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Hydrogeologie und Geophysik

Modeling of nitrate leaching from the unsaturated zone at the research site Wagna

Hans Kupfersberger

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Motivation and goals

- **Physically based modeling of nitrate leaching from the unsaturated zone considering soil heterogeneity and authentic crop growing patterns over a 17 year period (meteorological conditions)**
- **Identification and understanding of the most important factors**
- **Simulation of scenarios to assess crop growing patterns and define sustainable variants**
- **Computing of recharge and non-point pollution time series as input data for regional 2d saturated groundwater and transport flow model**

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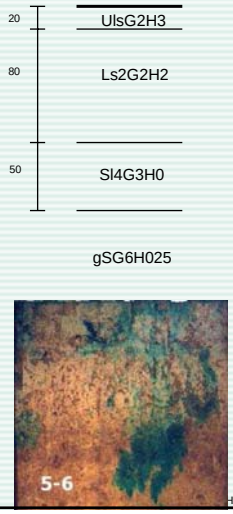
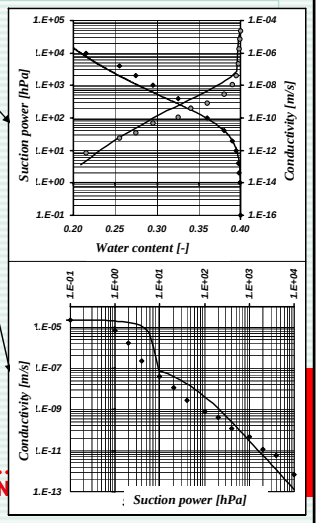
Soil type database



gravel	sand	silt	clay
8	28	53	11
9	31	41	19
9	55	23	14
73	25	1	1



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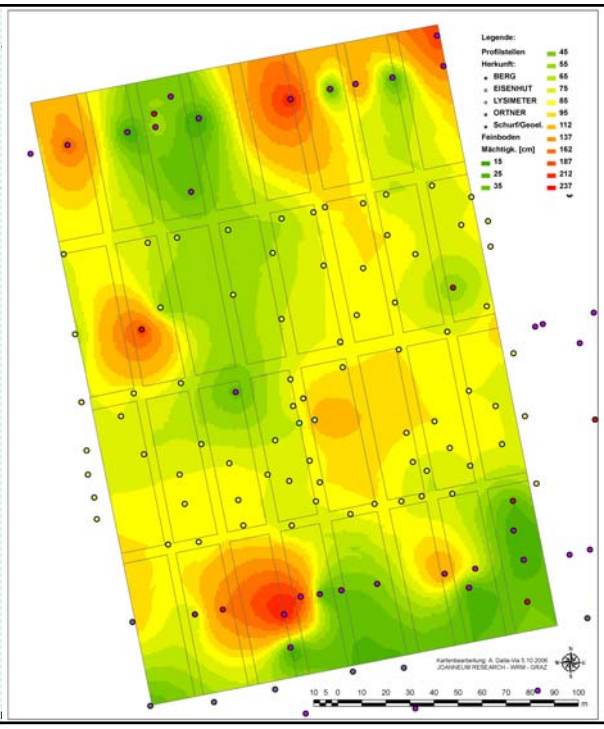

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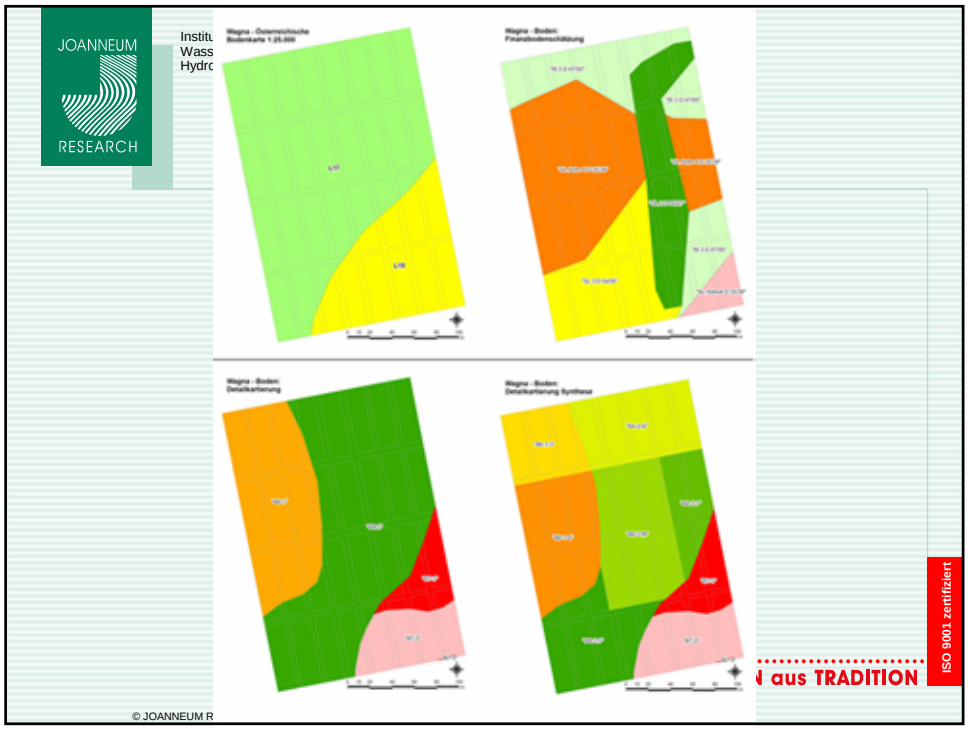

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Crop growing patterns

- **32 lots with 8 different crop growing patterns; comparison between corn monoculture and crop rotation patterns (including wheat, rape, barley and pumpkin)**
- **Usage of mineral fertilizer and pig liquid manure**
- **Fertilization scheme:**
  - ➔ Until 1992 usage of about 200 kgN/ha
  - ➔ Between 1993 and 1997 about 150 kgN/ha
  - ➔ From 1998 between 107 and 145 kgN/ha
    - No liquid pig manure in autumn
    - Interim green seeds
    - Ploughing only in springtime

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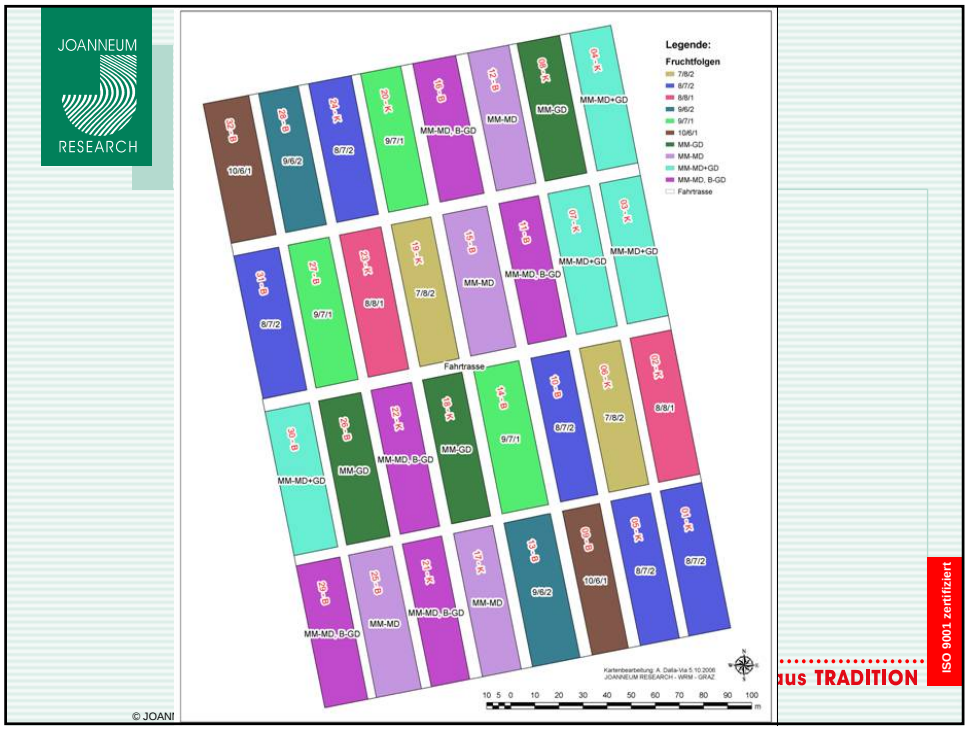
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Legende:
Fruchtfolgen
7/8/2
8/7/2
8/8/1
9/6/2
9/7/1
10/6/1
MM-GD
MM-MD
MM-MD+GD
MM-MD, B-GD
Fahrtrasse
MM-MD+GD
MM-MD, B-GD
MM-MD
MM-GD
Fahrtrasse
MM-MD+GD
MM-GD
MM-MD, B-GD
MM-GD
MM-MD, B-GD
MM-MD
MM-MD, B-GD
MM-MD
MM-MD, B-GD
10 5 0 10 20 30 40 50 60 70 80 90 100 m
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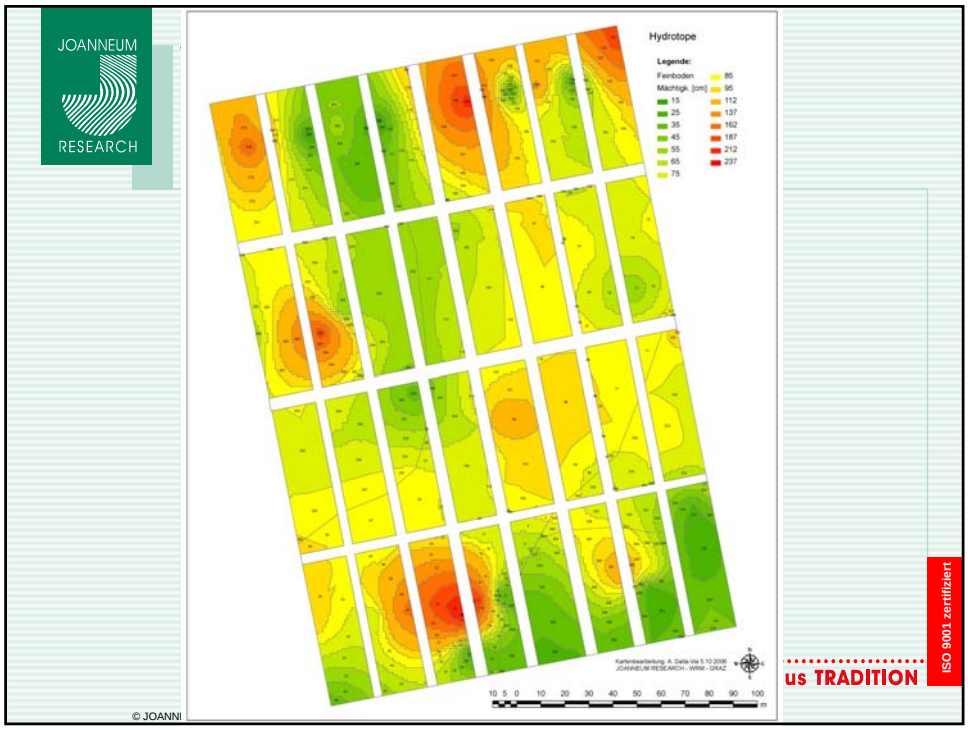
JOANNEUM
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Hydrotope
Legende:
Feinboden
Mächtigk. [cm]
15
25
35
45
55
65
75
85
95
112
137
162
187
212
237
10 5 0 10 20 30 40 50 60 70 80 90 100 m
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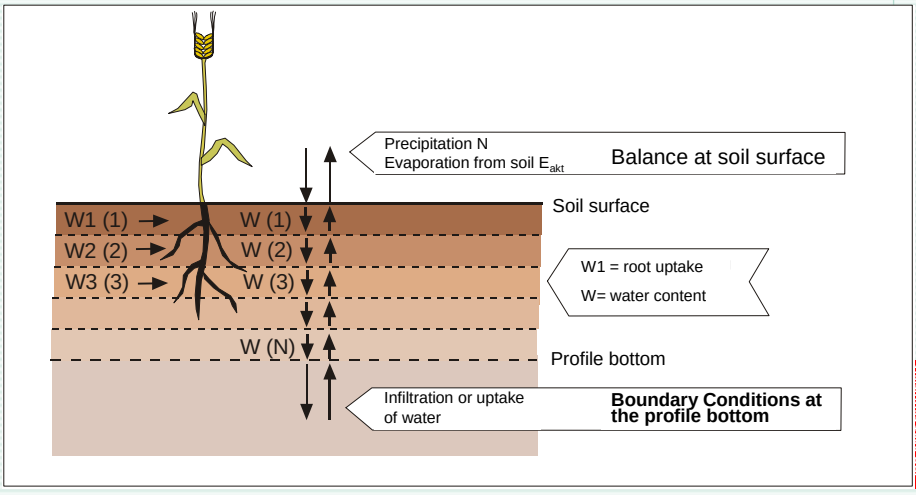
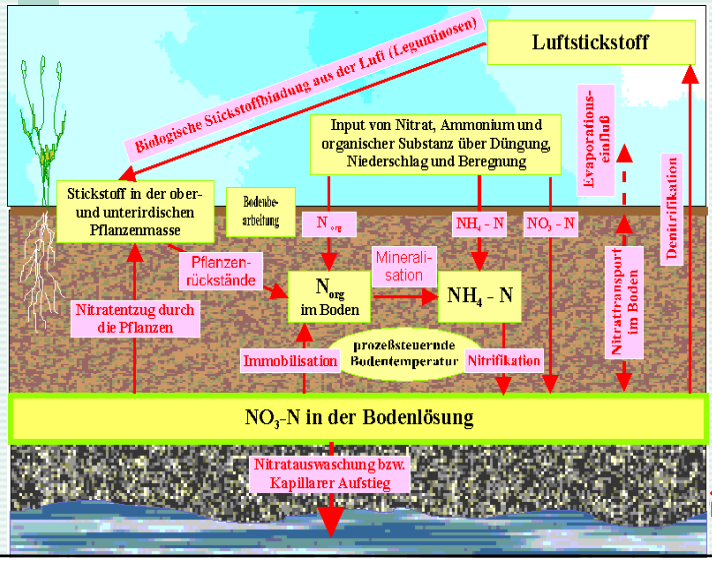
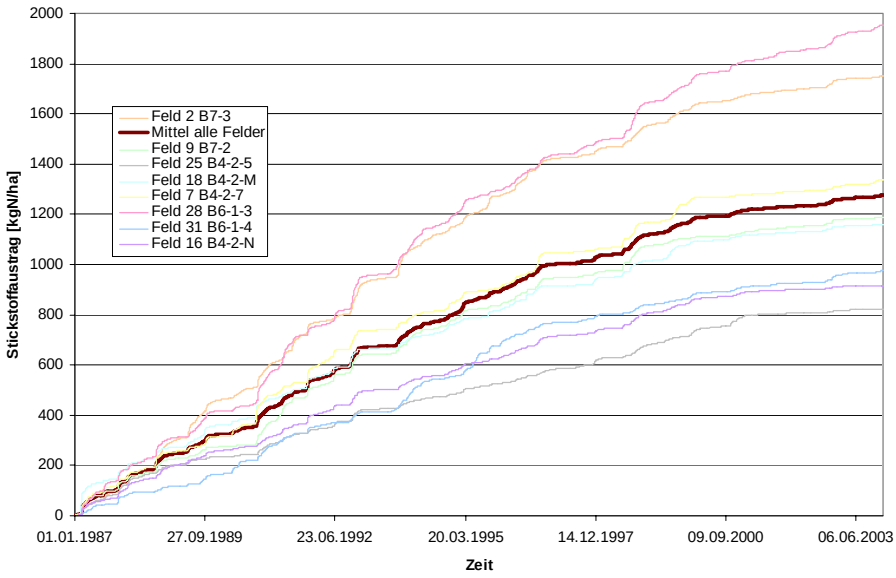
Concept of model SIMWASER
(Stenitzer, 1988)



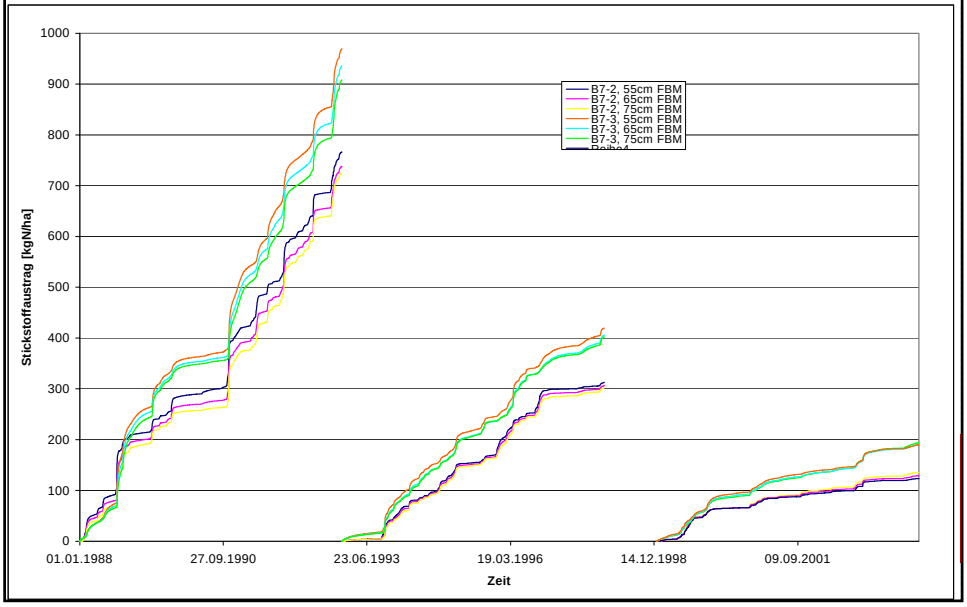
STOTRASIM principle
(Feichtinger, 1998)



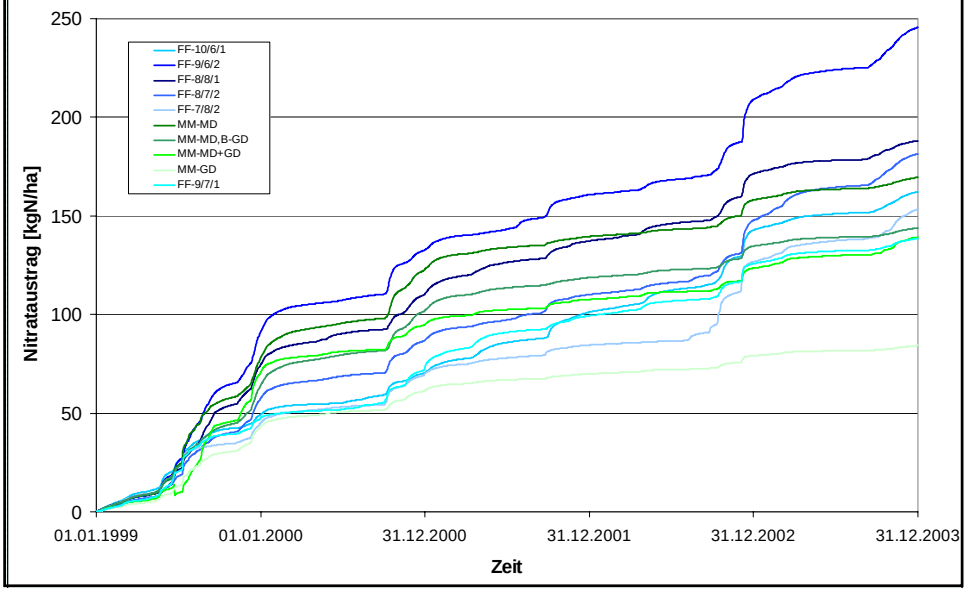
Nitrate leachate of fields representative for a given soil and crop growing



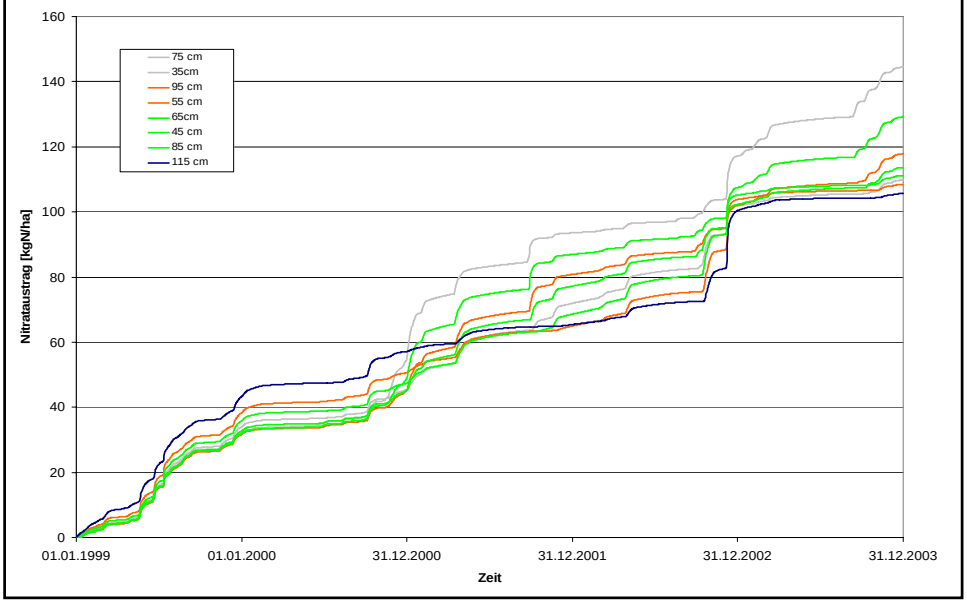
Nitrate leachate at field 5 with thickness of A-horizon between 55 and 75 cm for the fertilizing periods



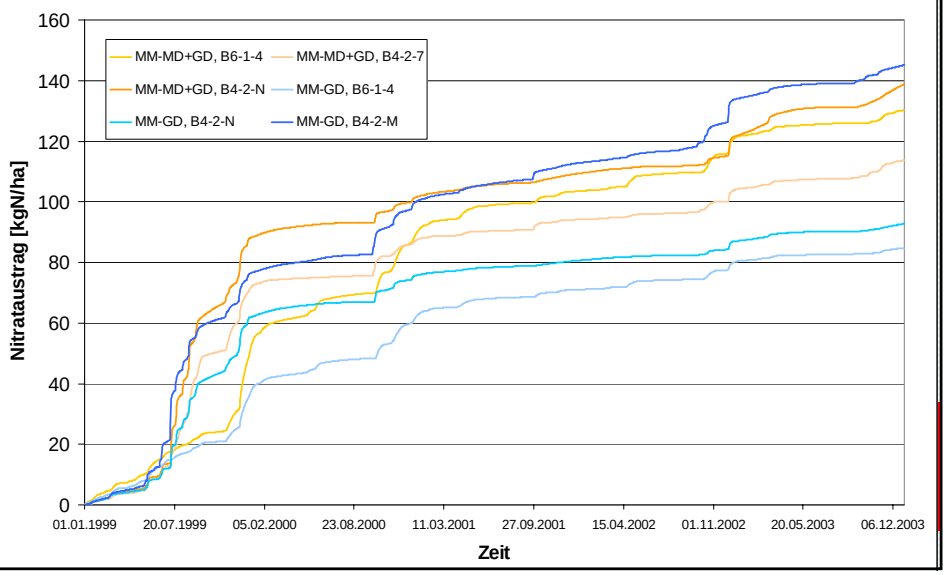
Cumulative, area weighted nitrate leachate of all fields with the same crop growing



Influence of top soil thickness - nitrate leachate for a given soil and crop rotation pattern



Influence of top soil (75 cm thickness)-nitrate leachate for a given fertilizer and crop rotation pattern



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Conclusions I

- ➔ **Strong variation of top soil thickness and soil type within small area**
- ➔ **Typically, far less information on soil is available**
- ➔ **Strong variation of cumulative nitrate leaching between single lots**
- ➔ **Pig liquid manure with less nitrate leachate than mineral fertilizer**
- ➔ **Corn monoculture with less nitrate leachate than crop rotation pattern**
- ➔ **Thickness of top soil of minor importance**
- ➔ **Amount of fertilizer still most important factor**

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Conclusions II

- Lysimeter important tool for site specific calibration of numerical models that allow for simulation and assessment of agricultural land use
- Sustainable groundwater leachate can be reached
- Resulting groundwater nitrate concentration predominantly depends on subsurface inflow concentration
- Water limiting component for crop yields rather than nutrients