Erarbeitung grundwasserverträglicher ackerbaulicher Bewirtschaftungsformen auf Basis von Langzeit-Modellierungen



Determination of Groundwater-Protective Agricultural Management Systems Based on Long-term Modelling

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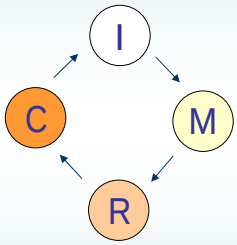
Outline

Introduction,
Background & Goals



Methods &
Modelling

Results of
Modelling

Conclusions &
Summary

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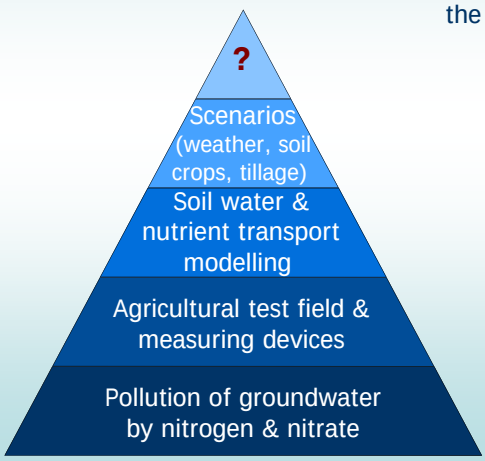
I Background & Goals of Research

Yield, nitrogen/nitrate leaching losses →
is cultivation sustainable &
groundwater-protective?

< 50 mg/l nitrate in
seepage water of
the unsaturated zone



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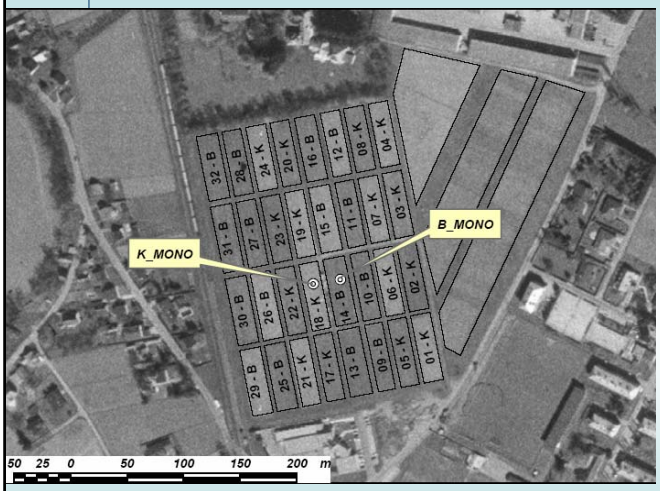
I The Wagna Research Field



Lots of the Wagna test field, B = organic farming,
K = conventional farming; location of two weighable
monolithic field lysimeters

Agricultural test site
since 1987

32 lots with ca.
1000 m² each

8 crop rotations

Since 1992: lysimeters,
new lysimeters in 2004
and 2006

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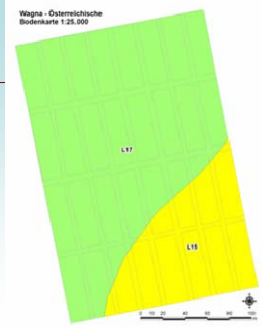
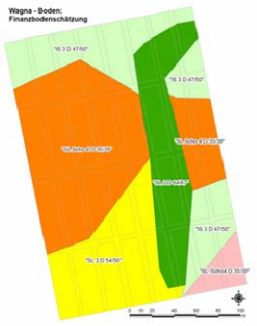
Wagna - Soil Types

Austrian Soil Map 1:25 000

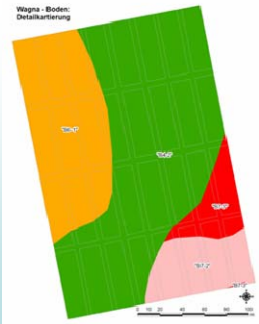


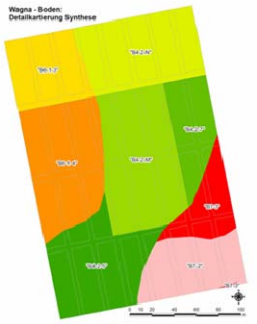


Soil types estimated by financial authorities

40 %: lS/Scho 4 D 35/39
20 %: lS 3 D 47/50
20 %: SL 2 D 64/67
20 %: SL 3 D 54/56

Detailed mapping





Combined soil map (3 maps + additional soil profiles)

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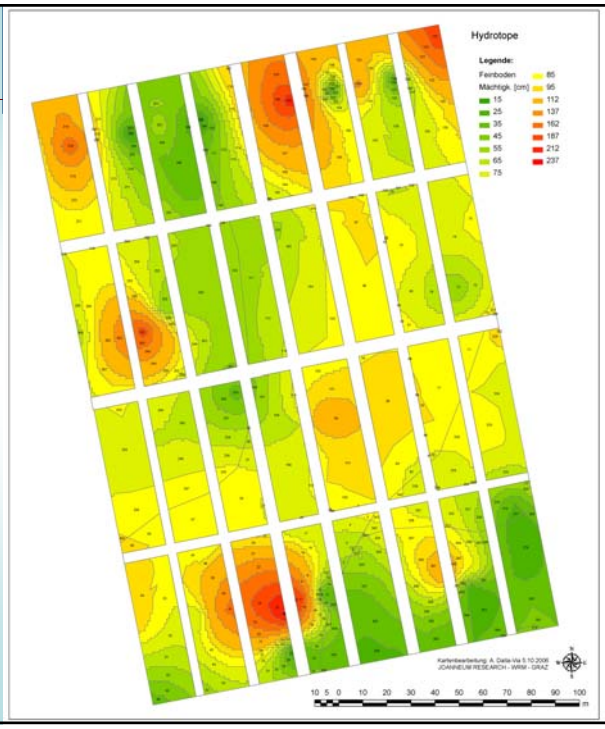
Wagna – Hydrotopes



Intersection of

- lot
- soil type
- thickness of fine soil layers

→ 278 hydrotopes

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Modelling – SIMWASER/STOTRASIM

SIMWASER – soil water balance/transport

STOTRASIM – nitrogen/nitrate transport

Meteorological parameters
Upper boundary conditions: precipitation, evapotranspiration
Lower boundary conditions: groundwater table or no water uptake by roots

Plant/crop & soil parameters
Cultivation/tillage (date, depths)

Modelling of nitrogen input, uptake by plants, ammonium sorption, mineralisation, nitrification, immobilisation, denitrification; nitrate leaching, groundwater recharge & dry matter (mean values & sums for each year 1993-2003)

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Maize Single-Crop Farming

8 maize scenarios and their fertilisation amounts

Fertilisation scenario	Nitrogen application [kg/ha/]
MM1 (Liquid manure + mineral fertiliser)	107
MM2 (Mineral fertiliser)	145
MM3 (Liquid manure + mineral fertiliser)	175
MM4 (Liquid manure)	107
MM5 (Liquid manure + mineral fertiliser)	163
MM6 (Mineral fertiliser)	290
MM7 (Liquid manure + mineral fertiliser)	261
MM8 (Liquid manure)	97

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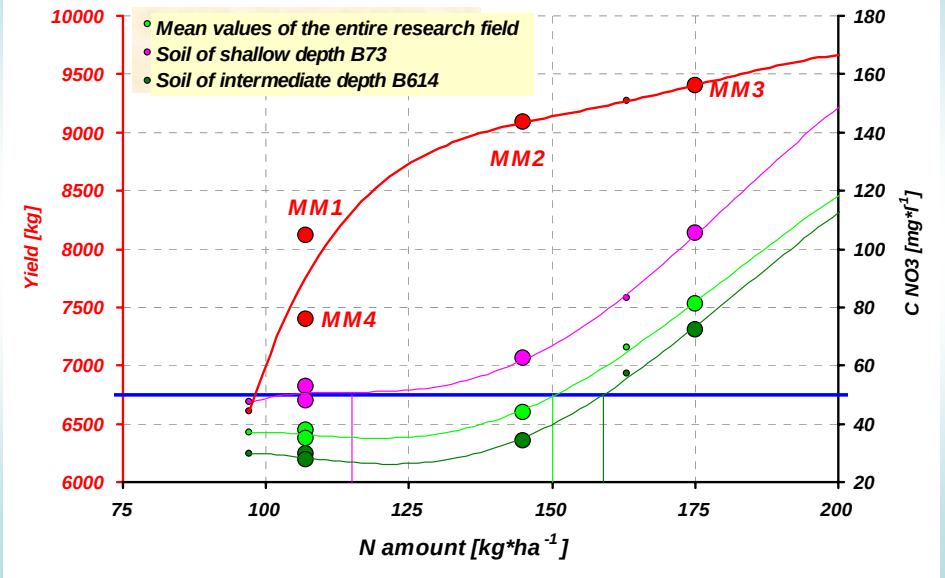
Scenario Results: Yield, N, NO_3



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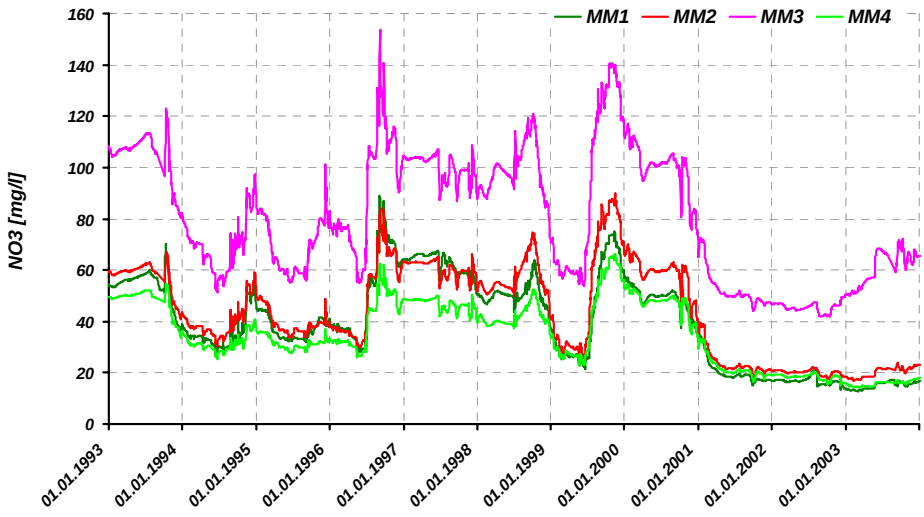
Course of NO_3 Concentration



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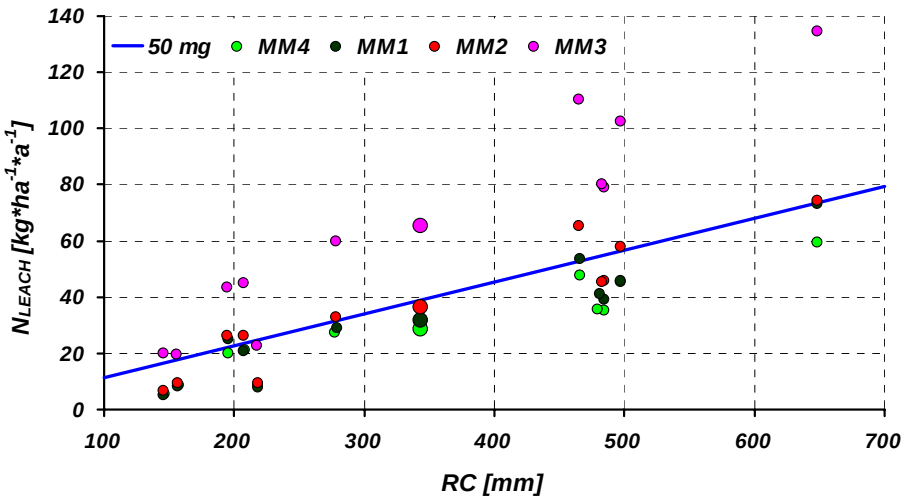
Groundwater Recharge & N Leaching



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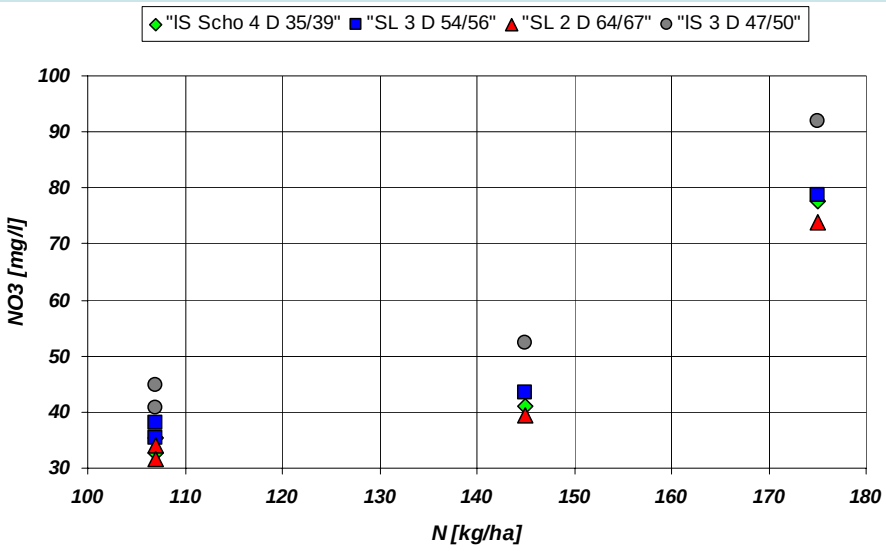
NO_3 Concentrations for 4 Soil Types



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Conclusions & Summary

- Groundwater-protective for soils of intermediate depths (results of mean values of the entire research field):
  - MM1 (107), MM2 (145), MM4 (107)
  - Nitrogen load: < 40 kg/ha

- Groundwater-protective for soil types estimated by financial authorities:
  - MM1 and MM4 – all soils
  - MM2 – all soils except lS 3 D 47/50

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Conclusions & Summary

- Groundwater-protective for soils of shallow depth:
  - fertilisation amounts up to 115 kgN/ha (liquid manure or mineral fertiliser)
  - fertilisation application: 50 % before sowing and 50 % into the crop
  - no fertilisation in autumn
  - winter catch crops (no legumes!) are necessary, tillage in spring

- Lysimeters are an important tool for obtaining information for model calibration and validation

  → help to determine sustainable agricultural cropping management systems

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Thank you for your attention!

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