



A decision support system for sustainable peatland management regarding long-term changes in ecosystem functions

Astrid Knieß¹ & Michael Trepel^{1,2}

¹ Ecology Centre, Christian-Albrechts-University Kiel, Germany

² State Environmental Agency, Dep. Water Management, Germany

Europeat



Problems of actual land use on peat soils

- Higher nutrient discharge into rivers and lakes due to mineralisation
- Loss of biodiversity due to intensification of land use and abandonment
- Higher emission of greenhouse gases
- Loss of natural nutrient retention
- Loss of flooding area



Aims of DSS

- Definition of realistic management targets
- Demonstration of long-term changes of peatland functions
- Modelling of interactions between system components
- Support of sustainable use, conservation and restoration of peatlands

Potential endusers

- Scientists, water boards, environmental agencies

Ecosystem Services: The benefits people obtain from ecosystems



**Millennium Ecosystem Assessment:
an international scientific assessment
of consequences of ecosystem
change for human well-being**

Peatland functions in the DSS

Regulation of global climate

CO₂ - emission/sequestration
CH₄ - emission
N₂O - emission

GWP

Agricultural and silvicultural production

Harvest of plant products

Regulation of catchment hydrochemistry

N - leaching

Existence of plants, animals and ecosystems

Coverage by red list plant species

Regulation of catchment hydrology

Water discharge
Peak discharge

Carrier function

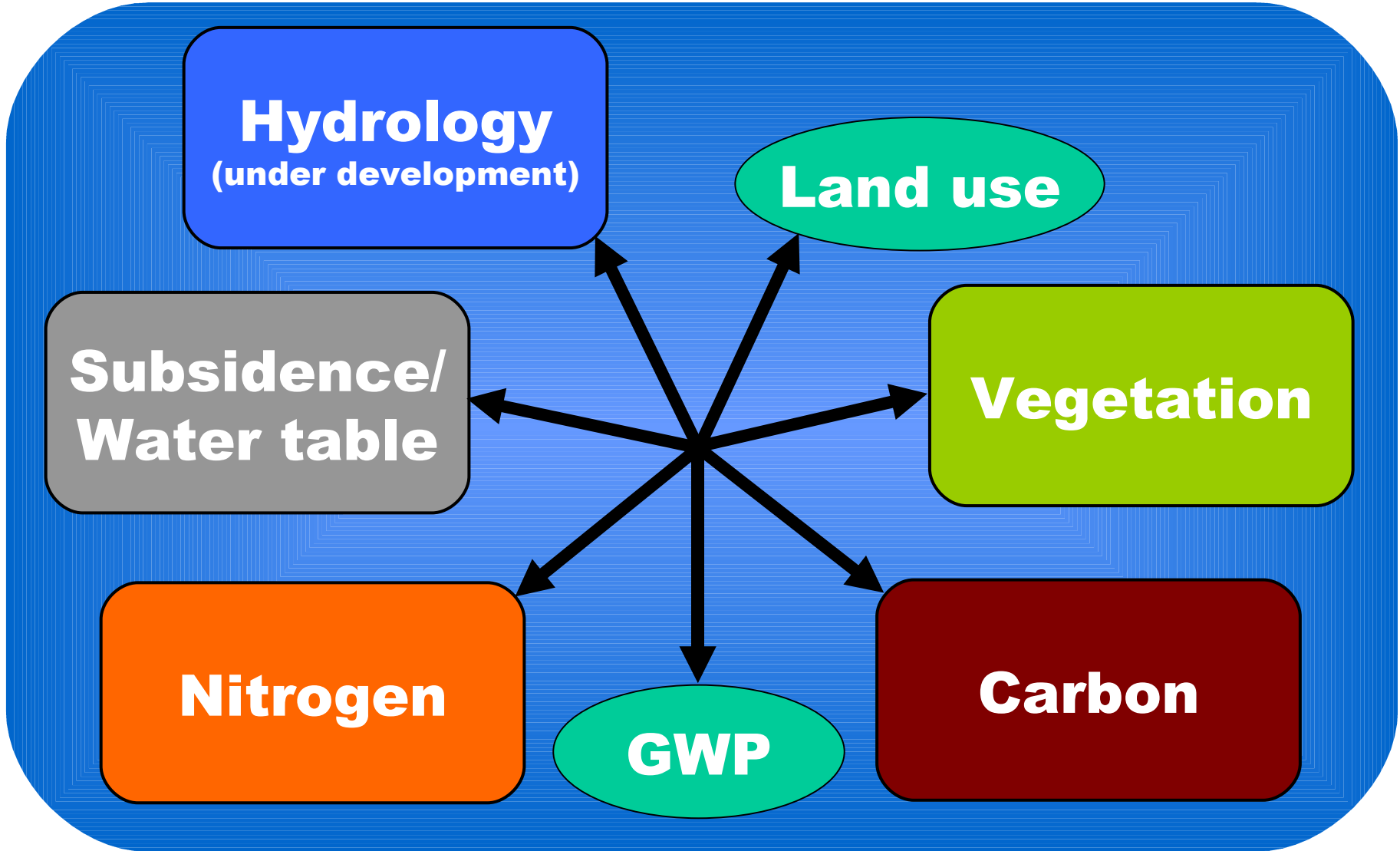
Land use category

Realisation of the DSS

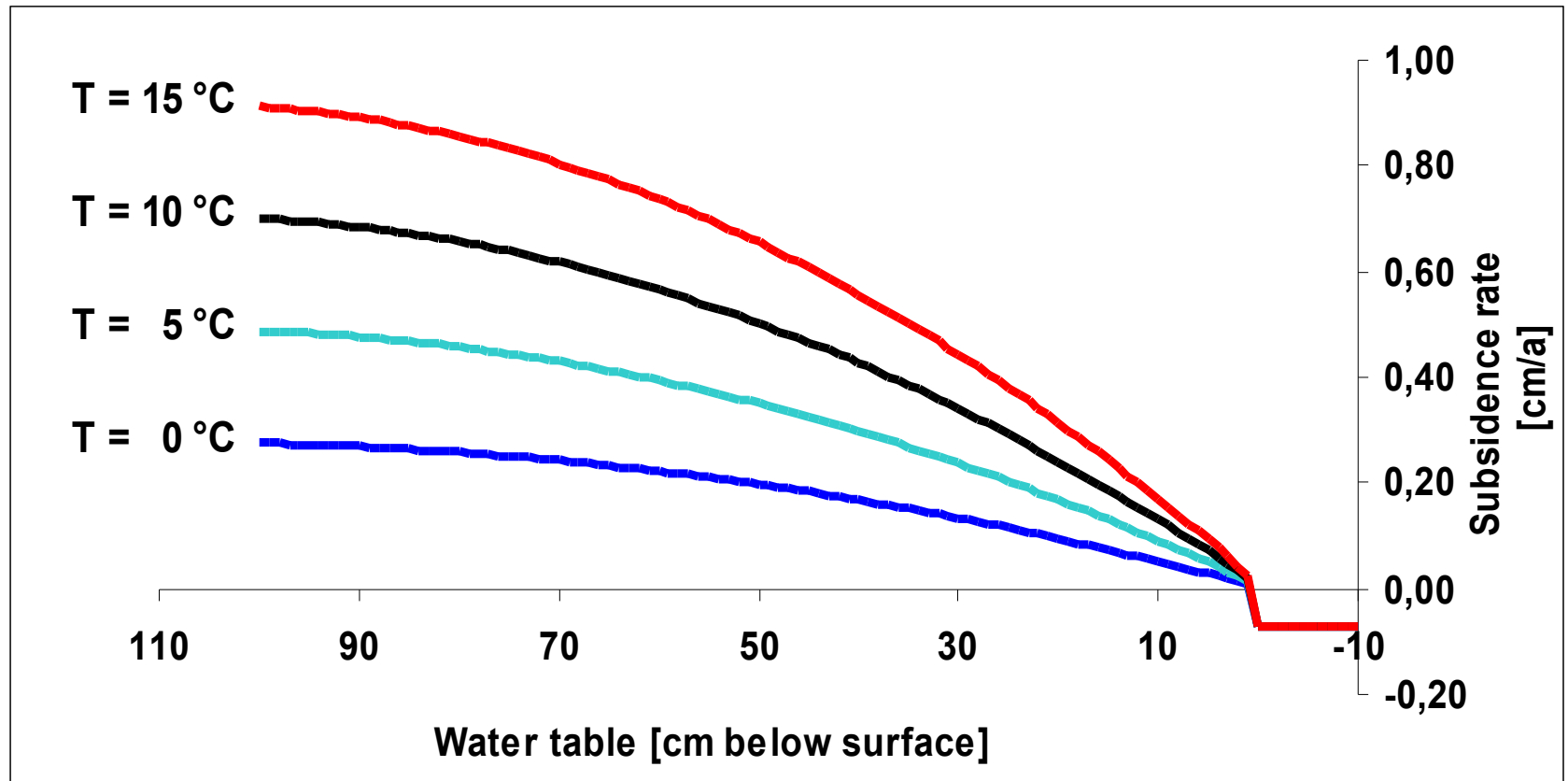
- **Semi-quantitative model**
 - MSEXcel
 - rules, qualitative statements, physical equations
 - developed from literature reviews, expert knowledge, first assumptions
- **One-dimensional**
 - “homogenous site/ field”
(homogenous land use, vegetation type, water table)
- **Yearly intervals**
 - Time span: 50 - 100 years
- **Reduced amount of input data**
 - Easy collectable within few days

Parameter	Unit	Actual land use	Second model year
Site Name	-	Metroprefektur rewetting 1	
Area	ha	40	
Peat thickness	m	0.5	>= 0.3
Impermeable layer below the peat	yes = 1, no = 0	1	0
Clay layer near surface	m	0	>= 0 and < 0.2
Land use number	1 to 11	11	none
Surface level	m ASL	-1.40	> -2.50
Lowest possible water table	m ASL	-2.90	< -1.50
Mean summer water table	cm below surface	-40	> -50 and < 110
Water table fluctuations	cm	20	> -50 and < 110
Air temperature	°C	8.3	>= 5 and <= 20
N-Deposition	kg N ha ⁻¹ a ⁻¹	20	>= 20
N-Fertilizer	kg N ha ⁻¹ a ⁻¹	0	0
Additional N-input after rewetting	kg N ha ⁻¹ a ⁻¹	0	0
Water source	1, 5, 10	0	mixed water
Field crop	maize/others/forest	others	others
Country	-	Germany	others
For calculation of parameters above:			
Precipitation	mm/a	650	
N-Deposition	mg N/l	1.2	1.7
Further input for vegetation module:			
Seedling cover vegetation release	example: yes = 1, no = 0	0	
Column of release in Mod_veg	Letter of column in Mod_veg	R	

Land use, Water management

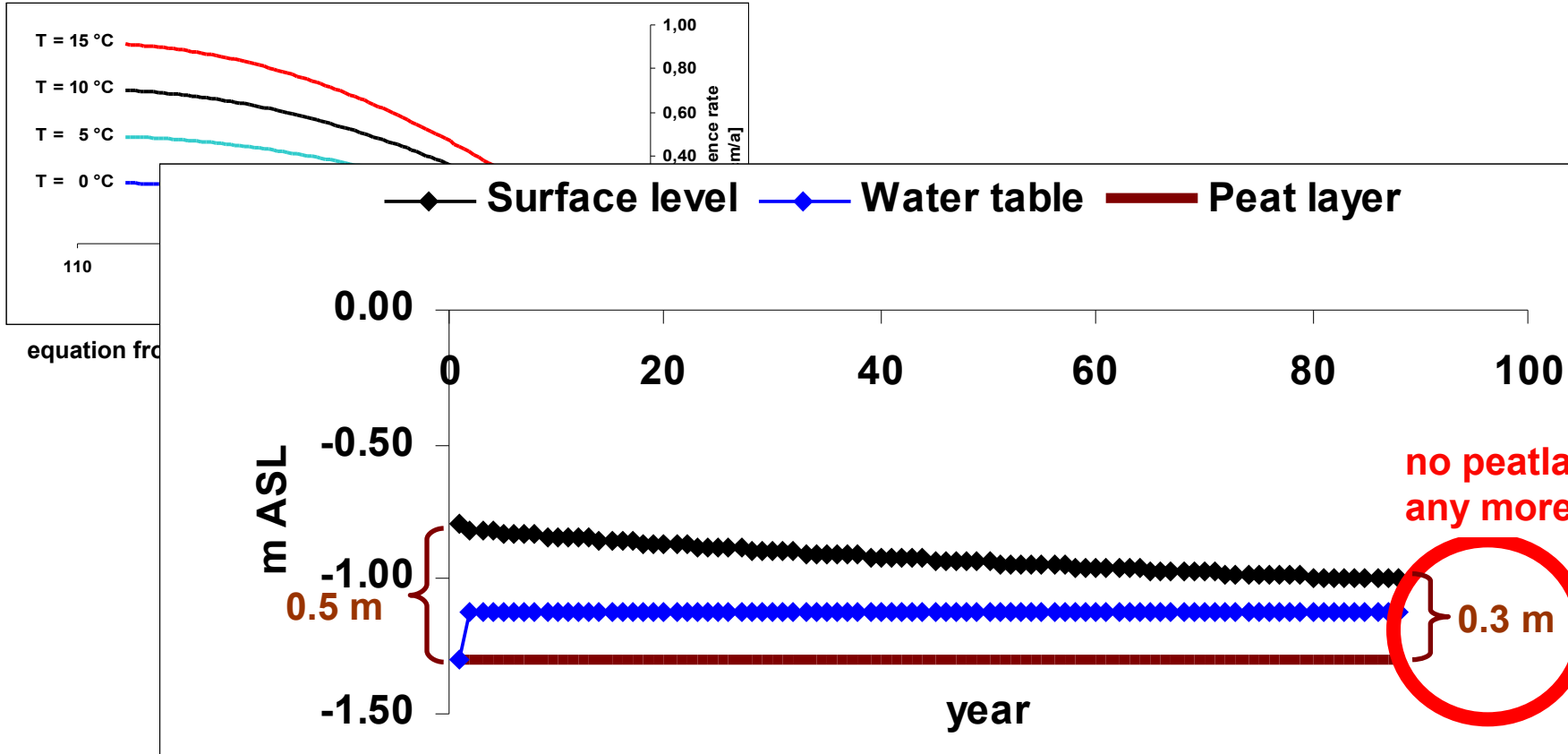


Subsidence/ water table

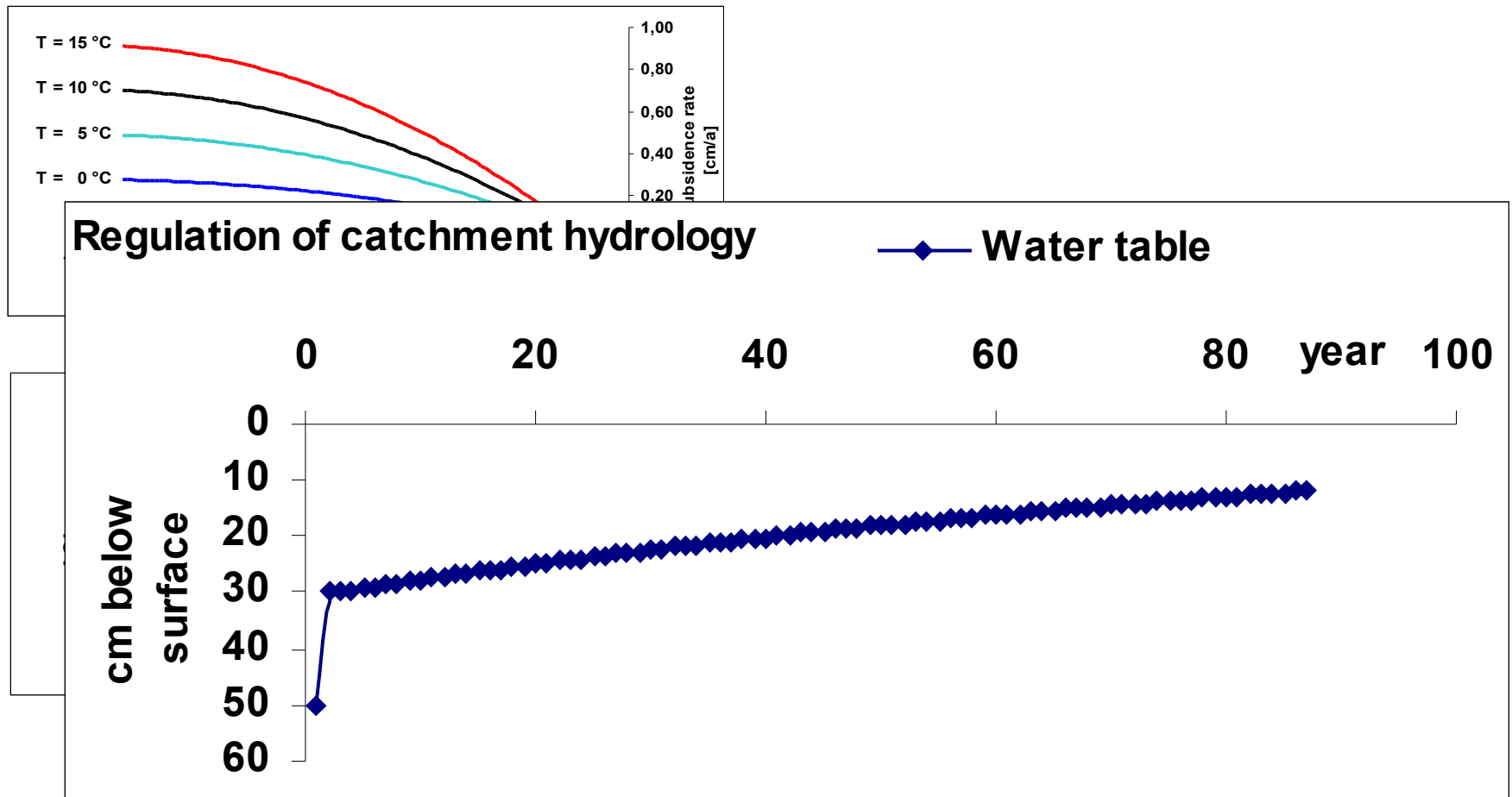


equation from Renger et al. (2002) extended

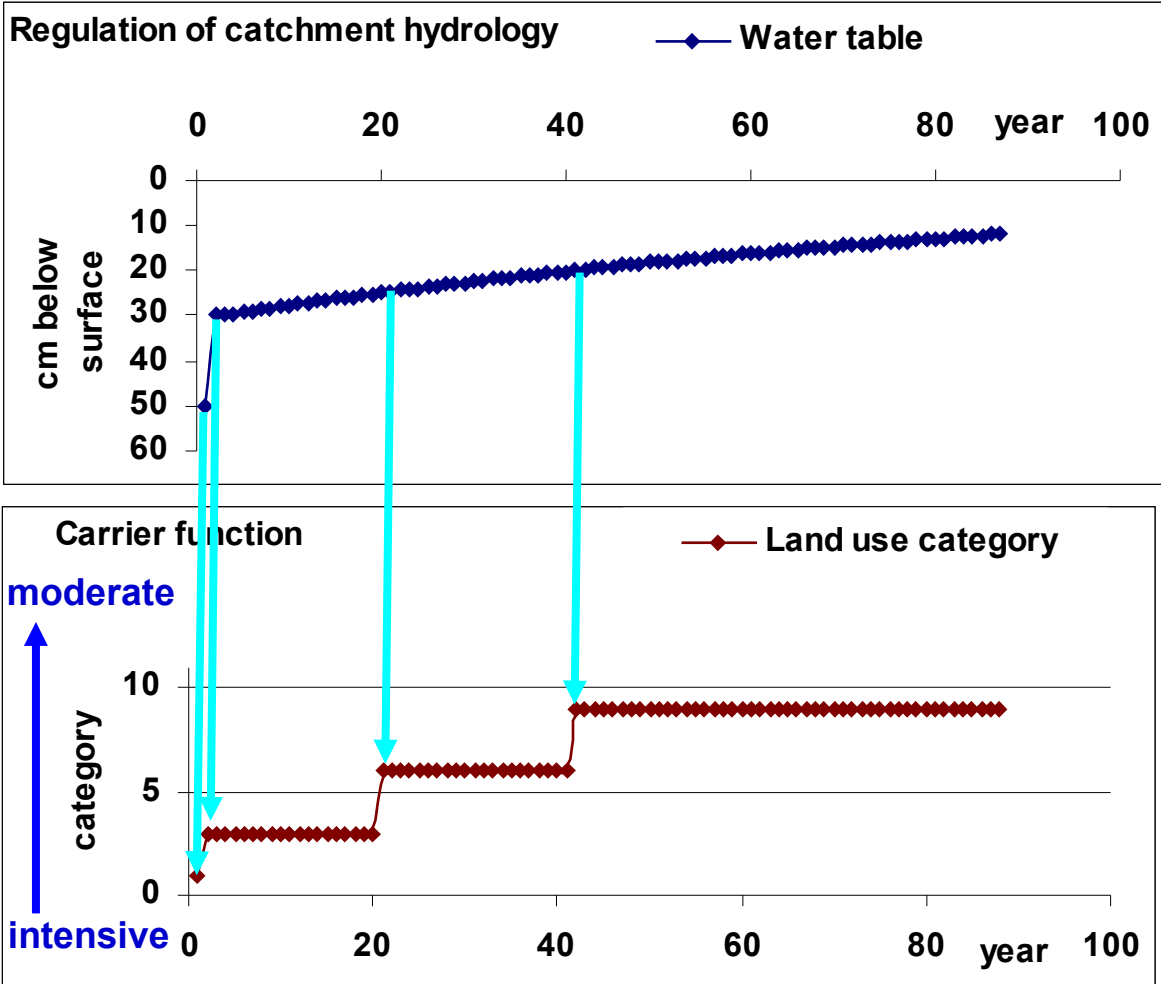
Subsidence/ water table



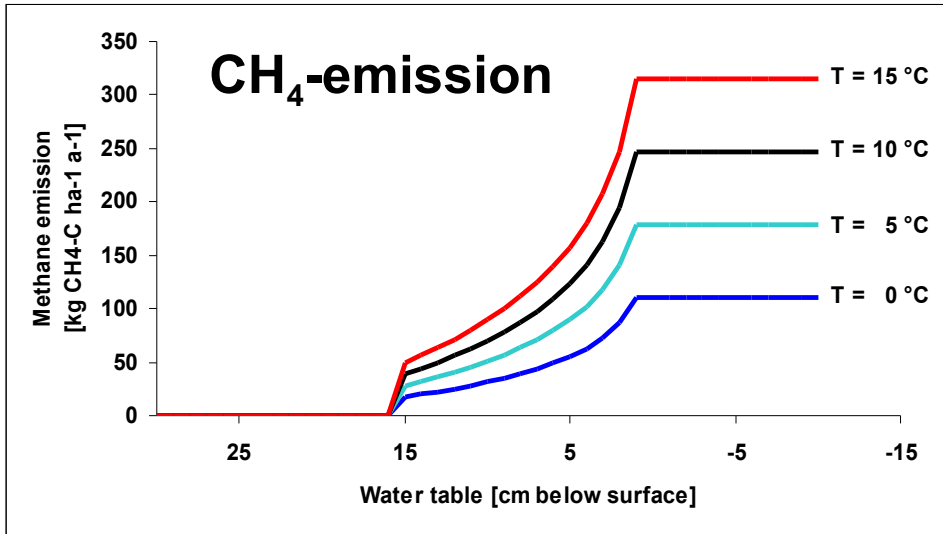
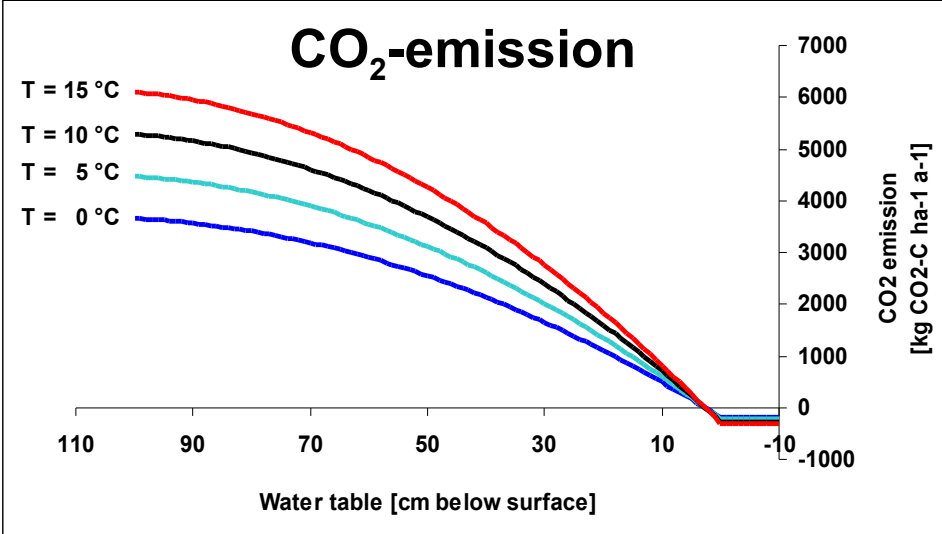
Subsidence/ water table



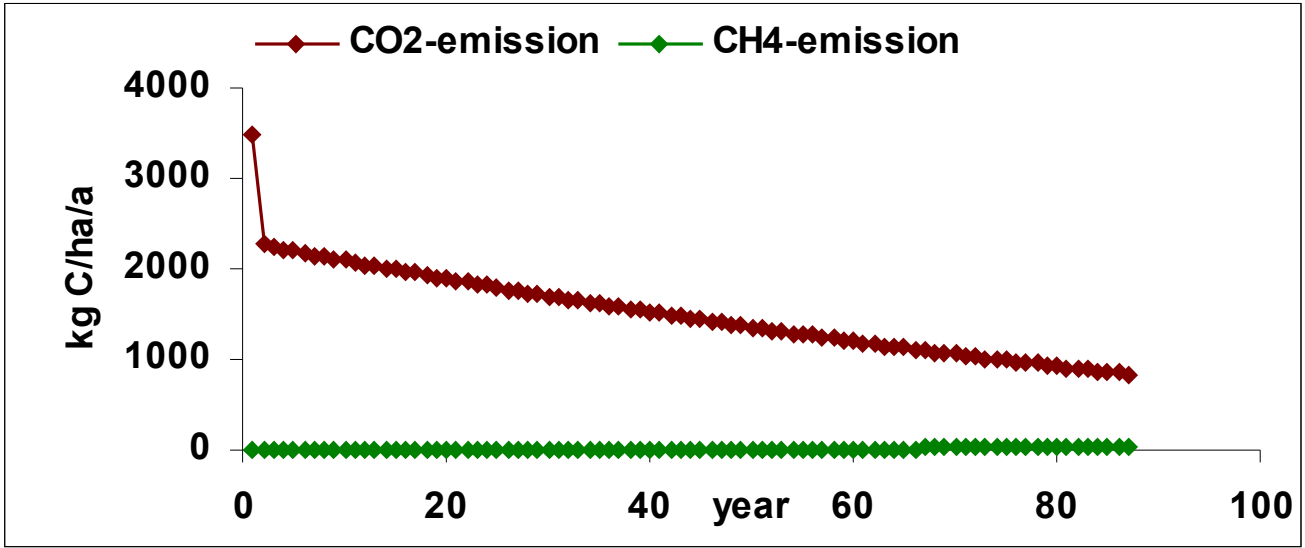
Subsidence/ water table



Carbon



equation from Renger et al. (2002) extended



Vegetation

- Vegetation change over time:
 - N-fixation, dry matter production, N-export by harvest
 - nature conservation value, economic value

see Poster at this conference
by
Bettina Holsten & Michael Trepel:
“Modelling vegetation-succession
on peatlands for land use
planning”

Modelling vegetation-succession on peatlands for land use planning

Bettina Holsten & Michael Trepel
Ecology Centre, Christian-Albrechts-University Kiel, Germany

Introduction

We have tested an online tool to predict changes in peatland vegetation over a 50-year period. The model simulates vegetation changes on peat soils with an annual time step. It is suitable for use in a wide range of peatland types. The model can be used to predict the changes in vegetation over a 50-year period. The model can be used to predict the changes in vegetation over a 50-year period. The model can be used to predict the changes in vegetation over a 50-year period.

Methods

The model uses the following input parameters:

- Soil texture (sand, silt, clay)
- Soil depth (cm)
- Water table (m)
- Temperature (°C)
- Light (h)
- Nitrogen (mg N m⁻² yr⁻¹)
- Phosphorus (mg P m⁻² yr⁻¹)
- Potassium (mg K m⁻² yr⁻¹)
- Calcium (mg Ca m⁻² yr⁻¹)
- Magnesium (mg Mg m⁻² yr⁻¹)
- Sulfur (mg S m⁻² yr⁻¹)
- Zinc (mg Zn m⁻² yr⁻¹)
- Copper (mg Cu m⁻² yr⁻¹)
- Manganese (mg Mn m⁻² yr⁻¹)
- Iron (mg Fe m⁻² yr⁻¹)

Results

Change from initial state (year 0) to final state (year 50) for different vegetation types.

Validation

Comparison of model results with observed vegetation after 50 years.

Vegetation type	Model result	Observed vegetation
Peat group 1 (MBSM)	37% cover	37% cover
Peat group 2 (MBSM)	17% cover	18% cover
Peat group 3 (MBSM)	17% cover	18% cover
Peat group 4 (MBSM)	17% cover	18% cover
Peat group 5 (MBSM)	17% cover	18% cover
Peat group 6 (MBSM)	17% cover	18% cover
Peat group 7 (MBSM)	17% cover	18% cover
Peat group 8 (MBSM)	17% cover	18% cover
Peat group 9 (MBSM)	17% cover	18% cover
Peat group 10 (MBSM)	17% cover	18% cover
Peat group 11 (MBSM)	17% cover	18% cover
Peat group 12 (MBSM)	17% cover	18% cover
Peat group 13 (MBSM)	17% cover	18% cover
Peat group 14 (MBSM)	17% cover	18% cover
Peat group 15 (MBSM)	17% cover	18% cover
Peat group 16 (MBSM)	17% cover	18% cover
Peat group 17 (MBSM)	17% cover	18% cover
Peat group 18 (MBSM)	17% cover	18% cover
Peat group 19 (MBSM)	17% cover	18% cover
Peat group 20 (MBSM)	17% cover	18% cover

Discussion

The model provides a valuable tool for predicting changes in peatland vegetation over a 50-year period. The model can be used to predict the changes in vegetation over a 50-year period. The model can be used to predict the changes in vegetation over a 50-year period.

Literature

Holsten, B. & Trepel, M. (2017) Modelling vegetation succession on peatlands for land use planning. *Ecology Centre, Christian-Albrechts-University Kiel, Germany*.

Application example: Mötjerpolder (Northern Germany)



- area of 320 ha
- owned by a nature conservation foundation
- peat thickness: 0.3 to 1.5 m

Part	Area [ha]	Before rewetting		Shortly after rewetting	
		Land use/ Vegetation	Summer water table [cm below surface]	Land use/ potential vegetation	Summer water table [cm below surface]
1	40	Reed	-10	Reed	-20
2	60	Extensive meadow and pasture	20	Reed	0
3	10	Forest / wood	20	Reed	0
4	50	Extensive meadow and pasture	40	Very extensive meadow	20
5	10	Forest / wood	40	Wood	20
6	150	Extensive meadow and pasture	70	Very extensive meadow	50

Example: input data

Microsoft Excel - DSS_lund_2.xls

Frage hier eingeben

Arial 10

C14 = 20

		Before rewetting			After rewetting		
Input		Actual land use			Second model year		
Parameter	Unit	Value	Description	Range / Default	Value	Description	Range / Default
Site Name	-	Mötjerpolder					
Scenario	-	rewetting 2					
Area	ha	60					
Peat thickness	m	0.5		>= 0.3			
Impermeable layer below the peat	yes = 1, no = 0	1		0			
Clay layer near surface	m	0		>=0 and <=0.2			
Land use number	1 to 11	7	grassland, extensive mowing		11	none	
Surface level	m ASL	-1.10		> -2.15			
Lowest possible water table	m ASL	-2.50		< -1.45	-1.50		< -1.2
Mean summer water table	cm below surface	20		> 20 and < 140	0		> -50 and < 140
Water table fluctuations	cm	15		20	10		20
Air temperature	°C	8.3		>= -5 and <= 25			
N-Deposition	kg N ha ⁻¹ a ⁻¹	28		28.22			
N-Fertilizer	kg N ha ⁻¹ a ⁻¹	0		75	0		0
Additional N-input after rewetting	kg N ha ⁻¹ a ⁻¹	0		0	0		0
Water source	1,5,10	5	mixed water		5	mixed water	5
Field crop	maize/others/forest	others		others	others		others
Country	-	G	Germany				
For calculation of parameters above:							
Precipitation	mm/a	830					
N-Deposition	mg N/l	1.7		1.7			
Further input for vegetation module:							
Inserting new vegetation relevee	example: yes = 1, no = 0	0					
Column of relevee in Mod_veg4	Letter of column in Mod_veg4	F					

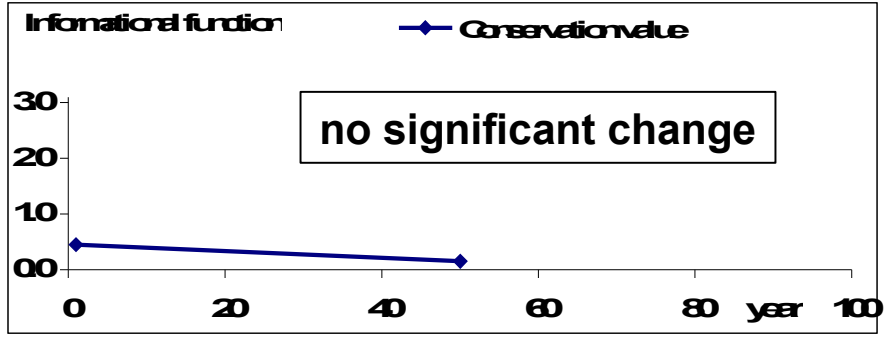
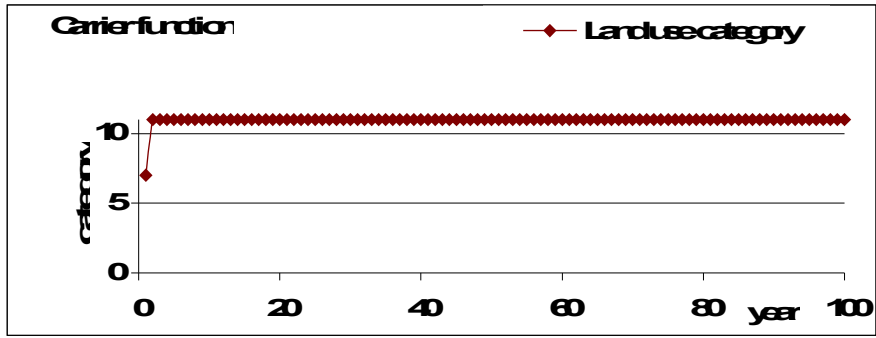
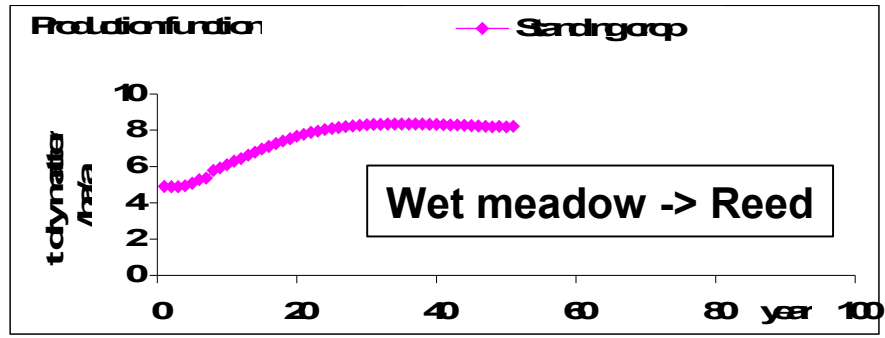
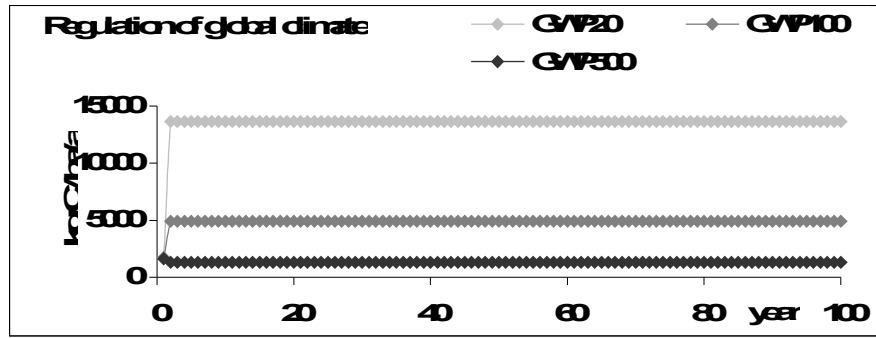
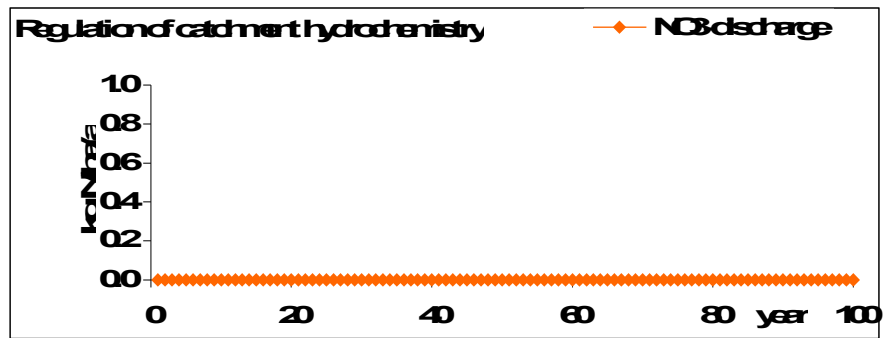
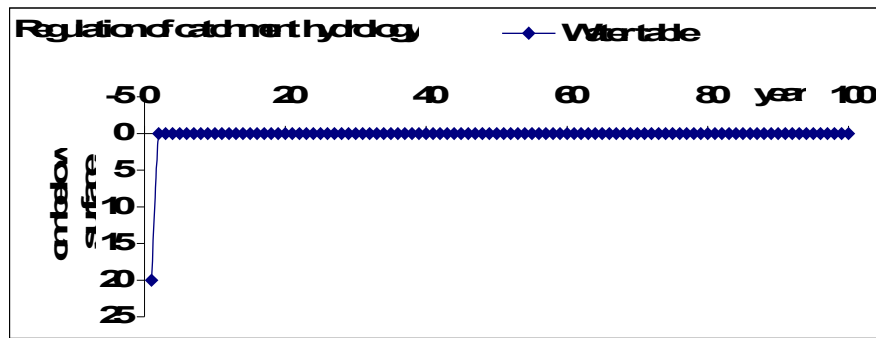
Input_par

Zeichnen

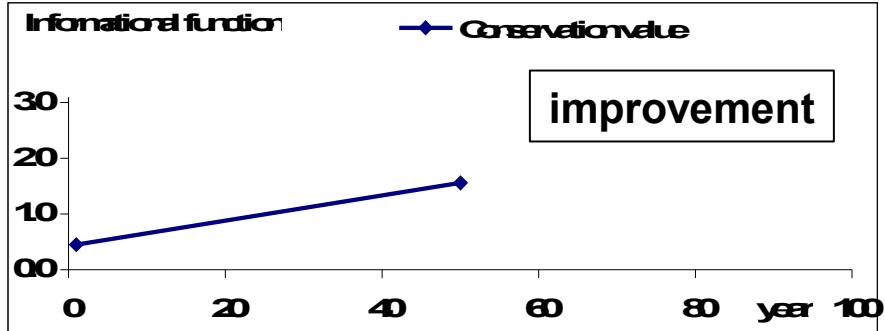
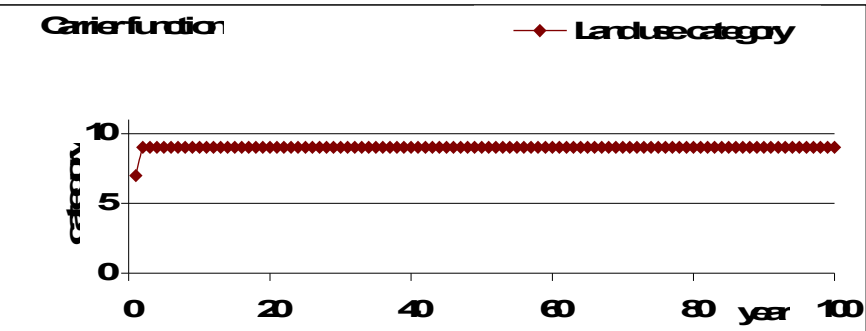
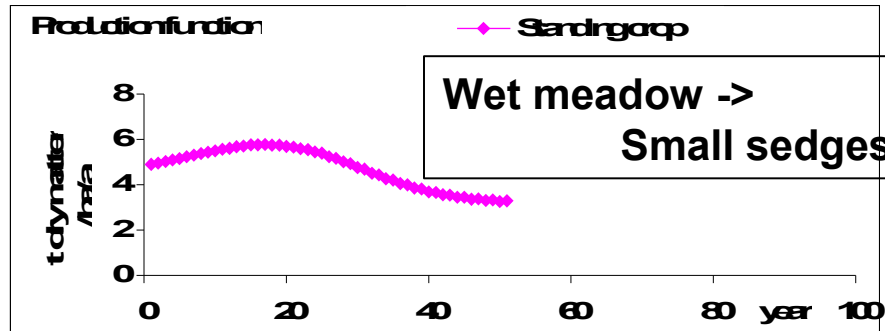
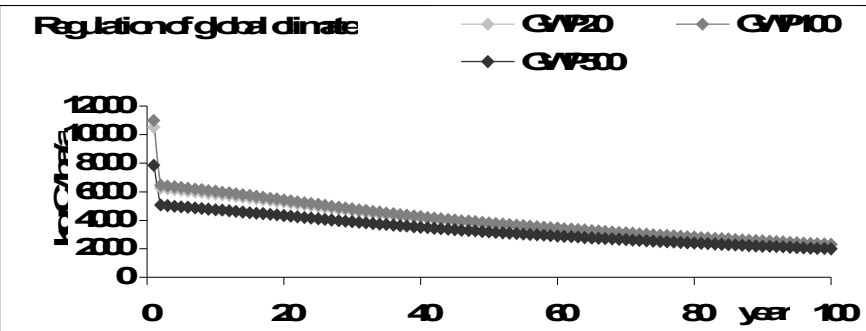
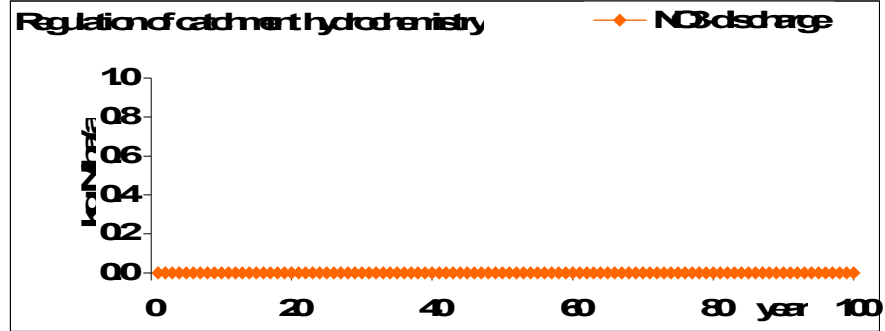
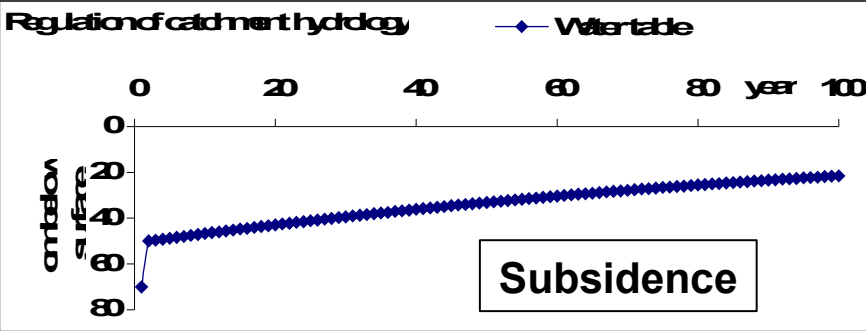
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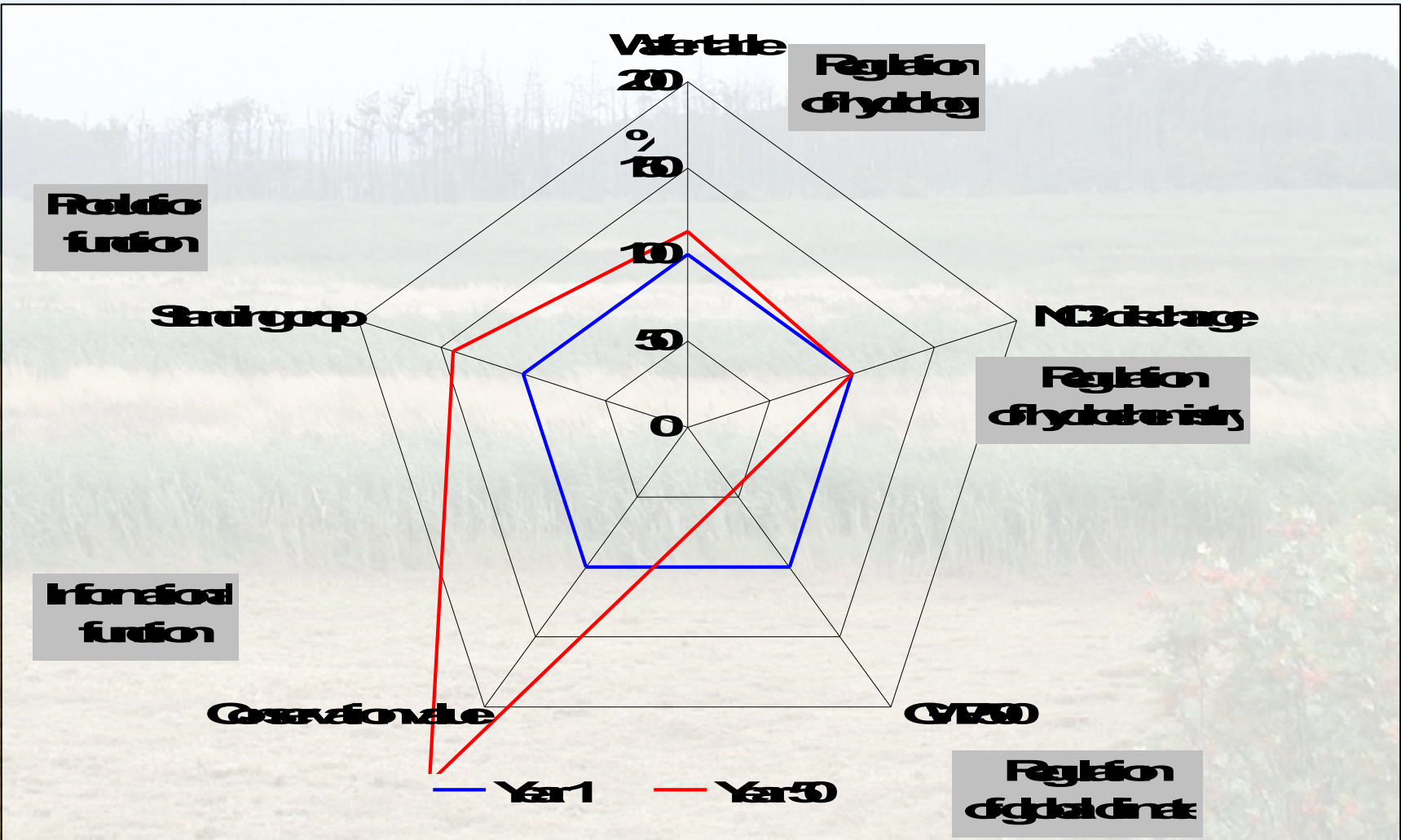
- 2 ➤ Land use: extensive grassland to abandonment
- Peat thickness: 0.5 m



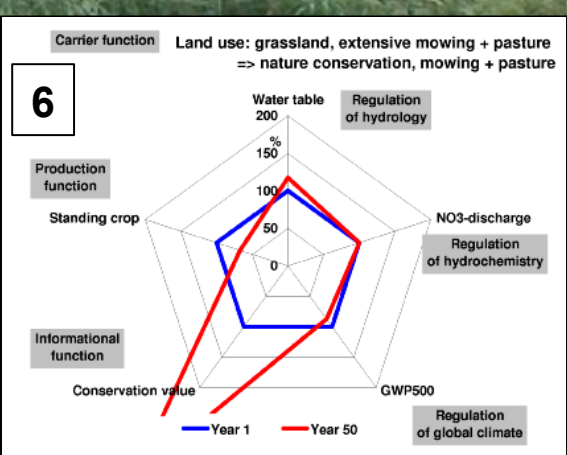
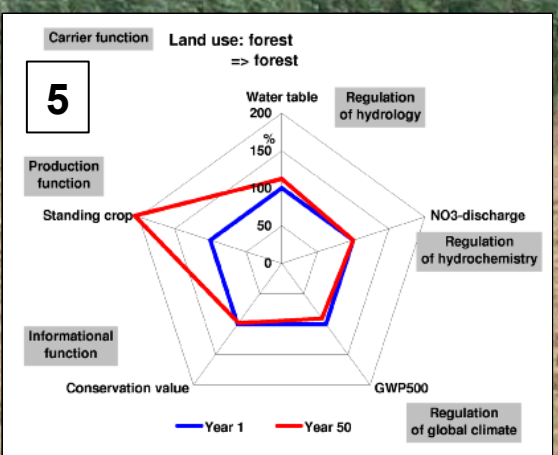
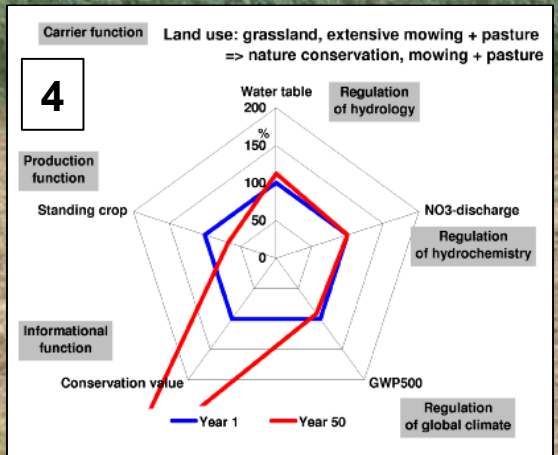
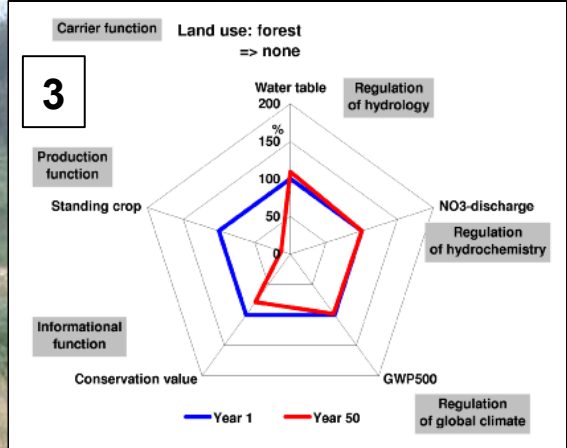
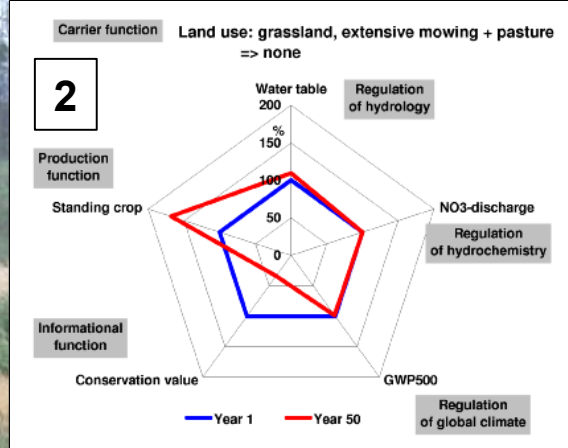
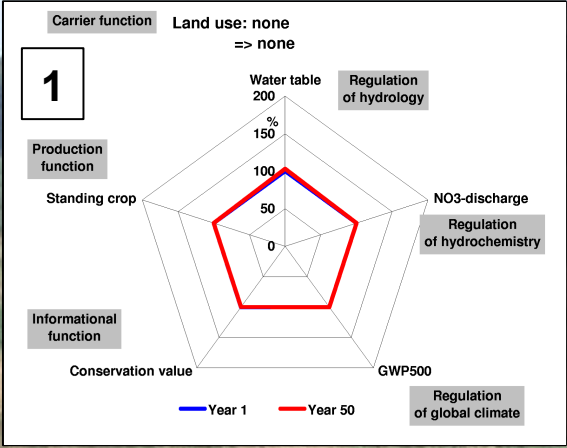
- 6 ➤ Land use: extensive grassland to very extensive meadow
- Peat thickness: 0.8 m



Relative change of peatland functions after rewetting of Mötjenspolder



Relative change of peatland functions after rewetting in different parts of Mötjenspolder



Conclusion

- **The results can be used**
 - to define realistic management targets and
 - to develop wise use concepts for peatlands.
- **The DSS**
 - simulates the effect of land use and water management on landscape ecological functions and
 - includes the long-term interaction between system components.

Thank you for paying attention !

