Nederlands Centrum voor Kustonderzoek

Book of Abstracts

NCK-days
March 10 + 11 (2005)
University of Twente
Enschede

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De NCK-dagen 2005 worden gesubsidieerd door de
Nederlandse Organisatie voor Wetenschappelijk Onderzoek NWO

NWO
Nederlandse Organisatie voor Wetenschappelijk Onderzoek

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Thursday, March 10

09.00 – 10.00	**Registration with coffee & tea**	
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	Van Heteren, Oost, Van der Spek	Island-terminus evolution as a function of changing ebb-tidal-delta configuration: Texel, The Netherlands
	Tran	Seasonal closure of tidal inlets in the central coast of Vietnam
	Winterwerp	Sediment-induced density currents
11.10 – 11.15	**Announcement of posters**	
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	Dankers and Winterwerp	The hindered settling of mud
	De Boer, Pietrzak and Winterwerp	On the vertical structure of the Rhine region of freshwater influence
	Solomatine and Velickov	Prediction of surges by multi-variate chaotic models
	Ham, Pietrzak and Stelling	DELFIN: an unstructured grid model for coastal flows
	Bruens	Applicability of morphological models for management issues in the Haringvliet estuary
11.15 – 12.30	**Poster session with coffee & tea**	
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	Bhattacharya and Solomatine	A data-driven approach to the assessment of sedimentation in coastal areas
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	Nederbragt, Mulder, Walburg, Hoogervorst and Duin	Large-scale sand balance of The Netherlands coastal system as a policy indicator
	Van Rijn and Schouten	Large-scale land reclamation at the Maasvlakte (Plan Leeuwestaart)
	De Ronde	Need and use for uncertainty or bandwidth of morphological model results
18.00 – 19.00	**Drinks** (in the Faculty Club, building no. 42)	
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PROGRAM NCK-DAYS 2005 (continued)

CAMPUS OF THE UNIVERSITY OF TWENTE, 'WAAIER' (BUILDING NO. 12)

Friday, March 11

08.15 – 08.45	**Registration with coffee & tea**	
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	Bouwma e.a.	An ecological perspective on biophysical interactions
	Temmerman, Bouma, Govers, De Vries, Wang	Modelling sediment accumulation in tidal marshes: identifying controlling factors on different time and spatial scales
	Van Duren, Petersen, Wiles and Häse	The influence of turbulent mixing on mussel food supply – is the answer blowing in the wind or going with the tidal flow?
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	Van der Veen, Hulscher, Knaapen	Predicting large-scale bedforms in the north sea
	Van der Meer, Németh, Hulscher	Sand waves and sediment transport equations
	Boers	Developing a new dune erosion calculation rule for The Netherlands
	Wijnberg and Aarninkhof	Video-driven prediction of coastline position
	Smit, Reniers and Stive	Nearshore bar response to time varying conditions
10.10 – 11.40	**Poster session with coffee & tea**	
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	Briere, Hulscher, Idier and Roos	Numerical modeling of sandbanks dynamics with Delft 3D
	Roos and Hulscher	Sand extraction from tidal sandbanks
14.00 – 14.30	**Tea-break**	
14.30 – 15.50	**Beach Barrier Coast; moderator: Gerben de Boer (TUD)**	
	Ruessink	Modelling tidal and wind-induced alongshore currents in the nearshore zone
	Van der Westhuysen, Zijlema Battjes	Evaluation of a deep water source term balance in *SWAN* featuring local saturation-based dissipation
	Van Thiel de Vries, van de Graaff, Reniers and Stive	Effects of wave groupiness on dune erosion
	Roelvink	Coastal processes modelling at US West Coast
15.50 – 16.00	**Closure**	

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ISLAND-TERMINUS EVOLUTION AS A FUNCTION OF CHANGING EBB-TIDAL-DELTA CONFIGURATION: TEXEL, THE NETHERLANDS

Sytze van Heteren[1)], Albert P. Oost[2)] and Ad J.F. van der Spek[1,3)]

[1)]Netherlands Institute of Applied Geoscience TNO – *National Geological Survey* [2)]National Institute for Coastal and Marine Management/RIKZ [3)]Netherlands Centre for Coastal Research/NCK

Long-term variability in barrier-terminus shape is not yet understood accurately. To explain observed changes through time on a decadal resolution, detailed island-terminus erosion-and-accretion records need to be linked to data on ebb-tidal-delta behavior. Historical maps of southwest Texel and the adjacent ebb-tidal delta, supplemented with quartz OSL (optically stimulated luminescence) ages of dune sand, span four centuries and show several links between coastal development and ebb-tidal-delta behavior. Updrift inlet migration governed recurved-spit formation (Figure 1), and changes in ebb-tidal-delta size and shape resulted in the formation of a bulge at the island terminus. Sustained updrift migration of the ebb-tidal delta resulted in a commensurate position shift of the bulge and eventually in flattening of the coastline. Regional coastal-management measures have had a strong influence on tidal-inlet and ebb-tidal-delta behavior, and therefore also on the changing shape of southwest Texel. Identification of relationships between ebb-tidal-delta behavior and changing barrier-terminus erosion-and-accretion patterns on a decadal to century time scale contributes to our understanding of coastal-system dynamics. Knowledge on such relationships is important where historical data are scarce and when future developments must be predicted for the development and optimization of coastal-management tools and policies. Any barrier terminus with preserved sets of dune ridges holds a potential record on past ebb-tidal-delta orientations, which provide clues on past changes in tidal prisms and wave versus tide dominance. Under the current ebb-tidal-delta configuration, the entire westward-oriented coast of southwest Texel is too exposed for lasting accretion. Bulges resulting from future merger of shoals with the coast in this area will be eroded rapidly.

Figure 1: Recurved spit on southwest Texel.

SEASONAL CLOSURE OF TIDAL INLETS IN THE CENTRAL COAST OF VIETNAM

Tran Thanh Tung [1)]

[1)] Delft University of Technology, Hydraulic Engineering Section

Description of research

Central Coast Area of Vietnam has more than sixty inlets and river entrances discharging into the sea. They play vital roles in social-economic activities in the region.

Seasonally closure and migration of tidal inlets usually occur in micro-tidal, wave-dominated coastal environments where strong seasonal variations of river flow and wave climate are experienced. These inlets are closed to the ocean for a number of months every year due to the formation of a sand bar across the entrance or due to the growing of a sand-spit from updrift to downdrift.

The closure of a tidal inlet or the shoaling of a river entrance at undesired periods would cause significant negative impacts to the flood discharge, coastal environment, ecological system, navigation, and fishery and cause unsustainable development of socio-economy in the region.

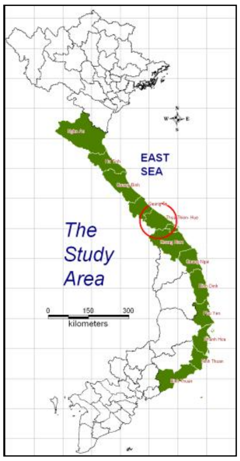

Figure 1: Air-photo of the Tu Hien Inlet, in Central Coast of Vietnam, in May 2004

Therefore, community interest in finding methods to keep these inlets permanently open has always been high. However, before attempting any engineering solutions to keep these inlets perennially open, it would be wise and practical to gain more insight into the morphodynamic processes governing seasonal inlet closure.

A special approach to control the closure of tidal inlets and shoaling of rivers entrances in the Central Coast Area of Vietnam must be recognized as a priority issue of the coastal zone management and to fulfil the highly demands from local people. The Tu Hien inlet, located in the Thua Thien Hue Province, Central Coast of Vietnam, is selected as a case-study for this research.

Thus, the main aims of this study are: i) identifying the dominant factors that influence to the opening and closure cyclic of tidal inlet; ii) implementation a valid model/technique to simulate the morphological process governing the closure and opening cycle of tidal inlets, and iii) applying this model/technique to develop a strategy to control/ stabilize tidal inlets under specific boundary conditions and social economic context in the Central Coast of Vietnam.

SEDIMENT-INDUCED DENSITY CURRENTS

Han Winterwerp[1)]

[1)]Delft University of Technology and WL | Delft Hydraulics

Suspensions of fine-grained sediment, such as cohesive sediment and silt, behave as a single-phase fluid. This implies that gradients in suspended sediment concentration are accompanied by gradients in fluid density, both in vertical and in horizontal direction. At scales much larger than the particle size, these density gradients may generate 1) interfaces in the water column (lutoclines), 2) damping of vertical turbulent mixing, and 3) baroclinic pressure gradients. These effects are referred to as sediment-fluid interactions.

It has been shown that these sediment-fluid interactions can generate sediment-induced density currents at already very moderate sediment concentrations, i.e. a few 10 to 100 mg/l, depending on the local hydrodynamic conditions, as encountered in for instance the North Sea. These sediment-induced density currents can contribute largely to the dispersion of fine sediment in harbour basins, on intertidal areas and in secondary channels.

Let us consider a flow in an open channel laden with cohesive sediment, in equilibrium with the local hydrodynamic conditions, i.e. at capacity conditions. If for some reason the amount of sediment in that channel increases (or, more likely, the flow velocity decreases), part of the sediment is deposited on the bed forming a layer of fluid mud because of the high water content of the mud flocs. This layer of fluid mud damps vertical turbulent mixing, reducing the transport capacity of the flow further. As a result a snowball effect occurs and eventually the entire sediment concentration profile and turbulent field collapse. This condition is referred to as saturation, which may be observed in many West European water systems.

Also in hyper-concentrated suspensions (i.e. a few 100 to 1000 g/l), as encountered in the Yellow River, saturation may occur. However, the time scales of turbulence collapse are much larger than in low-concentrated suspensions because of hindered settling effects. Moreover, it can be shown that hyper-concentrated flows stabilise when the sediment load increases. Such an increase though is not likely to be caused by bed erosion, as the permeability of the suspension is very small (hindered erosion regime). But the riverbanks can be eroded efficiently and rapidly, altering the river course continuously. This explains why hyper-concentrated flows are so persistent, yet unstable in their course.

It is shown that the behaviour of these low- and hyper-concentrated sediment-laden flows are both manifestations of the same physical processes, though at different scales, and can be described with the same physical laws. The most important parameters that govern the processes are the flux Richardson number, and the effective settling velocity of the sediment, i.e. including the effects of hindered settling. It is also shown that sediment-laden flows at concentrations in between the low- and hyper-concentrated regime cannot be stable and will collapse to form thick deposits of fine sediment.

DETAILED MEASUREMENTS OF VELOCITIES AND CONCENTRATIONS OVER FULL-SCALE RIPPLES IN OSCILLATORY FLOW

J.J. van der Werf[1], J.S Ribberink[1], J.S. Doucette[2] and T. O'Donoghue[2]

[1)]Water Engineering and Management, University of Twente [2)]Department of Engineering, University of Aberdeen

For the development and validation of process-based models for predicting wave-generated sand transport over rippled beds, measurements of the relevant processes under controlled laboratory conditions are required. Although a very large number of laboratory studies have been carried out on wave-generated ripples, there is a lack of reliable measurements in relevant scale ranges, which especially applies for intra-wave measurements over mobile beds. Recently, new experiments have been carried out in the Aberdeen Oscillatory Flow Tunnel (AOFT) at the University of Aberdeen in which detailed measurements have been made of the time-dependent velocity and concentration fields above full-scale ripples.

The AOFT is a large laboratory facility in which the near-bed horizontal flows, equivalent in period and amplitude to the near-bed flows of full-scale waves, can be generated over sand beds. The experimental series consisted of 3 different regular asymmetric (second-order Stokes) flow conditions. The experiments involved very detailed measurements of 1) concentrations using suction sampling, an acoustic backscatter system (ABS) and an optical concentration meter (OPCON); 2) velocity measurements using cross-correlation particle image velocimetry (PIV) supported by velocity profile measurements using an ultrasonic velocity profiler; 3) bed morphology using an acoustic sand ripple profiler and 4) net transport rates.

PIV, ABS and OPCON yield detailed measurements of the flow and suspended sediment field around and over the ripple throughout the flow period. As an example, Figure 1 shows OPCON measurements of the instantaneous concentrations during a wave cycle at different elevations above the ripple crest in which t/T=0 corresponds to flow reversal from offshore to onshore direction and t/T=0.43 to flow reversal from onshore to offshore direction.

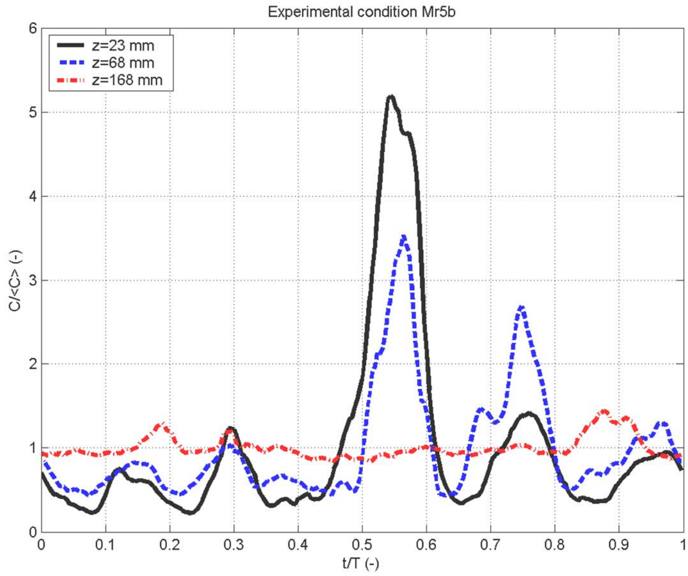

Figure 1: OPCON measurements of the instantaneous concentrations during a wave cycle at different elevations above the ripple crest.

This figure shows a large concentration peak just after flow reversal (t/T=0.55), which is associated with the passage of an injected suspension cloud generated by vortex shedding at the lee-side of the ripples. This peak is followed by a lower peak around t/T=0.75, and an even smaller third peak at t/T=0.95, which are both due to the passage of advected suspension clouds of adjacent ripples in the onshore direction. Higher up in the flow at z=168 mm, the concentration varies very little with time and the three peaks are not present.

The combined velocity and concentration measurements constitute a unique dataset on the detailed intra-wave sand transport processes over full-scale ripples in oscillatory flow. This dataset will be used to increase our insight in the wave-induced sediment transport over ripples. For example, we are interested in the near-bed streaming and the number and timing of the various concentration peaks.

This research is performed in the framework of the EU project SANDPIT through the 5th Framework of the EU Community Research Programme under contract number EVK3-CT-2001-00056.

THE HINDERED SETTLING OF MUD

Petra Dankers[1)] and Han Winterwerp[2)]

[1)]Delft University of Technology, Hydraulic Engineering [2)]WL | Delft Hydraulics and Delft University of Technology, Environmental Fluid Mechanics

Sand-mud mixtures occur in many natural environments, e.g. estuaries and rivers, but also at dredging sites. When large amounts of suspended sediment are present in these environments there can be several consequences for the ecosystem, e.g. decreased light penetration, decreased primary production and increased sedimentation rates. The importance of these effects merely depends on the dispersion, dilution and residence time of the sediment in the water. Information on the residence time of sand-mud mixtures in the water column is, however, limited. For sand particles the Stokes settling velocity can be used but this method does not apply for cohesive sediment, merely because the density of mud flocs is not known and the flocs are not spherically shaped. A further difficulty arises when the hindered settling regime is reached. This happens when, in the case of cohesive sediment, concentrations exceed a few g/l. In the hindered settling regime, volumetric concentrations are so high that the particles do not behave independently but interact. This leads to a significant decrease in effective settling velocity.
In the past, several hindered settling models have been used to determine the effective settling velocity, all for sand or cohesive sediment suspensions separately and not for mixtures. In this study we focus on the cohesive sediment part first; sand-mud mixtures are incorporated at a later stage.
The hindered settling equation commonly used for cohesive sediment suspensions is by Mehta (1986), which is a modified version of the Richardson and Zaki (1954) formula:

$$w_s = w_{s,r}\left(1-k\phi\right)^n \qquad \text{Eq. 1}$$

where w_s is the effective hindered settling velocity, $w_{s,r}$ is the reference settling velocity, i.e. the settling velocity of a single grain in still water, ϕ is the volumetric concentration of mud flocs ($\phi = c/c_{gel}$), c is the suspended sediment concentration by mass, c_{gel} is the gelling concentration by mass, k is an empirical coefficient ($\cong 1$) and n is a function of the particle Reynolds number: $2.5 < n < 5.5$. In this study a new formula for the hindered settling of cohesive sediment flocs is proposed (Winterwerp, 2002):

$$w_s = w_{s,r}\frac{\left(1-\phi\right)^m\left(1-\phi_p\right)}{1+2.5\phi} \qquad \text{Eq. 2}$$

where ϕ_p is the volumetric concentration of primary particles and m is an exponent accounting for non-linear effects. In this equation the effects of return flow, buoyancy and augmented viscosity are incorporated to account for hindered settling. This equation is tested by means of experimental data obtained from settling columns with kaolin suspensions.

References

Mehta, A.J., 1986. Characterisation of cohesive sediment properties and transport processes in estuaries. In: Mehta, AJ. (Ed.), Estuarine Cohesive Sediment Dynamics, Lecture Notes in Coastal and Estuarine Studies, No 14, Springer, Berlin, pp. 290-325.
Richardson, J.F. and Zaki, W.N., 1954. Sedimentation and fluidization, Part I. Transactions of the Institution of Chemical Engineers 32, 35-53.
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PREDICTION OF SURGES BY MULTI-VARIATE CHAOTIC MODELS

Dimitri Solomatine[1)], Slavco Velickov[2)]

[1)]UNESCO-IHE Institute for Water Education, [2)]SKF Research

Description of research

The problem of predicting surge water levels is important for ship guidance and navigation. The data collected in the coastal waters of the Netherlands (Hoek van Holland) were analysed with an objective of making such prediction. The applied linear prediction methods including autocorrelation and ARIMA models could not provide sufficient accuracy.

Recently developed methods in nonlinear dynamics and chaotic time series analysis are used in this study, to analyze, delineate and quantify the underlying coastal water level dynamics in the North See along several locations at the Dutch coast. This study analyses seven water level data sets, five of which characterise coastal locations and two relate to open sea locations. Both the water level data and the surge data (with the astronomical tide removed) are analyzed. The main objective of this analysis is to delineate and quantify the underlying dynamics of the coastal water levels and to quantify the variability and predictability of the coastal dynamics along the Dutch coast based on time series of observables. Having reconstructed the dynamics of the water levels, adaptive multivariate local models based on chaos theory were built which yield reliable and accurate short-term predictions.

For a single-variate chaotic model, RMSE is 3.6 cm for 1 hour, and 6.1 cm for 3 hours ahead prediction. The multi-variate chaotic model's RMSE for the 10 hours ahead prediction was about 10.5 cm, which is well comparable with the physically-based numerical model WAQUA currently being used in practice. This demonstrates that modelling methods and techniques based on the theory of nonlinear dynamics and chaos can serve as an efficient tool for accurate and reliable short-term predictions of water levels in order to support decision-makers in ship navigation.

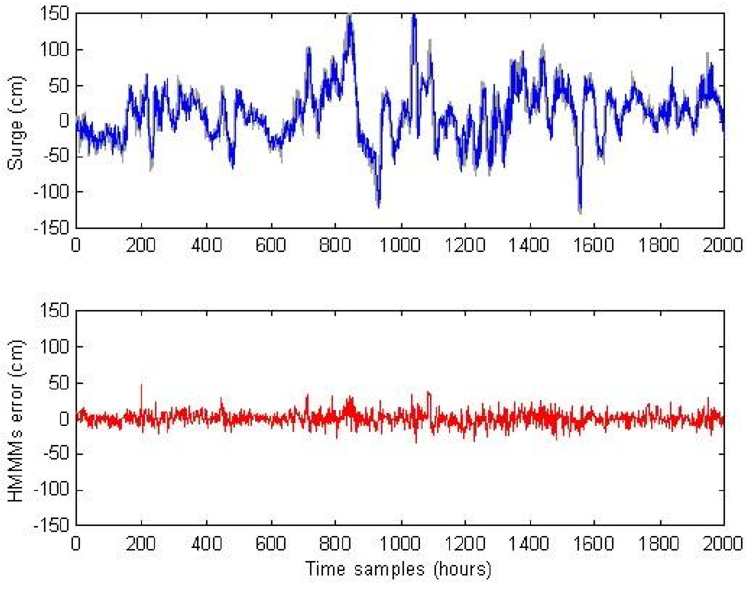


Figure 1. Mixture of models including future meteorological information. Prediction of the surges at Hoek van Holland zoomed at the stormy period (1-Jan-1995->31-Mar-1995) based on hourly time series (solid grey line). The prediction horizon is 6 hours. Mixture of local multivariate models (dark solid line) were used. The RMSE is 8.02 cm. Bottom figure shows the error.

APPLICABILITY OF MORPHOLOGICAL MODELS FOR MANAGEMENT ISSUES IN THE ESTUARY OF THE HARINGVLIET

Ankie Bruens

Rijkswaterstaat RIKZ

Abstract

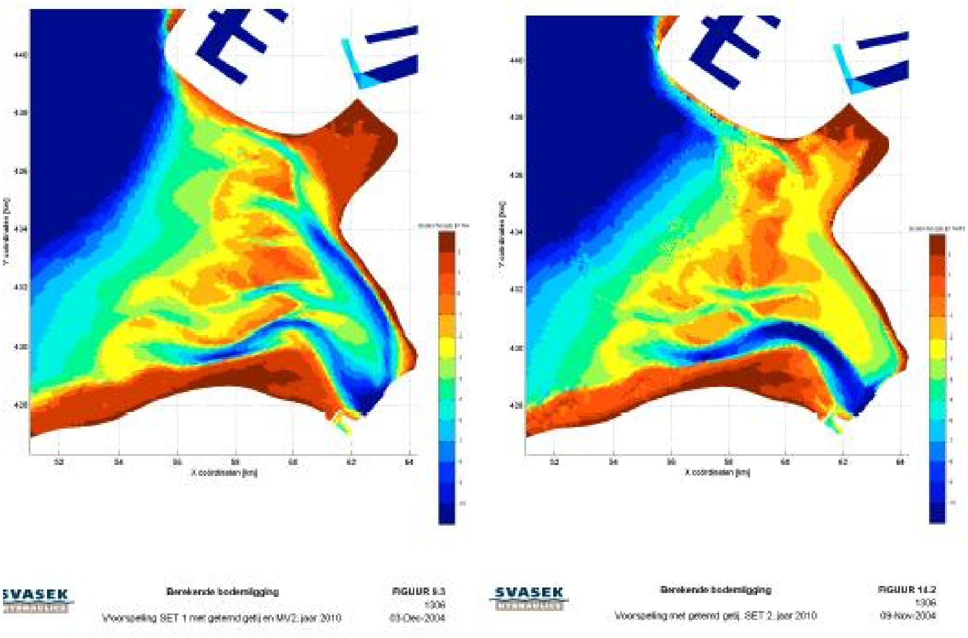
The estuary of the Haringvliet has an important ecological function. Within the framework of European ecological regulations, protected areas are designated. Human interventions are not permitted in case they have a destructive effect on the ecological function of the area. Coastal managers need to examine and evaluate (future) interventions for possible decline. The following morphological parameters are used to assess the ecological value of the area: - acreage intertidal area – location of shoals and channels – composition of the sediment

One of the management issues of this area reads: To what extent will the ecological function of the estuary be affected by a different discharge scenario of the Haringvliet sluices and/or the construction of MaasvlakteII? The development of the above-mentioned parameters need to be predicted and the value of the predicitions need to be assessed.

Within the project K2005*Voordelta, part of the Rijkswaterstaat KUST2005 program, activities are focused on the applicability of long-term morphological models for management issues concerning the effects of interventions in estuaries in general and the Haringvliet in particular. To this end different models are applied and/or analysed.

Perception of the value of numerical forecastings can be obtained by determining the (ultimate) range in predicted parameter values. A variety of causes can give rise to this range in values: extent of schematizing, extent to which relevant physical process are taken into account, applied boundary conditions and initial input values. This perception of the value of forecasting is important for decision makers. A methodical approach to retrieve the range in output values can lead to a better explanation of causes, and therefore lead to an improvement of applicability of numerical models for managerial issues.

The results of the K2005*Voordelta project in terms of insight in the range of model predictions and the underlying causes will be presented.



Figures: Two predictions of the area in 2010 with different boundary conditions and taking different physical processes into account. These figures indicate the above-mentioned range in model output.

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Map Uni Twente

Map Uni Twente

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