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Model approaches for Soil hydraulics and nitrogen balances on the Lysimeter scale with “CoupModel”

Ansätze zur Modellierung der Wasserhaushaltskomponenten und der Stickstoffbilanz in Lysimetern mit dem Modellpaket „CoupModel“

JOANNEUM RESEARCH

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1. Introduction
2. Model concept
3. Model use
4. Results
5. Conclusion

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1. Introduction

- CoupModel is a software for analysing the soil-plant-atmosphere system
- Coupling of the older models SOIL and SOIL-N
- Aim of this work was to test the applicability of the model on the lysimeter scale

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2. Model concept

General information

- One-dimensional transient-flow model for unsaturated zone
- CoupModel includes:
  - soil hydraulics
  - plant growth and development
  - Nitrogen and Carbon balances
  - sorption, transformation and reduction of material
- Detailed model input (e.g. climatic data, plant attributes)
- Simulation of nearly every ecosystem possible

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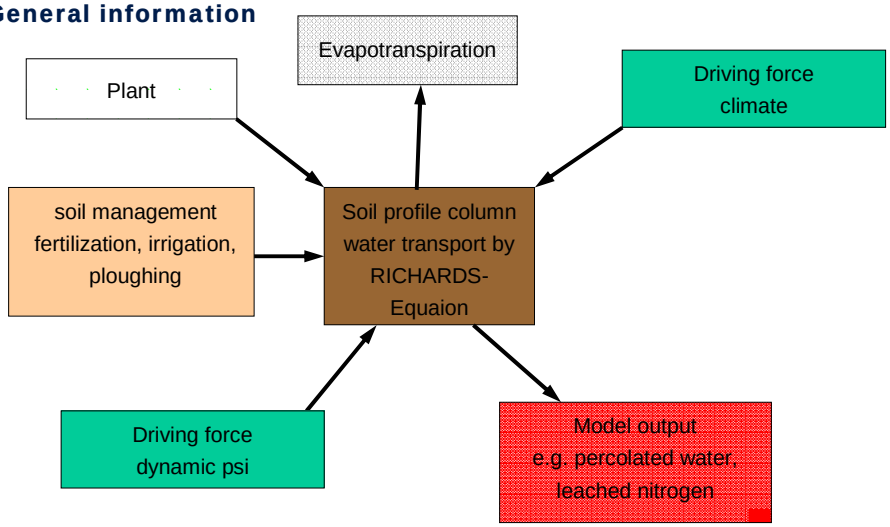
2. Model concept

General information



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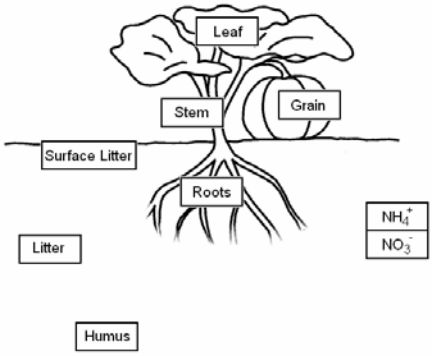
2. Model concept

Nitrogen Transport

- Nitrogen balances are simulated by biotic processes
- Nitrogen amounts represented by different pools
- Plant e.g. roots, stem, leafes
- Soil e.g. litter, humus, feaces



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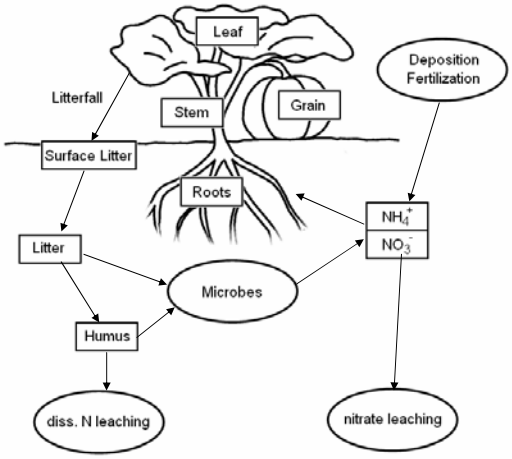
2. Model concept

Nitrogen Transport

- Soil e.g.
  - Litter
  - Humus
  - Faeces
  - NO_3^-
  - NH_4^+
- Different Ways of N-Input:
  - Atm. deposition
  - Manure (org.& min.)
  - Mycorrhiza



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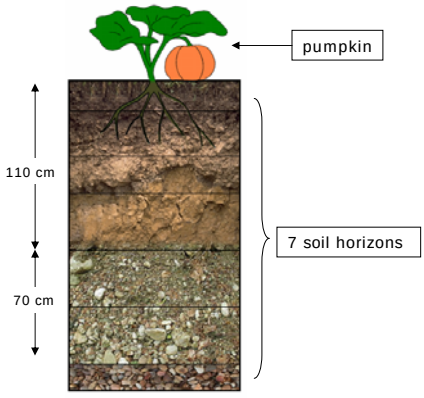
3. Model use

Object of investigation

- Biological farmed lysimeter in Wagna
- Weighable field lysimeter
- Undisturbed profile of local soil
- Profile divided in 7 horizons
- Vegetation: oil pumpkin *(Cucurbita peto)*, two plants



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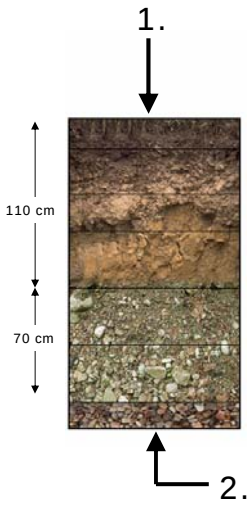
3. Model use

Driving forces

1. Climatic data in ten-minute-interval
   - Precipitation
   - Air temperature
   - Relative humidity
   - Wind speed
   - Net radiation

2. Dynamic psi:
   Applied pressure at suction-cups in daily mean values



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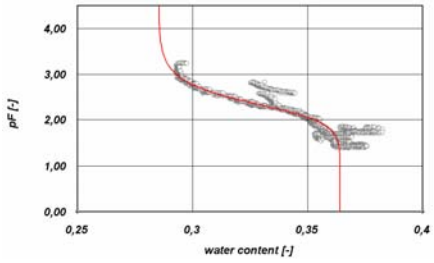
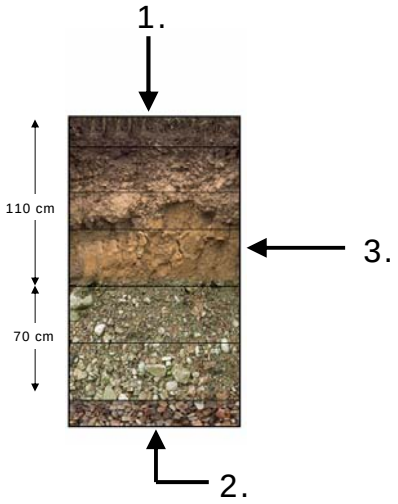
3. Model use

Spatial scale

3. Soil data
   - Horizon thickness
   - Water retention curves,
   - Water tension & -content
   - Soil temperature





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3. Model use

Time scale

- Simulation time from April to September 2005

Initial conditions

- Water contents and soil temperatures for each Profile
- Nitrate and Ammonium concentrations

Verification parameter

- Hydraulic attributes of soil horizons
- Process of plant development

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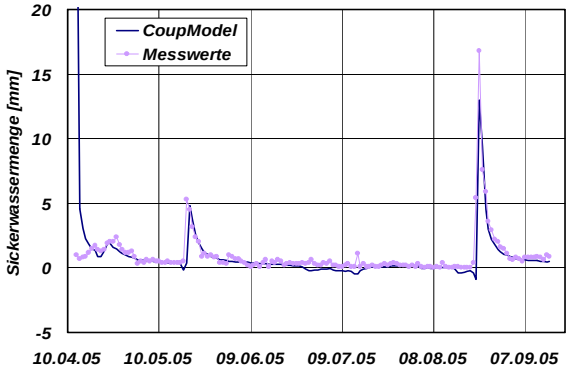
4. Results

4. Results – soil hydraulics



- Good temporal agreement of simulated and observed seepage hydrograph

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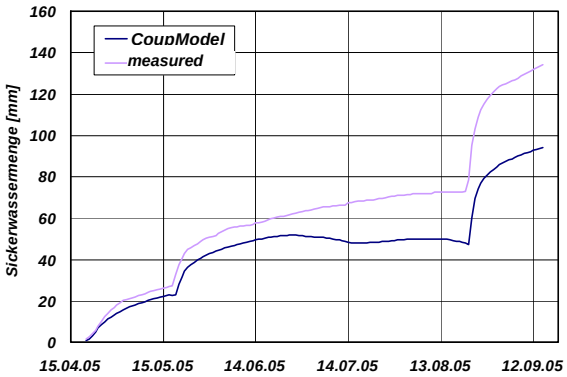
4. Results

4. Results – soil hydraulics



- Cumulated hydrograph shows discrepancies in seepage quantity

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4. Results

4. Results – soil hydraulics

- Discrepancies in hydraulic model because of
  - Incorrect plant development:
    - calculated evapotranspiration is too low
  - Inexact soil attributes
    - Unrealistic unsaturated conductivity
    - Undervaluation of soil storage capacity

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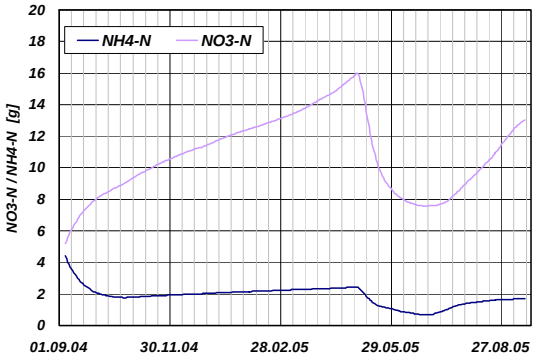
4. Results – nitrogen transport



- No data for verifying soil nitrate/ammonium concentrations available

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5. Conclusion

- CoupModel allows to create realistic simulations of water- and massbalances on the microscale (~1m²)
- the complexity of the Model requires very detailled information of soil physics and plant development
- driving forces may be measured climatic data series or generated statistical values
- if detailled data series are available, CoupModel is suitable for Models on the Lysimeter scale
- use as virtual lysimeter possible

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Thank you for your attention

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