NCR-days 2005

Research on river dynamics from geological to operational time scales

November 3 – 5

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October 2006

Publication of the Netherlands Centre for River Studies
NCR publication 29-2005
ISSN 1568-234X
Preface

The Netherlands Centre of River studies (NCR) successfully organised the NCR days for the 7th consecutive year in a row. During the NCR-days mainly young scientists presented their ongoing research. This led to lively discussions amongst the researchers themselves and persons responsible in river management in The Netherlands. This year the conference was located at the ARA Hotel in Zwijndrecht on the bank of one of the Rhine branches, the “Oude Maas”.

Two key note speakers, Henk Weerts from TNO and and Wilfried ten Brinke from RWS-RIZA, kicked off these NCR-days by presenting an overview of the theme River Dynamics from Geological to Operational Time Scales.

Henk Weerts illustrated that knowledge of water and sediment transport in river systems in the geological past is very important for functions in the subsurface in the Netherlands, such as the production of water, sand, gravel and clay or the construction of infrastructure on unstable subsiding ground. The reprocesses determine the distribution and the properties of the fluvial deposits in the subsurface.

Wilfried ten Brinke showed that knowledge of water and sediment transport in today’s river systems is very important for flood safety and water transport. In natural river systems sediment transport consists of relative longer periods of relatively slow, low volume and small particle transport interchanged with regular high discharge and irregular floods and branching being the periods where most of the larger size sediments are transported. In engineered river systems the sediment transport process has been altered severely: course sediments are captured upstream behind dams, huge quantities of sand and gravel are taken out of the river system as a resource for construction materials. Only suspended load fractions reach the sea nowadays.

With these inspiring notions the conference started.

The programme consisted of 42 selected presentations, 15 interesting contributions in the form of oral presentations falling under the three themes Sedimentation and Morphology, Water Quantity and Quality and River Basin Management and 27 poster presentations.

All presenters were invited to submit a short paper on their presentation for publication in the proceedings of the NCR-days 2005. The papers were reviewed by the NCR Programming Committee and Henk Weerts. This has resulted in 34 accepted papers in this NCR-publication, grouped into the sections: Sediments and Morphology (13), Water Quantity and Quality (10) and River Basin Management (11). The proceedings were finalised at TNO by Henk Weerts with the appreciated help of Ada van Schaik and Anja Livestro.

At the NCR-days two lively workshops took place respectively on downstream river systems and the reconstruction works in the river Maas. In these workshops water policy issues and technical problems were presented by people from the field and discussed with all participants in order to pinpoint topics for a research agenda for the future. We are convinced that some of the topics will re-appear in the future NCR-days.

Many of the issues raised were illustrated during the field trip on Saturday: river bank sedimentation in a nature reserve at the Rhoonse Grienden along the “Oude Maas” and a sand production pit of Boskalis at Zevenhuizerplas. Pictures of the field trip included in this volume give an impression of the visited sites.

We would like to thank Hans Hooghart of TNO, Jolien Mans of the NCR secretariat and Tine Verheij of Conference agency Routine for their work in organising the NCR-days 2005. They all have contributed to the success of the meeting, especially concerning the logistics. The continued financial support by NWO/ALW is gratefully acknowledged.

Finally, we are looking back at a very inspiring conference with many lively discussions and a joyful fieldtrip. We are confident that like the previous years, the network of mainly young researchers in river sciences has strengthened through the participation in the NCR-days offering them the opportunity for communication with fellow scientists and staff of water institutes in the Netherlands.

Henk Weerts, Ipo Ritsema and Ad van Os
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Modelling ecological risks of soil contamination in river floodplains

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Introduction
Within the framework of the NWO-LOICZ project ‘Bio-geomorphological interactions in river floodplains’, the ecological risks of heavy metal contamination in floodplains will be assessed for both current and future boundary conditions. It is generally acknowledged that risk assessments are strongly influenced by the spatial positions of both receptors and stressors (e.g. Hope, 2000). This is especially relevant for the exposure of floodplain organisms to heavy metal contamination, because heavy metal concentrations in floodplain soils show large spatial variability (Middelkoop, 2000). The present PhD study aims a.o. at incorporating the spatial positions of both floodplain organisms and (bio-available) contaminant concentrations in the risk assessment procedure. A spatially explicit individual-based exposure model has been developed (Fig.1), which is applied to assess the exposure of terrestrial floodplain species to cadmium contamination in the embanked floodplain ‘Afferdensche en Deestsche Waarden’. This paper aims at providing insight in the modelling procedure and the characteristics of the model.

Spatially explicit exposure modeling
During model development a food web approach was followed, taking into account feeding relationships between species. Four top-predator species were selected, subsequently inferring the composition of lower food web levels according to diet preferences (Schipper et al., 2006). Selected top-predator species are Little Owl (Athene noctua), Kestrel (Falco tinnunculus), Weasel (Mustela nivalis), and Badger (Meles meles). Of these, Weasel and Kestrel are currently present in the study area. Badger, Kestrel and Little Owl are so-called target species for river floodplains according to national Dutch policy. Spatially explicit model input consists of cadmium concentrations in soil or sediment, data on the distribution of ecotopes, and floodplain inundation characteristics. The grid based model (cell size 5x5 m) is implemented in MS Excel with MS Visual Basic Application and it has a modular structure.

**Figure 1. Model approach.**

- = spatially explicit input data
C = contaminant concentration

```
C soil
  |__________________________|
  | ecotopes                |
  |__________________________|
    | inundation             |
    |__________________________|
      | potential habitat      |
      |__________________________|
        | actual habitat         |
        | foraging behaviour     |
          |__________________________|
```

FOOD WEB LEVEL 1

FOOD WEB LEVEL 2

FOOD WEB LEVEL 3
One of the modules simulates spatially explicit foraging behavior. This applies to 2nd and 3rd level species only, as 1st level species (terrestrial invertebrates and vegetation) are assumed to be sessile with respect to the spatial model resolution. The foraging behavior module involves the selection of a starting cell, representing the nest of a specific organism, based on habitat requirements and inundation characteristics. Subsequently, cells foraged during the organism’s life time are selected within its home range, according to habitat requirements and a random element.

A second module calculates exposure concentrations. Internal cadmium concentrations for 1st level species are derived directly from soil concentrations by means of bio-accumulation factors or regression equations. For 2nd and 3rd level organisms, exposure concentrations are first calculated for each model cell that is foraged (equation 1). These cell-specific exposure concentrations are determined by adding up the contaminant concentrations of all diet items present in the cells, weighted according to the fractions of the items in the diet of the receptor. Because many predators consume the whole carcass of a prey, the contaminant load of the prey’s gut and its contents influences the final exposure estimates (Walker et al., 2002). Therefore a prey-specific gut content correction factor (GCC) is incorporated.

\[
P_E = \sum_{i=1}^{n} f_{i,j} \cdot C_{i,j} \cdot GCC_j
\]  

(1)

where \( C_i \) = exposure concentration cell \( i \) (mg kg\(^{-1}\)); \( f_{i,j} \) = fraction of diet item \( j \) in cell \( i \) (dimensionless); \( C_{i,j} \) = internal contaminant concentration in diet item \( j \) in cell \( i \) (mg kg\(^{-1}\)); \( GCC_j \) = gut content correction factor for diet item \( j \) (dimensionless)

Subsequently, exposure estimates are calculated by summing up the exposure concentrations of all cells visited, weighted according to the relative amount of time that the receptor has spent per cell, which is assumed to be proportionally related to the receptor-specific habitat quality HQ, (equation 2). Finally, exposure estimates are compared to toxicity reference values in order to determine whether organisms are at risk (Schipper et al., 2006).

\[
PEC = \frac{\sum_{i=1}^{n} HQ_i \cdot C_i}{\sum_{i=1}^{n} HQ_i}
\]  

(2)

where \( PEC \) = predicted exposure concentration (mg kg\(^{-1}\)); \( HQ \) = habitat quality of model cell \( i \) (dimensionless)

Further developments

Model performance will be tested for the case study area ‘Afferdensche en Deestsche Waarden’ and evaluated through comparison of measured and predicted internal cadmium concentrations for several mammal species. Subsequently, individual-based risk estimates will be translated to population-level effects, as populations are considered more relevant assessment endpoints than individual organisms. Finally, the consequences of climate change and/or floodplain rehabilitation measures for exposure and risk estimates will be investigated. The model developed can thus facilitate river and nature managers in the delineation of high- and low-risk areas, enabling them to optimise cost-effectiveness of soil and sediment sanitation for sustainable flood defence measures and environmental rehabilitation.

References


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