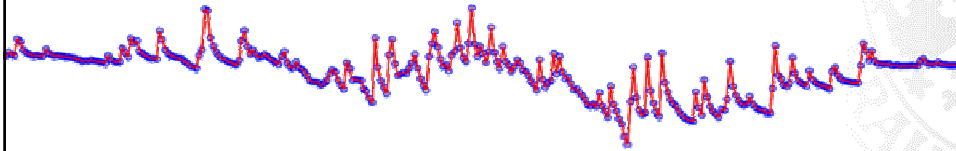


Modeling of soil water and solute transport on the lysimeter scale



Ulrike Jansen¹, Wolfgang Durner¹, Johann Fank²

¹Technische Universität Braunschweig, Germany

²Joanneum Research, Graz

Diffuse Einträge in das Grundwasser: Monitoring – Modellierung – Management | Graz, 29.-31. Januar 2007

Objective

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

Diffuse Einträge in das Grundwasser: Monitoring – Modellierung – Management | Graz, 29.-31. Januar 2007

Outline

- The Wagna Lysimeter
- Observations
- Modeling of the Wagna Lysimeters' soil water dynamics
- Modeling of a tracer leaching from the lysimeters

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: LfL Bayern, 2003

Diffuse Einträge in das Grundwasser: Monitoring – Modellierung – Management | Graz, 29.-31. Januar 2007

The Wagna Lysimeters



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



Foto: Fank, 2005

Diffuse Einträge in das Grundwasser: Monitoring – Modellierung – Management | Graz, 29.-31. Januar 2007

The Wagna Lysimeters



show no "island effects"



Diffuse Einträge in das Grundwasser: Monitoring – Modellierung – Management | Graz, 29.-31. Januar 2007

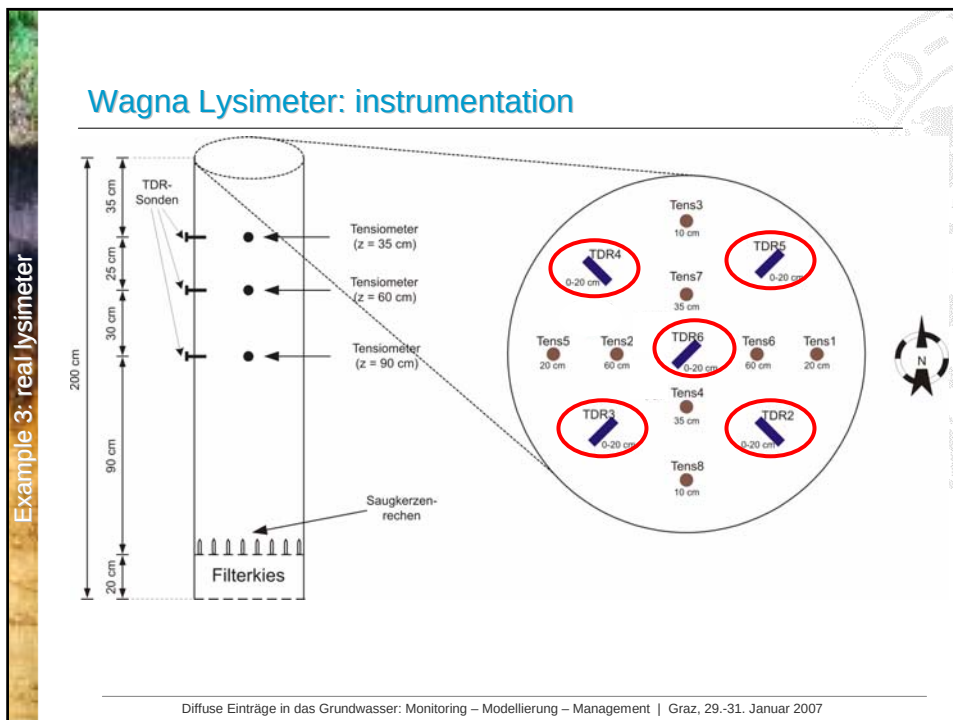
The Wagna Lysimeters



... are
sometimes hard
to find



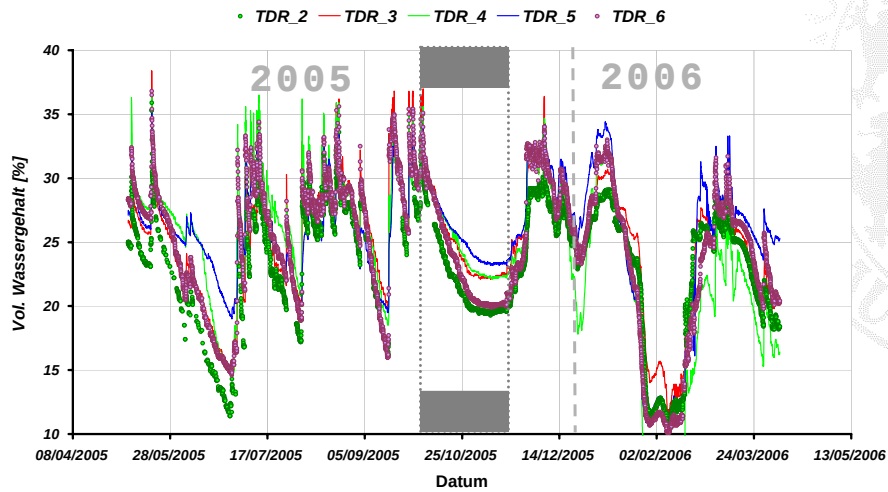
Diffuse Einträge in das Grundwasser: Monitoring – Modellierung – Management | Graz, 29.-31. Januar 2007



Outline

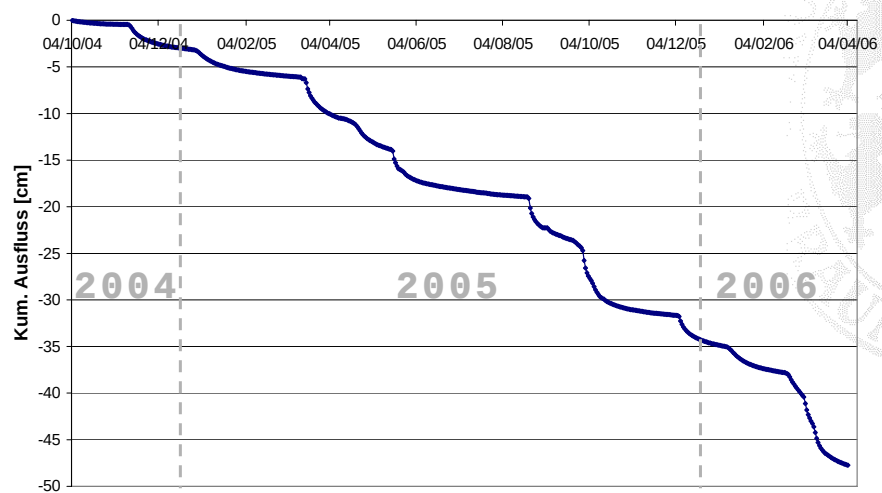
- The Wagna Lysimeter
- Observations
- Modeling of the Wagna Lysimeters' soil water dynamics
- Modeling of a tracer leaching from the lysimeters

lysimeter water contents @ 0-20 cm

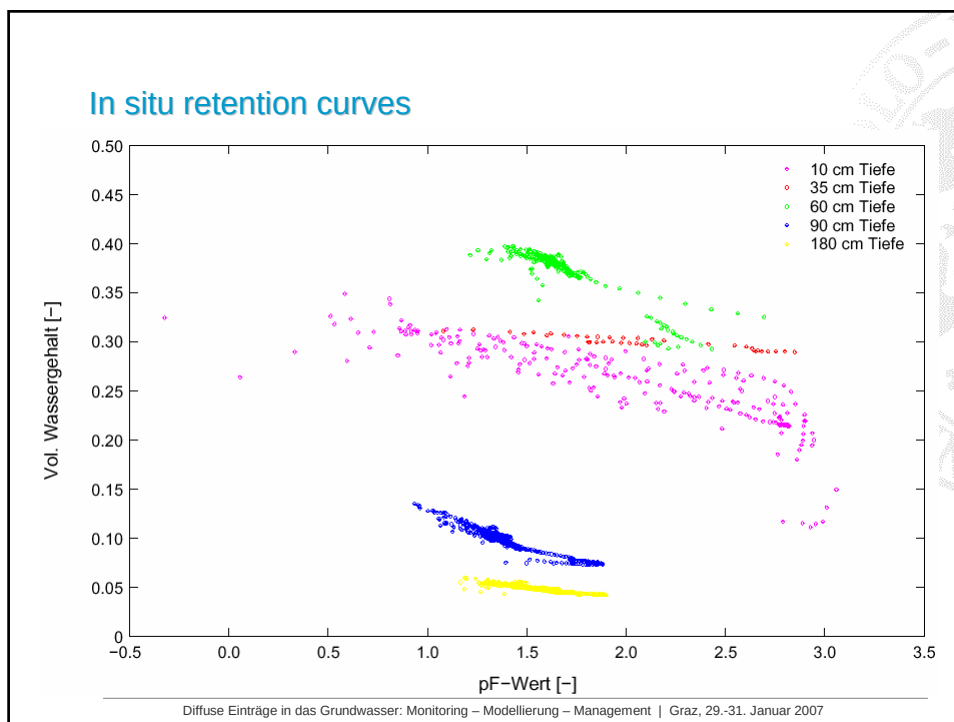
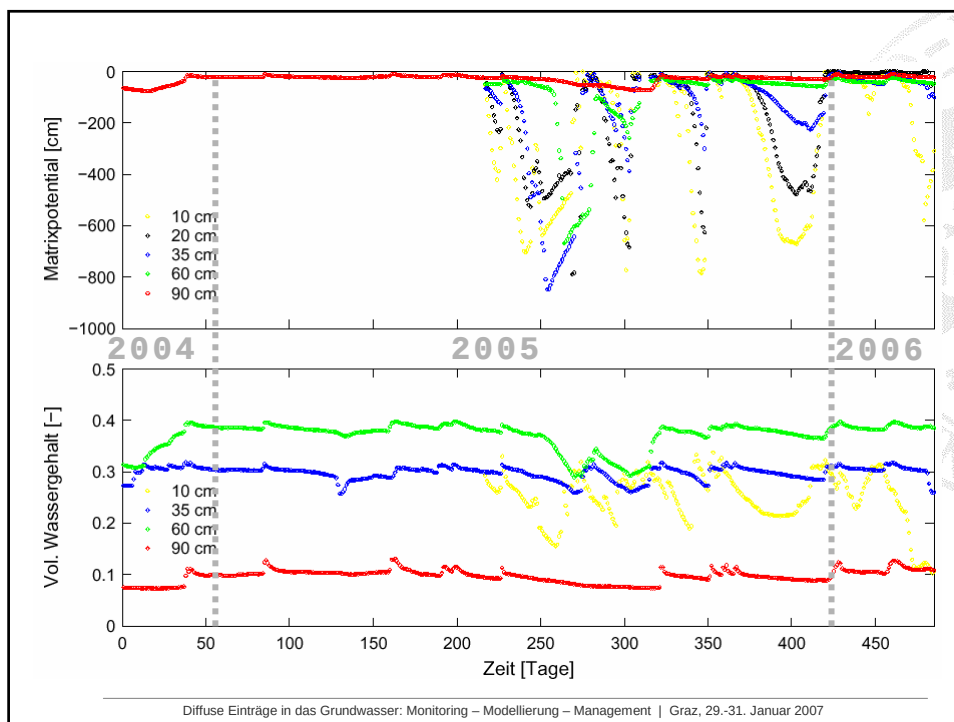


Diffuse Einträge in das Grundwasser: Monitoring – Modellierung – Management | Graz, 29.-31. Januar 2007

Cumulative lysimeter outflow



Diffuse Einträge in das Grundwasser: Monitoring – Modellierung – Management | Graz, 29.-31. Januar 2007

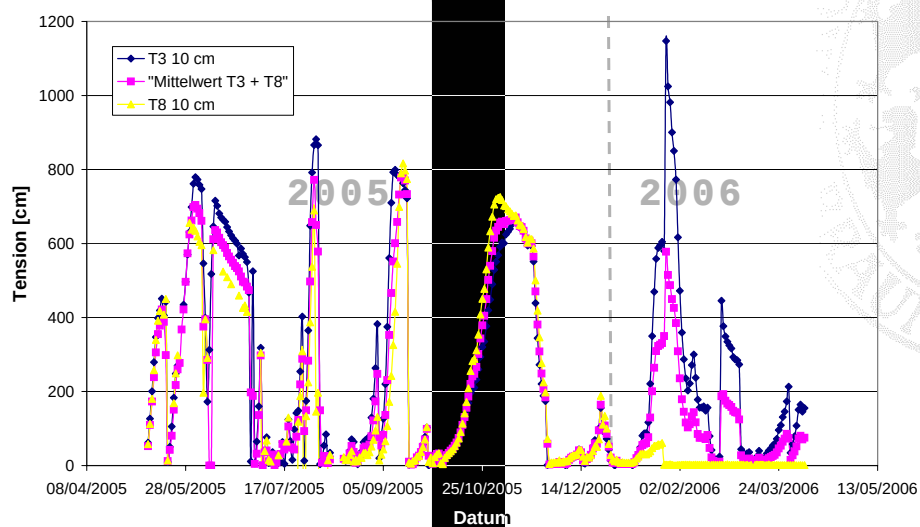


Outline

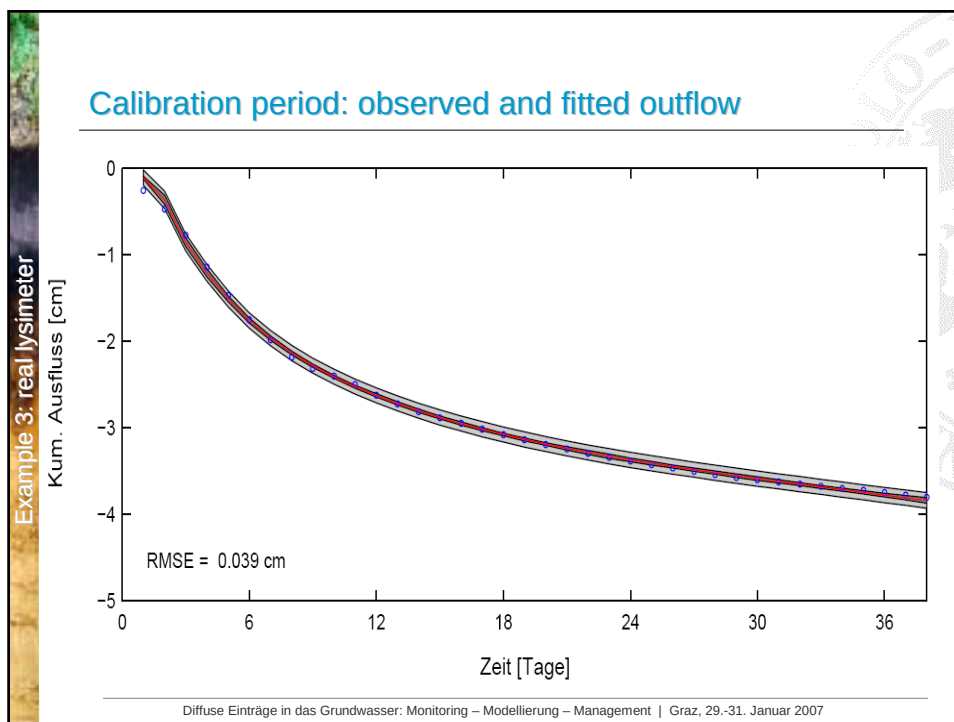
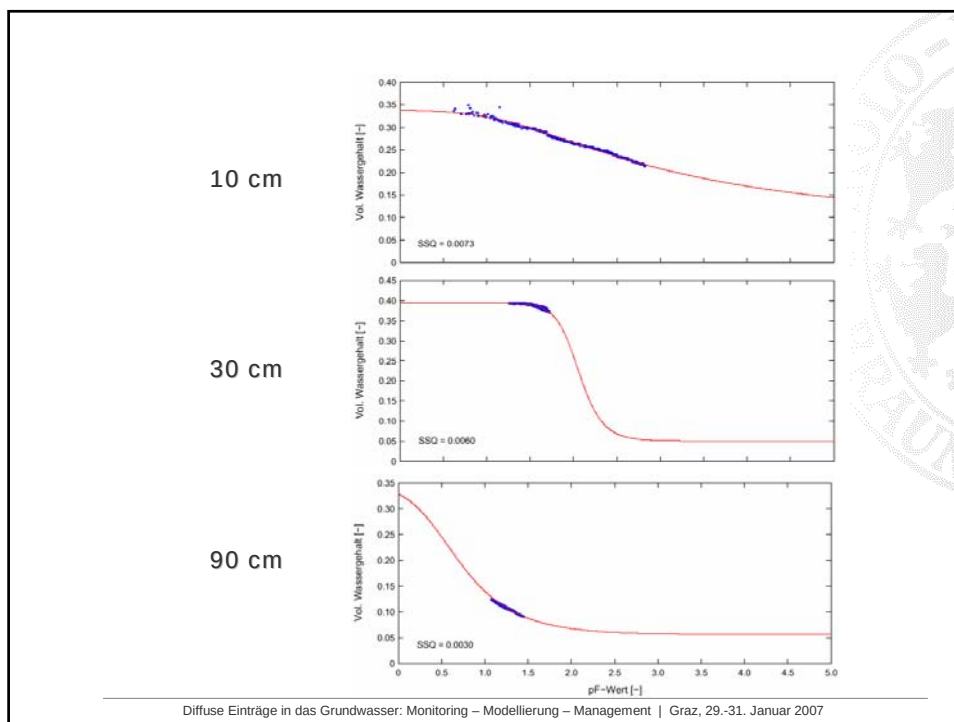
- The Wagna Lysimeter
- Observations
- Modeling of the Wagna Lysimeters' soil water dynamics
 - Inverse modeling: Calibration
 - Forward Modeling: Validation
- Modeling of a tracer leaching from the lysimeters

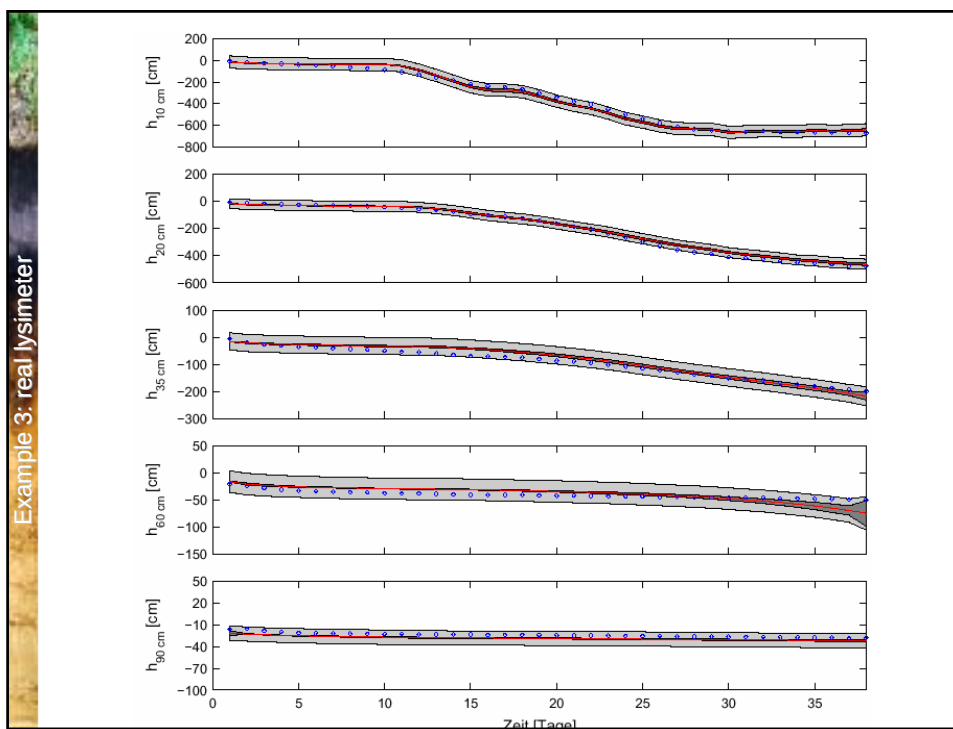
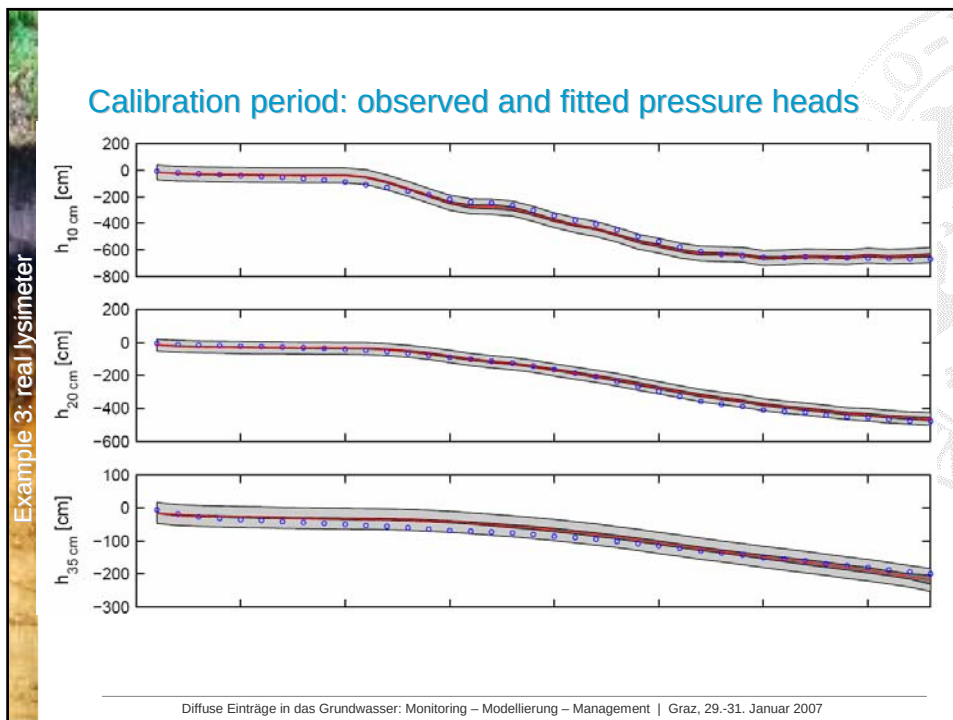
Diffuse Einträge in das Grundwasser: Monitoring – Modellierung – Management | Graz, 29.-31. Januar 2007

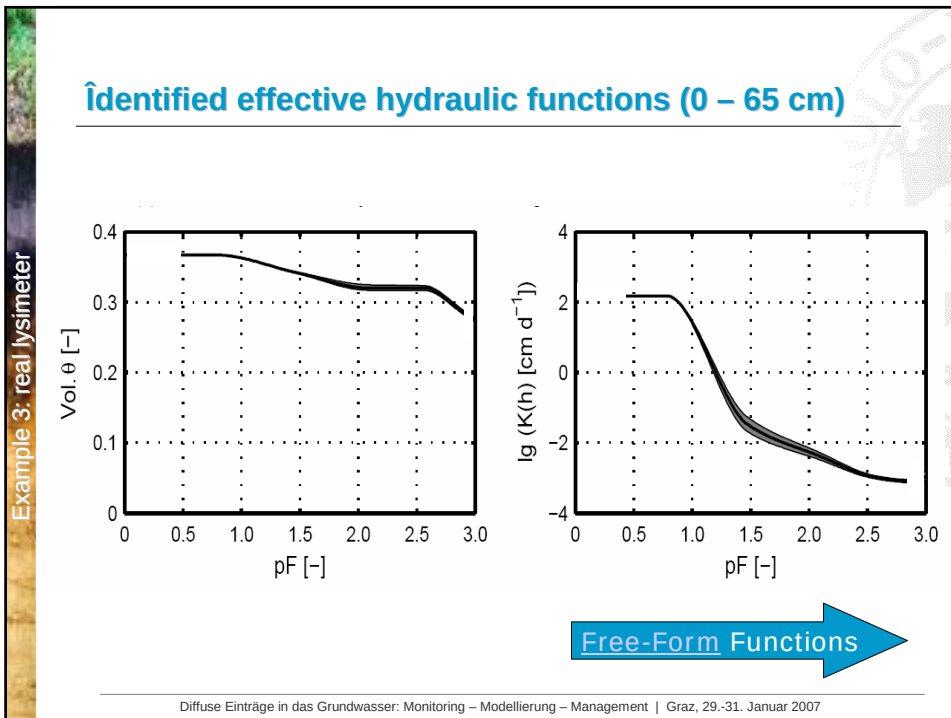
pressure heads @ 10 cm



Diffuse Einträge in das Grundwasser: Monitoring – Modellierung – Management | Graz, 29.-31. Januar 2007







Lesson 3

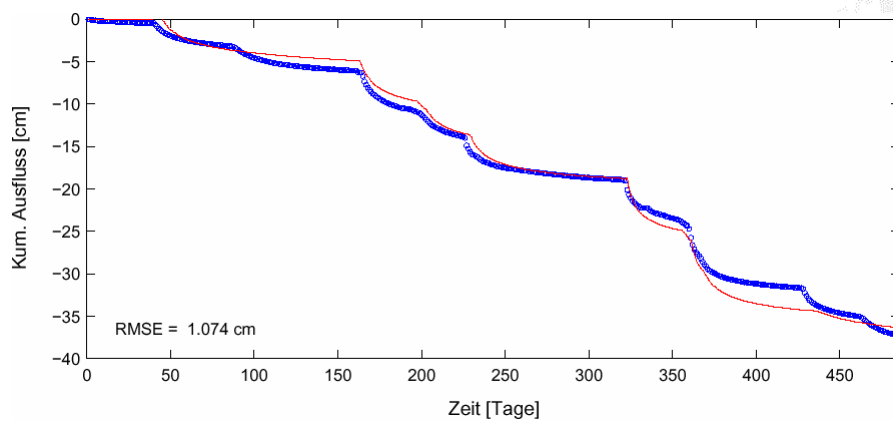
- Fitting the real Wagna data during a calibration period was reasonably successful
- Water content data could not be matched
- The identified hydraulic properties have a shape which cannot be described by simple models

Outline

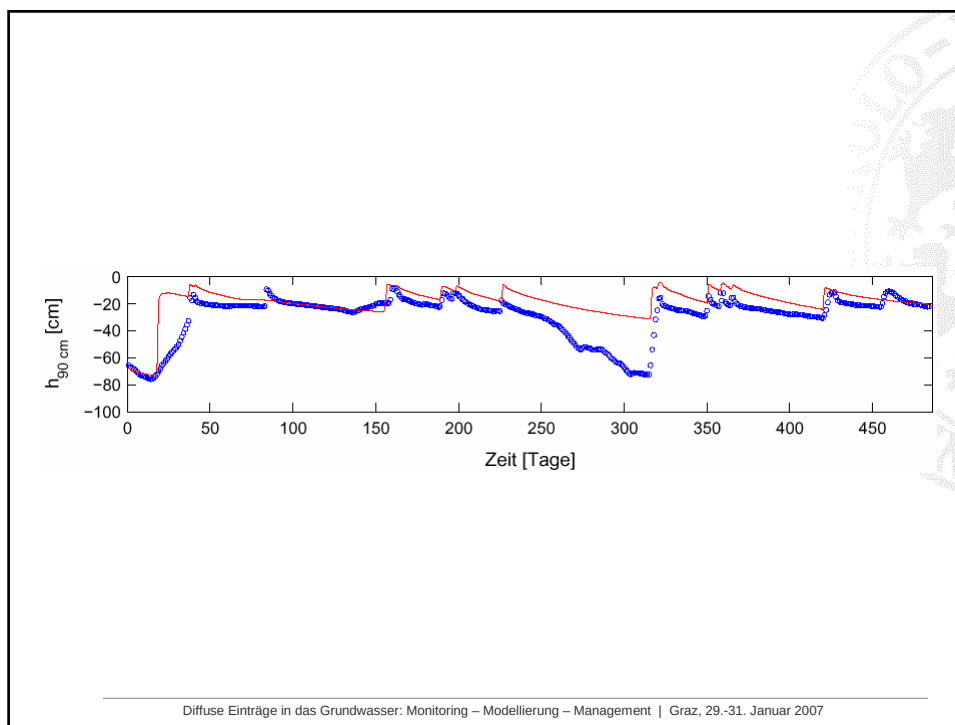
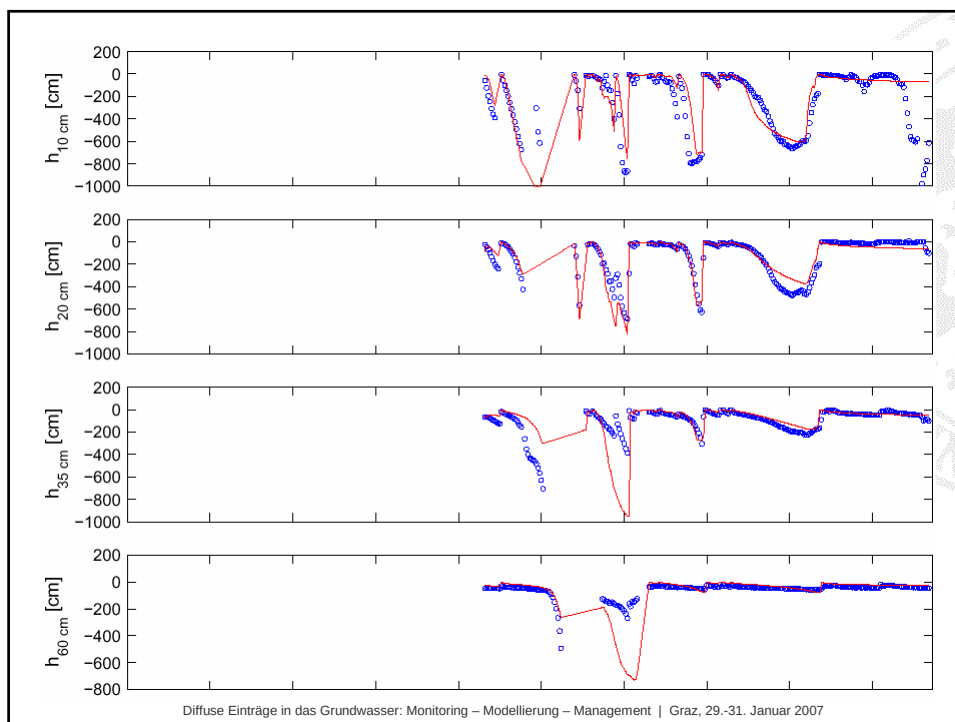
- The Wagna Lysimeter
- Observations
- Modeling of the Wagna Lysimeters' soil water dynamics
 - Inverse modeling: Calibration
 - Forward Modeling: Validation
- Modeling of a tracer leaching from the lysimeters

Diffuse Einträge in das Grundwasser: Monitoring – Modellierung – Management | Graz, 29.-31. Januar 2007

Forward modeling: cumulative lysimeter outflow



Diffuse Einträge in das Grundwasser: Monitoring – Modellierung – Management | Graz, 29.-31. Januar 2007



Lesson 4

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

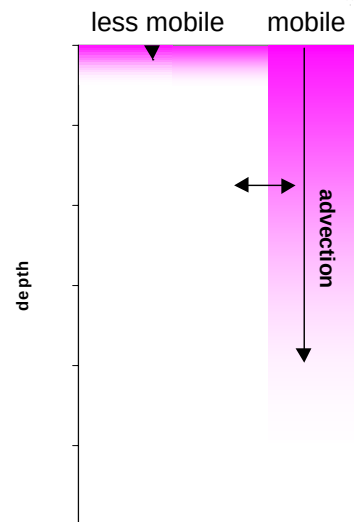
Outline

- The Wagna Lysimeter
- Observations
- Modeling of the Wagna Lysimeters' soil water dynamics
 - Inverse modeling: Calibration
 - Forward Modeling: Validation
- Modeling a tracer breakthrough

Prediction: Complete failure

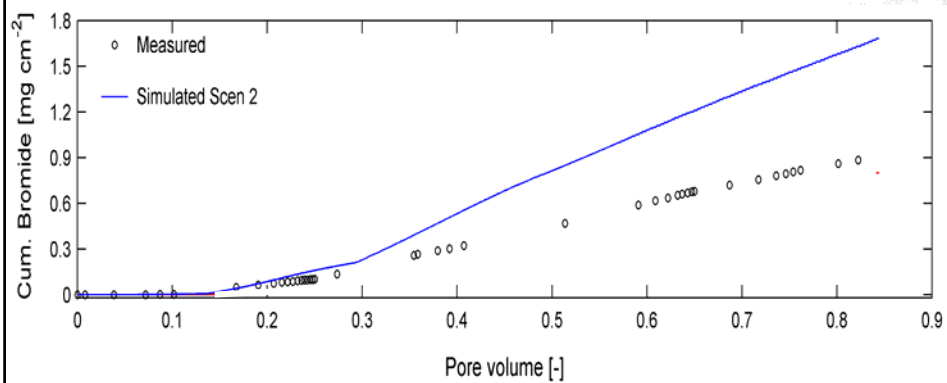
Two-Region model

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



Diffuse Einträge in das Grundwasser: Monitoring – Modellierung – Management | Graz, 29.-31. Januar 2007

Simulated and measured Bromide leaching



Diffuse Einträge in das Grundwasser: Monitoring – Modellierung – Management | Graz, 29.-31. Januar 2007

Lesson 5

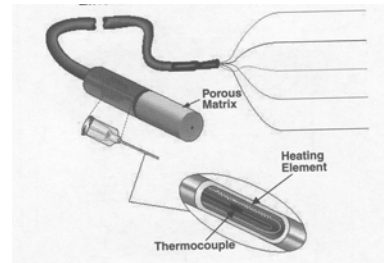
- A proper description of water transport is a **necessary condition** for modeling solute transport ...
... but **not a sufficient** one.

Conclusions



Challenges

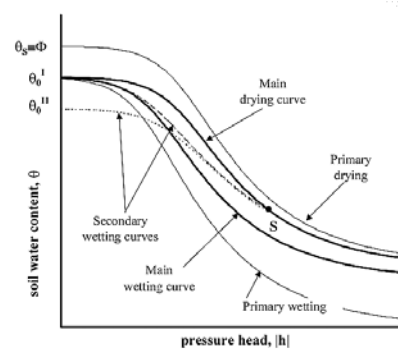
- ❖ Improvement of sensor technology
- ❖ Adequate treatment of hysteresis
- ❖ Root water functioning
- ❖ Fusion with geophysical methods



Diffuse Einträge in das Grundwasser: Monitoring – Modellierung – Management | Graz, 29.-31. Januar 2007

Challenges

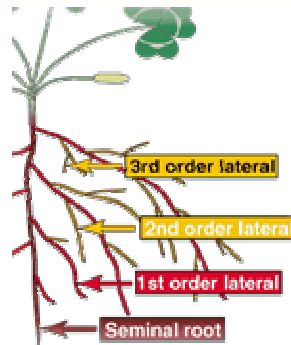
- ❖ Improvement of sensor technology
- ❖ Adequate treatment of hysteresis
- ❖ Root water functioning
- ❖ Fusion with geophysical methods



Diffuse Einträge in das Grundwasser: Monitoring – Modellierung – Management | Graz, 29.-31. Januar 2007

Challenges

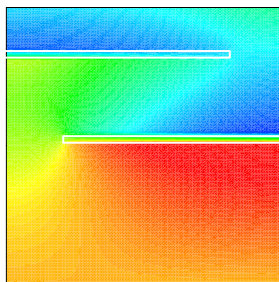
- ❖ Improvement of sensor technology
- ❖ Adequate treatment of hysteresis
- ❖ **Root water functioning**
- ❖ Fusion with geophysical methods



Diffuse Einträge in das Grundwasser: Monitoring – Modellierung – Management | Graz, 29.-31. Januar 2007

Challenges

- ❖ Improvement of sensor technology
- ❖ Adequate treatment of hysteresis
- ❖ Root water functioning
- ❖ **Fusion with geophysical methods**



Diffuse Einträge in das Grundwasser: Monitoring – Modellierung – Management | Graz, 29.-31. Januar 2007

Thank You !