

# **Eco-hydrological assessment of German lowland catchments**

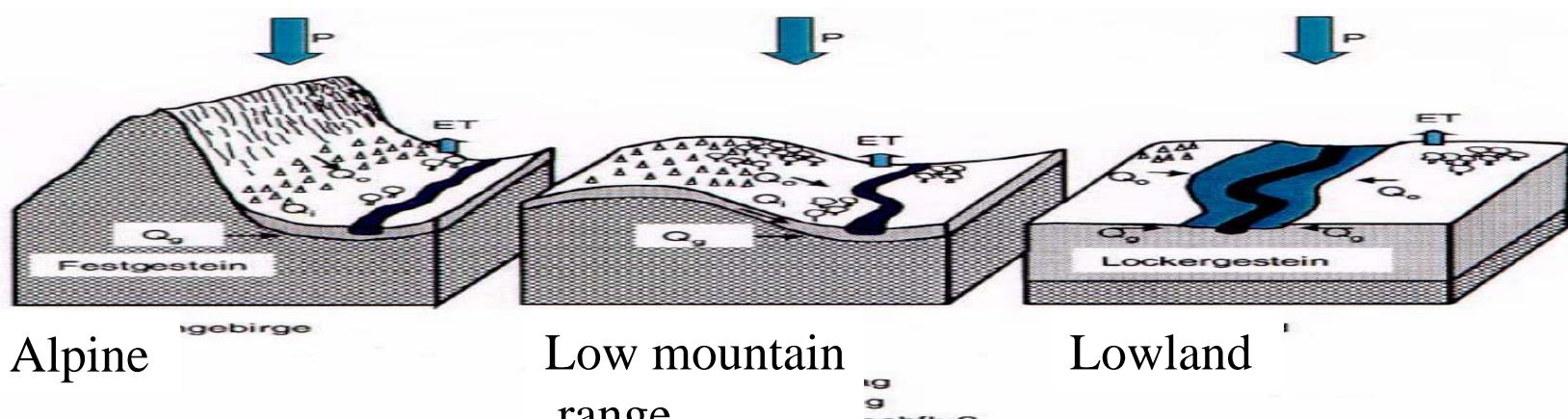
**– experiences and challenges–**

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**Dep. Hydrology & Water Resources Management  
Ecology Centre, CAU Kiel**

# Landscape processes in lowlands

- Low hydraulic gradients
- Large water retention/storage potential caused by lakes and wetlands
- Saturation overland flow > infiltration excess overland flow (Horton)
- High spatial variability in soils due to ice-age
- Connected/unconnected potholes



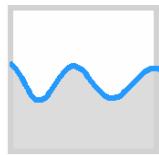
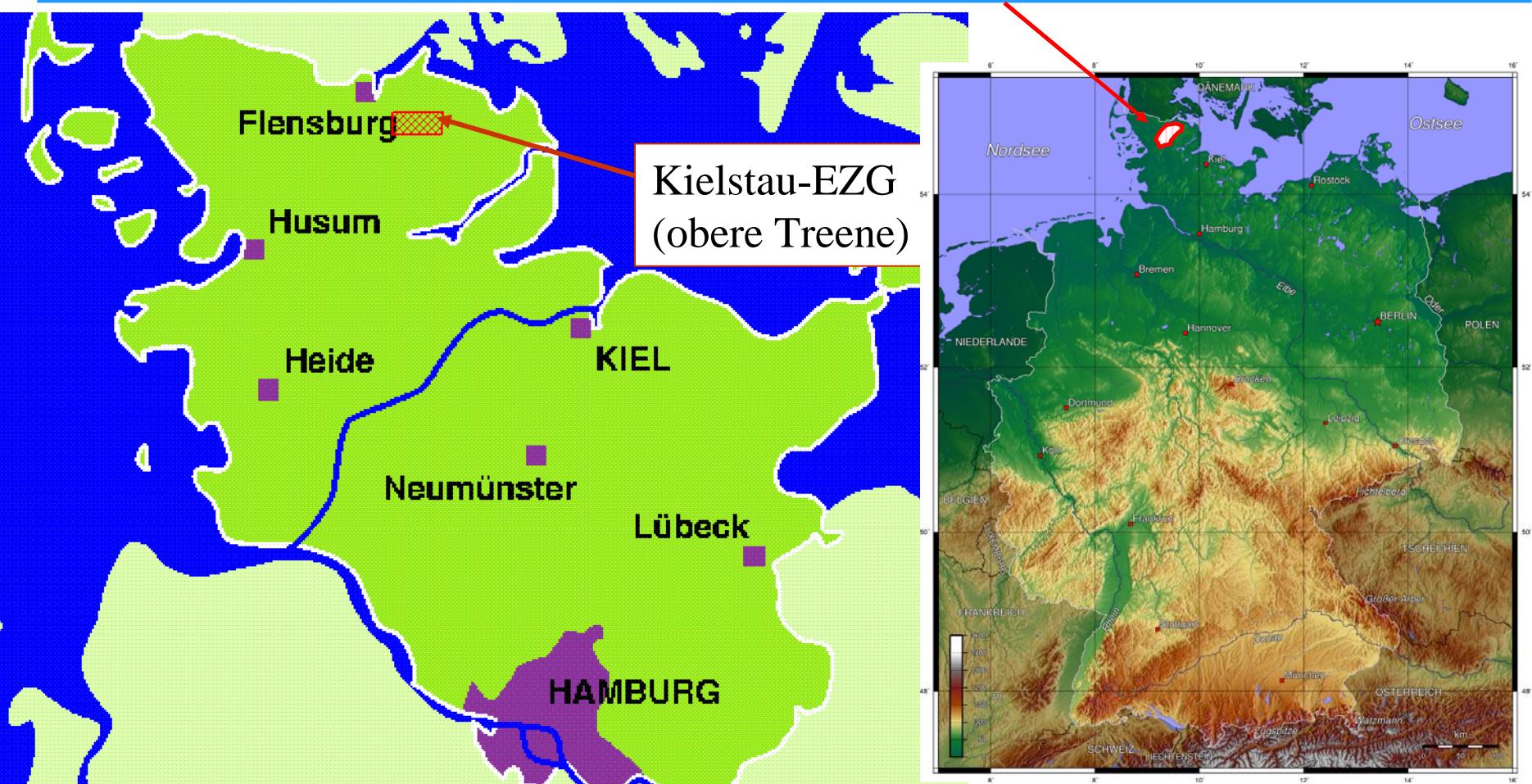
# Anthropogenic Impacts

- Tile drains
- Ditches
- River regulations



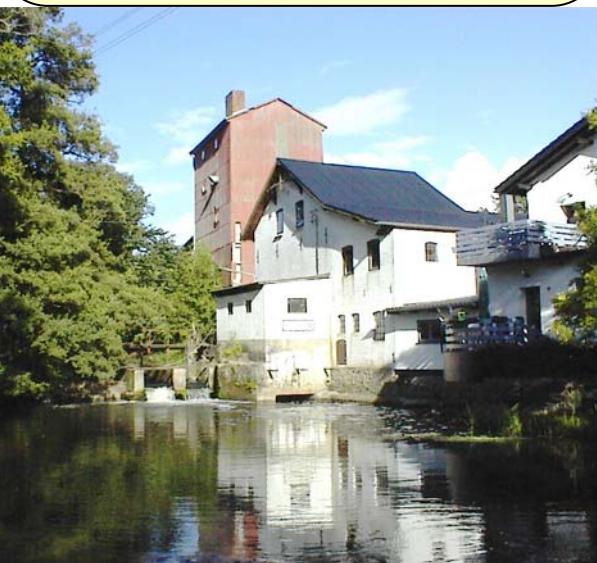
# **Assessment of lowland processes: -the catchments-**

# Treene and Kielstau catchments



# Sampling strategy: nested approach

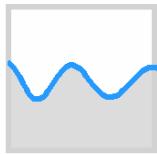
Treene catchment:  
517 km<sup>2</sup>,  
60 km river length



Kielstau catchment  
50 km<sup>2</sup>,  
11 km river length

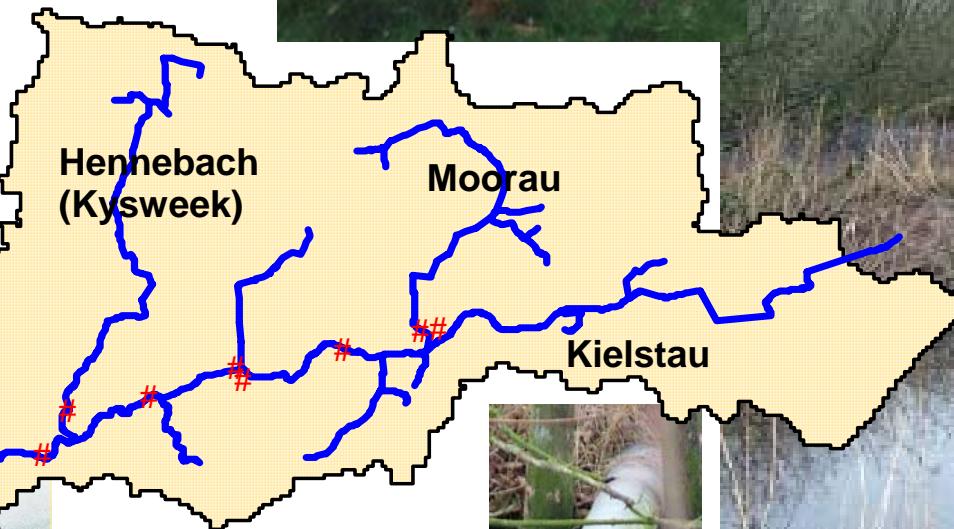
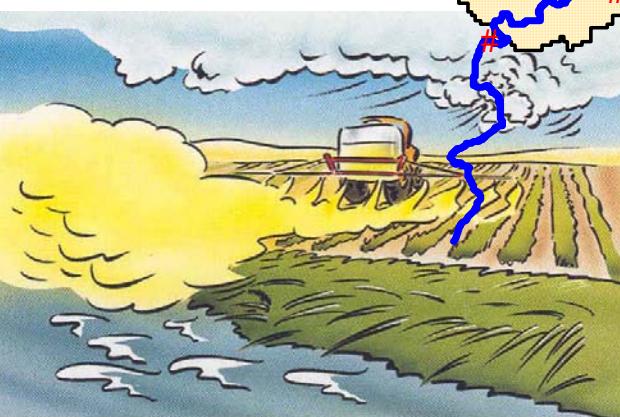


drained section of  
Kielstau catchment  
0.15 km<sup>2</sup>,  
200 m ditch length



# **Assessment of water quality**

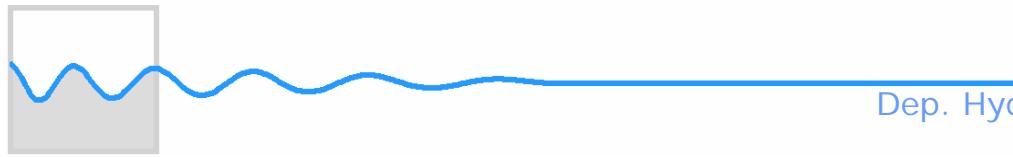
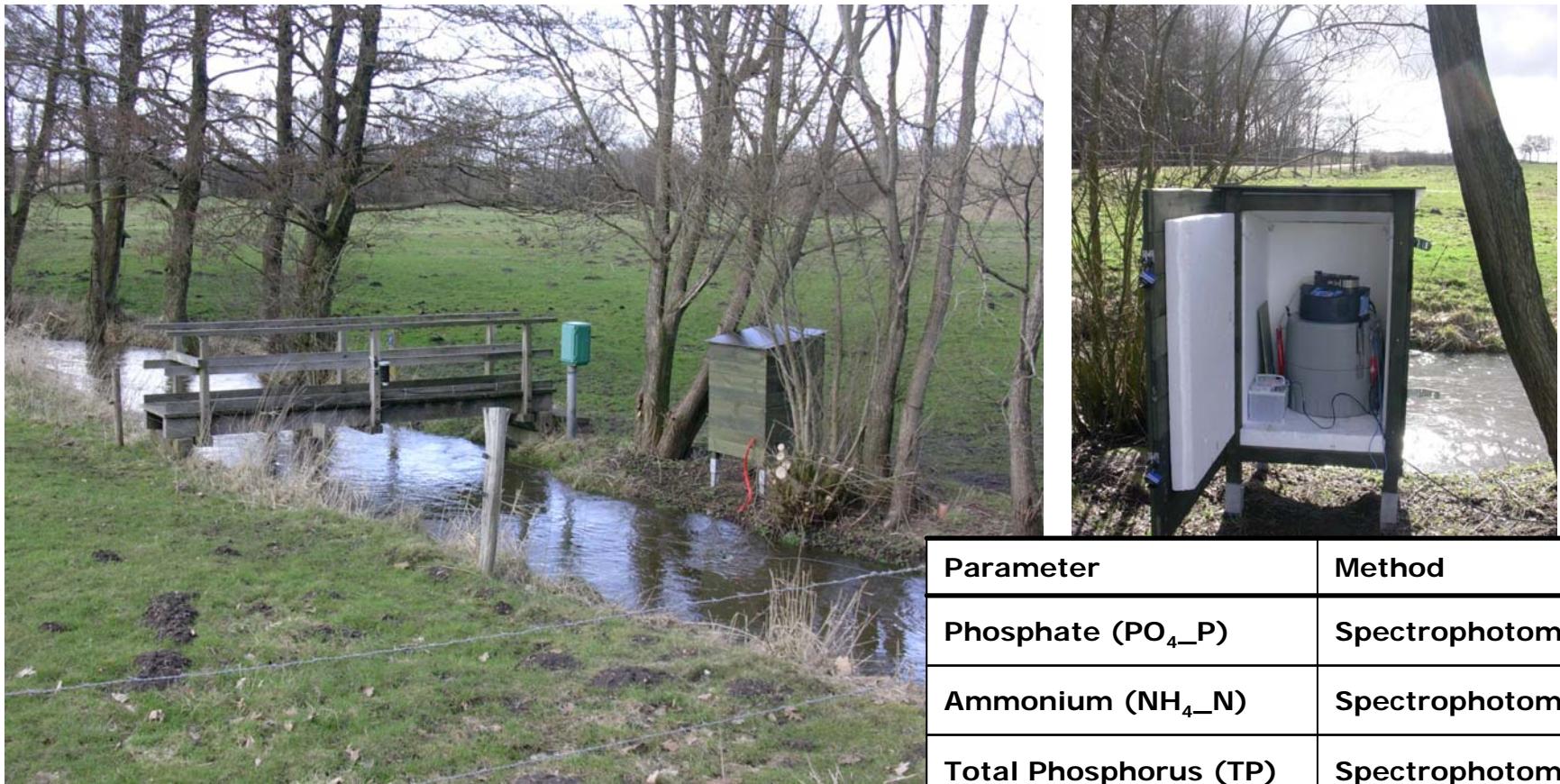
# Potential nutrient entry pathways



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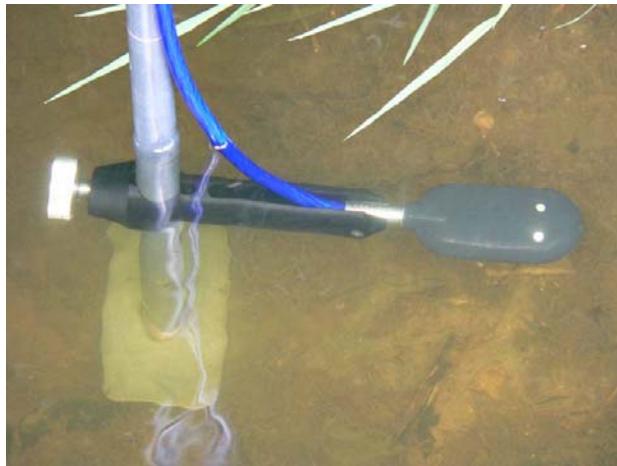
# Continuous observation and sampling



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Parameter	Method
Phosphate ( $\text{PO}_4\text{-P}$ )	Spectrophotometry
Ammonium ( $\text{NH}_4\text{-N}$ )	Spectrophotometry
Total Phosphorus (TP)	Spectrophotometry
Nitrate ( $\text{NO}_3$ )	Ion chromatography
Chloride (Cl)	Ion chromatography
Sulphate ( $\text{SO}_4$ )	Ion chromatography

# In situ measurement campaigns

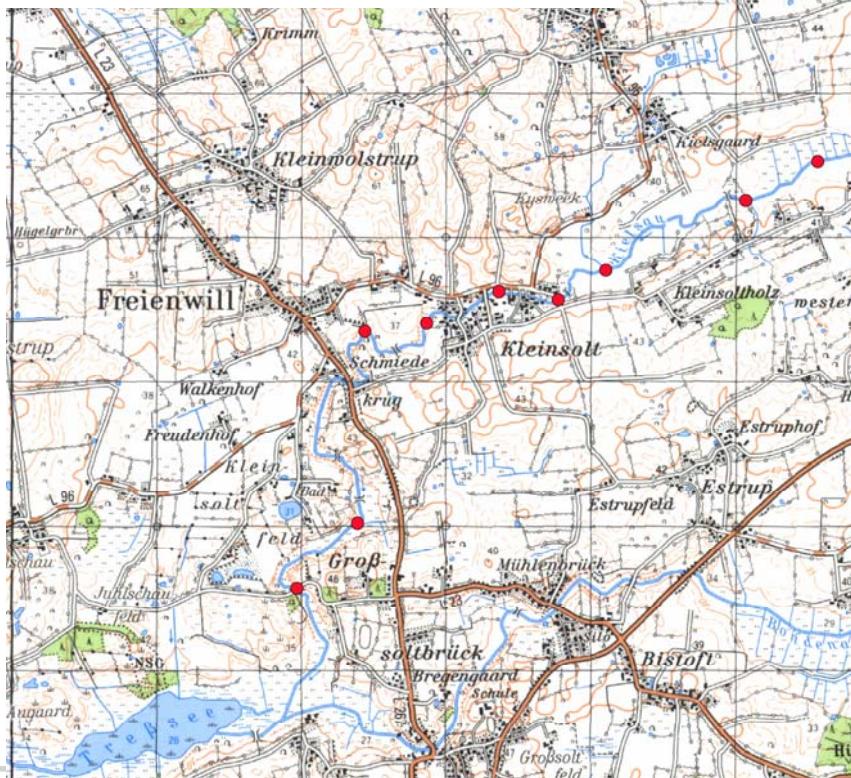


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# Water quality transects –sampling strategy

- 16 sampling points
- 9 tributaries



oberhalb des Zulaufs (a)



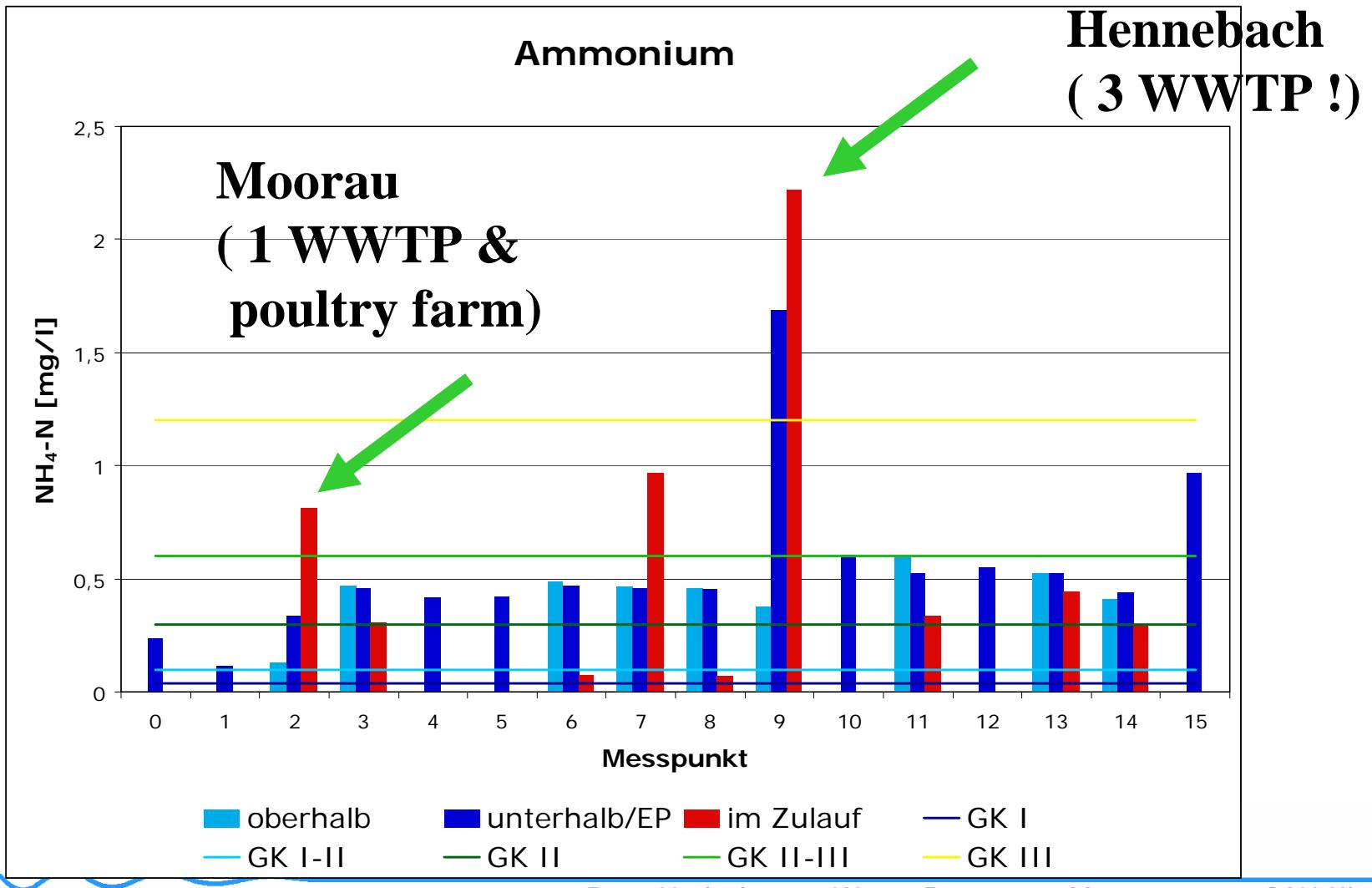
unterhalb des Zulaufs (b)

Zulauf

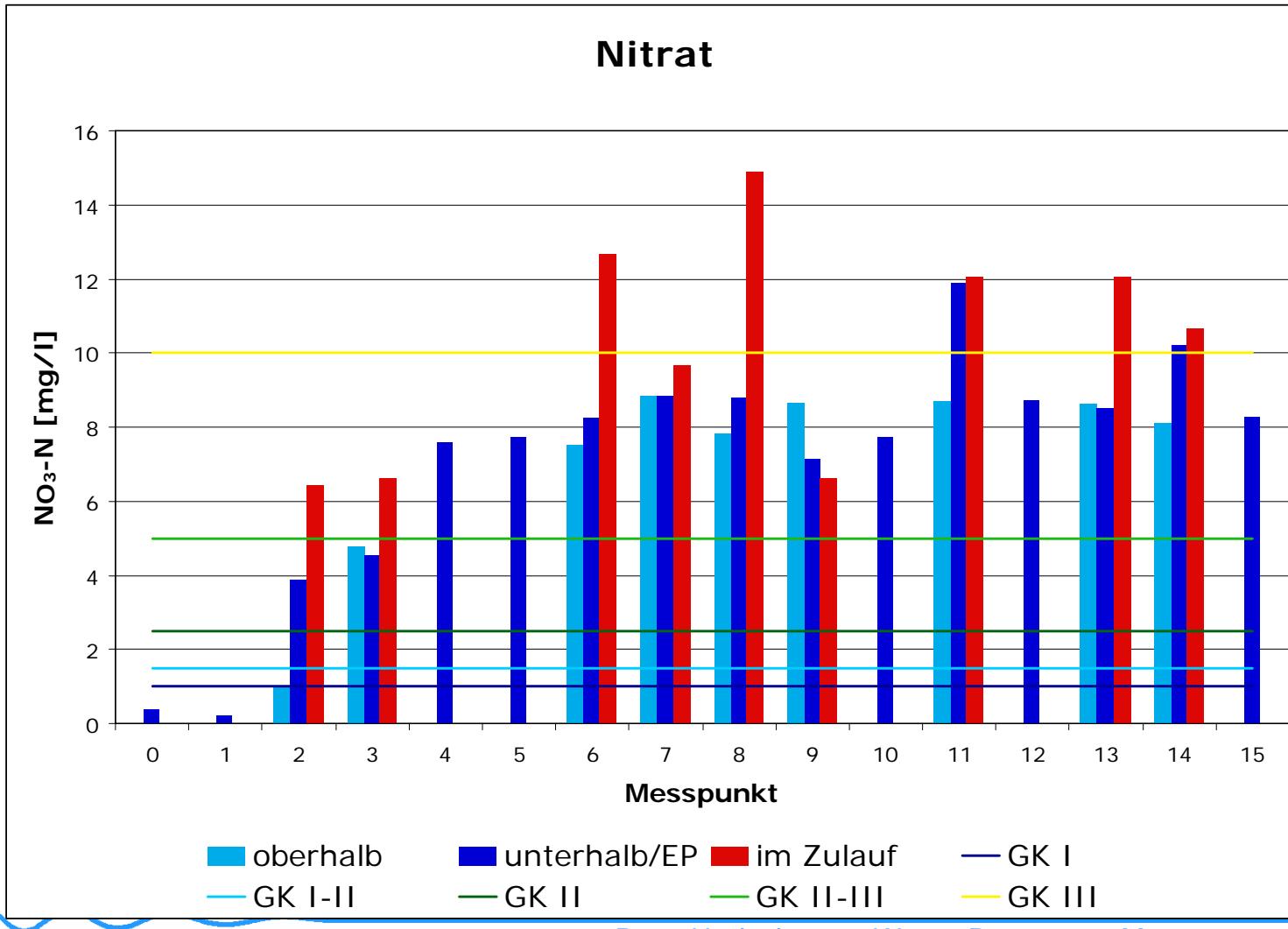
im Zulauf (c)

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# Ammonium-N mainly from point sources



# Nitrate-N- mainly non-point sources

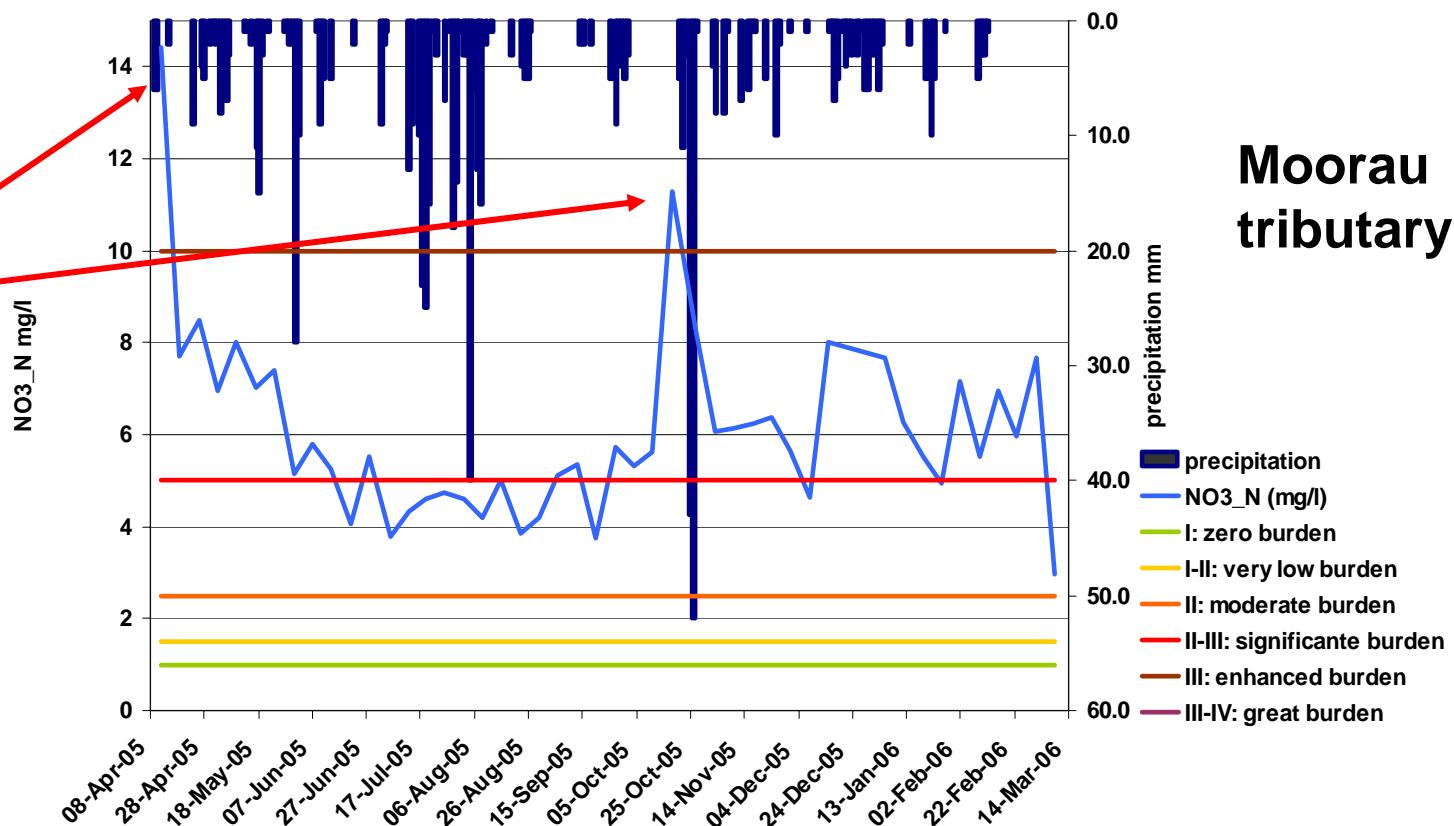


# Water quality assessment - LAWA 1998

## Nitrate nitrogen

LAWA class III-IV  
(great burden)

Moorau  
tributary



All the other  
sampling points  
reached at least  
LAWA class III  
(enhanced burden)

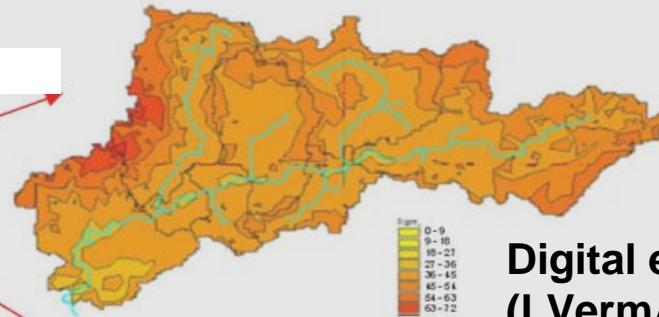
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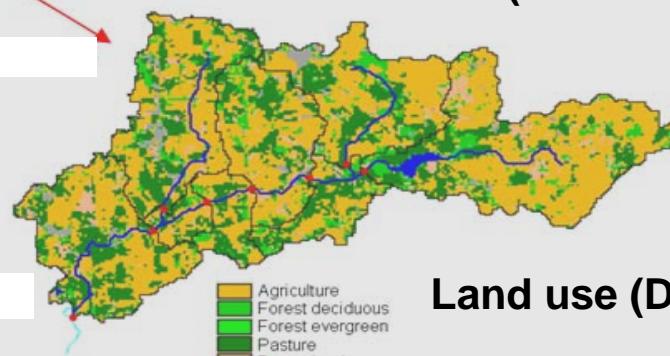
# **Eco-hydrological modelling**

# Input data for the Kielstau catchment

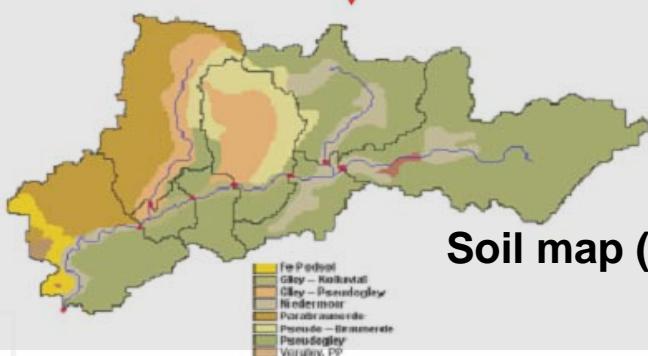
## Maps



Digital elevation model  
(LVermA, 1995)



Land use (DLR, 1999)

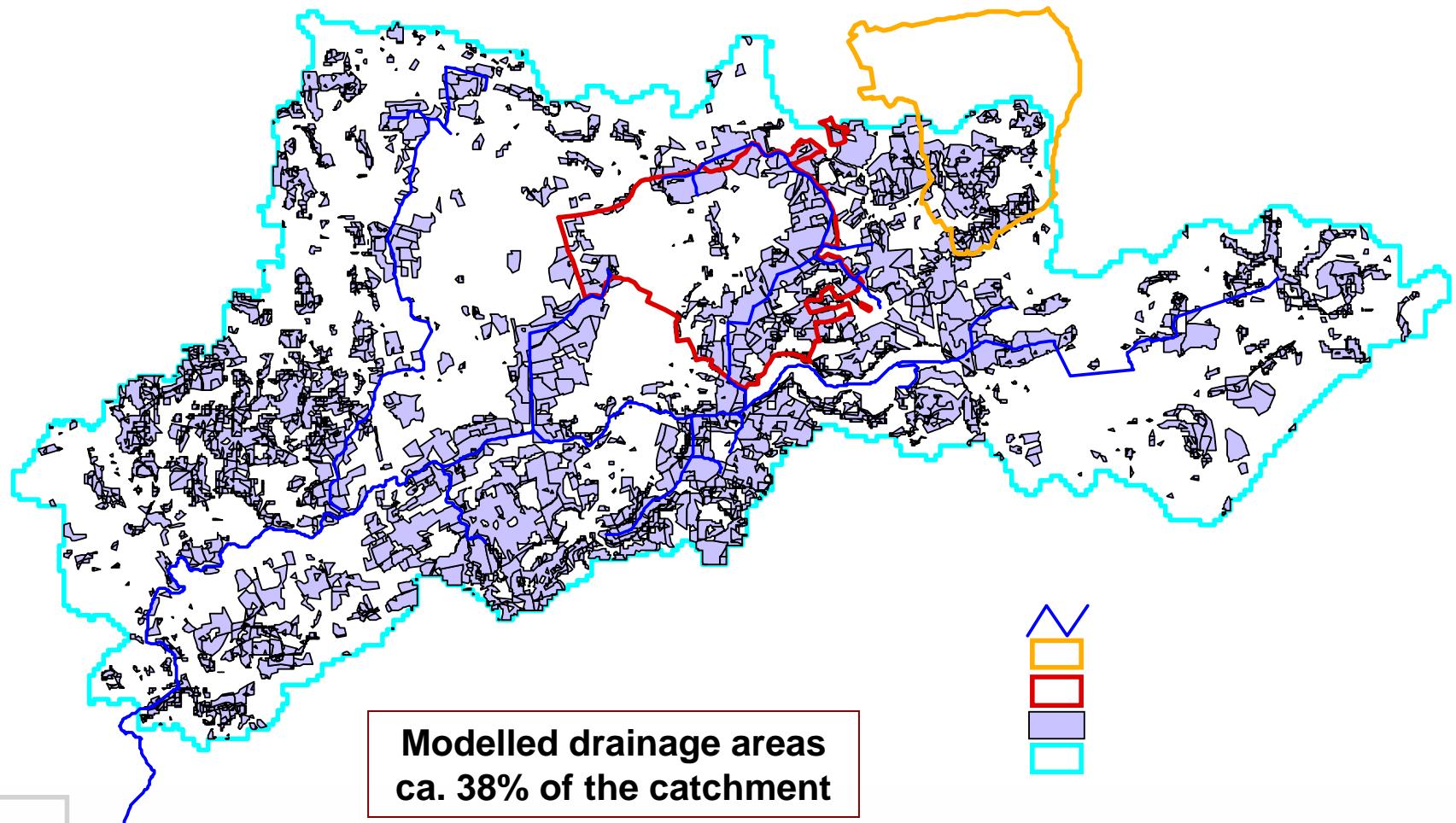


Soil map (BGR, 1999)

Time series data:  
- climate data (DWD)  
- discharge values (LANU)

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# Simulated distribution of drainage density, GIS- based algorithm



**Modelled drainage areas  
ca. 38% of the catchment**



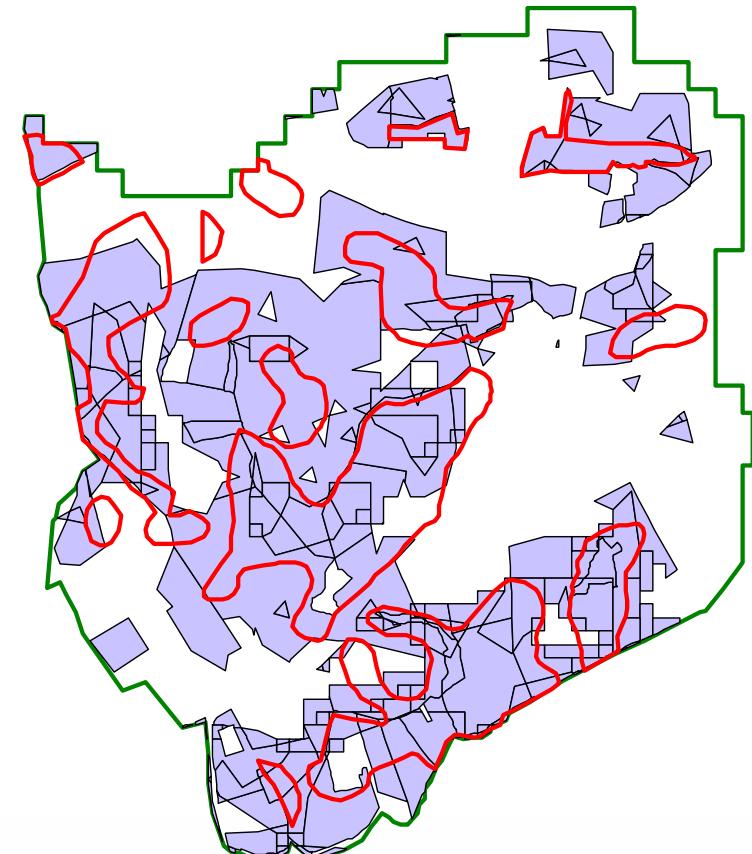
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# Validation of drainage algorithm



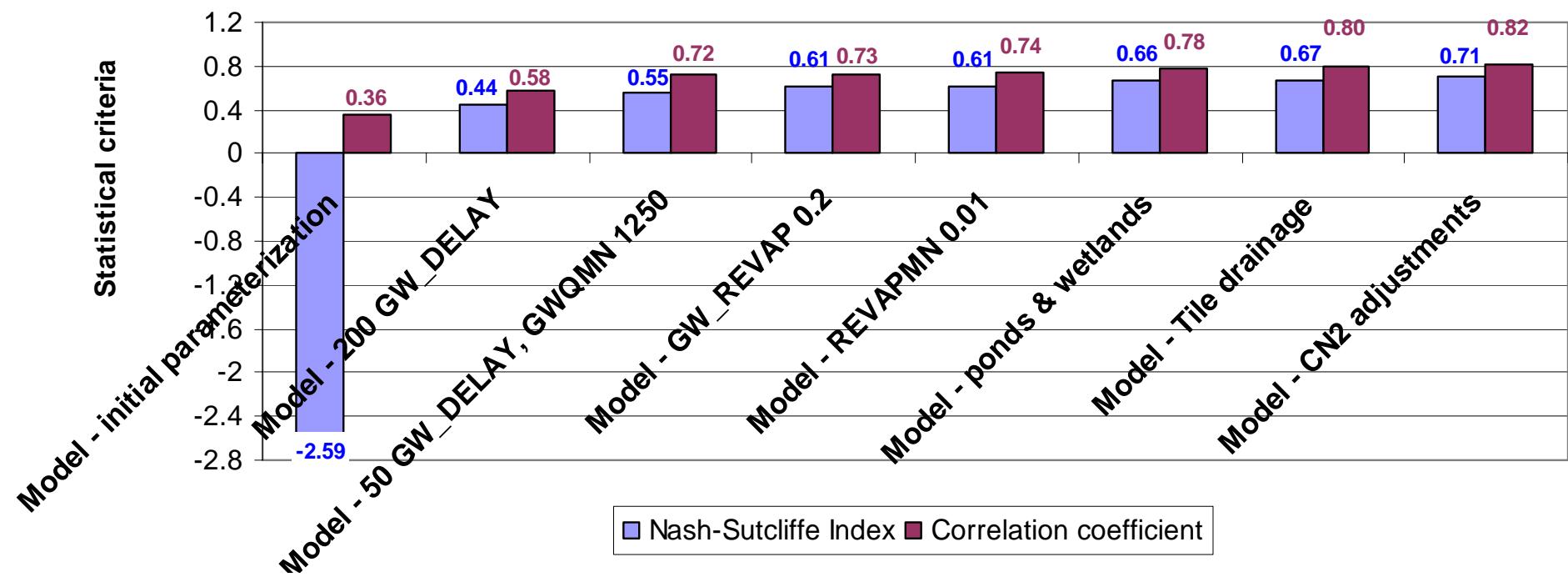
Agricultural area	381 ha	
Drained areas (digitized)	141 ha	37% (d. LN)
Drained areas (modelled)	184 ha	48% (d. LN)
Exact overlap	98,5 ha	70%
Absolute area difference		11%



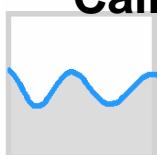
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# Stepwise model calibration of the Kielstau



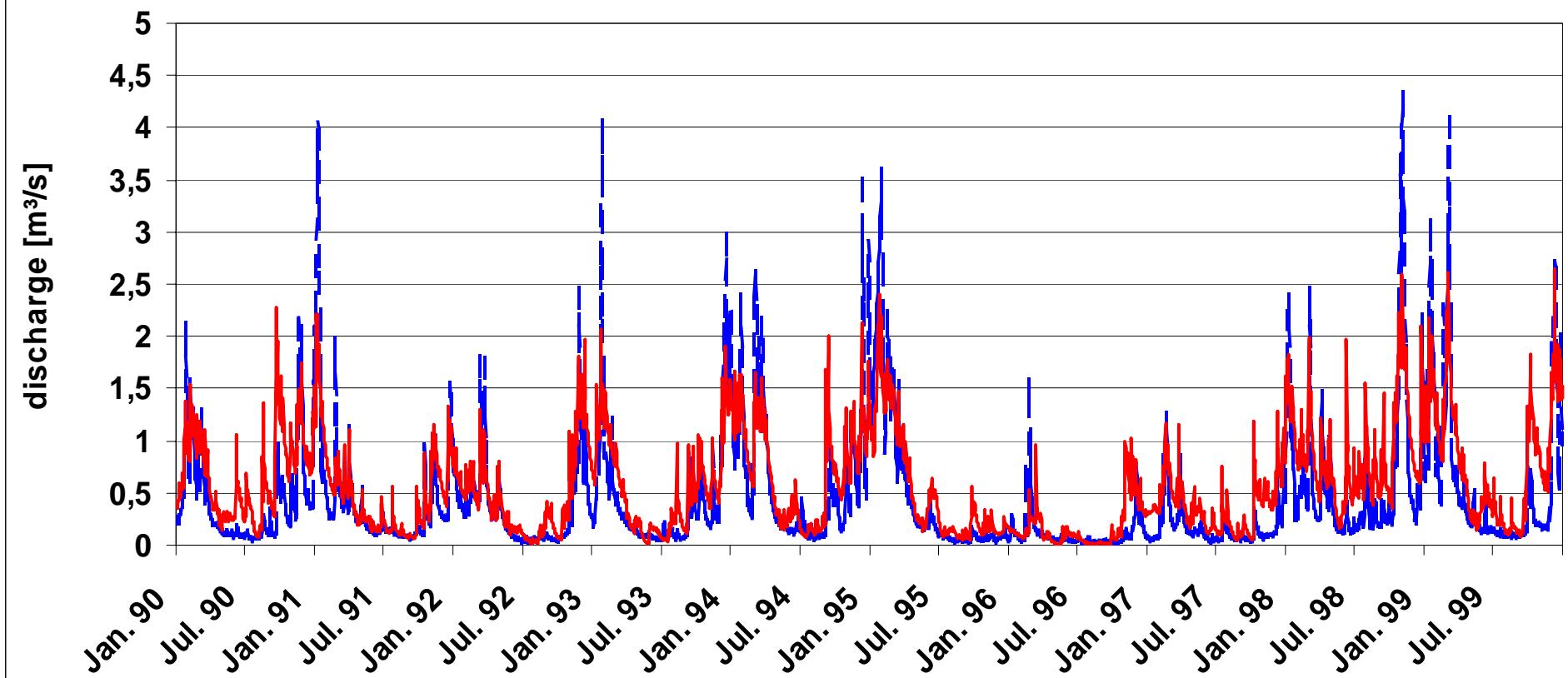
Calibrated period: 01.01.1990 - 31.12.1999



# Daily runoff Kielstau

Nash-Sutcliffe Index: 0,71 Correlation: 0,82  
MAE: 0,18 RSME: 0,36 r2: 0,66

measured  
modelled

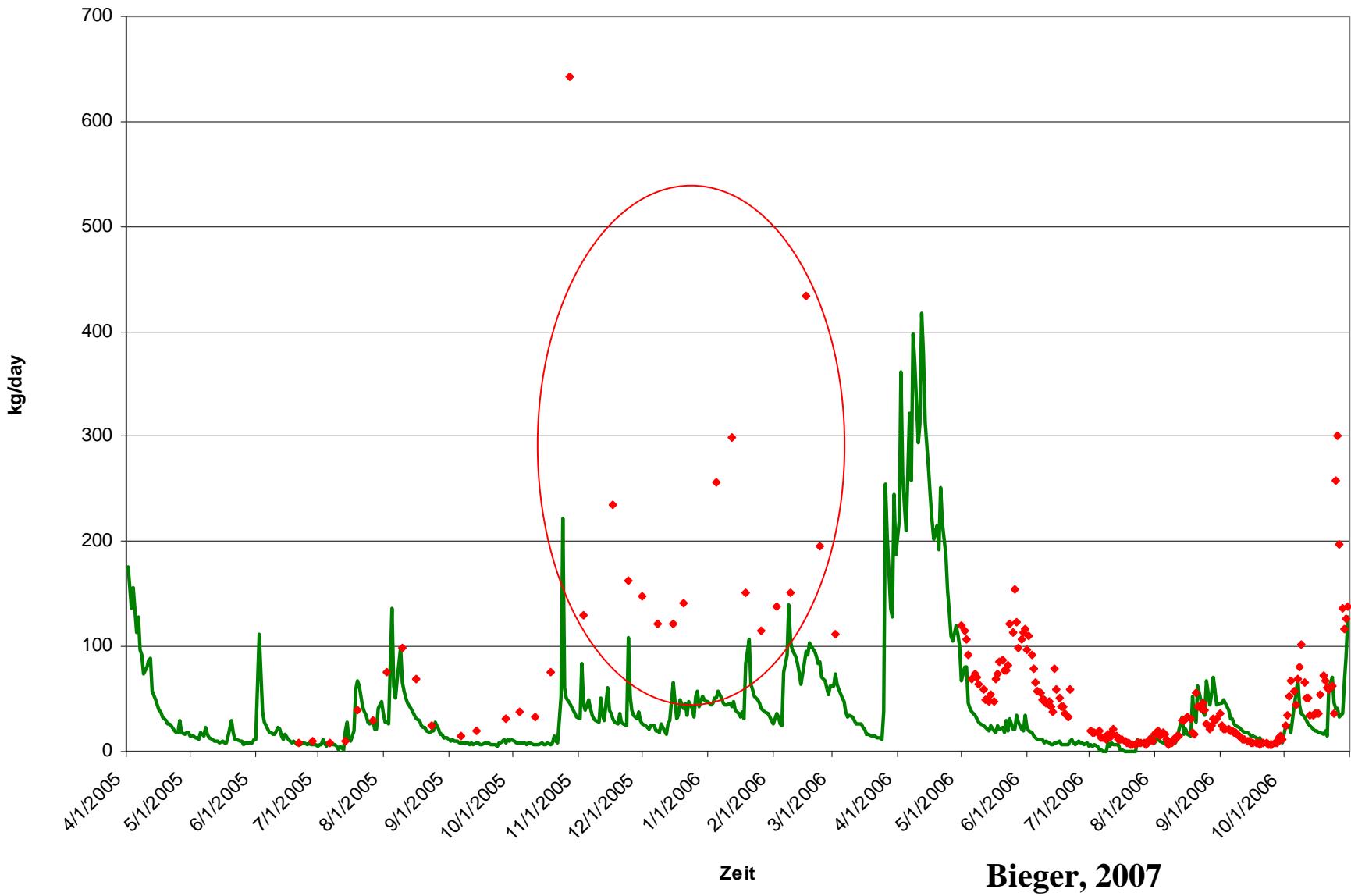


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(Tavares 2006)

# Nitrate loads per day –simulated and measured



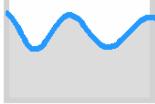
# Geese Farm, active from Oktober - December

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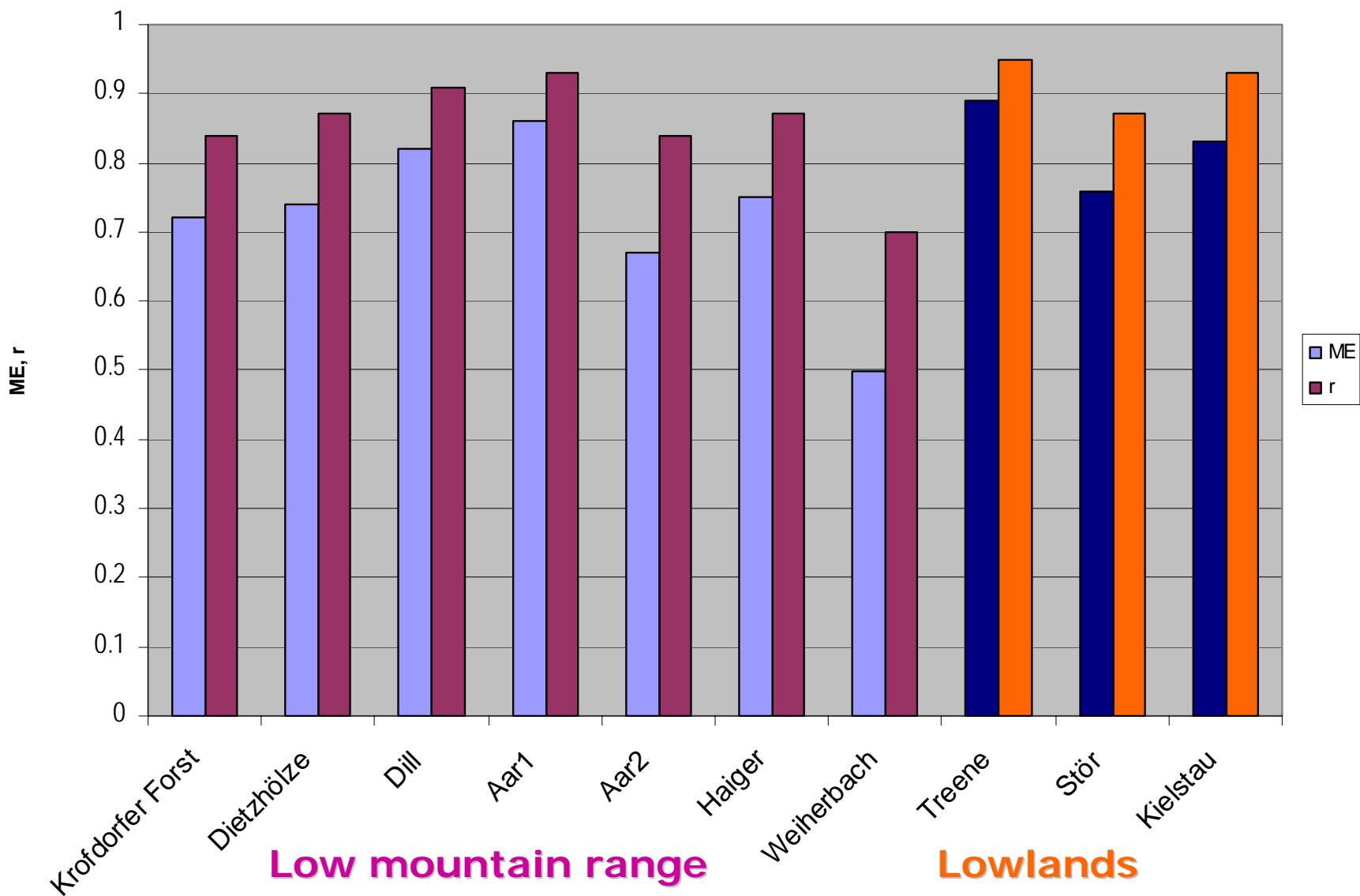
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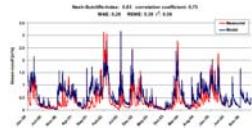
# **Comparision of modelling performance in different landscapes**

# Model performance - hydrology



# **future perspectives**

# Modelling the ecological potential of aquatic habitats



Watershed  
Hydrology  
and erosion

Discharge dynamics,  
sediment load



In-stream  
Hydraulics

Flow velocity,  
water depth,  
sediment transport

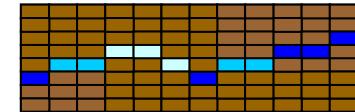
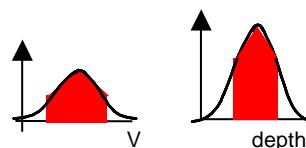
River  
Morphology  
Substrate,  
plants,  
bank structure



[www.freshwaterecology.info](http://www.freshwaterecology.info)  
The Taxa and Autecology Database for Freshwater Organisms



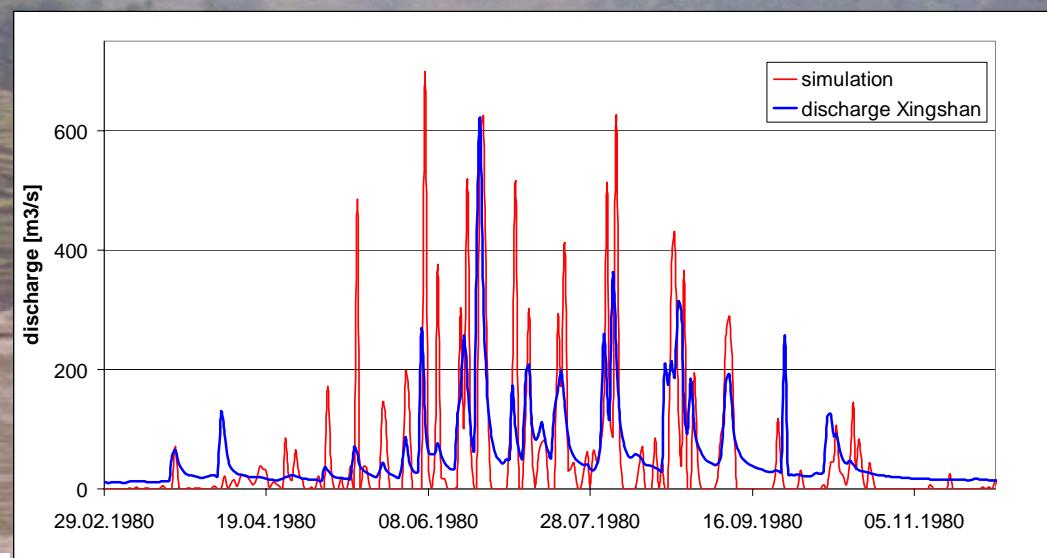
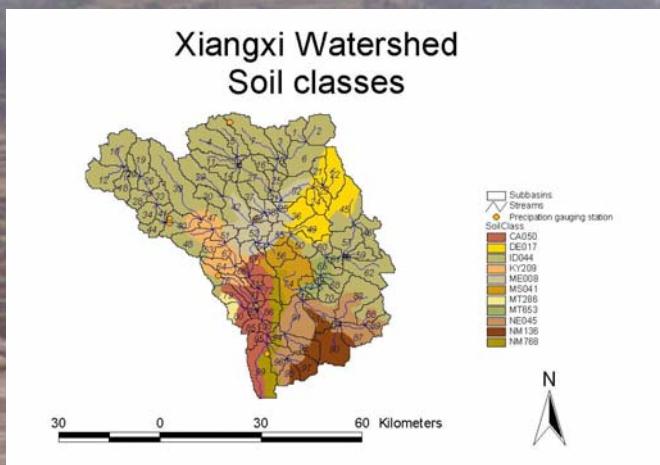
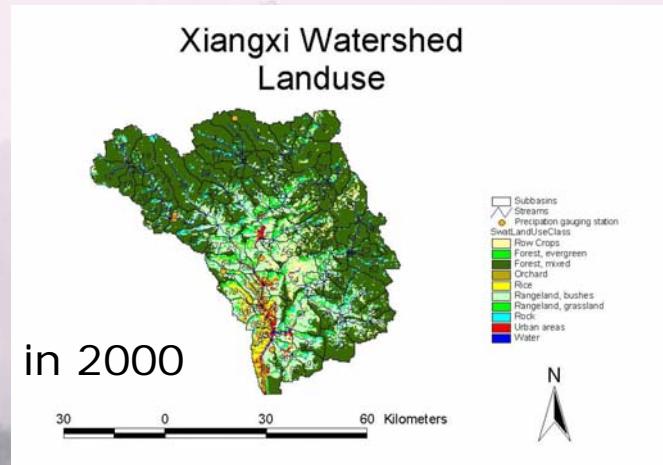
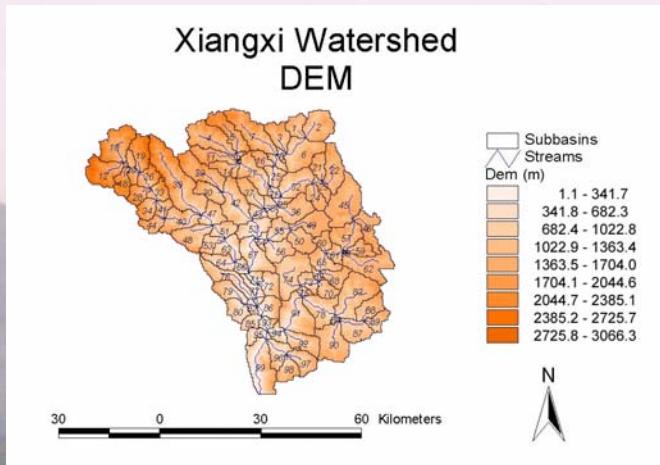
**Ecological functions**  
for each **parameter**  
and each **species**



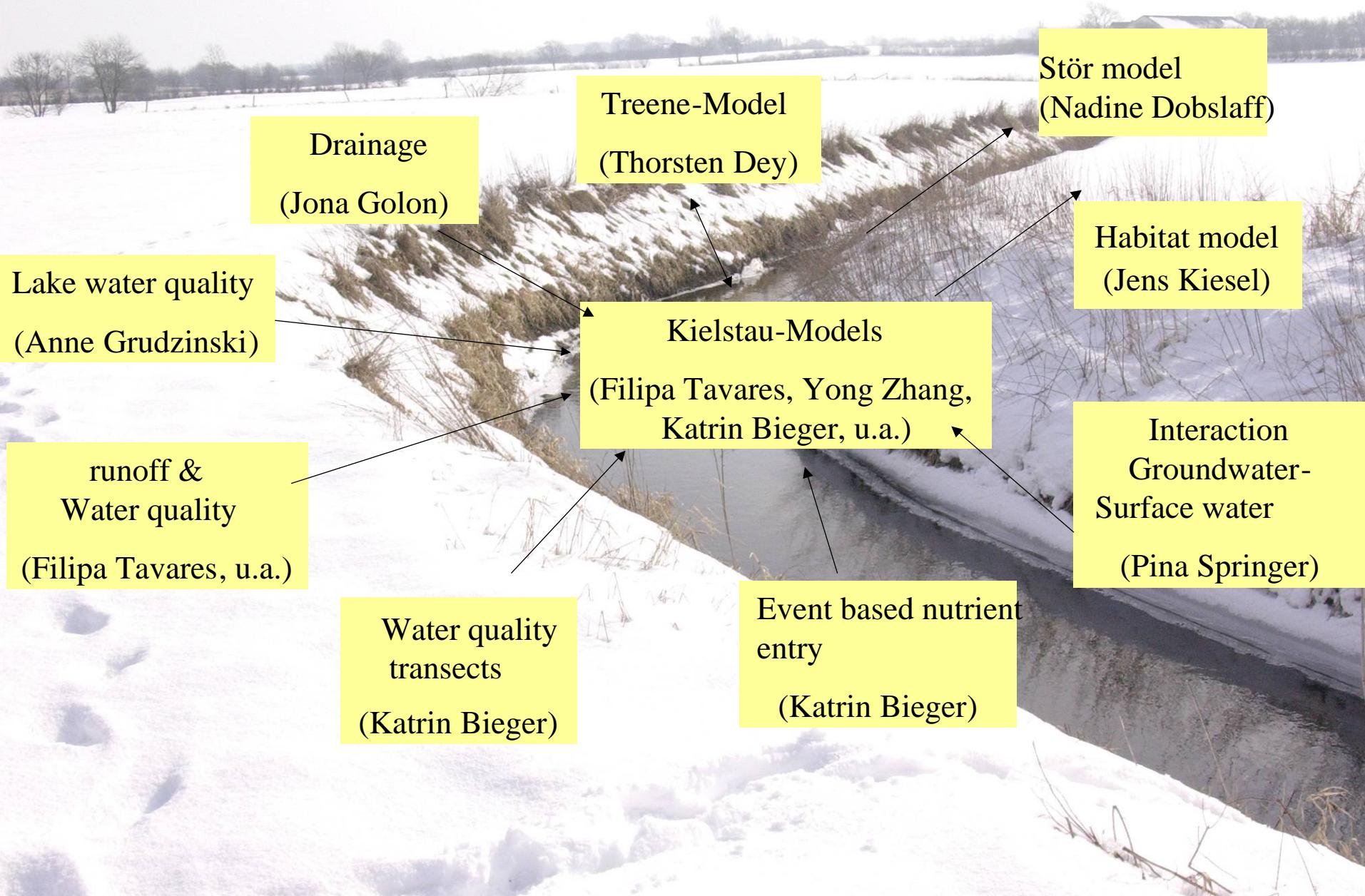
**Ecological  
potential**

Jens Kiesel, 2007-2010

# SWAT model for XiangXi river



# *Thank you to my team*





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