Dynamics in groundwater and surface water quality

Improving load estimates by characterizing the concentration response to rainfall events

M3-workshop, June 16th 2010

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This presentation

- Introduction
- DYNALQUAL experimental setup
- Results: event response patterns
- Improving load estimates
- Conclusions
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Introduction

Thesis title: Dynamics in groundwater and surface water quality
From field-scale processes to catchment-scale monitoring

Part 1: Processes
The groundwater contribution to surface water contamination in a region with intensive agricultural land use (Noord-Brabant, The Netherlands)
Published in Environmental Pollution 2007

Field-scale measurements for separation of catchment discharge into flow route contributions
Published in Vadose Zone Journal 2010

Direct quantification of the tile drain and groundwater flow route contributions to surface water contamination: from field-scale concentration patterns in groundwater to catchment-scale surface water quality.
Submitted to Environmental Pollution

Part 2: Monitoring
Weather-induced temporal variations in nitrate concentrations in shallow groundwater
Published in Journal of Hydrology 2009

Application and evaluation of a new passive sampler for measuring average solute concentrations in a catchment scale water quality monitoring study
Published in Environmental Science & Technology 2010

Improving load estimates for NO3 and P in surface waters by characterizing the concentration response to rainfall events
Conditionally accepted for Environmental Science & Technology

Part 3: Modeling
Using field scale measurements of flow route contributions to improve integrated model representations of dynamic groundwater-surface water interactions
Conditionally accepted for Water Resources Research

Synthesis
Implications for water quality monitoring, solute transport modeling, and water quality management
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Introduction

Total N leaching (kg N/ha)

- 0 - 10
- 10 - 20
- 20 - 50
- > 50

Oenema et al., 2007
General Goal of DYNAQUAL:

To measure, understand and predict variability in groundwater and surface water quality
1 maart 2007
Afvoer: 280 l/s
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Experimental setup
Experimental setup

Outflow location
Outflow location

- Discharge
- P-analyser
- Hydrion-10
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Results: event response patterns

- **Discharge** (m³ s⁻¹)
- **Groundwater** (cm below surface)
- **NO₃** (mg l⁻¹)
- **P** (mg l⁻¹)

**Time scale x-axis:**
1 day
Results: event response patterns

Discharge (L/s)

P-tot (µg/l)

NO₃ (mg/l)
Water quality sampling frequencies are generally not sufficient to capture the dynamic behavior of surface water quality

Kirchner et al. (2004), Hydrological Processes
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Improving load estimates

Event response characteristics

- Concentration change (dN, dP)
- Time to maximum concentration change (TdN/P)
- Recovery shape parameter (aN, aP)

![Diagram showing concentration change and recovery over time](image-url)
Improving load estimates
Improving load estimates

A. Discharge (m$^3$.s$^{-1}$)

B. NO$_3$ (mg.L$^{-1}$)

C. NO$_3$ load (g.s$^{-1}$)

D. Total NO$_3$ load (Kg)
Improving load estimates

- **Measured load**
- **Estimated load with ERR**
- **Estimated load without ERR**
- **Best estimate of total load**

![Graph A](image1)

- **Total NO₃ load (Kg)**:
  - Jul 2007: 0
  - Oct: 0
  - Feb 2008: 0
  - Jun: 0

- **Graph B**

- **Total P load (Kg)**:
  - Jul 2007: 0
  - Oct: 0
  - Feb 2008: 0
  - Jun: 0
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Conclusions

- Continuous water quality measurements provide new opportunities for water quality monitoring, modeling & management

- Quantitative hydrological measurements can be used to upgrade the interpretation of low-frequency water quality measurements
Special thanks to:

Ype van der Velde: co-worker

Our ‘crowd’: for showing interest

Deltres
For more information:

- Google “DYNAQUAL” and find our newsletters
- email me at joachim.rozemeijer@deltares.nl

Any questions?