Modelling of water and nitrate transport on catchment scale
– Outline of an intercomparison study of MIKE SHE and HydroGeoSphere

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Introduction

NICA project
– Nitrate reduction in geologically heterogeneous catchments

• The main aim of NICA is to develop tools to:
  ➢ Delineate sensitive and robust areas in a catchment
  ➢ Estimate smallest scale where models have potential predictive capabilities

⇒ Implementation of differentiated agricultural management

Low nitrate reduction → Sensitive area

High nitrate reduction → robust area
Introduction

An intercomparison study

• Numerical models: MIKE SHE and HydroGeoSphere
• Modelling task: Water and nitrate transport on catchment scale
• Focus: Drain flow and flow around redox-interface
• Data for calibration: Stream discharge
  Hydraulisk head
  Drain discharge
  Nitrate transport
Lillebæk catchment

• A clayey catchment
• Intensively monitored since 1989 (LOOP-program)
• Area: 4.7 km²
• Precipitation: 839 mm/år (1990-2004)
• Land use: Intensive agriculture (88%)
  Nature (5%)
  Built-up areas (5%)
  Forest (2%)
Study area

Geology
**Method**

**MIKE SHE model**

- Model area: 14.7 km²
- Cell size: 50 m x 50 m
- Flow components: Overland flow 2D, Stream flow 1D, Saturated flow 3D
- Unsaturated zone simulated with DAISY
Discussion

Problems in the current model framework

- Lack of coupling between Daisy and MIKE SHE (under development)
- Mass conserving problems in MIKE11
- Vertical discretization => Drying of cells
Discussion

Mass conserving problems in MIKE11

- Transport in MIKE11 is described by the advection-dispersion equation (1D)
- No degradation in stream system is currently included
- The solution is not mass conserving!

Comparison of accumulated mass transported from MIKE SHE to MIKE11 and the mass found at end of stream network in MIKE11
Drying of cells

- Problems with drying cells due to fine discretization of near surface layers
- Handling of dry cells in MIKE SHE - No complete dry out of cells => artificial hydraulic head

![Graph showing elevation of groundwater table in cell (38,56)]
Discussion

Drying of cells

Hydraulic head in cell (38,56)

[Elevation in meters]

[Recharge in mm/month]

[Graphs showing data over time from January 1990 to January 2005]
Can I solve these problems in HydroGeoSphere?