coast and River | | |
| Baseproject name | : | System knowledge and response | | |
| Project name | : | Survey of the need for experimental facilities including a Journal and dissertations evaluation. | | |
| Projectleader/Institute | | Dr. Ir. J.A. Roelvink | WL Delft Hydraulics | |
| Project number | : | 03.01.04 | | |
| Projectduration | : | 01-03-2000 | - | 31-12-2000 |
| Financial sponsor(s) | : | ICES-2 program | | |
| | | WL Delft Hydraulics | | |
| | | Delft University of Technology | | |
| | | | | |
| Projectparticipants | : | WL Delft Hydraulics | | |
| | | Delft University of Technology | | |
| | | | | |
| Total Project-budget | : | € 123.000 | | |
| | | | | |
| Number of involved PhD-students | : | 0 | | |
| Number of involved PostDocs | : | 0 | | |
| | | | | |
| | | | | |
| | | | | |

Delft Cluster is an open knowledge network of five Delft-based institutes for long-term fundamental strategic research focussed on the sustainable development of densely populated delta areas.




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During the execution of the project the research team included:

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| | |
| | |

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| 3 | |
| | |