Modeling of soil water and solute transport on the lysimeter scale

Ulrike Jansen¹, Wolfgang Durner¹, Johann Fank²
¹Technische Universität Braunschweig, Germany
²Joanneum Research, Graz

Objective

- Modeling the Wagna Lysimeters' soil water dynamics
- Modeling a tracer breakthrough
The Wagna Lysimeters

have a real-time controlled suction at the lower boundary
The Wagna Lysimeters

are weighed with very high accuracy and high time resolution

Foto: LW Bayern, 2003

The Wagna Lysimeters

can be ploughed and treated near the surface as the whole field

Foto: Faedy, 2005
The Wagna Lysimeters

show no “island effects”

Foto: Fank, 2005

The Wagna Lysimeters

... are sometimes hard to find.

Foto: Fank, 2005
Outline

- The Wagna Lysimeter
- Observations
- Modeling of the Wagna Lysimeters’ soil water dynamics
- Modeling of a tracer leaching from the lysimeters
lysimeter water contents @ 0-20 cm

Cumulative lysimeter outflow
In situ retention curves
Outline

- The Wagna Lysimeter
- Observations
- Modeling of the Wagna Lysimeters’ soil water dynamics
  - Inverse modeling: Calibration
  - Forward Modeling: Validation
- Modeling of a tracer leaching from the lysimeters
Calibration period: observed and fitted outflow

RMSE = 0.039 cm
Calibration period: observed and fitted pressure heads

Example 3: real lysimeter

Lesson 3

- Fitting the real Wagna data during a calibration period was reasonably successful
- Water content data could not be matched
- The identified hydraulic properties have a shape which cannot be described by simple models
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Forward modeling: cumulative lysimeter outflow

![Graph showing cumulative lysimeter outflow over time, with RMSE = 1.07 cm](image)
Lesson 4

- Predicting the seasonal water regime was not really successful
- Reasons are
  - root water uptake
  - freezing and thawing
  - temporal changes in hydraulic properties

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- Modeling a tracer breakthrough
Prediction: Complete failure

Two-Region model
- soil consists of domains of different mobility
- domains are in rate-limited exchange

Simulated and measured Bromide leaching
Lesson 5

- A proper description of water transport is a necessary condition for modeling solute transport ...
  ... but not a sufficient one.
Challenges

- Improvement of sensor technology
- Adequate treatment of hysteresis
- Root water functioning
- Fusion with geophysical methods
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Thank You!