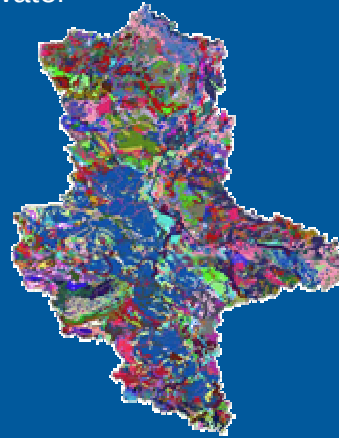


Prognosis of diffuse N-fluxes into groundwater from agricultural used soils in Sachsen-Anhalt, Central Germany

Uwe Franko, Martina Puhlmann, Ina Prutzer, Horst Ringe

UFZ; Department Soil Physics

Das diesem Projekt zugrunde liegende Vorhaben wurde durch das Ministerium für Landwirtschaft und Umwelt des Landes Sachsen-Anhalt mit Mitteln des Europäischen Strukturfonds (EFRE) und des Ministeriums für Wirtschaft und Arbeit des Landes Sachsen-Anhalt gefördert. FKZ 76213/01/03



*Diffuse Inputs into the Groundwater
Monitoring-Modeling-Management
International conference - Graz 2007*

 HELMHOLTZ
CENTRE FOR
ENVIRONMENTAL
RESEARCH - UFZ

Prognosis of diffuse N-fluxes into groundwater from agricultural used soils in Sachsen-Anhalt, Central Germany

- Objectives
- CANDY-Model
- Regionalization
- Development of scenarios
- Organisation of simulation runs
- Results



 HELMHOLTZ
CENTRE FOR
ENVIRONMENTAL
RESEARCH - UFZ

OBJECTIVES

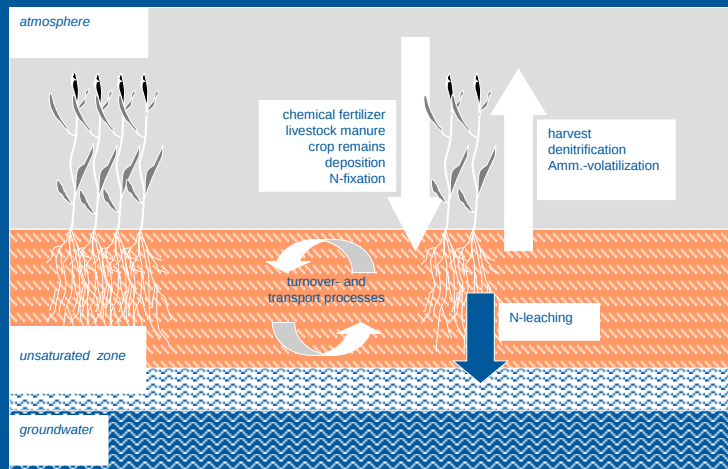
- problem:
 - What are the land use options to reduce diffuse N export from agro-ecosystems in Sachsen-Anhalt
- goals
 - adaptation of the CANDY model
 - simulation of different intensive land use levels
 - assessment of results regarding mitigation and economy

Prognosis of diffuse N-fluxes into groundwater
from agricultural used soils
in Sachsen-Anhalt, Central Germany

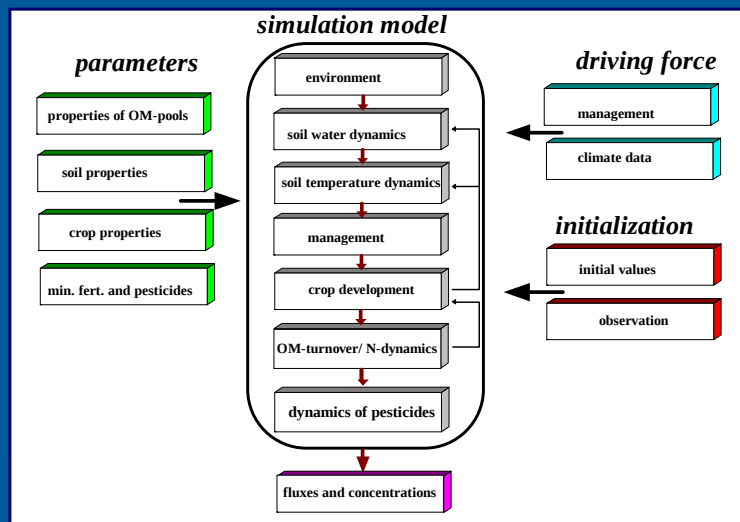
- Objectives
- **CANDY-Model**
- Regionalization
- Development of scenarios
- Organisation of simulation runs
- Results

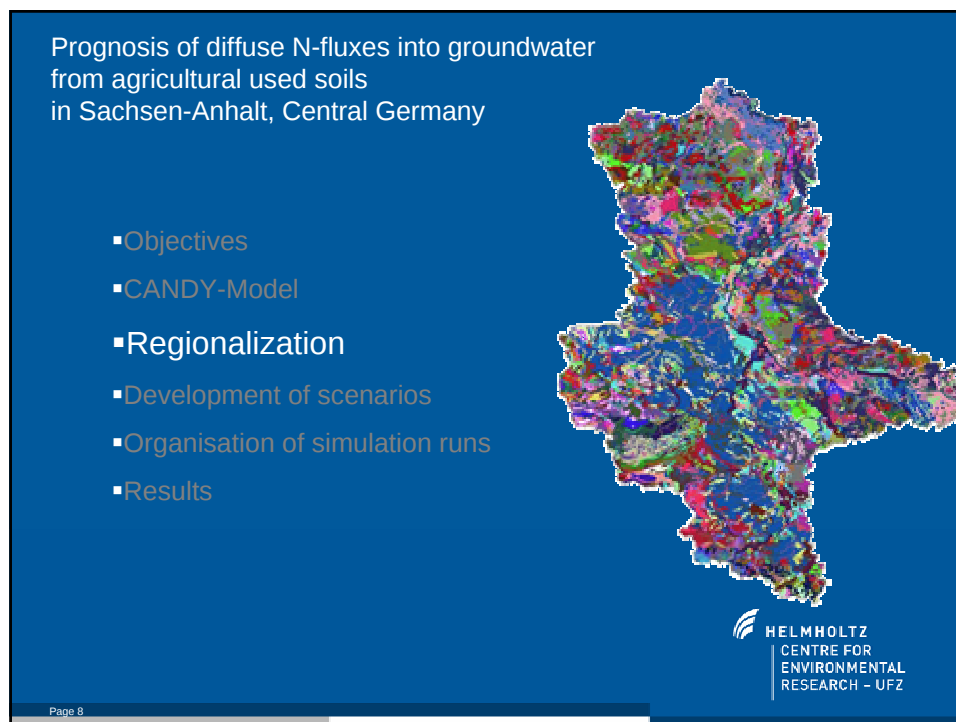
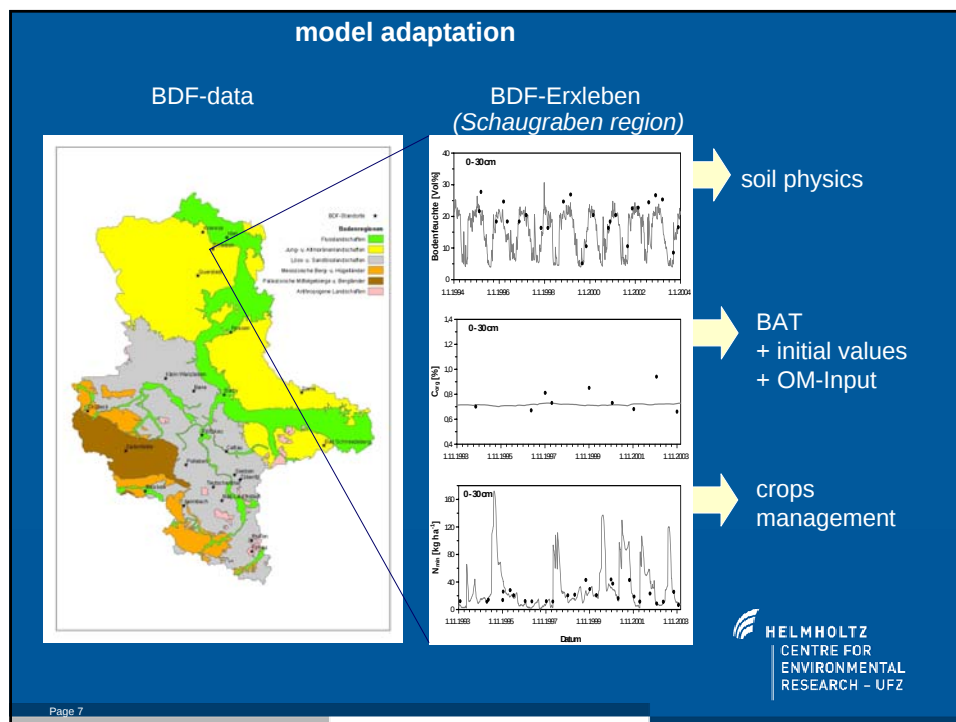


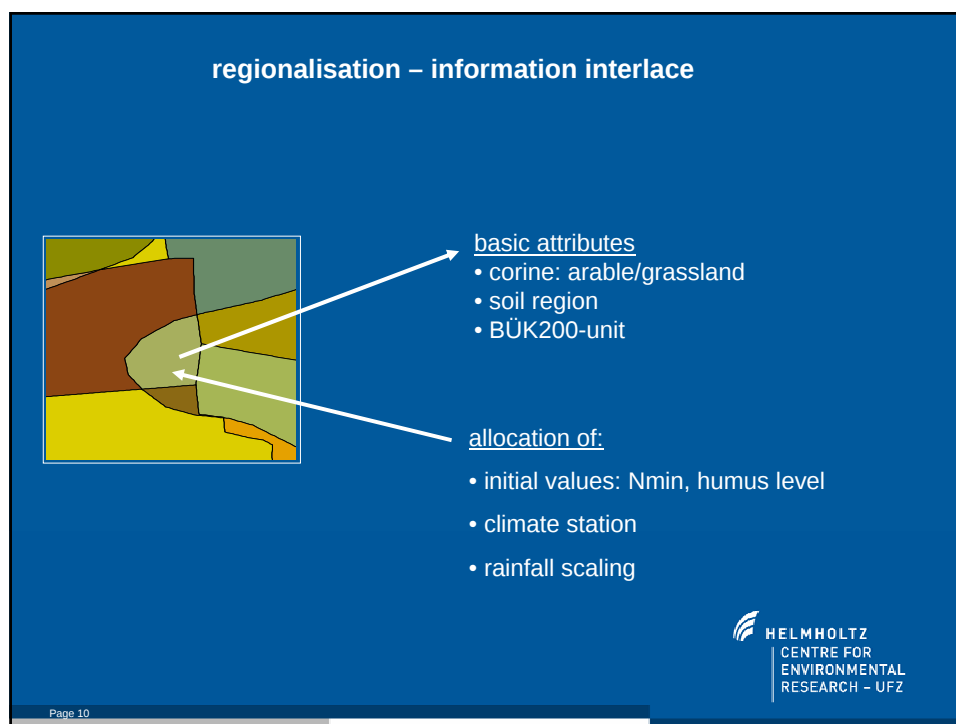
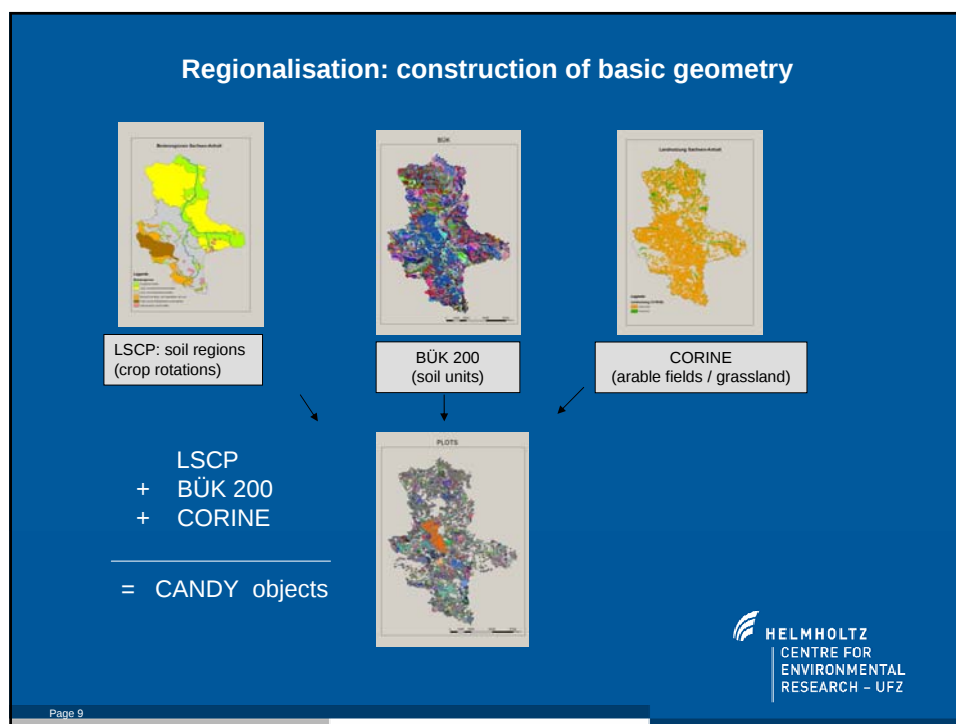
Modelling the C-N-cycle



CANDY-Model



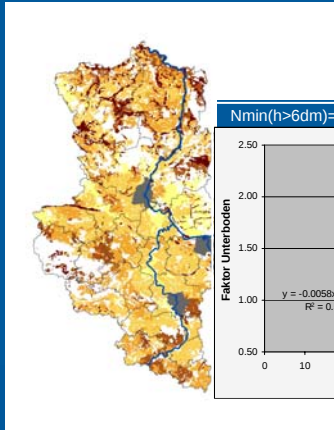




intial conditions

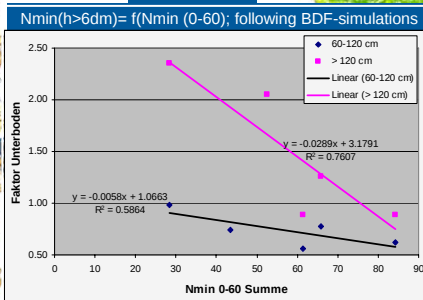
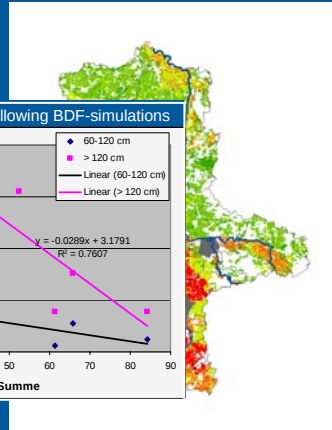
carbon

Cums= f(Crep,WMZ) -> Franko et al. (1997)



nitrogen

Nmin(0-60cm) = f(Textur) -> Körschens et al. (1988)



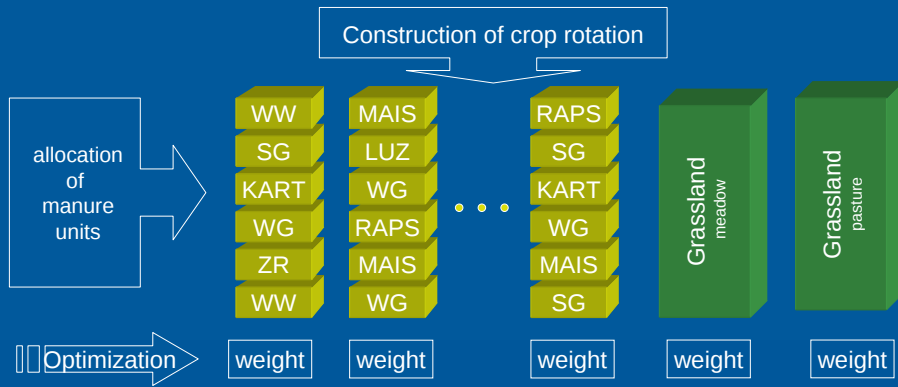
Prognosis of diffuse N-fluxes into groundwater from agricultural used soils in Sachsen-Anhalt, Central Germany

- Objectives
- CANDY-Model
- Regionalization
- Development of scenarios
- Organisation of simulation runs
- Results

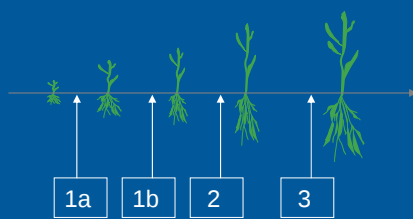


scenario-development: management

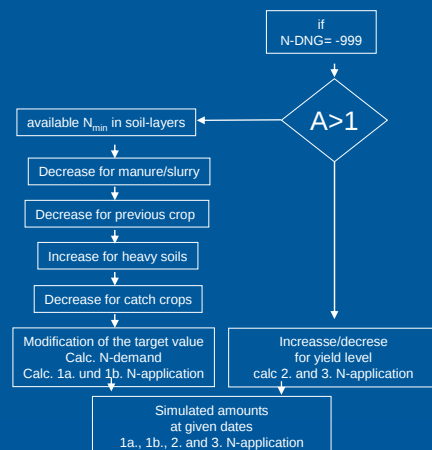
each soil regions with 3 farm types, depending on production livestock, crops, mixed agricultural statistics : proportion of crops and livestock



scenario-development: Modelling of fertilizer application rates



Templates for fertilization events,
N-amount as missing value -999



scenario-development : overview

initial conditions: 1989 => $N_{\min}$ (*Körschens et al.*)
 C_{rep} (*Franko et al.*)

Status Quo : land use 1990 - 2003 (official statistic data)

Prognosis 2004 - 2030

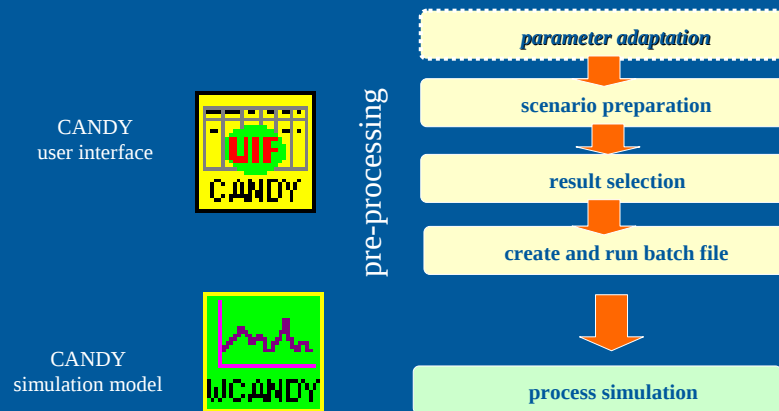
- | | |
|--|------------|
| • business as usual | baseline |
| • organic farming | öko |
| • 30%-reduction of recommended N-fertilization | sba-30 |
| • set aside | still (L-) |
| a) grassland without legumes | |
| b) grassland with legumes | still (L+) |

Prognosis of diffuse N-fluxes into groundwater
from agricultural used soils
in Sachsen-Anhalt, Central Germany

- Objectives
- CANDY-Model
- Regionalization
- Development of scenarios
- Organisation of simulation runs
- Results

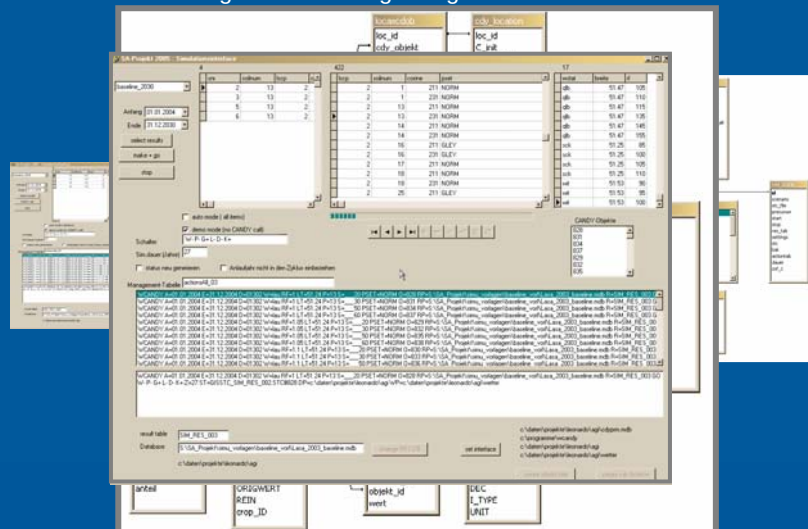


CANDY: Organisation of simulations



parameters: start, end, plot-ID, soil-ID, climate-ID, object-ID,
result-database, result-table, Status-File, ...

Regional Modelling: Organisation Scheme



Prognosis of diffuse N-fluxes into groundwater from agricultural used soils in Sachsen-Anhalt, Central Germany

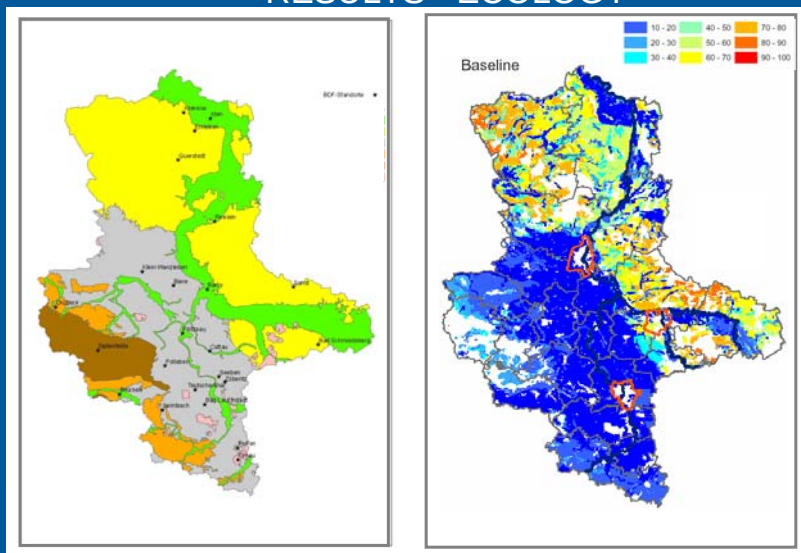
- Objectives
- CANDY-Model
- Regionalization
- Development of scenarios
- Organisation of simulation runs
- Results



HELMHOLTZ
CENTRE FOR
ENVIRONMENTAL
RESEARCH – UFZ

Page 19

RESULTS - ECOLOGY

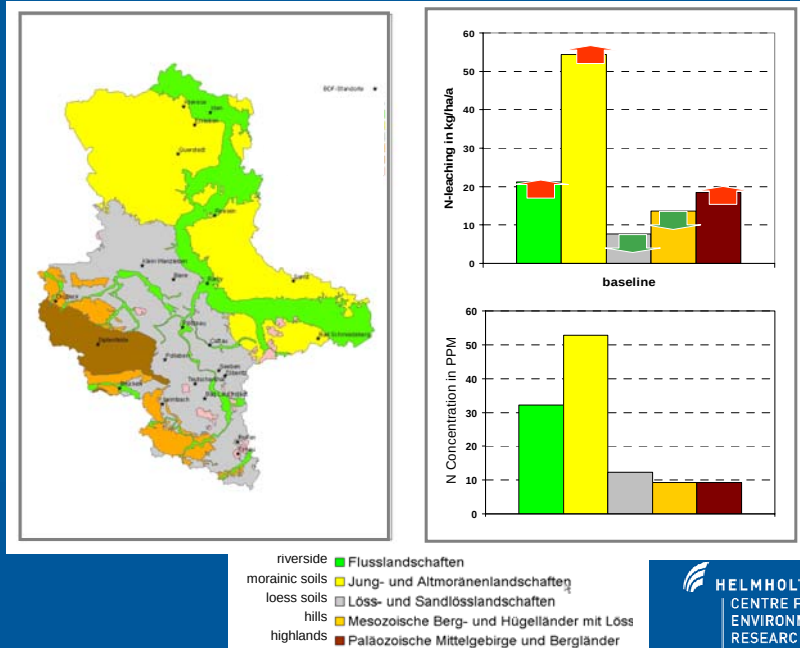


riverside ■ Flusslandschaften
morainic soils ■ Jung- und Altmoränenlandschaften
loess soils ■ Löss- und Sandlösslandschaften
hills ■ Mesozoische Berg- und Hügelländer mit Löss
highlands ■ Paläozoische Mittelgebirge und Bergländer

HELMHOLTZ
CENTRE FOR
ENVIRONMENTAL
RESEARCH – UFZ

Page 20

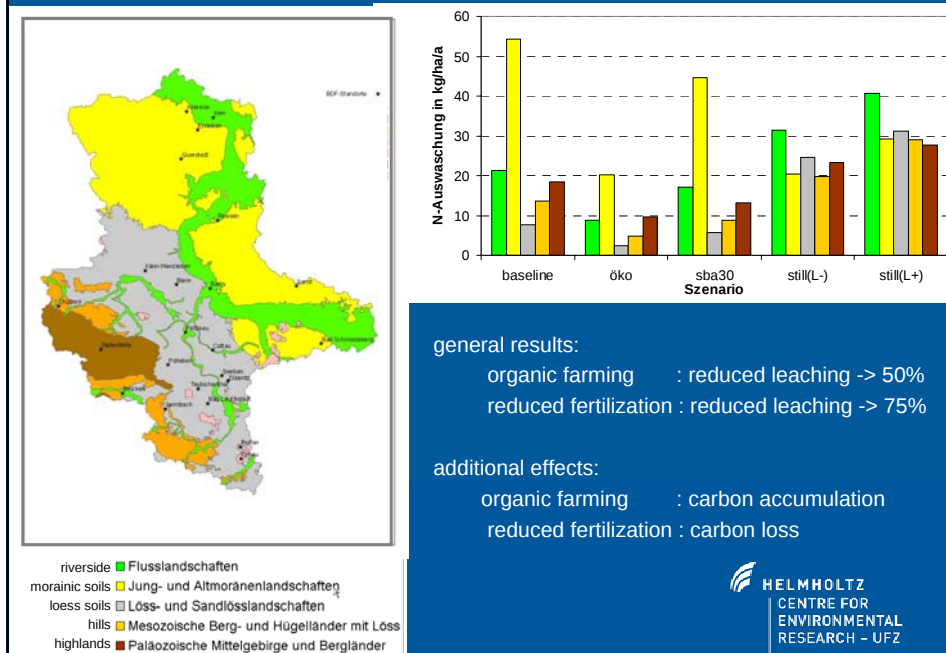
RESULTS - ECOLOGY



Page 21

HELMHOLTZ
CENTRE FOR
ENVIRONMENTAL
RESEARCH - UFZ

RESULTS - ECOLOGY



Page 22

HELMHOLTZ
CENTRE FOR
ENVIRONMENTAL
RESEARCH - UFZ

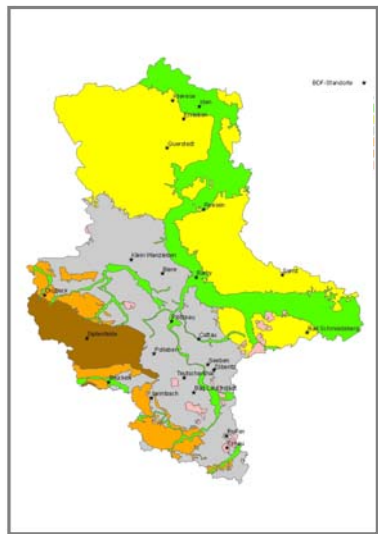
general results:

organic farming : reduced leaching -> 50%
reduced fertilization : reduced leaching -> 75%

additional effects:

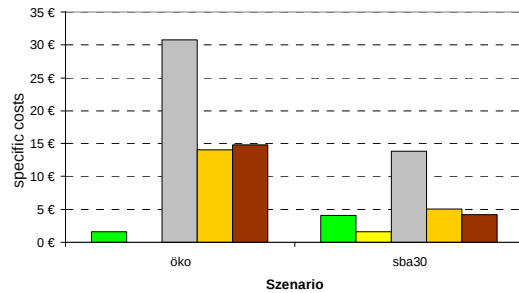
organic farming : carbon accumulation
reduced fertilization : carbon loss

RESULTS - ECONOMY



riverside ■ Flusslandschaften
 morainic soils ■ Jung- und Altmoränenlandschaften
 loess soils ■ Löss- und Sandlösslandschaften
 hills ■ Mesozoische Berg- und Hügelländer mit Löss
 highlands ■ Paläozoische Mittelgebirge und Bergländer

Page 23



calculation of specific costs:

$$CO\$T_x = \frac{PROFIT_{baseline} - PROFIT_x}{N_LEACH_{baseline} - N_LEACH_x}$$

HELMHOLTZ
 CENTRE FOR
 ENVIRONMENTAL
 RESEARCH - UFZ

CONCLUSIONS

Assessment based on :

- N-leaching (level)
- Nitrate concentration
- trend of N-leaching
- humus storage
- costs (lost earnings)

the best choice depends on site conditions

- organic farming is a good option for all site conditions
- setting aside is only for light soils a possible alternative
- reduction of N-fertilization is best alternative except for morainic soil and riverside regions



HELMHOLTZ
 CENTRE FOR
 ENVIRONMENTAL
 RESEARCH - UFZ

Page 24

THANK YOU !