



Regional application of STOTRASIM for modeling of water and nitrogen dynamics in the unsaturated zone

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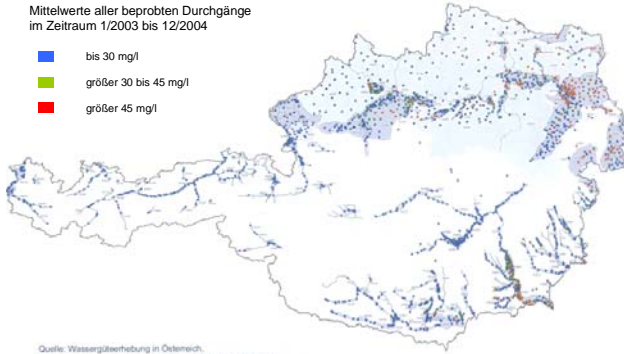

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INTRODUCTION, 1

- Sustainable Water Management: EU - WFD
- **M**onitoring reveals


Auswertung der Porengrundwassermessstellen
Mittelwerte aller beprobten Durchgänge
im Zeitraum 1/2003 bis 12/2004

■	bis 30 mg/l
■	größer 30 bis 45 mg/l
■	größer 45 mg/l



Quelle: Wassergüteüberhebung in Österreich,
Bundesministerium für Land- und Forstwirtschaft, Umwelt und
Wasserwirtschaft, Sektion VIII Wasserwirtschaftliche Planung,
Ämter der Landesregierungen

Auswertung/Graphik: Umweltbundesamt GmbH, April 2006



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INTRODUCTION, 2

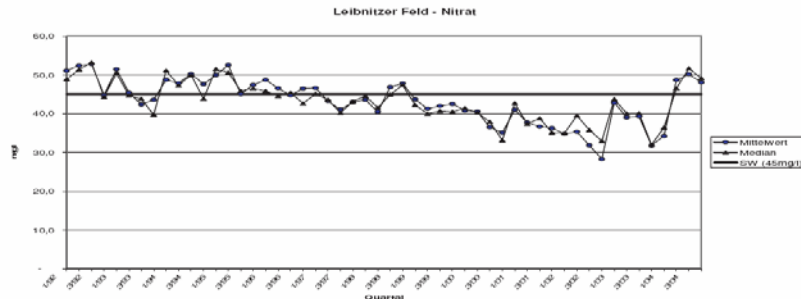


Abb. A/2.1-7: Leibnitzer Feld – 104 km², 28 Messstellen, Beobachtungsgebiet.

Quelle: Wassergüte in Österreich, Jahresbericht 2006



- **M**odeling as a tool to propose sustainable
- **M**anagement practices, evaluated by **M**onitoring following

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MODEL STOTRASIM, concept

STOTRASIM / SIMWASER

Vertical flow of water and nitrate-nitrogen within a soil profile (UZ) of arable land. Interrelating weather, agricultural management, soil properties and groundwater.

SIMWASER

Water balance, plant growth and crop yield of any crop rotation on daily basis

Input: precipitation, irrigation

Output: evapotranspiration considering interception

Water fluxes: Darcy's law → capillary rise or seepage

STOTRASIM

Nitrate-nitrogen balance for a soil profile on daily basis.

Input: fertilisation, precipitation, irrigation, assimilation by legumes

Output: plant uptake, volatilisation, denitrification

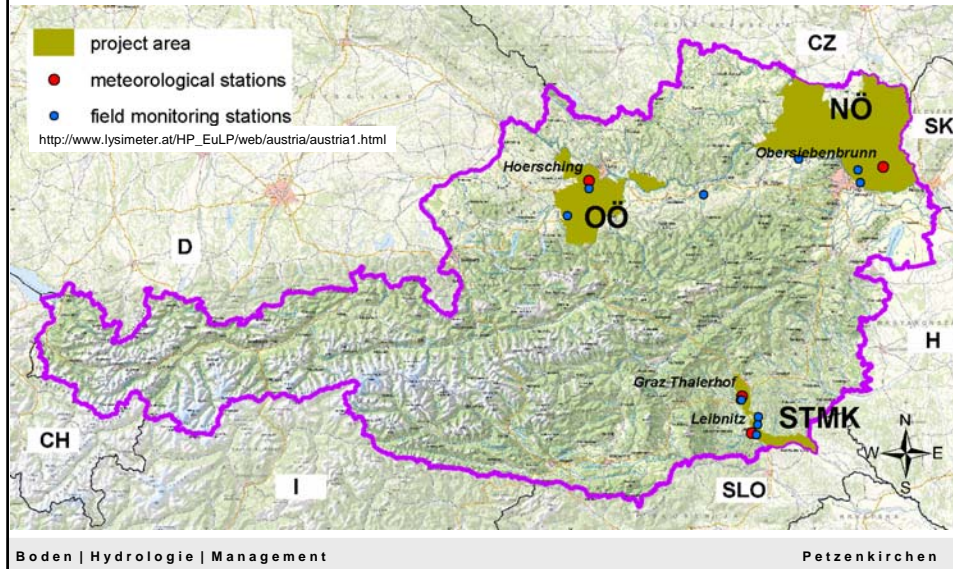
Nitrogen fluxes: CDE, mineralisation, immobilisation (4 org. pools)

→ Nitrate leaching or capillary rise

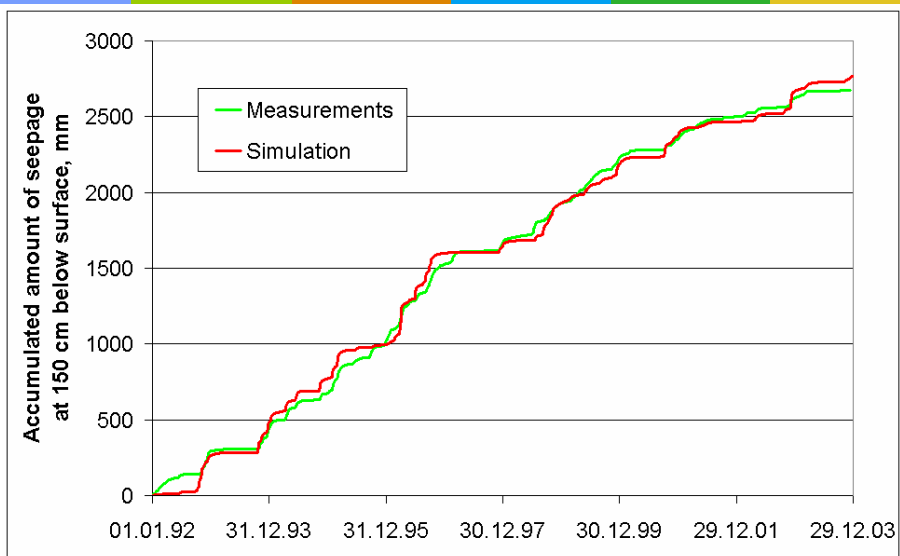
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Data for model calibration; Monitoring sites



MODEL STOTRASIM, calibration



MODEL APPLICATION; PROJECTS, REGIONS, RESULTS

Project

Evaluation of the water management effectiveness of catch crops

Objective: evaluation of ÖPUL 2000 concerning the effectiveness of catch crops for reducing nitrate leaching to the groundwater.

Catch crop management offered by ÖPUL 2000 based on subsidies:

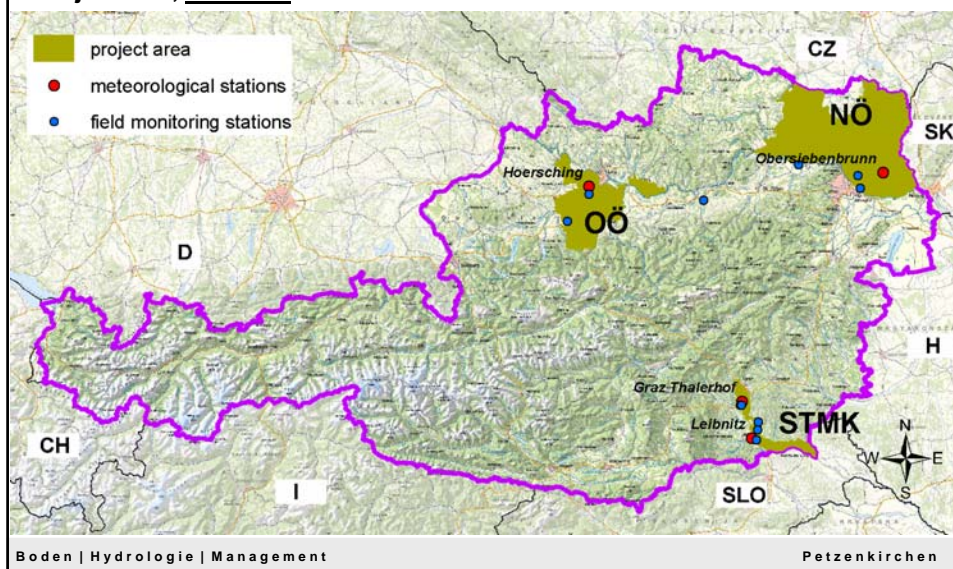
Variant	Type	Sowing at the latest	Cultivation as of
A	green crop in summer/autumn	20.8.	15.11.
B	green crop in autumn/winter killed by frost	30.9.	15.2. following year
C	hardy green crop in autumn/winter	15.10.	1.3. following year
D	green crop in summer/winter	31.8.	15.2. following year

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MODEL APPLICATION; PROJECTS, REGIONS, RESULTS

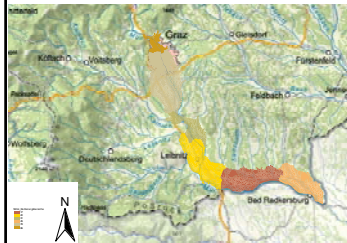
Project area, Weather data



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MODEL APPLICATION; PROJECTS, REGIONS, RESULTS



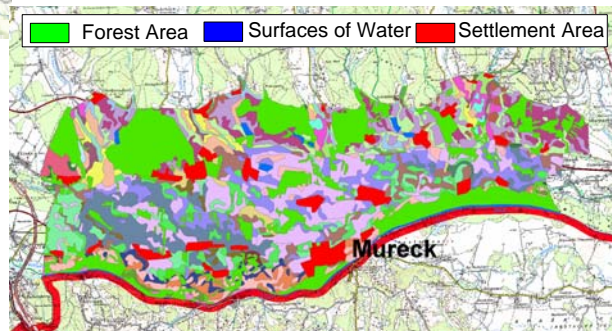
Soil information: national soil survey service, working areas and soil units within such a working area

Number of soil units

NÖ: 979

OÖ: 511

STMK: 194



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MODEL APPLICATION; PROJECTS, REGIONS, RESULTS

Agricultural Management: Management of arable land was defined on the basis of data from agricultural statistics and in close cooperation with local experts on agriculture (LBU, WBOÖ, LLWKNÖ, BOKU, LAKO). Attention was paid, that for the tested crop rotations periods from harvest in autumn until cultivation in next spring included both bare fallow and the alternative catch crops according to ÖPUL 2000

STMK Crop rotation G												
Crop	Sowing	Harvest	Plant residues	Tillage	Inorganic fertilizer				Organic fertilizer			
					NO ₃ -N	NH ₄ -N	FM	TM	C-Gehalt	C/N	NO ₃ -N	NH ₄ -N
			%	Tiefe [cm]	kg/ha	kg/ha	kg/ha	kg/ha	%	C/N	kg/ha	kg/ha
Bare fallow	01. Jan 79	30. Apr 79	0	0								
	01. Mai 79			5								
Soybean	01. Mai 79	15. Sep 79	100									
Bare fallow	16. Sep 79	31. Dez 79	0	0								
Bare fallow e	01. Jan 80	21. Apr 80	0	0								
	15. Apr 80			25								
	18. Apr 80				23,5	46,5						
	20. Apr 80			5								
	22. Apr 80			5								
Corn	22. Apr 80	26. Sep 80	100									
	22. Mai 80			5								
	30. Mai 80			0	69							

Number of crop rotations:

NÖ: 5

OÖ: 4

STMK: 2

Modeling:

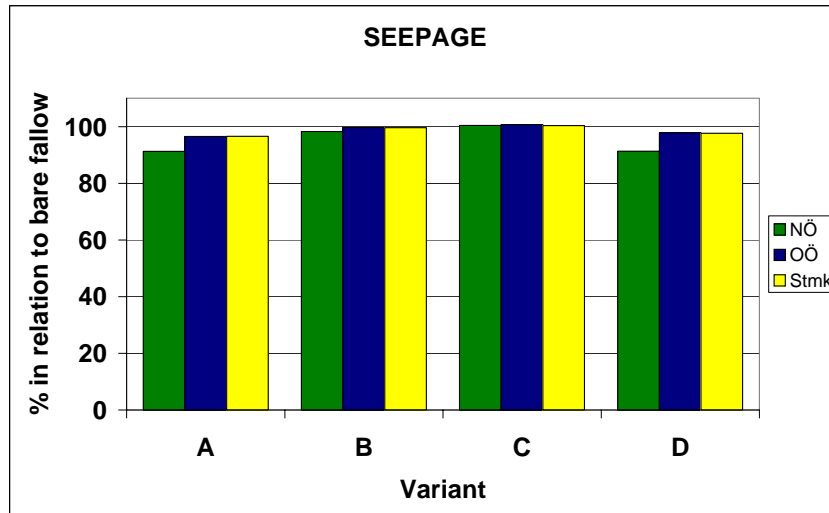
Period: 1980 - 2000
Period of assessment:
1990 - 2000

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MODEL APPLICATION; PROJECTS, REGIONS, RESULTS

Summarized results

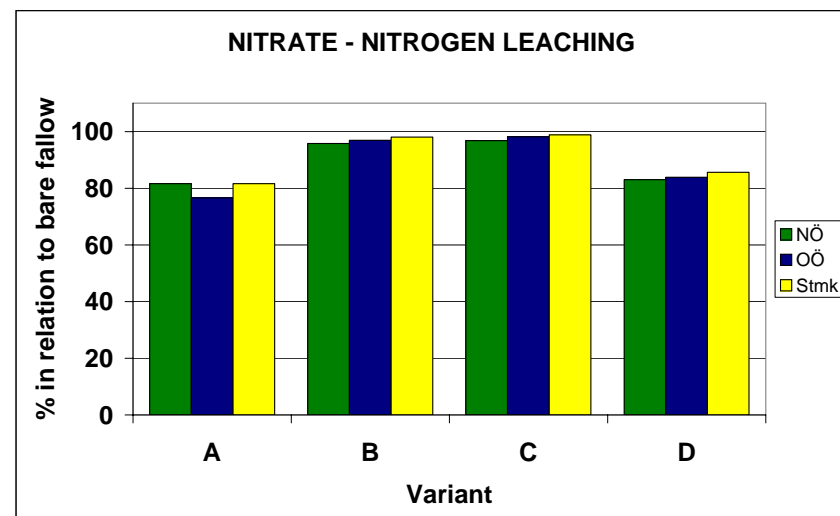


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MODEL APPLICATION; PROJECTS, REGIONS, RESULTS

Summarized results

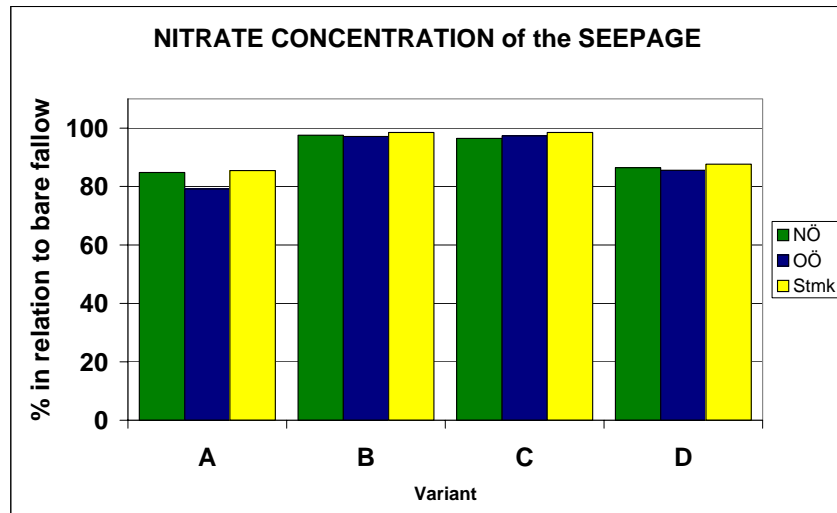


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MODEL APPLICATION; PROJECTS, REGIONS, RESULTS

Summarized results



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MODEL APPLICATION; PROJECTS, REGIONS, RESULTS

Summary

- Compared to bare fallow variant A and D reduce nitrate-nitrogen leaching and the nitrate concentration of the seepage considerably and equally well.
- Variant B and C exhibit only little effect reducing groundwater pollution with nitrate.
- These results apply to all tested regions.
- The effectiveness of catch crops for reducing nitrate leaching to the groundwater is closely linked to its dry matter production.
- Therefore, on behalf of an efficient groundwater protection, the cultivation of catch crops should be as soon as possible and as long as possible.

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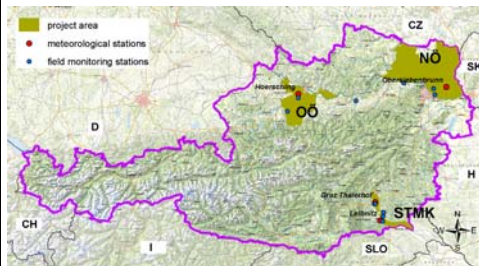
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MODEL APPLICATION; PROJECTS, REGIONS, RESULTS

Project

Water management of basins

Water management of basins is an ongoing sub-project of the research network WATERPOOL, <http://www.waterpool.org>. For the region of Southeast Styria tools are elaborated in order to support the sustainable utilisation of the groundwater resources. Within this framework seepage and nitrate leaching have been assessed by STOTRASIM for arable land.



Weather data: Leibnitz, Graz-Thalerhof
Soil Information: Soil units according the national soil survey service
Agricultural management: as mentioned before, dominated by maize

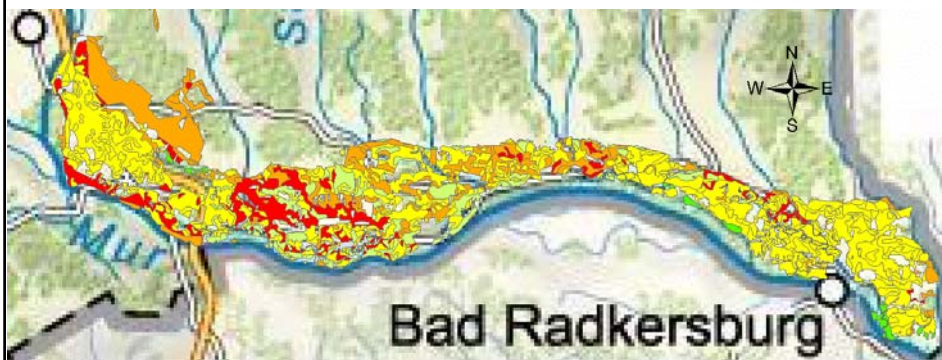
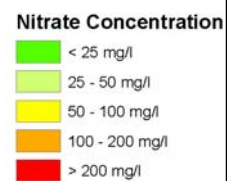
Modeling:
Period: 1984 - 2004
Period of assessment:
1993 - 2004

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MODEL APPLICATION; PROJECTS, REGIONS, RESULTS

Nitrate concentration of the leakage at 180 cm below surface; an example of results



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MODELING the unsaturated zone, PART OF MMM

