NCR-days 2005

November 3 – 4

Book of Abstracts

Ad van Os (ed.)

November 2005

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Wetenschappelijk Onderzoek

Introduction

Ad van Os,Programming secretary, NCR

The Netherlands Centre for River Studies (NCR) aims to provide an open platform for all people interested in scientific research and communication on river issues. To that end NCR organises once a year the so-called NCR-days, where on two consecutive days scientists present their ongoing river studies, in order to maximise the exchange of ideas and experiences between the participants and to provide the researchers a sounding board for their study approach and preliminary results. Based on these contacts they can improve their approach and possibly establish additional co-operation.

The NCR-days 2000, 2001, 2002, 2003 and 2004 were held in the mid and eastern part of the Dutch Rhine and Meuse River stretches.
In 2005 we'll be visiting the estuarine part of these rivers: the NCR days of 2005 will be held on November 3th and 4th, 2005 in Zwijndrecht in the western part of the Netherlands. They are organised by TNO in co-operation with Routine (Nijmegen) and the NCR secretariat. The organising committee consists of the following persons:
Ipo Ritsema (TNO);
Hans Hooghart (TNO);
Ad van Os (NCR programming secretary NCR);
Tine Verheij-van der Linden (Routine, Nijmegen).

The proceedings of the NCR-days in the past were published in the NCR publication series (NCR publication 03-2001, 07-2001, 20-2003, 24-2004 and 26-2005).
The present book contains the programme and the abstracts of oral and poster presentations.

To increase the exchange between researchers and Water Managers especially those dealing with smaller inland water basins (Water Boards) and with the downsteam river stretches/estuaries parallel workshops were introduced at the NCR-days of 2004, where research "supply and demand" met.
These Workshops were thought to be a good idea by the participants, so we continued to programme them in 2005. They are scheduled in the afternoon of the first day in three parallel sessions, lasting over 2,5 hours giving ample time for in depth discussions. The introductions will be given by invited speakers from practice.
Of course we are also very happy with the two key note speakers scheduled at the start of the NCR-days.

To celebrate the first 5-year lustrum anniversary in 2003 we established the NCR-days Presentation and Poster Awards. They both consist of a Certificate and the refunding of the participation costs for the NCR-days. These awards are also available this year.
The participants determine the winners.

NWO/ALW again has granted a financial contribution for the organization of the NCR-days 2005. The NCR Programming Committee is very grateful to NWO/ALW for this contribution.

The organisers are looking forward to an interesting and fruitful conference.

Programme NCR-days 2005

"Research on river dynamics from geological to operational time scales"

Thursday, 3 November 2005

09.00 - 09.30 Reception and registration
09.30 - 10.00 Opening – ***Ipo Ritsema, TNO***

Keynote lectures

10.00 -10.30 Keynote lecture 1. ***Henk Weerts (TNO)***
Fluvial deposits in the subsurface of The Netherland
10.30 -11.00 Keynote lecture 2. ***Wilfried ten Brinke (RWS-RIZA)***
Sediment dynamics in restrained rivers: the Dutch Rhine as an example

11.00 -11.20 *Coffee and tea break*

Presentation session 1, Sedimentation and Morphology

11.20 - 11.40 ***Bart Makaske,*** **Recent avulsions on the Taquari megafan, Pantanal, south-western Brazil; natural or human causes?**
11.40 - 12.00 ***Andries Paarlberg,*** **Modeling river dune development**
12.00 - 12.20 ***Gilles Erkens,*** **Calculating Quantities of Rhine and Meuse Sediments trapped in the Dutch Delta over the last 10,000 Years**
12.20 - 12.40 ***Leonie Bolwidt,*** **Morphological behaviour of bifurcations in the Netherlands: the implications on river management**

12.40 - 13.00 Poster introductions (1 min/poster)

13.00 - 14.30 Lunch and poster session

14.30 -14.45 *Break for transforming meeting room(s)*

Workshops (three parallel sessions)

14:45 - 17.30 **Workshop I** **Beneden rivieren**
14:45 - 17.30 **Workshop II** **Werken aan de Maas**
14:45 - 17.30 **Workshop III** **Kleine wateren**

17.30 - 19.00 Drinks

19.00 - 20.30 Dinner

Friday, 4 November 2005

Presentation session 2, River Basin Management

09.00 - 09.20 ***Bauke Steenhuisen,*** **Public Values in River Basin Management**
09.20 - 09.40 ***Bianca Stalenberg,*** **Time scales: key role in urban development of river landscapes**
09.40 - 10.00 ***Yan Huang,*** **Appropriate Modeling for River Basin Management with Application to Flood Risk**
10.00 - 10.20 ***Menno Straatsma.*** **Floodplain roughness mapping synergy: lidar and spectral remote sensing**

10.20 - 11.00 Coffee and tea break

Presentation session 3, River Basin Management

11.00 - 11.20 ***Ivo Thonon,*** **The impact of 'Room for the River', climate and land-use change on deposition of sediment and heavy metals on Dutch floodplains**
11.20 - 11.40 ***Aline te Linde,*** **Water and Economics of the Netherlands; Integral modeling of water and economics on national and catchment scale**
11.40 - 12.00 ***Rongchao Li,*** **Integrated water allocation for the Yellow River basin in China**

12.00- 13.30 Lunch
13.30- 13.50 *Break for removing posters*

Presentation session 4, Water Quantity and Quality

13.50 - 14.10 ***Reinier de Nooij,*** **The importance of hydrodynamics for biodiversity: synergy between safety and nature?**
14.10 - 14.30 ***Aart Overeem,*** **Forecasting levels and their uncertainties for the River Rhine at Lobith**
14.30 - 14.50 ***Mohamed Yossef,*** **Lowering the groynes; will it reduce the flood level after all!**
14.50 - 15.10 ***Gertjan Zwolsman,*** **Water quality of the Rhine and Meuse rivers during the summer drought of 2003 - preview of climate change?**

15.10 - 15.30 Coffee and tea break

15.30 - 16.30 Workshop summaries, NCR Presentation and Poster Awards and closing statements

16.30 - 17.30 Drinks

Optional for those participants staying for the excursion:
19:00 – 23:00 Dinner in Restaurant Veerhuis, Dordrecht

Saturday, 5 November 2005

09.00 - 13.00 Excursion Southwest-Netherlands:
- visit Rhoonse Grienden along the River Oude Maas
- visit sand mining lake Zevenhuizen.

Abstracts

Key Note

Fluvial deposits in the subsurface of The Netherlands

Henk Weerts
TNO Built Environment and Geosciences – National Geological Survey

As the National Geological Survey, TNO-NITG applies geosciences for a sustainable management and use of the subsurface and its natural resources. The emphasis lies on the application of geoscience, not on geoscience itself. Within the Netherlands Centre for River Studies our main focus is the characterization and modelling of fluvial deposits. Characterization and modelling of these deposits is only possible if we understand the sedimentation processes and the facies distribution that results from them. A second prerequisite is the presence of enough data to enable modelling of the facies distribution. Modelling of the sedimentation process itself is relevant if it provides better understanding of sedimentary structures and facies geometry.

In our densely populated country, land use is not restricted to the surface alone. The subsurface is also used, for example for groundwater abstraction, sand and gravel mining, carbon dioxide storage, heat exchange, subsurface building and foundation of large buildings. Detailed knowledge of the subsurface properties and their variability is necessary for optimal land use, be it at or below the surface.

Four examples of using fluvial facies distribution, sediment properties and reservoir modelling at different space and time scales to optimize land use are presented:

- In the southern part of our country, fine grained Lower Pleistocene Rhine deposits act as an aquitard that protects an important aquifer. However, ground water quality in the aquifer is threatened by pollution and / or salt water intrusion at several locations. Apparently, the aquitard leaks. Facies characterization and distribution determining the aquitard properties is predicted by combining borehole data and detailed knowledge from a subrecent fluvial analogue.
- Coarse grained Rhine-Meuse deposits from the last ice age are widely used for sand and gravel mining. Particle size distribution within these deposits is variable. Identification of large scale fluvial units with different properties reveals coarser grained versus finer grained zones.
- The facies properties and distribution in the Holocene Rhine delta determines land subsidence due to settling and oxidation. Consequences of future changes in surface water management can be predicted more precisely by combining borehole data, facies characterization and reservoir modelling.
- Prediction of sediment distribution at bifurcation points of the present Rhine is necessary for optimal river management. A detailed “reservoir” model of the subsurface of the river bed was constructed using borehole data, seismic data and geostatistics. Exposure of this model to different flow conditions reveals zones of bed erosion.

How good or promising the results of these examples may be, one should always remember that they are an approximation of reality, not reality itself. They are only models. The models can be improved by adding more data. Even more important is better understanding of the processes that formed the deposits. And that, of course, requires research on river dynamics from geological to operational time scales.

Key Note

Sediment dynamics in restrained rivers: the Dutch Rhine as an example

Wilfried ten Brinke
RWS-RIZA

Nearly all rivers are to some extent influenced by man. This impact may be relatively modest and have little effect on natural sedimentary processes. Many rivers, however, are subject to significant man-induced changes that may even control their morphological behaviour. These changes may refer to changes in discharge, changes in river geometry and/or changes in sediment transport. Changes in river geometry are most common and generally affect river plan form through training works or channel straightening, and river depth or gradient through dredging. Man-induced changes in discharge may result from changes in land use such as urbanization and, more directly, from flow regulation. Changes in sediment transport may result from changes in the quantity and/or the composition of sediment delivered from upstream.

Examples of the morphological response to man-induced changes of the river system are widespread. Corresponding studies mostly deal with a major change of one of the river characteristics only. The direction of morphological response in these cases is generally straightforward. Predictions are more complicated for rivers in densely populated areas where several impacts affect the river system at the same time. The Dutch Rhine is an example of such a restrained river.

Restrained rivers are generally characterized by erosion of the riverbed. This may be due to several impacts: a deepening of the river as a response to a reduction of the river width (groynes, riprap), a gradient adjustment as a response to meander cut-offs, dredging of shallows, a reduced sediment input due to sediment traps upstream. In the Dutch Rhine all these impacts play a role at the same time. The riverbed of a large part of the Dutch Rhine branches, therefore, has been eroding for most of the last century. Sedimentation on the riverbed takes place in the lower reaches, where the flow is influenced by the sea or Lake IJssel.

The erosion of the bed also indicates that the load of sand and gravel entering the Netherlands is relatively small. In fact, the yearly load of mud and silt is three times higher than that of sand and gravel. Most of the year this ratio is even higher since the transport of sand and gravel is mainly a high water event: during a flood of a few weeks the river shifts a load of sand and gravel amounting to half the load shifted on average in a whole year. This transport takes place close to the riverbed, generally in the form of dunes that cover the entire bed and migrate downstream.

Even though most of the sediment transport is mud and silt, the river itself is a sand and gravel bed river: the current velocities in the main channel are too strong for the finer sediments to settle to the bed. These fine sediments are therefore simply flushed down to the lower reaches where they settle in lakes, harbour basins and such. Deposition of these sediments on the floodplain is insignificant: the Dutch floodplains have already risen to such a height that little deposition takes place during floods.

The lower reaches are efficient in trapping the fine sediments: the impact of the outflow of the Rhine and Meuse on sediment concentration in the North Sea is insignificant. The riverbed of the upper reaches is very coarse-grained. This is partly due to the fact that the bed has eroded through the Holocene deposits into the more coarse-grained Pleistocene deposits. But also the combination of strong currents and little sediment input has created a coarse-grained armour layer in the upper layer of the subsoil. Clearly, geology and the response to river management interact in determining the behaviour of restrained rivers.

Presentation **Theme: Sediment & Morphology**

Recent avulsions on the Taquari megafan, Pantanal, south-western Brazil; natural or human causes?

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Presenter:
Bart Makaske

The Taquari megafan in the Pantanal wetlands (south-western Brazil) is one of largest alluvial fans on Earth, with a maximum radius of 250 km and an area of 49.000 km2. The Pantanal wetlands are generally recognized as a unique ecosystem, featuring a very high biodiversity. In the Pantanal, the Taquari joins the axial Paraguay River, which is part of the La Plata drainage system. Recent avulsions of the Taquari River (started around 1979 and 1988) caused extensive flooding of the lower fan and silting up of the old Taquari channel. The effects of the avulsions negatively impact the traditional land use (cattle ranching) and affect the ecosystem. In the perception of the local population the avulsions represent a sudden and dramatic change of the river system. A geomorphological study of remote sensing data, however, demonstrates that the recent avulsions logically fit into the natural pattern of channel shifting on the Taquari alluvial fan that has been ruling the geomorphological evolution of this area for many millennia.
A closer analysis of the recent avulsions was carried out in order to explain their exact locations and timing, and to determine their causes. A field survey included detailed GPS-measurements of water-level gradients, river-depth and flow measurements, and collection of bed and bank sediments for grain size analysis and organic material for 14C age determination. Also, a time series of air photos and satellite images, and available hydrological records were analysed. The field data suggest a gradient advantage of the most important avulsion route with respect to the old Taquari channel, and very high recent Taquari channel-belt sedimentation rates. Rapid lateral migration of the Taquari channel at one of the avulsion sites contributed to the avulsion. The avulsions were probably triggered by extreme Taquari floods, with backwater effects from the Paraguay River causing additional water-level rise on the lower fan.
It has been postulated in previous work that the recent avulsions were caused by an increase in sediment input from the Taquari catchment in response to deforestation since the early 1970s. Although there are indications of considerable recent sedimentation, the present study shows that most likely a sharp rise in Taquari and Paraguay discharges in the early 1970s initiated the avulsions, with prior development of critical conditions at the avulsion sites due to long-term channel-belt aggradation. The rise in discharges was mainly a result of a regional climatic fluctuation.

Presentation

Modelling river dune

Paarlberg, A.J., Dohmen-Janssen, C.M., Hulscher, S.J.M.H. & Termes, A.P.P.
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Presenter:
Andries Paarlberg

Water levels during floods are largely influenced by bed roughness in the main channel of a river. A large contribution to the main channel roughness is caused by flow over river dunes, which develop on the river bed as a result of the interaction between flow and sediment transport. The dynamic behaviour of dunes is not yet completely understood. We want to improve water level predictions during floods by gaining more insight in the processes that are most important for dune development.

A physics-based simulation model, which is originally developed to simulate the development of solitary offshore sand waves, is applied to flume conditions. The model is based on the two-dimensional vertical shallow water equations. Two parameters which have a direct influence on the velocity profile and bed shear stress, namely the vertical eddy viscosity and a slip parameter, are calibrated using flume data. Simulations show that realistic bedform behaviour of dunes with gentle slopes is obtained: dunes grow in amplitude, develop into asymmetric features and migrate.

During their development, the lee-side of dunes may become so steep that the flow separates forming a flow separation zone at the lee-side of dunes. Since turbulence is modelled using a constant eddy viscosity and a partial slip condition at the bottom boundary, flow separation cannot be treated explicitly with the model.

To keep the model as simple as possible (i.e. “appropriately”), a parameterization of flow separation is proposed, which is based on detailed flume data. The separating streamline, which is the upper boundary of the flow separation zone, is parameterized. Since there is flow recirculation in the flow separation zone, the parameterized separating streamline is used as bed level for flow computations. This effectively means that the details in the flow separation zone are not computed.

The parameterization is based on the observation that the shape of the flow separation zone is independent of flow conditions. The dimensions of the flow separation zone (and thus the separating streamline) are related to the bedform height, the local bed slope at the point of flow separation and a constant reattachment angle of -25˚ with the average bed slope. The sediment transport in the region outside the flow separation zone, is determined from the computed bed shear stress. In the region of the flow separation zone, the sediment transport and bed evolution is parameterized such that the bedform migrates correctly.

Using this approach, dune development can be simulated in cases where flow separation occurs, without the necessity of computing details in the flow separation zone. Knowing the dimensions of the dunes and of the flow separation zone, better estimates of the roughness caused by dunes can be obtained. This can help to improve waterlevel predictions.

Presentation

Calculating Quantities of Rhine and Meuse Sediments trapped in the Dutch Delta over the last 10,000 Years

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Presenter:
Gilles Erkens

Holocene sedimentation in the Rhine-Meuse delta (central Netherlands) is facilitated by sea-level rise and tectonics, but is most importantly the result of the sediment flux received through rivers from the hinterland. The majority of Rhine and Meuse sediments entering the delta are trapped between the delta apex and coastal barrier, at least during the later part of the Holocene. This has resulted in a stacked sequence of fluvial deposits, which forms a record of Holocene fluvial sedimentation in the Netherlands by the river Rhine and Meuse.
It is not accurately known how much sediment is delivered to the Dutch delta by these rivers over longer time periods (e.g. > 1 ka) and if long-term averaged sediment delivery is variable or follows a trend. We developed a way of using subsurface data (Rhine-Meuse delta borehole database, complementary digital maps, radiocarbon dates) to calculate volumes of river deposits for subsequent time slices. This yielded a quantitative reconstruction of the hinterland sediment flux received in the Netherlands during the Holocene.

Holocene river deposits form a heterogeneous prism-shaped body across the central Netherlands. The volume of this prism is defined as the volume between the modern land surface and the borehole-reconstructed Pleistocene palaeo-valley subsurface. After correction for peat and tidal floodbasin deposits at the downstream end, the prism volume is a measure of total Rhine and Meuse deposition since delta formation began (~8000 year ago). To reconstruct changes in sedimentation rate while the prism was building up, we used detailed cross-sections and maps. More than 1300 14C dates provide accurate and robust age control for the various deposits. Five high resolution North-South cross sections across the entire width of the delta (length: 20 km in the east, 50 km in the west) provide a detailed (100 m core spacing) Holocene lithostratigraphy. Each cross-section is representative for a specific part of the delta. These cross-sections and the 14C dates allow quantifying specific volumes for different facies and lithologies (overbank fines; coarser bedload deposits) for each 1000 yr time frame. The relative proportions are then extrapolated to yield volumes for the prism slices. A comparison is made between different cross-sections to see the response of different parts of the Rhine delta to external factors. In this way, for the first time, a detailed quantitative reconstruction of millennial scale sediment delivery to the delta is made. These numbers reflect the sedimentation of the River Rhine under natural conditions over longer timescales, which sets the present-day (measured) sediment delivery rates in perspective.

The sedimentation rates for the Rhine delta show a distinct increase towards the later part of the Holocene. This can be attributed to climate-induced and human-induced vegetation (land use) changes in the upstream part of the Rhine drainage basin. The next step is to compare this clear sedimentation trend in the delta with sedimentation in other sinks along the River Rhine (i.e. the Upper Rhine Graben). If this trend is present in both sinks, this is a response on drainage basin scale. Hence, the calculated sedimentation rates allow us to determine the response of the Rhine system, expressed in sediment budgets, to changes in its drainage basin since the start of the Holocene, 10,000 years ago.

Presentation

Morphological behaviour of bifurcations in the Netherlands: the implications on river management

Leonie Bolwidt & Peter Jesse
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Presenter:
Leonie Bolwidt

In the past 7 years research has been performed at the 3 main bifurcation points in the river Rhine (the Pannerdensche kop, the IJsselkop and the Merwedekop). Measurements have been performed on sediment transport, subsoil (geological profile from the top 4 meters), top layer, water levels, stream velocities and river discharges. From these measurements information on among others: water and sediment division over the bifurcation point, dune characteristics (height, length, migration velocity), bed roughness, grain size patterns from the top layer, selective transport due to secondary current was gathered. With this information a lot of insight was developed in the morphological behaviour of these bifurcation point. The next step is to transform this scientific understanding into guidelines for river managers. These guidelines are needed for design, recovery and management of the river system. Examples of subjects in which these are used are:
* sediment balance of the Rhine branches, needed for the policy on extraction of sand;
* determine the morphology effects of room for the river projects
* Adapting a better dredging policy of the navigation channel
In this presentation the focus will be on transforming scientific research results to applications for managers.

Presentation **Theme: River Basin Management**

Public Values in River Basin Management

Bauke Steenhuisen[1], Willemijn Dicke[1], Heleen Weening[1], Jan Schoot-Uiterkamp[2], Lex Runia[3], Geert Roovers[3]
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Presenter:
Bauke Steenhuisen

River management serves several interests, e.g. protection against flooding, environmental interests, shipping etc. Some of these interests are labelled as 'public values' and government feels responsible for safeguarding these values. Both the designation of public values and the way they are being safeguarded differs from country to country.
Considering the wide variety of values, both in scope, in hierarchy and impact, different interests ask for different approaches in the way they are safeguarded. Safeguarding will even become more complex since some of these values are in conflict with each other. The inherently international nature of safeguarding public values in river basin management will furthermore increase the complexity of prioritising public values.
Last decades show several cases in which safeguarding of public values and trade-off's between them have not been dealt with carefully such as the realisation of some urban areas in riverbeds (Nijmegen, Roermond), causing a decrease of discharge capacity of the river, or the deepening of the Western Scheldt for shipping, causing a severe decline of ecological values in this estuary.
The need for institutional arrangements that can guarantee safeguarding and prioritising different public values is furthermore increased by uncertain developments in climate and a growing pressure on river basins due to human influence, related to environmental, social en economical sustainability in delta areas like the Netherlands. Recent flooding problems (Elbe and Donau in recent year's, throughout Europe) increase this importance.
Within the framework of the Bsik-programme Public Values, Delft University of Technology and Oranjewoud consultants and engineers, started a survey to investigate the institutional arrangements that can safeguard different public values within river basins. The Ministry of Transport, Public Works and Watermanagement supports the survey. The survey started in 2004, and will be finished in 2006.

At the NCR-days we can show the theoretical framework and provide the first results from the river basin management cases. The first general conclusions on public values in riverbasins will be presented.

Presentation

Time scales: key role in urban development of river landscapes

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Presenter:
Bianca Stalenberg

How to protect river cities now and in the future from flooding, maintaining and developing an attractive landscape, and meeting the wishes of different stakeholders at the same time? Within the Water Research Centre of Delft University of Technology, three researchers perform a multi-disciplinary research to answer this question. In all of the three disciplines, hydraulic engineering, landscape architecture and policy analysis, time scales play an important role. In this paper we argue that planning should combine the short term and the long term at the same time.
The river landscape can be viewed with the Layer Model, which is composed of three layers: underground (soil), networks (traffic, water) and the occupied layer. Every layer has his own time scale. The underground has a geological and therefore longer timescale in comparison with the two other layers. Ergo this layer has to be leading for the others according to the policy-makers. In practice however this can turn out differently. In river cities many stakeholders, like city planners, flood managers and environmental organizations, play a role; each from their own point of view. Here the tension between the timescales of city development and of the natural and artificial river development surfaces. Planning, focusing on short term development, often leads to a disintegrated landscape. An interdisciplinary long term vision for a larger (spatial) scale is often not (or not enough) taken into account. On the other hand, long term planning is tough. Policy-makers have to cope with uncertainties about the future and actions necessary for the long term are often more radical. They might therefore meet more resistance from the public. The concept of ‘adaptive policy-making’ can bring relief: in the short term only those actions are taken that are time urgent and that are needed to preserve flexibility for actions in the long term. In this way actions are presently taken for protecting the river cities according to the currently demanded safety level and flexibility is preserved for (phased) future developments. In the paper we will argue through some examples that this adaptive approach is technically and spatially feasible and that it will lead towards robust structures of river landscapes.

Presentation

Appropriate Modeling for River Basin Management with Application to Flood Risk

Yan Huang, University Twente
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Presenter:
Yan Huang

Evidences show a growing gap between scientific knowledge available and practical needs required for Integrated River Basin Management (IRBM). This gap becomes manifest when e.g. objectives or problems are not clearly defined and correctly translated into the different "languages" that are used by scientists and end users; or when the development of measures is not based on adequate scientific principles, resulting in ineffective implementation of the proposed measures. Thus, there is a need for the development of a new method to bridge the gaps with an accurate and efficient tool to support decision making in relation to management activities, i.e. an integrated Decision Support System (DSS). Preferably, such an instrument should not be excessively complex or overly simple, but appropriately sufficient to analyze the difficulties encountered in IRBM.
To bridge the gap between scientific principles and practical needs in IRBM, addressing issues of model selection as well as evaluation methods for DSS performance, a systematic design approach, based on the knowledge and experience obtained during the development of a DSS for the Elbe River in Germany, a system analysis approach, termed as appropriate modeling, has been developed in this thesis. Serving to achieve the objectives a DSS, appropriate modeling provides an approach for the design of a DSS for IRBM.
This approach has been applied to the development of an Integrated Flood Risk Assessment (IFRA) system as a key component of a DSS for the River Elbe. Note has to be taken that it has been found that current difficulty encountered in IFRA is the neglect of velocity that plays a vital role in causing flood damage, in addition to inundation depth. However, this has not been quantitatively expressed. Following the appropriate modeling approach, an IFRA framework has been developed. A case study is carried out to analyze the consequence of a deliberately enforced dike break as a flood management measure. The results show an effective risk assessment using the IFRA framework, in which a significant difference is observed in the spatial distribution of risk when flow velocities are taken into account.
The application shows that the appropriate modeling approach proves effective for identification of model complexity as well as for a comprehensive presentation of IFRA results using uncertainty analysis. The approach is developed in a generic sense and therefore need not be limited to flood risk assessment; this approach could well be applied to the development of a DSS for other objectives such as ecology, or objectives involving multiple disciplinary objectives such as a combination of ecology, flood risk and navigation in IRBM.

Presentation

Floodplain roughness mapping synergy: lidar and spectral remote sensing

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Presenter:
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The distribution of vegetation structural characteristics, i.e. vegetation height and density, and inherent roughness is the main knowledge gap in hydrodynamic modeling of floodplains. Vegetation slows down water flow velocity, thereby creating higher water levels, and increasing the flood risk. Dynamic management of floodplains induces succession of floodplain vegetation. This leads to a high spatiotemporal variation of vegetation structural characteristics. To provide hydraulic modelers with input, the spatial distribution of vegetation characteristics is needed. To catch up with succession the method has to be detailed and fast. Our aim is to provide a vegetation structure map covering the whole floodplain.
Lidar remote sensing, also known as laser altimetry or airborne laser scanning is an active remote sensing system which results in three dimensional clouds of laser points. These point clouds prove very useful for the quantitative mapping of vegetation height and density of herbaceous vegetation, shrubs and forest, but fail to distinguish between water, paved areas, beaches or meadows. In this respect spectral remote sensing is a complementary data source enabling easy recognition of the classes undetectable by lidar data.
Here, I present a two-stage method to derive vegetation roughness from multispectral and lidar remote sensing data. In the first step, an object-oriented classification is carried out, which is based on multispectral data to distinguish between all classes mentioned above. In the second step, the objects that can not be described meaningfully by lidar data are labelled using a lookup table, otherwise the vegetation structure is characterized using the lidar data.

Presentation

The impact of 'Room for the River', climate and land-use change on deposition of sediment and heavy metals on Dutch floodplains

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Presenter:
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Floodplains are important sinks for sediments and associated contaminants in river basins. Upstream changes, like climate and land-use changes, together with local changes in floodplain topography resulting from rehabilitation projects like 'Room for the River' may drastically affect the functioning of floodplains as sinks. We therefore aimed to quantify the potential impacts of these changes on floodplain deposition along the lower Rhine River.

We performed model calculations for two 10-km Waal River reaches near Druten and Bemmel for current and projected conditions for 2050. The considered climate change may cause floodplains to be inundated 10 % longer, while land-use changes may reduce sediment loads by 13 %. We included floodplain rehabilitation measures such as digging of secondary channels, removal of minor embankments and lowering of the floodplain surface.

Currently, approximately 1.5 kg m^{-2} y^{-1} sediment and 0.5 g m^{-2} y^{-1} Zn, 0.085 g m^{-2} y^{-1} Pb, 0.08 g m^{-2} y^{-1} Cu and 1.5 10^{-3} g m^{-2} y^{-1} Cd are deposited in the model areas. Upstream changes reduce these values by 3–20 % but hardly change trapping efficiencies. Where 'Room for the River' reduces flood water levels, deposition decreases by 9 % and trapping efficiencies by 7 %. However, a secondary channel may lead to 24 % more deposition, because of higher trapping efficiencies and more deposition at lower discharges. This shows that changes in floodplain topography may have a larger impact on sediment and metal deposition on river floodplains than upstream changes in climate and land use.

Presentation

Water and Economics of the Netherlands; Integral modeling of water and economics on national and catchment scale

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Presenter:
Aline te Linde

In recent years some attempts are made to gain more insight in the social-economical value of water. A systematich and integrated approach on catchment scale that can calculate direct and indirect effects of policy of measures on regional and national scale, is still lacking at the moment.
The purpose of this BSIK-Living with Water project is to develop an integrated water and economics model that can be used to calculate the economical effects of meausures on the physical water system and on water quality. This model will then serve as an important tool for the application of a social cost-benefit analysis of the implementation of the European Water Framework Directive in the Netherlands.
The project will display the many different wateruse functions, starting on a national scale. It will be thoroughly analysed how these functions interact with economics and water dynamics. Existing models will be used as much as possible and coupled using the modular framework as proposed by HarmonIT.

Presentation

Integrated water allocation for the Yellow River basin in China

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Presenter:
Rongchao Li

Although to some extend agreements were reached on a basin wide water allocation for the Yellow River Basin in China, in practice huge gap between water supply and demand and differences of opinions still cause serious conflicts and tensions among upstream and downstream provinces and across sectors, particularly under rapid changing of social-economic and demographic developments. Establishing a rational basis (based on best available information) for inter-provincial water allocation will strongly contribute to an integrated Yellow River basin development.
Simulation of the water balance for the whole basin is considered indispensable to represent/trace alternative water allocation options and to prepare the information for the negotiation process on water allocation. In the present paper the application of the simulation model RIBASIM to the modelling of the water balance will be presented as well as the use of the model to prepare some alternative water allocation schemes. The inter-provincial water allocation disputes on water quantity will be analysed on the basis of the present and projected future demands and taking into account the interaction among upstream and downstream provinces, the hydrological regime and storage possibilities. The various strategies should illustrate the available space for water allocation and negotiation and in particular address the bottlenecks. This reconnaissance of strategies and impacts will provide insight in the possibilities for trade-offs in water allocation among the provinces and should stimulate communication and the negotiation process between provinces.

Presentation **Theme: Water Quantity & Quality**

The importance of hydrodynamics for biodiversity: synergy between safety and nature?

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Large-scale reconstruction measures are being prepared and implemented in river basins of north-western Europe for the purpose of flood defence, ecological rehabilitation and infrastructural improvements. These measures will have far-reaching consequences for the physical structure, hydrodynamics and hydroconnectivity, and hence for the ecological functioning and biodiversity of river-floodplain ecosystems. River managers are legally obliged to take protected species and their habitats into account in their effect assessments for spatial planning, physical reconstruction and management (e.g. Environmental Impact Assessments and Strategic Environmental Assessments).
We examined the relationship between protected and endangered riverine species (target species) and hydrodynamics in river-floodplain ecosystems, covering both the ecological significance of hydrodynamic conditions and the relative importance of riverine target species for policy and legislation. The importance of different hydrodynamic conditions along a lateral gradient was quantified for various taxonomic groups. Our results show that (i) target species require ecotopes along the entire hydrodynamic gradient; (ii) different parts of the hydrodynamic gradient are important to different species, belonging to different taxonomic groups; (iii) low-dynamic parts are highly important for many species and (iv) species differ in their specificity for hydrodynamic conditions. Many species of higher plants, fish and butterflies have a narrow range for hydrodynamics and many species of birds and mammals use ecotopes along the entire gradient. Even when focussing only on target species, the entire natural hydrodynamic gradient is important. This means that the riverine species assemblage as a whole can benefit from measures focussing on target species only. River reconstruction and management should aim at re-establishing the entire hydrodynamic gradient, increasing the spatial heterogeneity of hydrodynamic conditions.

Presentation

Forecasting levels and their uncertainties for the River Rhine at Lobith

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Presenter:
Aart Overeem

Forecasts of water levels at the entry point of the river Rhine in the Netherlands (Lobith) are of considerable importance for safety and shipping. Every day forecasts of the water level at Lobith 1 and 2 days in advance are issued by the Institute for Inland Water Management and Waste Water Treatment (RIZA). These forecasts are obtained from a multiple linear regression model, called Model Lobith, which gives good forecasts, because the average of the residuals is small. However, the uncertainty in the forecasts is not well known, while this information is for example of importance during high water periods to give insight into the chance of exceeding critical water levels. During the presentation also conditional Parzen densities will be presented to capture this uncertainty in the forecast of Model Lobith. It will be shown these densities yield usable information regarding the uncertainty in the forecast during high water periods. So this approach holds a promise for use in operational forecasting of levels at Lobith. The presented technique can be generalized to the analysis of residuals from other forecast models.

Presentation

Lowering the groynes; will it reduce the flood level after all!

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Presenter:
Mohamed Yossef

In order to investigate the resistance of groynes during different submergence levels, experiments have been conducted in a physical model with a scale of 1:40 for a schematised river reach, which is based on the geometry of the Dutch River Waal. The transverse velocity profiles for all test cases were measured. From the analysis of the effect of submergence, it was possible to devise a relation between the blockage by a groyne, and the effective roughness in the groynes' region. Such a relation allows an estimate of the effect the groynes on the effective roughness of the river. It further allows an assessment of the effect of lowering the crest level of existing groynes on flood level.
From the analysis presented in this paper it was found that, lowering the groynes is more pronounced during medium floods. However, during the design flood (extreme condition); the effect of lowering the groynes is rather small. The result shows that the reduction in water level amounts only to 4 cm. It is important to realise that, the estimates made in this paper are based on a schematic channel, not on numerical model of real-life river.

Presentation

Water quality of the Rhine and Meuse rivers during the summer drought of 2003 - preview of climate change?

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Presenter:
Gertjan Zwolsman

It is generally recognised that climate change will affect the discharge patterns of the Rhine and Meuse rivers. Especially the anticipated increase in extreme river discharges (floods and droughts) poses serious problems to water management authorities, both with regard to water quantity and water quality aspects. Water quality effects of climate change are not sufficiently recognised, however, although there are indications that this may become a serious problem in the future. Water quality problems are already serious during long periods of drought, especially in the summer, due to a combination of low river flows and high water temperatures. The summer of 2003, which was exceptionally dry, may serve as a preview of the effects of ongoing climate change on water quality. We have compared the water quality of the Rhine and Meuse rivers in 2003 to that in preceding years, to get an impression of the consequences of decreasing river flow and high temperatures on water quality. The results indicate that water quality in 2003 was relatively poor compared to that in previous years. The main reason for this is the limited dilution of the pollution load in 2003, as shown by the behavior of conservative substances (e.g. chloride, fluoride). Moreover, sediment-water exchanges will become more important during low flow conditions, leading to increased nutrient concentrations in the water column, as found in the Meuse river in 2003. Chemical standards for drinking water preparation were exceeded in the Meuse River in 2003 (for fluoride, ammonium and organic contaminants). In the Rhine River and Lake IJsselmeer, chloride concentrations were close to the drinking water standard in October 2003. Empirical relations between chloride, fluoride, and river flow have been derived, which can be used to predict future concentrations in periods of drought.

Poster 1

Modelling suspended sediment dynamics in the river Meuse

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It is generally known that a major part of the annual suspended sediment load and associated contaminants is transported by rivers in a minor period of time, during flood events. For the Meuse applies that 60- 80% of the total particulate contaminant load is transported in 10% of time and that the heavy metal concentration is strongly related to SSC. Therefore different stakeholders, from nature conservators and river managers to the drinking water sector and industry, have interest in an accurate prediction of SSC, at least for flood events.
This study aims to develop a simple, physically-founded multiple regression model that gives a best possible estimate of the suspended sediment concentration (SSC) in the Meuse at all discharge regimes.
SSC is generally expressed as a power-function of discharge (Q):

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a so-called rating curve, but considerable scatter appears around this rating curve. Inspection of a detailed 10-year time series of suspended sediment concentration (SSC) and discharge of the Meuse at Eijsden indicates that SSC is (besides discharge) structurally controlled by factors other than hydraulic: exhaustion and replenishment of different sediment sources. Clockwise hysteresis and other effects of sediment exhaustion can be observed during and after flood events and effects of stockpiling of sediment in the river bed during low-discharge periods are obvious in the SSC of the next flood. Parameters that represent different sediment sources and the presence or absence of stock for sediment uptake from these sources are implemented in a regression equation. This simple and comprehensive method results in a more reliable prediction of SSC at all discharge regimes regardless of antecedent conditions, for single-peaked and multi-peaked flood events as well as at low flow conditions, but opportunities for improvement remain and will be tested in future research.

Poster 2

Modelling the influence of vegetation on the morphodynamics of a flood event in the Allier, France

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Understanding the interactions between vegetation and the morphology of rivers is becoming increasingly important in view of modern river management and climate change. There is a need for predictive models for the natural response of rivers to river rehabilitation. One way to study the effects of river rehabilitation is to study natural reference rivers. The Allier in France is considered as a landscape reference for the to-be-restored Border Meuse in the Netherlands. The Allier is highly dynamic, large amounts of sand and gravel are transported during floods and its morphology changes considerably from year to year. The riparian vegetation is characterised by pioneer species on the low-lying dynamic point-bars, herbaceous vegetation and grass on the higher parts and extensive softwood floodplain forests, mainly consisting of poplars, on the older and higher floodplains. Due to the river dynamics, this river shows natural rejuvenation of vegetation such that older forests are removed by erosion and young pioneer vegetation can start growing on the point-bars. This model study investigates the role of vegetation on the morphological changes of a single flood event that took place in December 2003. A state-of-the-art 2-DH morphodynamic model was applied in a 6 Mm^2 study area. This model accounts for the effects of vegetation on the hydraulic resistance and on the reduction of bed shear stress and subsequent bed load sediment transport. The model results show that vegetation has a pronounced effect on the hydrodynamics and morphodynamics. The results also reveal that this model has only limited success in simulating the observed morphological changes. Recommendations for further model development will be made. It can be concluded that vegetation is an important factor for the morphodynamics of gravel bed rivers, but our knowledge is at present insufficiently advanced to accurately predict the morphological changes in this section of the Allier.

Poster 3

A pilot application of bottom vanes in the Elanjani River, Bangladesh

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Bottom vanes are hydraulic structures, placed on an alluvial riverbed under an angle with the main flow generating a vortex that produces transverse transport of bed load and near-bed suspended load. This mechanism can be used to apply bottom vanes to correct the morphology of a river bed in a certain desired manner, for instance to create sufficient depth for navigation, to mitigate bank erosion or to change the division of sediment transports at bifurcations.
In the past research on bottom vanes is mostly done in flume experiments. The aim was to test whether bottom vanes are a solution for real river problems in Bangladesh, a pilot application of bottom vanes was needed.
In the framework of a joint project between TU Delft and the Bangladesh University of Engineering and Technology (BUET), under the project "Experimental research on Effect of Bottom Vane on River Flow and Morphology" a pilot project is obtained.
The selected river bend to place the vanes is in an outerbend with an erosion rate of 5 à 6 m a year. If nothing will be done the houses of the, at the outerbend located, village Porabari, near Tangail, in the Tangail district, Bangladesh, will be damaged and wasted out within years. The river is called Elanjani and is a tributary of the Dhaleswari River, which is a tributary of the big Jamuna River (Brahmaputra). This sand river is 30-40 m width and is sufficient dry in the dry period.
The design was made in the beginning of March 2005. The Design was based on some guidelines conducted from the few pilot applications conducted by Odgaard, the inventor of the bottom vanes. And based on the flume experiments done in the past at the BUET outdoor facility.
Light materials were chosen, such as bullah (wood specie) and bamboo, because our test covers only one flood and after the flood the morphology will be changed, therefore after each flood a modification is necessarily. Design contains 3 groups of 3 vanes, total 9 vanes, whereby two groups are placed upstream and one downstream of the apex. In the middle are no vanes placed to overcome problems with the unknown streamlines in this sharp bend.
The vanes have an angle to the flow of about 20 degrees. This causes sediment transport in the direction of the outerbend. Driving in the Bullah makes the vanes stable enough during the flood. Between those bullah the bamboo was placed. The bamboo wall was placed below bed level, to prevent water to flow beneath it. The vanes are 2.4 meter high and cover only a small part of the stream during flood stage when the water level is approximately 10 m. Gunnybags are placed around the vanes to overcome problems with scouring.
After the construction was finalized end of April the set-up of the monitoring program took place. To analyse the effect of the vanes, cross-sections had to be measured. Also sediment samples are taken and a program is made to measure the scourholes. During the project every day the waterlevel will be recorded, this will give use the necessarily information about the occurring flood peak. The current velocity and direction will be modelled with Delft 3D.
After the flood, when all data is available, the analyses of the effect of bottom vanes in real rivers in the morphology can take place. Hopefully we can then present bottom vanes as the solution of erosion problems in small rivers in Bangladesh.

Poster 4

Three-dimensional flow patterns in a fish passage

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A fish passage is a means for fish to bypass a hydraulic construction such as a weir, which is constructed in such a manner that the discharge through the passage is minimal. At the Hydraulics Laboratory of Wageningen University an evaluation of the hydraulic functioning of the “De Wit” fish passage has been conducted, from a user perspective (Boiten, 2004). This has resulted in stage-discharge relations and practical advises for use. However, the complex three-dimensional flow patterns through the slots and in the compartments of the fish passage were left unaddressed. The present BSc thesis concerns the physics of the flows in the fish passage which occur at different water levels. Using an Acoustic Velocity Meter (ADV), the flow in the compartments is measured. The measurements were subsequently visualized and interpreted. In the course of the thesis it was quantified where in the compartments turbulence energy is being dissipated and how the water flows through the compartments. Successful fish migration requires that flow velocities are not too high and that there are areas in the compartments where the fish can rest. The “De Wit” fish passage seems to fulfill these requirements. The total energy loss integrated over a compartment is distributed both horizontally and vertically due to a helical type of flow pattern, causing flow at the surface to oppose the direction in which the total head loss occurs. At the core of the helix an area is present with relatively low velocities, which supposedly may serve as a place where fish can rest.

Poster 5

Bubble screen and bend scour

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Dredging in the inner part of sharp bends is often necessary to maintain the desired depth in the fairway. This is due to the secondary flow that erodes the outer bend and transports the bed material to the inner bend. In the river Waal near St. Andries and in the bend before Nijmegen fixed layers are constructed to counteract the bed scour development. Other solutions like bottom vanes exist, but may hinder shipping. A reversible alternative solution might be a bubble screen in the outer bend. Preliminary experiments in a strongly curved laboratory flume with horizontal bed have indicated that a bubble screen in the outer bend significantly modifies the secondary flow. This technique could be extended to rivers with erodible bed. As a consequence of the decreased or reversed secondary flow in the sharp river bends, the transverse bed slope might decrease. Hence, dredging in the inner bend would be no longer necessary to maintain the desired depth in the fairway.

Poster 6

Appropriate modelling of vegetation roughness for river management purposes

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Apart from the geometrical properties of a river channel (e.g. depth, width, slope) the most important parameter that determines the local water depth for a given discharge is the hydraulic roughness. The presence of vegetation in a floodplain, or in a river's main flow section, complicates the issue of determining its hydraulic roughness value. To date, several methods exist to describe the influence of vegetation on a flow field. However, it remains unclear which of these methods is most suitable for specific real-life situations. For the different methods an attempt is made to give scale boundaries, which may be used as guidelines when vegetation effects are to be included in river management investigations.

Poster 7

Sediment sorting in dunes and long-term river morphodynamics

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Through affecting the small scale morphology (e.g., dune dimensions, bed surface composition, and bed roughness), sediment sorting processes affect sediment transport, changes in mean bed level, and water levels. In a morphodynamic river model, the interaction among grain size selective sediment transport, sorting processes and changes in mean bed level is described in terms of sediment continuity models. Recent progress in the development of these models was made by Blom & Parker (2004), who developed a framework for sediment continuity for conditions dominated by dunes. Instead of discrete bed layers, the framework is based on a probability density function of active bed surface elevations, which indicates the likelihood of a certain bed elevation being exposed to the flow. Present research by the author involves extension of the model to conditions with net aggradation and degradation of the river bed. The time evolution of both the vertical sorting profile and its effect on net aggradation or degradation of the river bed is studied numerically for a number of case studies. It appears that vertical sorting through bed form migration predominates the effects of net aggradation/degradation upon the vertical sorting profile.

Poster 8

Expert opinion about uncertainties in roughness coefficient

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Water level predictions in rivers may be used for designing flood defence measures and evaluating natural rehabilitation in flood plains. These water level predictions are uncertain and a major part of this uncertainty is caused by the uncertainty in the roughness coefficient. To quantify the influence of the uncertain roughness coefficient on water level predictions, we need a quantification of the uncertainty in the roughness coefficient. For this purpose, besides data analysis, we apply expert opinion. This paper focusses on the experts' opinions about uncertainties in the roughness coefficient. The opinions are gathered by conducting a questionnaire via an internet application. In this paper, we present the set-up of the questionnaire, such as questions, answer-possibilities and a description of the people (experts) invited to fill out the questionnaire. The next step in the analysis is to combine the experts' opinions. Different methods exist for combining expert opinion, one of which will be applied. In future research, the uncertainties resulting from the expert opinion will be combined with the uncertainties resulting from data analysis. Furthermore, the uncertain roughness coefficient will be implemented in a hydraulic river model to determine its effects on water level predictions. This research is supported by the Technology Foundation STW, applied science division of NWO and the technology programme of the Ministry of Economic Affairs.

Poster 9

GPR potential in recent fluvial records – embanked floodplains

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For future river management it is important to assess recent sedimentation rates in embanked floodplains. An embanked floodplain near Winssen, the Netherlands, was selected for sedimentation history assessment. This location along the river Waal is known for its relatively undisturbed character and the availability of historical age control (Middelkoop, 1997). The research involved detailed mapping of sedimentary units by ground-penetrating radar (GPR) profiling controlled by 15 hand-cored drillings and 5 undisturbed sediment cores. The 100 MHz GPR profiles were collected in an area with a drape of flood-loams (1-3 m thick). At the time of surveillance the groundwater table was at ~3.3 m depth, allowing a penetration depth of up to four meter. It is possible to discriminate four distinct radar facies:

1. Predominantly transparent facies. This is interpreted as a sandy clay drape (overbank deposits), dating predominantly post-1873 AD. Occasionally intercalated sand layers are detectable.
2. Down-stream dipping reflection sets, with distinct geometry. Interpreted as gravely sandbars with foresets and an age between 1810 and 1873 AD.
3. Channel-forms filled with semi-transparent (sub-)horizontal reflections. Fine sandy to clayey, laminated residual channel fill deposits, locally fining-upward, 1810 and 1873 AD.
4. Indistinct, irregular reflection configurations. Sand dominated channel deposits, 1810 and 1873 AD.

The age-thickness ratio of the loam drape yields an overall accumulation rate of about 0.6-0.8 cm/yr. The underlying sandbars are interpreted as products of flood regime events. The residual channels are addressed to the aggradation phase of the fluvial system. Deeper coarse-grained channel deposits could not be imaged by GPR but are retrieved by the cores.

The presented method works well under given circumstances (relatively low groundwater table, after a period of low river discharge). GPR yields a very detailed three-dimensional picture of the facies assemblage including position and geometry of sedimentary units within embanked floodplain units. Furthermore the mapping accuracy of the loam drape can be improved by the GPR profiling. Ongoing geochemical analysis will yield indirect information of sedimentation rates while OSL dating within this type of sediments and anticipated time domain is tested against the historical age control.

Poster 10

Modeling the variability of bedform dimensions

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The occurrence and development of bedforms such as river dunes or sand waves generated by water flows have been investigated extensively because of the importance of bedforms for flow resistance. Bedform dimensions affect form drag and thus the total hydraulic roughness of the river or sea bed. As this hydraulic roughness influences water levels significantly, it is important to enlarge insight in the occurrence and behavior of bedforms.
Several physical and empirical relationships exist that predict bedform dimensions under steady flow conditions. These relationships, based on flow and sediment properties, field and flume data, compute mean bedform characteristics. In such relationships bedforms are considered as periodic features with bedform length λ, bedform height Δ and a constant migration rate c. These mean bedform dimensions are generally used to predict form drag. However, bedforms are not regular. They are three-dimensional and irregular in size, shape and spacing. In various situations, it appears that just applying mean values is not sufficient. Variability of bedform dimensions needs to be taken into account, for instance when modeling (1) the thickness of cross-strata sets, (2) bed roughness or (3) vertical sorting.
The variability of bedform dimensions has been analyzed by considering probability density functions of bedform height, trough elevation and crest elevation divided by its mean value. It appears that the coefficient of variation of the bedform height is within a narrow range. This appears to be valid for the trough elevation and crest elevation, as well. In future research the parameters that influence the variability of bedform dimensions will be investigated, in order to be able to better predict the variability.

Poster 11

Water management in the Dutch delta and effects of climate change

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At present, there are many developments in water management of the Dutch southwestern Delta area: restoration projects for nature (i.e. 'Haringvliet Sluices ajar'), waterquality studies in lake Volkerak-Zoommeer, Room for the River, etc. Within all these developments hydrodynamic aspects of fresh and salt water in different parts of the Delta ànd their mutual relations play a crucial role.

The aims of this study are
1) to research this relative context between these developments and
2) to answer the question whether the choices in water management are solid in the long term.
For this purpose different scenarios for the future Delta are combined with the effects of climate change (rising sea level en changing river discharge). To investigate the influence of the different developments, an overall Deltamodel is used that contains the western ('Zuid-Hollandse') Delta and southern ('Zeeuwse') Delta. The calculations are made with the 1D hydrological computer model SOBEK.
Results will be available at the end of September.

Poster 12

Sediment transport at the Merwedekop bifurcation

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Modern river management in the Netherlands requires detailed information on the morphological behaviour of the river bifurcations in the river Rhine. In the past years the bifurcations Pannerdensche Kop and IJsselkop were studied. Presently, a third bifurcation is being studied: the Merwedekop, the location where the Bovenmerwede splits into the Nieuwe Merwede and the Benedenmerwede. The Merwedekop is situated in the fine-grained, tidally-influenced, downstream part of the Dutch Rhine Delta. Aim of the study was to determine the influence of the water discharge, the local bed composition and the tidal cycle on the sediment transport. Data were collected during the discharge wave of January 2004. The bed load transport was measured directly using a Delft Nile Sampler, but also indirectly using multibeam echo soundings and a dune tracking technique. The suspended load transport (excluding wash load) was measured using Acoustic Sand Transport Meters.
Both the bed load transport and the suspended load transport strongly varied during the discharge wave. The bed load transport showed an anti-clockwise hysteresis; the suspended load transport a clockwise hysteresis. The transported bed load had the same composition as the local bed material, suggesting that all grain size fractions in the riverbed were mobile. The highest bed load transport therefore occurred on the location with the highest flow velocities (outer bend), not on the location with the finest bed sediment (inner bend). The suspended load transport, on the other hand, was largest in the inner bend, probably because the relatively coarse bed material in the outer bend could not easily be transported in suspension. The local bed composition thus did have a slight influence on the sediment transport.
Both the bed load transport and the suspended load transport showed a large daily variation due to the tidal cycle. In the Benedenmerwede and the Bovenmerwede, the highest transport occurred during low tide and during outgoing tide. In de Nieuwe Merwede, however, the highest transport occurred during incoming tide. This paradox is caused by the Haringvliet sluices, which prevent a free contact between the Nieuwe Merwede and the sea. At incoming tide for instance, the water discharge through the Benedenmerwede and the Bovenmerwede is hampered, while the water discharge through the Nieuwe Merwede is promoted. This results in low flow velocities in the Beneden- and Bovenmerwede and in high flow velocities in de Nieuwe Merwede.
We conclude that the sediment transport at the Merwedekop is significantly influenced by the water discharge, the tidal cycle and the presence of the Haringvliet sluices, but not by the local bed composition. This is different from the situation at the Pannerdensche Kop and IJsselkop. These bifurcations are situated in the upstream part of the Dutch Rhine Delta and have coarse bed sediments that are not fully mobile, leading to a suppression of the sediment transport, especially in the outer bends where the bed sediments are coarsest (see our contribution in the NCR-proceedings of 2004). In contrary to the Merwedekop, the highest bed load transport at the Pannerdensche Kop and the IJsselkop thus occurred in the inner bends. Because of the setting far away from the sea, the Pannerdensche Kop and IJsselkop are not tidally-influenced. A similarity between the Merwedekop and the IJsselkop is the influence of sluices in one of the downstream branches. At all three bifurcations, the sediment transport strongly reacts to changes in the water discharge.

Poster 13

Ecological risks of sediment pollution in river floodplains

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During the last century, large amounts of particulate-bound heavy metals have been deposited on the river floodplains in the Rhine-Meuse delta. Although sediment quality has improved considerably since the 1970s, exposure to heavy metals might currently still pose risks upon floodplain species, due to the persistence of the deposited metals.
In the future, the amounts and distribution of sediment deposition and hence the heavy metal concentrations in the floodplains are expected to change as a consequence of alterations in river discharges, which result from climate change. Furthermore, floodplain rehabilitation measures are foreseen for large parts of the river floodplains in the Netherlands, leading to modifications in hydromorphology, geochemistry and land use patterns. This will influence both sedimentation processes and the spatial distribution of metals and riverine organisms. Both climate change and floodplain rehabilitation measures are thus expected to influence ecological risks of heavy metal pollution.
Within the framework of the NWO-LOICZ project 'bio-geomorphological interactions in river floodplains', a PhD-study is carried out to investigate ecological risks of heavy metal contamination under current and future boundary conditions. A spatially explicit exposure model has been developed, which takes into account the spatial distribution of heavy metal concentrations and the spatially explicit foraging behaviour of floodplain organisms. Model results will be shown concerning the exposure of top-predator species to cadmium pollution in the Afferdensche and Deestsche Waarden embanked floodplain. The developed model can facilitate river and nature managers in the delineation of high- and low-risk areas, thus enabling them to optimise cost-effectiveness of soil and sediment sanitation for sustainable flood defence measures and environmental rehabilitation.

Poster 14

Quasi-2d coherent structures in a shallow separating flow

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In many river geometries, the phenomenon of flow separation is important (e.g. groyne fields, harbour entrances, bridge piers). The associated large-scale quasi-twodimensional turbulence is able to influence the over-all flow on larger scales, which can cause problems regarding e.g. navigation and erosion. Therefore, improving the modelling of these large vortices is of practical relevance.
This project aims at a better understanding and modelling of separation and, especially, vortex shedding in an environmental shallow flow. First, information about the physical mechanisms governing separation and vortex shedding are provided by physical experiments on various flow geometries. Secondly, the results will be used to improve a numerical shallow water model which is to be used in civil engineering applications. Physical mechanisms which are found to be relevant for separating shallow flows will be included in this model.
A hypothesis about the dominant physical mechanism governing vortex shedding in shallow flow has been formulated. Detailed PIV experiments on three different flow geometries are almost finished. Postprocessing sessions of the acquired data tend to point toward the hypothesis, which stresses the crucial role of the secondary recirculation which is often present in a separation geometry. A sufficiently grown-up secondary recirculation is able to induce vortex shedding. Moreover, the primary recirculation seems to cause a spatial “scale jump” in the horizontal length scale of the dynamic eddies. A Reynolds stress analysis does show this scale jump very clearly.
Experience has been developed with the behaviour of existing numerical models regarding shallow separation and vortex shedding (mainly Large Eddy Simulation). The next aim is to perform three full-scale LES computations in analogy with the measured PIV geometries, using a parallel computer cluster.

Poster 15

Adaptive management of transboundary river basins

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Adaptive management aims at active learning and continually improving management strategies. Active learning includes gathering comprehensive knowledge of the current system and expected changes, e.g. by experimentation or simulation. Because current knowledge is not sufficient for future water management, water management strategies need to be adaptable to new information and changing circumstances. Improvement of management strategies may require changes in the whole management regime (law, policy, formal and informal actor networks). Public participation and information management are of key importance for a learning and adapting water management regime.
In the framework of the NeWater project (EU 6th framework programme), the water management regimes of seven transboundary river basins have been reviewed. In transboundary water management conflict and cooperation between the riparian countries play a central role. The Rhine basin serves as an example in which cooperation among national governments as well as non-governmental actors is well developed. The poster will include a comparison of the transboundary regimes and an indication of the extent to which these regimes are adaptive.

Poster 16

River System Health: a meaningful framework for scientific integration?

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Nowadays, knowledge bases from a wide array of scientific disciplines (e.g. ecology, hydrology, economics, policy sciences, sociology, historical geography) are required to provide truly integral management solutions for riverine environmental problems. In present day river management, such integral solutions have been difficult to realise due to existing differences within scientific disciplines related to the visions, aims, problems, etc. that guide research (the so-called knowledge-constitutive value frame) and the scientific language, methodological approach, techniques, etc. that are needed to perform specific research (the logical-contextual value frame). Following this, possibilities may be lost in water management regarding the acknowledgment of the full scope of existing societal values.
A promising approach to enable integration of scientific knowledge from divergent disciplines into a meaningful perspective for river management is provided by the River System Health (RSH) concept (Vugteveen et al., submitted). The basis of RSH is a holistic representation of people, their activities and their impacts integrated with the ecology and resources of the river system.
Our project aims at mapping the scientific values of divergent scientific diciplines and to explore the possibilities for incorporation of these value frames into the concept of RSH. At a scientific level this means assessing the commonalities and differences regarding scientific thinking and practices that exist between different scientific fields, and trying to solve existing bottle necks for integration under RSH. In practice, the concept of RSH may offer a suitable framework for the development of integrated quality assessment- and management tools for river managers, enabling integrative management choices by combining information on ecological status and potential, economic costs and benefits, and social needs and constraints within the river system.

Poster 17

Sediment transport concepts in the modeling of large scale morphology in rivers with non-uniform sediment.

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For the assessment of (long-term) hydraulic and morphological consequences of interventions in a river adequate (1D, 2D and 3D) modeling tools are required. Presently there are many different sediment-related model components available that can be used in these models. For example, different sediment transport formulas, a 'uniform' or a 'graded' sediment model approach, various sediment continuity model concepts, the bed roughness can be fixed or predicted using various roughness predictors, etc. For practical river studies (e.g. Grensmaas or Rhine branches) it is not immediately clear how to select appropriate sub-model concepts for that specific river problem. This is often due to i) a lack of insight in the sensitivity of the model results for different sub-models and river schematizations, ii) a lack of insight in the validity of the various sub-models for that river problem, and iii) a lack of practical experience with the application of these concepts in river problems.
In the planned poster presentation a comparison will be made between 1D models for large scale river morphology, set-up with different combinations of sediment models. This gives an insight in which sediment-related model components are particularly important for the final model results. The differences between concepts will be presented by comparison of the results of different models for one or two applications, being an experimental laboratory set-up and/or a real-life river case.

Poster 18

Generic Estimates of Palaeo-peak Discharge for Series of Channel Belts

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Fluvial records, through palaeo-discharge estimates, provide a proxy for climate produced runoff. In potential they are an instrument to evaluate climate model (GCM) output versus field records, particularly for GCM runs simulating past climate situations such as the Last Glacial Maximum (LGM) or the middle Holocene. In particular the middle and lower reaches of the worlds' larger rivers provide a powerful proxy, because their palaeo-discharge concerns aggregated values produced in drainage basins with a footprint equal to that of several cells in GCM models (allowing direct comparison without up-scaling uncertainties). However, if fluvial records are to be used in GCM evaluations, a database is required to store the properties of fluvial records (size: channel-belt geometry; time: duration of formation and age). Then in addition, a method is required that treats all stored information generically while translating reconstructed properties into peak discharge estimates. For GCM evaluation purposes the focus should be on the mean discharges and modal peak discharges, not on the most extreme situations thought to have occurred. With that in mind, a pilot-project exploring the palaeo-discharge proxy and designing a generic approach to use it for climate model evaluation has been carried out.
We considered only locations in relatively wide parts of valleys along medium-large rivers suitable to estimate modal peak palaeo-discharge from channel belt geometries, for hydrodynamic reasons (channel velocities maxima at bank full conditions, they are not that much higher during extreme peaks than during modal peaks) and for preservation reasons (in wider valleys, lateral migration improves preservation potential and thereby resolution of the produced sequence). We used deterministic formulae based on hydraulic laws for channel flow, with empirically fit coefficients converting eventual channel belt dimensions back to instantaneous channel widths and depths. We applied these formulae to sets of minimum and maximum estimates for channel-belt width, thickness, longitudinal gradient, sinuosity, duration of formation and channel type, thereby producing a cloud of minimum and a cloud of maximum estimates for modal peak discharge. This method is demonstrated for the Lower Rhine and Meuse palaeovalley in the Lower Rhine Embayment (Germany, Netherlands). The peak discharge estimating formula was applied to a series of sites along the river, where each site is comprises a sequence of subsequent channel belts spanning the LGM to the Holocene. The formula produces a modal peak discharge estimate for each channel belt deposit individually and independently. The results are very similar for coeval units downstream along each river, showing the overall consistency of the method and of the reconstructions used as input.
Before this method can be applied in GCM evaluation, a database of river records of this type with continental coverage needs to become available, and this will take some time and international community effort. Nevertheless there is prototype for a database and a generic method showing that with a set of relative simple, straightforward parameters, consistent peak discharge reconstructions from river data can be produced.

Poster 19

Optical dating of fluvial deposits - results on roman ship 'De Meern 1'

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Optically stimulated luminescence (OSL) dating is the only method to directly determine the age of fluvial channel deposits. In this research we present optical ages on fluvial sand covering a Roman barge that was discovered near Utrecht. From dendrochronological and archaeological investigations of the ship and associated finds the barge is known to have sunk between 180 and 200 AD. Our optical ages are in excellent agreement with this tight independent age control. Additional measurements on individual grains of quartz showed that the OSL signal in the majority of grains was completely reset prior to deposition. These results demonstrate the applicability of optical dating for obtaining chronological information on fluvial deposits. Our next challenge is to develop methods to accurately date fluvial deposits formed during the last decades to provide data that can be used for river management.

Poster 20

From sounding to parameter characterization of bed levels for morphological predictions

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The navigable profile of the river Waal is limited by shallows in steep bends and crossings . These shallows can have length scales of 1 to 2 km due to large-scale dynamics of bed-form averaged levels, or 50 to 100 m due to small-scale bed forms. To support river management, both types of morphodynamics should be predicted. Therefore a procedure is developed to process multi-beam echo soundings into a database of bed-form averaged levels and a database of bed form parameters. This procedure is applied to bed levels of the river Waal, to enable the development, calibration and verification of bed-level prediction tools. The resulting databases are available for research on river morphology.

Poster 21

Prediction of uncertainties in bed level changes in the Grensmaas (NL)

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This study presents an uncertainty analysis of the morphological behaviour of a graded sediment river with a Monte Carlo simulation method. The river Grensmaas (The Netherlands) serves as a pilot. A sensitivity analysis shows that the uncertainties due to the discharge variation and the variation of the bed composition are the two main sources of uncertainty in the morphological computations of the Grensmaas. Because of practical reasons (e.g. long computation times) only the uncertainty due to discharge variation is considered herein. The Nearest Neighbor method is applied to derive 300 time-dependent discharge series for the 300 Monte Carlo simulations. The Monte Carlo simulations have resulted in an expected bed level change and a 90% confidence interval. Both parameters are compared with a previous results based on a regime approach (historical, dry, mean, wet discharge series). We conclude that the expected bed level change is comparable with the mean discharge regime. However, the 90% confidence interval is larger than the band width between the dry and wet discharge regime.

Poster 22

Examining the effect of using different model concepts and varying detail of data on nutrient load estimates in the Rhine River Basin

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Quantifying nutrient loads, delivered from the river basin via the river outlet to the coastal sea, is important for studies describing the nutrient budget in the coastal sea and the related primary production. Various models have been developed to estimate the riverine nutrient output, depending on point and diffuse emissions, as well as environmental characteristics, such as slope, land use, population etc. These models are often calibrated with nutrient concentrations along the river. These model types vary from deterministic models applied in small catchments to empirical approaches used for global-scale estimates. The objective of the present study is to evaluate the impacts of changes in land use and climate on nutrient fluxes in large rivers. As a first step we explore to what extent the sensitivity of the estimated nutrient fluxes depends on using different model concepts, data availability, and spatial and temporal detail of the input data. With the relative data-rich river Rhine as an experimental river basin, we can explore different modelling approaches, compare their performance, and evaluate whether these can be applied to predict nutrient loads for data-poor river basins, where less data for calibration is available and a coarser spatial resolution must be used.

Poster 23

Dynamic transfer and retention of nutrients within lowland catchments

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Various modelling approaches exist for the river basin scale (> 10 000 km2) simulation of nutrient fluxes. All of these approaches combine point and diffuse nutrient emissions with landscape and hydrological characteristics to simulate regional long-term (years) nutrient fluxes. The influence of landscape factors and hydrology on nutrient transfer and retention is quantified by relatively simple empirical concepts. In this way, the pattern of nutrient transfer and retention can be reproduced fairly well.
However, the exact processes and pathways of transfer and retention within the landscape, and their spatial and temporal distribution are still unknown and not included in these models. Especially the influence of hydrological connectivity is not yet fully incorporated in the modelling. Hydrological events, distance to streams, groundwater travel times, the existence or absence of riparian buffer zones and river residence times all influence the final nutrient load out of the catchment and should be incorporated in current modelling approaches.
From field studies of the Ahja jõgi catchment in South-Eastern Estonia, we identified the landscape and hydrological factors influencing nutrient transfer and retention at the catchment scale (100 – 10 000 km2). Using this information, we set up a grid-based dynamic hydrological model, which includes a conceptual groundwater storage and flow module as well as a module that simulates river residence times. This hydrological model was calibrated for the 1992-2002 period using weekly discharges at the outlet of the catchment. In addition, we developed an emission model, which uses land-use mapping and agricultural and wastewater statistics as input.
These two models yield input for a third model, in which nutrient fluxes and concentrations in the entire catchment were simulated for weekly time steps during the study period.
This approach reproduced the spatial and temporal variation of nutrient delivery to the river fairly well, as well as in-stream retention in various river stretches. This improved model is helpful for determining the spatial and temporal extent of nutrient sources and sinks and their influence on catchment export. Furthermore, the consequences of land use change, agricultural practices, wastewater treatment and buffer strips on nutrient export of the catchment can be quantified.

Poster 24

MSc Thesis Geautomatiseerd Draaiboek Hoogwater Boezem (English: Automated Flood Scenario)

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Geautomatiseerd Draaiboek Hoogwater (GDH) can in English be translated by Automated Flood Scenario. GDH river was originally developed to support the management process during floods in river systems. The program structures information, communication and actions. Until its development only paper based flood scenarios were in use. During the floods of the main rivers in the Netherlands in ’93 and ’95, it was observed that it is difficult to get the right information at the right time from these paper flood scenarios. This led to a request for an automated version of the flood scenario for river systems.
After completing this GDH river the question came up for a GDH for other water systems like lakes, coastal areas and ‘boezem’ systems. These systems will also benefit of an improvement in controllability during flood situations. This MSc thesis at the University of Twente has been dealing with the development of GDH Boezem by order of STOWA and Royal Haskoning. The final product of this thesis has been the development of a functional design of GDH boezem. The research has been based on the Frisian water management and then was generalized.
Starting point was the functional design of GDH river. Because of its generic design only few changes were necessary. These changes followed from some fundamental differences found between boezem systems and river systems. More investigation was needed regarding the information request of the boezem manager versus that of the river manager during flood situations. Experiments have been performed in cooperation with the Frisian water managers to find out if, and if so, what extra information is needed for decisions in boezemsystems. Parameters included in the experiments were boezem waterlevel, wind, outside waterlevel and precipitation. The results led to some interesting conclusions regarding the importance of information about these parameters for decisions in normal and flood boezem waterlevel control. In the case of the program GDH boezem could be concluded that information about the current and the expected water levels will be sufficient.
All changes found during the thesis were incorporated into the functional design of GDH boezem.

Poster 25

Alluvial Architechture of fine grained Deposits

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The main aim of this project is to characterize the alluvial architecture of Holocene fine-grained overbank deposits in the Netherlands, and to apply this characterization to Early Pleistocene fine-grained overbank deposits in order to predict their subsurface facies distribution and hydrologic and geomechanical properties. Detailed knowledge of the spatial distribution of these properties is necessary for sustainable use of the subsurface (e.g. groundwater extraction, remediation of pollution, sand and gravel mining).
The Holocene fine-grained sediments have been deposited by meandering and anastomosing precursors of the present River Rhine (and River Meuse). They constitute essentially an impermeable layer, with some 'leaks' due to channel belt sand bodies. The Quaternary sequence in the Netherlands consists predominantly of permeable channel belt sands, deposited under glacial conditions. Impermeable layers occur sporadically, but are important, because they greatly influence the hydrologic and geomechanical problems encountered. In this project we will use the huge datasets available at Utrecht University and the National Geological Survey to characterize the alluvial architecture of the fine-grained Holocene deltaic deposits, and use this as an analogue for ancient deposits in the Quaternary.
Six cross sections will be used to characterize the Holocene fluvial deposits. Four sections are already available; two more sections will be drilled for this project. One section will be located in the proximal part of the delta and one will be located in the area of the River Vecht and the River Angstel (between Utrecht and Amsterdam, see figure 1). Knowledge of the facies distribution of the fluvial deposits in the distal setting that is dominated by peat domes and in-filled lakes is still limited. This will be investigated in the Vecht-Angstel area.
The sections will be used to obtain quantitative variations between channel belt sand proportions relative to overbank deposits and peat along the delta plain. This will be used to construct a 3-D facies model of the entire Holocene delta, in which longitudinal and lateral changes in facies distribution are taken into account. The characteristics of the facies distribution will be compared with the available data on facies of the Waalre Formation (Early Pleistocene age). Detailed sedimentological knowledge of the facies of the Waalre deposits is limited to several open pits in the south of the Netherlands and adjacent Germany. Outside these pits, information is available from well-descriptions and geophysical logs in the data-base of the National Geological Survey. This part of the project will result in a facies model for the entire fine-grained top of the Waalre Formation, aiming at a prediction of properties of this formation outside the area studied by corings and excavations.

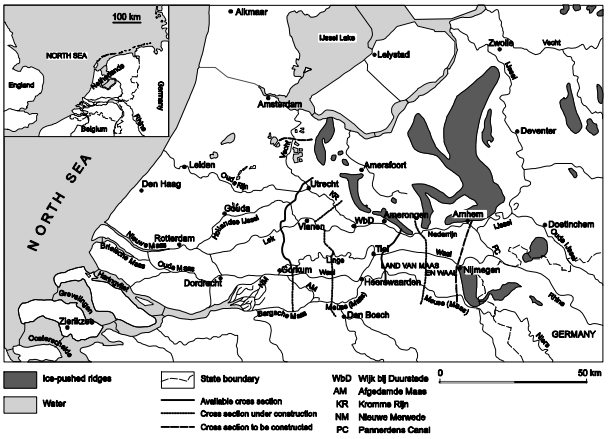

Figure 1. The Holocene Rhine-Meuse delta in the Netherlands. The locations of the cross sections are indicated on the map.

Poster 26

A modular model approach in flow forecasting by neural networks

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Artificial neural networks (ANN) have proven to be useful for hydrologic forecasting. However, they are not always accurate in predicting extreme events, and often are seen as “block boxes”. Using modular and hybrid models may improve the accuracy and incorporate domain knowledge into models. In this study a modular system which identifies the baseflow is incorporated in a modular scheme, and compared with models trained on the full data sets. Experimental results show that this approach leads to more accurate models which could be better accepted by the practitioners.

Poster 27

Evaluating en Predicting Sediment Behaviour in the Dutch Delta

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Sediment behaviour is an important factor in the sustainable management of the Dutch Delta. In the lower parts of the rivers Rhine and Meuse, the deposition of large quantities of sand and mud plays a key role in the river management with regard to navigation, safety against flooding and sediment pollution.
In the 'Room for the River' project the strategies that aim at the safety of the Netherlands against flooding are investiged. A higher level of safety will be achieved by restoring the floodplains of the river Rhine. However, in the lower reaches of the river Rhine, the lowering of the riverbed level is considered as a relatively cheap short-term alternative for more expensive long-term solutions. Lowering of the riverbed has a considerable impact on river morphology, as well as the stability of structures such as groynes and dykes.

In recent decades the deposition of large quantities of polluted mud has resulted in considerable areas of polluted riverbed in the southwestern part of the Netherlands. In case of resuspension of polluted sediments, these polluted riverbeds will affect the water quality. Since the water quality of the Rhine has improved significantly, the resuspension of polluted sediments will cause a detoriation of the water quality and thereby the quality of the ecosystem. On the other hand, if these polluted riverbeds are covered by newly supplied sediment, the quality of the riverbed will improve. Evaluation and prediction of both resuspension and deposition is therefore crucial for the proper management of polluted riverbeds.

An important first step is to evaluate the sediment budget in past decades.
The following step is the setup and calibration of a simulation model for the prediction of suspended sediment transport.

The 2D modelling systems WAQUA will be used for the simulation of flow patterns and DELWAQ for the simulation of suspended sediment transport. For the prediction of morphological changes in the river bed the 1D modelling system SOBEK-MOR will be made ready for use in the Dutch Delta.

The subsequent project steps will provide the water manager with the desired insight in the processes involved in sediment transport, erosion and deposition. This knowledge will be used in planning and evaluation of dredging operations, floodplain restoration and general water and sediment management. With this knowledge, gains in meeting stakeholder demands en reducing costs can be made.