THE EGMOND FIELD DATA AND THEIR USE FOR THE VALIDATION OF MATHEMATICAL MODELS

H.J. de Vriend, R. Reinalda and H. Derks

Presented at the SOGREAH-Seminar "Field Measurements necessary for verification of morphological numerical models", Grenoble, France, October 14, 1987

THE EGMOND FIELD DATA AND THEIR USE FOR THE VALIDATION OF MATHEMATICAL MODELS

by H.J. de Vriend, R. Reinalda and H. Derks DELFT HYDRAULICS, P.O. Box 152, Emmeloord, The Netherlands

ABSTRACT

The 1981 and 1982/1983 field measurement campaigns in the nearshore zone at Egmond, The Netherlands, are outlined and the access to the resulting data sets is indicated.

Besides, the use of these data for mathematical model validation is discussed and some general remarks are made on the set-up of synoptic field campaigns to generate data sets for model validation purposes.

INTRODUCTION

A large part of The Netherlands is protected from the sea by dunes and sandy beaches, sometimes of critical width. Besides this sea defence function, the nearshore zone has many other functions, related to e.g. recreation, natural environment, water supply, fisheries, etc. A careful management of this zone, needed to maintain all these functions, requires a thorough knowledge of the physical processes there.

In the framework of the TOW Coastal Research Programme, a joint effort of the Ministry of Transport and Public Works (Rijkswaterstaat), the Delft University of Technology and DELFT HYDRAULICS, various study programmes on coastal processes have been carried out. Among these were two field campaigns in the nearshore zone at Egmond, in 1981 and in 1982/1983. They have been described at length in a series of reports (Derks, 1982-1984), summarized by Derks and Stive (1984) and recently by Reinalda (1988). The first part of the present paper is a compilation of this report, extended with some information on how to get access to the data.

The second part of the paper gives a discussion on how and to what extent the Egmond data could be used to validate mathematical models. The conclusions are generalized into some remarks on how to define and set-up field campaigns aiming at synoptic data sets for mathematical model validation.

THE EGMOND CAMPAIGNS

Objectives

In recent years the physical understanding and the mathematical modelling of waves, currents and sediment motion in coastal areas have made a considerable progress, and the numerical simulation of these phenomena becomes an increasingly important tool in coastal hydraulics. However, the physical understanding of the various

phenomena is largely based on the results of theoretical studies and experiments in the laboratory, if only because the conditions in nature are usually far more complex, with a strong interaction between the various phenomena. This means that there is an urgent need for verification of mathematical models on the basis of accurate and detailed field data.

The collection of simultaneous data on waves, currents and sand transport phenomena in the nearshore zone requires an extensive measuring system. However, no sufficient information was available on the requirements for the well-functioning of such a system as a whole. Therefore a general objective of the study was to test such a measuring system in the field.

- In more detail the primary objectives of the field campaigns were:
- to collect experience in the planning and the logistics of this type of field campaigns;
- to test the various constructional provisions;
- to collect data to study the functioning of the devices and instruments for the measuring of currents, sediment concentrations, waves, waterlevels and bottom topography under various hydraulic and meteorological conditions, both inside and outside the surfzone;
- to test the system for data acquisition and data analysis at the site.

Besides, it was attempted to set up the campaigns in such a way, that they would provide data that could serve to study the hydrodynamic and morphological phenomena in the nearshore zone and to verify mathematical models claiming to describe these phenomena.

As far as the meteorological conditions were concerned, the execution of the measurements had to be possible under windforce 8 Beaufort at least. Moreover, the constructional provisions should guarantee safe exposure to winter storm conditions. Occurrence of storms of windforce 10 to 11 Beaufort is normal in this area.

Site and season

For economical and flexibility reasons, the constructional provisions required for the field measurements had to be temporary. This means that the proposed second field campaign should not necessarily be executed at the same location as the first one. On the basis of experience gained from the first campaign it might be decided to choose another location.

For the selection of the measuring site various aspects had to be considered, like the features of the coast, the accessibility, the possible interference with other users of the beach, fishing activities in the nearshore area, the availability of electricity, water, sewerage, telephone communication, etc. Both field campaigns were carried out near Egmond. Like at the major part of the Dutch coast, breaker bars are present here, but in alongshore direction the bottom topography is relatively uniform. Because of the presence of the bars and a mean tidal range of 1.5 m, appreciable shifts of the surfzone occur, which complicate the selection of measuring locations in the cross-shore profile. This complication is enhanced by the storm set-up, which can easily amount 1 m or more during North-Westerly storms.

-2-

Because of the experimental character of the measurements it was decided to execute the first campaign during relatively calm conditions. In order not to interfere too much with other beach activities, the measurements were executed in May and June 1981, that is before the actual holiday season. For the second campaign rough conditions were wanted, so it was executed in the period September 1982 till January 1983.

Set-up of the 1981 campaign

The measurements were taken near kmp. 36,000, situated 2 km north of the central carpark at the Egmond boulevard. A location closer to Egmond was considered less attractive because of the start of the bathing season in May. The set-up of the field campaign was rather modest, as it was primarily meant for obtaining the required experience in the set-up and execution of the more extensive second field campaign. For placing the instruments in position, 3 surfzone stations were constructed in a single line perpendicular to the shore (see Figure 1). The distance between the stations was 20 m. They consisted of a working platform, 3 m x 3 m, supported by a steeltube scaffolding. The surfzone stations were connected with each other and with the shore by a foot jetty, which was also used to support the cable connections between the platforms and the shore.

along which a carriage with two horizontal arms for supporting the measuring instruments could be moved up and down. The sensor piles were placed 1.0 m seaward of the platforms, and the instruments could be placed 1.1 m from the sensor pile. Further in the surfzone a row of 30 poles and a marking pole were erected in order to assess the direction of the wave crests by means of a video-camera on the middle surfzone station.



Figure 1 Layout measuring system 1981







Figure 3 Measuring stations in line A



Figure 2 Layout measuring system 1982/1983

de Vriend

-4-

In addition to the 3 surfzone stations, 2 offshore stations were installed in the same survey line. The first one consisted of a heavy steel pile driven into the seabed at a point where the seabed was 4 m below MSL. This station was permanently equipped with a tide recorder and a wave staff. The second offshore station was in 10 m waterdepth, and consisted of a wave buoy and an automatic current meter moored to the seabed.

Fianlly it is mentioned that all measuring signals were transmitted to the shore, either by cable or by radio, except the data from the selfrecording current meters. Data acquisition was done directly onshore of the survey line by means of a PCM-system (Pulse Code Modulator) in a facility of portable cabins on the beach.

Set-up of the 1982/1983 campaign

This field campaign was held out of the bathing season, and therefore it was possible to do the measurements at kmp. 38,000, which is right off the central carpark at Egmond. The features of the coast here are identical to those at the site of the first campaign, but the location is much more favourable, if it were only because a number of necessary provisions, like electricity, water, sewerage, and telephone, could easily be arranged, and the site was easy to be reached.

The set-up of the campaign was more comprehensive than in 1981, also because of the additional objective to provide data on the hydrodynamic and morphological phenomena in the nearshore zone. In order to obtain an insight into the alongshore variability of the phenomena, measurements were taken in two survey lines, 100 m apart, and both normal to the shore (see Figures 2 and 3).

In the main survey line 4 surfzone stations and 5 offshore stations were installed. The design of the surfzone stations was more or less similar to that in 1981, though some improvements were carried through in order that the stations could stand a winter storm. The distance between the surfzone stations was 20 m, and they were connected with each other and the dunes by a foot jetty. Apart from some minor improvements the constructional provisions for the support of the measuring instruments were similar to those in 1981.

The first offshore station was again a heavy steel pile, driven into the seabed where it was about 5 m below MSL. Various types of instruments could be attached to this pile. In the other 4 offshore stations instruments were moored or placed on the seabed. The distances of these stations from the shore were 700 m, 3,000 m, 7,000 m and 25,000 m.

These offshore measuring stations were meant to gather information on the cross-shore variation of the current, and on the change in the wave characteristics between deep water and the shore.

In the second survey line (B), 100 m South of the main line (A), 4 additional surfzone stations were installed. These stations were also within reach from the shore. The provisions for placing instruments were limited. At each station only one current meter could be placed. Moreover, at the two middle stations a video camera was placed for measuring the angle of the wave crests. To that end, the various piles in the main survey line, the positions of which were known, were used as a reference, together with a marking pole between the main and second survey line. For the acquisition, a HP 1000 computer with subsystem was used. Software was available for on-line data processing and plotting.

Instrumentation

Phenomena of primary interest for the study of nearshore processes are the instantaneous water velocities, the mean current velocities, the sand concentrations, the water surface elevations, the mean waterlevels, and the bottom topography.

A variety of instruments appeared to be available for measuring these phenomena. However, there was little or no experience in operating these instruments in the surfzone. This applies especially to instruments designed for measuring instantaneous water velocities and sand concentrations. Since it is essential that the instruments produce data which correctly represent the phenomena in nature, a careful evaluation of their operation was made (Derks, 1982-1984; Derks and Stive, 1984; Reinalda, 1988). The results of this evaluation, though one of the primary objectives of the two Egmond campaigns, will not be discussed herein.

A review of the measured quantities and the instrumentation is given in Table 1. For further details, reference is made to the abovementioned background reports and summaries.

Data collection and analysis

The major part of the measuring signals of the various instruments were transmitted directly to the shore, either via a cable or wireless. The signals of the current meters NBA and Flachsee in the offshore zone were stored in the instrument itself, like those of the Ott XX tidal recorder and of the DAG 6000 pressure meter.

The maximum number of signals to be recorded simultaneously was 23 during the 1981-campaign, and 40 during the 1982/1983-campaign. In total, 52 measurement series were made, varying from 30 minutes to 13 hours. The measurements were taken under different weather conditions, with offshore significant wave heights between 0.2 m and 4.6 m. A summary of the collected data is given in Table 2.

| campaign | number of measurement series | duration of measurement series | number of parameters | offshore significant wave height |
|-----------|------------------------------------|---|-------------------------|--|
| 1981 | 5 | 5 hours | 20-25 | 0.2-1.5 m |
| 1982/1983 | 20 17 10 | 30-45 minutes 1- 3 hours 3-13 hours | 10-20 10-20 35-45 | 0.3-2.5 m 0.3-2.5 m 0.2-4.6 m |

Table 2 Collected data

| Mangurad | Type of instrument | | | | Number | |
|------------------|--------------------|------------------|------------|------|-----------|--|
| quantity | Brand Principle | | Size | 1981 | 1982/1983 | |
| mean current | NBA | prop./compass | | 1 | 4 | |
| velocity | Flachsee | prop./compass | | - | 1 | |
| instantaneous | Marsh McBirney | ЕМ | 3.8 cm | 2 | 5 | |
| flow velocity | Colnbrook | EM | 11 cm | 1 | 1 | |
| | Vektor Akwa | ac.(travel time) | 24 cm | 2 | 2 | |
| | ASTM | ac.(Doppler) | 1-3 cm | 1 | 2 | |
| | SIMRAD HC 100 | ac.(travel time) | 19 cm | 1 | - | |
| | NSW | EM | 5,5 cm | - | 1 | |
| mean water | Vega | press. sensor | | - | 1 | |
| level | OTT XX rec. | float | | 1 | - | |
| | TPD rec. | float | | - | 1 | |
| | DAG 6000 | press. meter | | - | 2 | |
| inst. water sur- | Plessey | wave staff | | 3 | 6 | |
| face elevation | Datawell | wave rider | | 1 | 3 | |
| wave direction | videorec./poles | visual | 10x30 m | 1 | - | |
| | | | 100x100 m | - | 1 | |
| sand concen- | ASTM | ac.(backscatter) | 1-3 cm | 1 | 2 | |
| tration | DELFT HYDRAULICS | suction | 16 cm | 4 | - | |
| | | id. | 1.3 cm | - | 5 | |
| bottom comp. | samplers | sieving | | | | |
| bottom level | special HF | echo-sounding | 4 cm/1 MHz | - | 4 | |
| | standard | echo-sounding | - | 1 | 1 | |
| | stadard | levelling | - | 1 | 1 | |
| water temp. | temp. sensors | el. resistance | 1 cm | - | 4 | |
| wind speed | Thies | prop./vane | | 1 | 1 | |

Table 1 Instrumentation

.

The extent of the field campaigns necessitated a well-organized system for acquisition and storage of the data. During the 1981-campaign a PCM-system (Pulse Code Modulator) was used at the measuring site. With this system maximally 112 channels can be sampled and recorded simultaneously. The sampling frequency at the lowest recording speed is 133 s⁻¹ per channel, and the maximum recording time then is 8 hours. Moreover, all the measuring signals could be recorded by in total 4 penrecorders, in order to have the opportunity of a direct check of the operation of the instruments. Signals were synchronized using simultaneous marker pulses.

In the 1982/1983-campaign a HP 1000 computer with subsystem was available at the site. The system was provided with data analysis and plotting facilities, in order to have the possibility to check the quality of the results during or shortly after a measurement series. After each measurement, the correctness of the data storage was checked.

General standards to assess the performance of a current meter in the surfzone do not exist. However, a visual comparison of simultaneously recorded signals from the various instruments gave a fairly good insight into their performance. Besides, the data were subject to a time series analysis, in order to examine the functioning and reliability of the current meters in a more quantitative way.

In addition to the measurements for testing and intercomparing the various instruments, the 1982/1983-campaign included a number of measurement series focussed on the physical processes in the nearshore zone.

| Code of measurement | Date of measurement | wind direction | wind force | wave height | number of survey lines | duration of mea- surement |
|---|--|--|--|---|--|---|
| EG 2000-2260 EG 2270 EG 2280 EG 2300 EG 2310 EG 2320 EG 2330 EG 2340 EG 2350 EG 2360 | $\begin{array}{c} 04-11-82\\ 05-11-82\\ 10-11-82\\ 10-12-82\\ 15-12-82\\ 16-12-82\\ 21-12-82\\ 27-12-82\\ 14-01-83\\ 18-01-83\\ \end{array}$ | SE E WSW W W WSW WSW NW | 1 B 5 B 7 B 6-7 B 9 B 8-9 B 8-9 B 7-8 B 8 B 9 B | low 0.15 m 2.20 m 2.20 m 3.50 m 4.40 m 3.70 m 4.00 m 3.80 m 4.60 m | 2 1 2 1 1 1 2 2 2 1 | *) 13 hours 5 hours 5 hours 5 hours 5 hours 5 hours 3 hours 13 hours 6 hours |

*) 5 minutes per 1/2 hour

Table 3 Coastal process measurements

Table 3 gives a concise summary of these measurement series. In all of them the waves were measured in the various locations, from deep water to the surfzone, by means of Datawell wave riders and Plessey wave staffs. The mean current velocities in the offshore zone were measured with the NBA and Flachsee current meters. In series with one survey line, the available water velocity meters were positioned in the main survey line A, with three instruments at most in the vertical. In the case of two survey lines, three water velocity meters were positioned in line B and the remaining ones in line A. The collected data have been processed and inventoried, thus forming a valuable set of information for further studies on coastal processes, e.g. to evaluate and improve theories and numerical models.

Access to the data

The raw data from the two campaigns were stored on magnetic tape, and so were the results of the time series analyses at the site. For a complete inventory of the measured data and a detailed eveluation of the performance of the various instruments, reference is made to Derks and Stive (1984) and to the basic reports (Derks, 1982-1984). These reports (in Dutch), which also contain a comprehensive review of elaborated results, are available at cost price at DELFT HYDRAULICS, at the address given in the heading of this paper (attn. Mr. H. Derks).

So far, the raw data have not been documented to the extent, that they could be processed without further assistance. In principle, however, the data are available at the cost of bringing them into the proper format and of the material expenses (hardware medium + mailing costs). For further information, please contact Mr. Derks.

USE OF THE EGMOND DATA FOR MODEL VALIDATION

General

From the point of view of synoptic data collection, the Egmond campaigns should be considered as introductory to more extensive campaigns in the future. A thorough study of the spatial variability of the currents in the surfzone, for instance, requires a 3D grid of measuring points, rather than at most two survey lines. Besides, the number of suitable current meters was too small for an appropriate number of simultaneous velocity measurements. Recent experiences in the USA, in the DUCK85 and SUPERDUCK experiments at the east coast (Mason et al., 1987; Mason, 1988) and in the NSTS-program at the west coast (Seymour, 1987) have made clear, that much more equipment is needed to generate a synoptic data set for scientific use.

Another drawback of the Egmond data set is that, due to the defectiveness of the concept of sediment concentration measurements, hardly any useful sediment transport data have been produced.

In spite of these shortcomings, the campaigns have yielded valuable point data (time series) on the nearshore water motion. In the next sections the aptitude of the data set for process studies and model validation will be discussed, with the emphasis on waves, currents, sediment transport and morphodynamics, respectively.

Waves

Obviously, the set-up of the wave measurements virtually excludes the possibility of using the data for wind wave generation studies. However, the data do provide useful information about

de Vriend

-9-

- the local characteristics of the wave field (spectra, directionality, groupiness) and the associated orbital motion; see e.g. Van Heteren and Stive (1984).
- low frequency water surface oscillations (surfbeat, edge waves); see e.g. Gerritsen and Van Heteren (1984).
- the dissipation of wave energy by breaking; see e.g. Battjes and Stive (1984, 1985), Stive and Battjes (1986).

When horizontally two-dimensional features of the wave field and the associated phenomena (set-up, currents) are concerned, caution should be exercised. The sea bed topography at Egmond can be characterized as a double-bar system (see Figure 4) with

- an outer bar, located some 400 m offshore, with its top at about 3 m below MSL and with a fairly weak longshore variability (length scale > 1 km), and
- an inner bar system, located at some 100 m offshore, with its top at about 1 m below MSL and exhibiting a strong longshore variability (length scale ~ 200 m).



Fig. 4 Sea bed topography 1982/1983

As appears from Figure 4, the majority of the measuring stations in the 1982/1983 campaign was located at the inner bar system, whereas no measuring station at all was available at the outer bar. This means that the nearshore data from this campaign concern a situation far from alongshore uniformity.

As far as the wave field is concerned, this non-uniformity is not much stronger than the topographical one (see Figure 5), which indicates that wave models for uniform coasts could yield a reasonable description of the wave height distribution. This explains why the data could be used to verify a wave decay model (Battjes and Stive, 1984 and 1985).

de Vriend

-10-





On the other hand, the measured data are too concise to be used for the verification of horizontally two-dimensional wave models (refraction, diffraction, shoaling, breaking) at the level of the underlying physical concepts. At best, the data could be used to

locally check the results of this type of models.

de Vriend

-11-

Mean currents and water surface elevations

Mean currents and the attending water surface elevations in the nearshore zone can be due to a variety of mechanisms (tide, storm surges, wave-induced forcing, wind, etc.), each with its own specific length and time scales. Clearly, the concepts underlying models of these currents can only be verified using data covering appropriate space and time ranges. Inversely, a data set covering a given area and a given time span can only be used to verify models of currents with corresponding inherent length and time scales.

From this point of view, the Egmond data could only be used to verify small-scale current phenomena, like wave-induced circulations and small-scale topography-induced features of tidal and wind-driven currents. Moreover, the longshore non-uniformity implies, that currents and water surface elevations are strongly interactive and cannot be considered separately. This means, for instance, that there is no direct relationship between the wave energy decay in a crossshore sections and the set-up of the mean water surface in that section. Thus wave modellers are deprived from a very convenient possibility to verify their wave decay models.



Fig. 6 Depth-averaged current as predicted by a friction-dominated flow model (Wind and Perrels, 1982); wave field from Figure 5

Figure 6, showing a result of a nearshore current computation with a friction-dominated flow model (Wind and Perrels, 1982; also see Boer et al., 1984), gives a rough indication of the longshore non-uniformity of the nearshore current. It has to be noted that this type of flow model tends to exaggerate the longshore non-uniformity (Wu and Liu, 1984). Bearing in mind, however, that the inertial adjustment length of a nearshore current is some one hundred times the water depth, the longshore non-uniformity must remain strong, even if

de Vriend

-12-

inertia is included.

Figure 6 also shows, that the measuring stations do not quite cover the most striking features of the coastal current system, at least under storm conditions. This emphasizes, once again, that the Egmond 1982/1983 data should not be used for the verification of longshore current models.

Another aspect that was not given very much attention in the Egmond campaign (nor in most other field campaigns) is the vertical structure of the mean flow. Plane longshore currents, with all velocity vertors parallel to the shore, are virtually non-existent. There will always be some degree of rotation of the velocity vector in the water column, due to boundary layer effects if waves and currents have different directions (see e.g. Davies et al., 1988), or due to wind and "undertow" effects (see e.g. Svendsen, 1984).

Consequently, the magnitude, and especially the direction of the measured velocity is very sensitive to the vertical position of the measuring point. Although not explicitly mentioned in the final reports, this corresponds with findings in the field: the velocity directions showed such strong vertical variations, that they were attributed to a current meter deficiency (also see De Vriend and Stive, 1987).

This sensitivity to the vertical position of the measuring point is even enhanced in tidal situations, because it is not the absolute vertical position that counts, but rather the relative one (i.e. the distance to the bottom divided by the water depth). This, comined with the fact that the inner surfzone undergoes a substantial shift during the tide, makes data from long-duration measurements in a spatially fixed nearshore measuring point difficult to interpret.

Apart from these complications, which would also occur in a uniform situation, the longshore variability of the sea bed topography gives rise to important additional complications: the vertical structure of the flow tends to vary from place to place. Consequently, the current can no longer be considered as being composed of a two-dimensional depth-averaged velocity field and a universal vertical profile function, twisted or not. This means that the inshore velocity field at Egmond should have been measured in a 3D grid and within a short time (in view of the tidal variations), in order to be of use for the verification of mathematical current model concepts (also see Seymour, 1987).

The foregoing should not lead to the conclusion that the Egmond velocity data are of no use, at all. The availability of simultaneous high-resolution wave and current records provides the possibility to investigate local aspects of the water motion, such as the interaction between turbulence and the wave orbital motion (also: how can they separated?) and the low-frequency variation of the current (correlation with surfbeat/edge waves; see Gerritsen and Van Heteren, 1984).

de Vriend

-13-

Sediment transport

From a data collection point of view, the sediment transport measurements in the Egmond campaigns have not been very successful. No reliable means for bed load measurements could be deployed (cf. Seymour, 1987) and the measuring techniques for suspended load proved unreliable without a facility to average over the bed forms. Recent laboratory experiments (Bosman and Steetzel, 1986) and another field campaign at Groote Keeten, on the Dutch coast somewhat north of Egmond (Bosman, 1986) have shown that this is a bottle-neck, indeed. Even a simple suction technique provides useful information, if only the sampling procedure includes (mechanical) averaging over the bed forms. Another finding from this more recent field campaign is the important role of non-local effects in the suspended sediment concentration: in many situations it is virtually impossible to establish a relationship between the suspended sediment concentration in a point and the local hydrodynamic and sedimentological parameters, whereas from visual observation at the site it is obvious that the measured concentration is determined by an event further upstream.

Since the Egmond campaign provided no reliable data on sand concentrations, and in order to facilitate access to other data, the working group "Sand Transport in Coastal Conditions" of the TOWprogramme has developed a data base system with data from laboratory and field measurements elsewhere. This well-documented data base, including yearly supplements, is for sale at the price of Hfl. 5000,-. For further information, please contact Dr. L.C. van Rijn, at the address given in the heading.

Sea bed topography

At first sight, sea bed topography surveys seem to be possible with standard techniques. In the fordable zone adjacent to the beach rodand-level surveys can be made and beyond that zone standard echosounder surveys can be made from boats. Experience from various major field campaigns (Egmond: Reinalda, 1988; NSTS: Seymour, 1987; DUCK85: Howd and Birkemeier, 1987) makes clear that this is probably a little too optimistic: it turns out difficult to attain the accuracy and the resolution (in space and time) necessary to assess and explain the sediment transport pattern in the nearshore zone.

The topographic surveys during the Egmond 1982/1983 campaign show that the inner bar system is quite varaible and can be altered completely by a single storm, whereas the outer bar is much more stable. Further information, e.g. on the magnitude and the direction of the net sediment transport between two consecutive surveys, cannot be derived from the available data.

Thereby it has to be noted that bottom level data alone, however accurate and however dense, do not provide sufficient information to assess the sediment movement between two consecutive surveys. Unless another relationship is given (e.g. the transport direction throughout the area), the sediment balance equation yields no unique solution for the magnitude and the direction of the sediment transport vector. A very simple illustration of this statement is given in Figure 7.



Figure 7 Non-uniqueness of the sediment tranport field as derived from topographic changes only.

DISCUSSION AND CONCLUSIONS

Although the Egmond campaigns were not primarily set up in order to generate a data set for the validation of mathematical models, they have generated valuable experience and ideas on how to set up a campaign that does have this purpose.

First, it is clear that the objectives have to be set in advance:

- what kind of models (physical phenomena, modelling concept, number of dimensions, points of doubt) have to be validated?
- what kind of situation (topography, conditions, length and time scales) has to be considered?
- what kind of validation (verification of model concepts, calibration, check on results) is wanted?

In view of the effort and the costs involved, there is no point in setting up a field campaign "blindly", trusting that the results will be of use for model validation at one time or another.

Site, instrumentation, and number and location of measuring stations have to be selected in accordance with these objectives. Preliminary runs with the mathematical model(s) to be validated can be of great help here. They give a first indication of what kind of solutions are to be expected in the area under consideration and where the interesting features are likely to occur.

Besides, it is recommended to investigate in what kind of larger-scale system the measuring site is embedded (e.g. large-scale tidal circulation, eroding or accreting shoreface, uniformity of the coast, etc.), if it were only to estimate the boundary conditions and to judge the applicability of the models to the specific situation.

Ideally, the models are run in close connection with the measurements, in order to be able to adjust the measuring program if and when necessary. This requires the on-line elaboration of measured and computed data, to the extent that the model can be run with appropriate boundary conditions, and that a preliminary comparison of computational results and measured data is possible. Unfortunately, the logistics needed to achieve this situation are so demanding, that it is seldomly feasible.

Looking at the Egmond campaigns from a model validation point of view, the resulting data set reflects the drawbacks of not following such a model-oriented procedure. Especially as a consequence of the longshore

-15-

de Vriend

-2`

-2

non-uniformity of the sea bed topography, in combination with the location of the measuring points, the data are suited for local analyses (spectra, correlation analyses, etc.), but hardly for the validation of multi-dimensional models.



Figure 8 Interaction diagram for nearshore hydrodynamic and morphological processes

Finally, it has to be pointed out that the hydrodynamical and morphological phenomena in the coastal zone are the results of a complicated interaction between waves, currents, bed forms, sediment transport and bottom topography (see Figure 8). Unraveling this interaction process is an absolute necessity

morphological prediction methods surpassing for the level of extrapolations from the past. For this very demanding task all possible tools have to be utilized, from theoretical models, via numerical models and laboratory experiments through to the most sophisticated field measuring techniques, in site as well as remote. Omitting any of these tools means a painful truncation of the possibilities to help this important and fascinating development forward.

de Vriend

-16-

ACKNOWLEDGEMENT

The major part of the work underlying this paper was done by the working group "Field Measurements" of the former TOW Coastal Research Programme.

REFERENCES

Battjes, J.A. and Stive, M.J.F., 1984. Calibration and verification of a dissipation model for random breaking waves. Proc. 19th ICCE, Houston, Texas, p. 649-660. Battjes, J.A. and Stive, M.J.F., 1985. Calibration and verification of a dissipation model for random breaking waves. J. Geoph. Res., 90, C5, p. 9159-9167. Boer, S., De Vriend, H.J. and Wind, H.G., 1984. A system of mathematical models for the simulation of morphological processes in the coastal area. Proc. 19th ICCE, Houston, Texas, p. 1437-1453. Bosman, J.J., 1986. Some aspects of sediment concentrations in the surfzone. Delft Hydraulics Laboratory, Report M1965 part III, 47 pp. Bosman, J.J. and Steetzel, H.J., 1986. Time and bed averaged concentrations under waves. Proc. 20th ICCE, Taipei, R.O.C., p. 986-1000. Davies, A.G., Soulsby, R.L. and King, H.L., 1988. A numerical model of the combined wave and current bottom boundary layer, J. Geoph. Res., 93, C1, p. 491-508. Derks, H., 1982-1984. Field campaigns at the Egmond coast. I: Layout and use of measuring set-up, field campaign 1981. Part executed measurements and results, -Part II:Revies of field campaign 1981. III: Layout and use of measuring set-up, field campaign Part 1982/1983. INevies of measurements, field Part executed campaign 1982/1983. 0000 and Part Measuring series 1000, measurements for investigation of performance of instruments, field campaign 1982/1983. Measuring series 2000, measurements for investigation of Part VI: waves, currents and sand concentrations, field campaign 1982/1983. Part VII: Results of investigation of performance of instruments in the surfzone, field campaign 1982/1983. Delft Hydraulics Laboratory, Report series R1597 (in Dutch). Derks, H. and Stive, M.J.F., 1984. Field investigations in the TOW study programme for coastal sediment transport in The Netherlands. Proc. 19th ICCE, Houston, Texas, p. 1830-1845. De Vriend, H.J. and Stive, M.J.F., 1987. Quasi-3D modelling of nearshore currents. Coastal Engrg., 11, no. 5/6, p. 565-601. Dingemans, M.W., Stive, M.J.F., Kuik, A.J., Radder, A.C. and Booij, N., 1984. Field and laboratory verification of the wave propagation model CREDIZ. Proc. 19th ICCE, Houston, Texas, p. 1178-1191. Gerritsen, F. and Van Heteren, J., 1984. Low frequency oscillations on the Dutch coast. Proc. 19th ICCE, Houston, Texas, p. 625-641.

Howd, P.A. and Birkemeier, W.A., 1987. Storm-induced morphology changes during DUCK85. Proc. "Coastal Sediments '87" Conference, New Orleans, Louisiana, p. 834-847.

Mason, C., 1988. Recent storm process experiments at DUCK, NC. In preparation for 21st ICCE, Malaga, Spain.

Mason, C., Birkemeier, W.A. and Howd, P.A., 1987. Overview of DUCK85 nearshore processes experiment. Proc. "Coastal Sediments '87" Conference, New Orleans, Louisiana, p. 818-833.

Reinalda, R., 1988. Measurements in the nearshore zone at Egmond, The Netherlands. DELFT HYDRAULICS, Report H246, 42 pp.

Seymour, R.J., 1987. The Nearshore Sediment Transport Study data sets. This issue.

Stive, M.J.F. and Battjes, J.A., 1986. Random wave breaking and induced currents. IAHR Coll. Wave Breaking and Wave-induced Currents, Grenoble, France (published as DELFT HYDRAULICS Communication 360).

Svendsen, I.A., 1984. Mass flux and undertow in the surfzone. Coastal Engrg., 8, p. 303-329.

Van Heteren, J. and Stive, M.J.F., 1984. Wave kinematics and directionality in the surfzone. Proc. 19th ICCE, Houston, Texas, p. 70-81.

Wind, H.G. and Perrels, P.P., 1982. FRIMO: a finite element model for coastal currents dominated by bottom friction. Delft Hydraulics Laboratory, Report W439-1, 18 pp.

Wu, C.S. and Liu, P.L.-F., 1984. Effects of non-lineair inertial forces on nearshore currents. Coastal Engrg., 8, p. 15-32.