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

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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

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

Peatland functions in the DSS

Regulation of global climate

CO_2 - emission/sequestration

CH_4 - emission

N_2O - 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

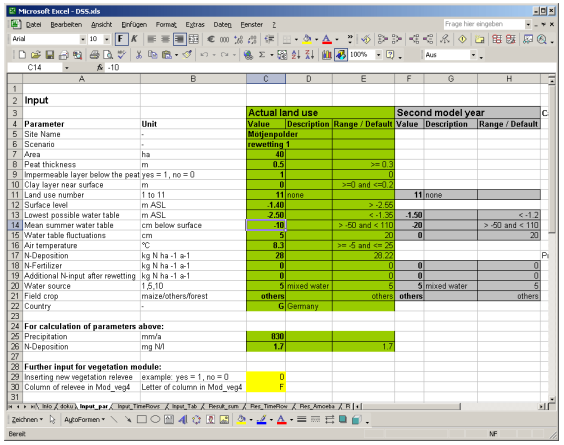
Peak discharge

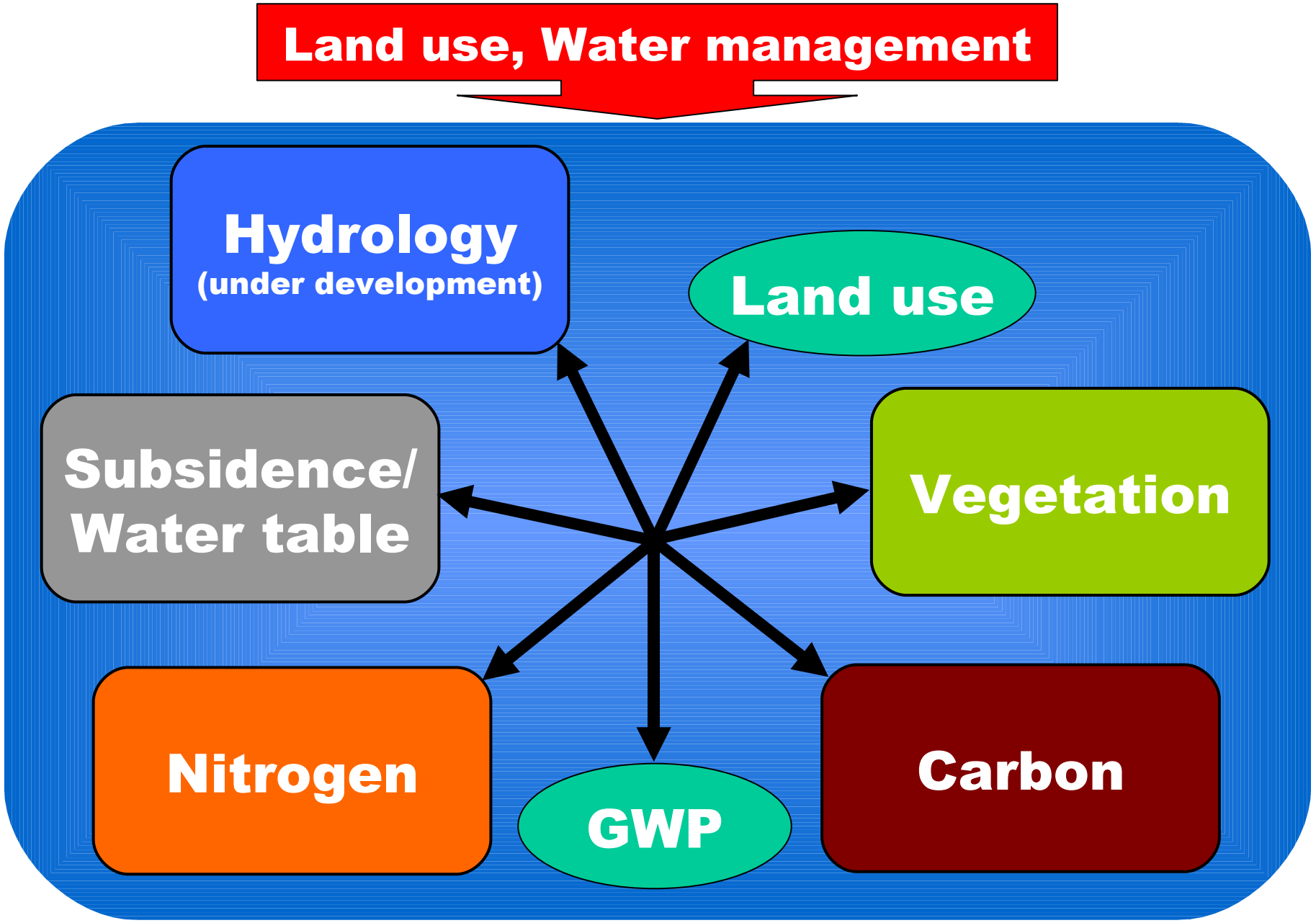
Carrier function

Land use category

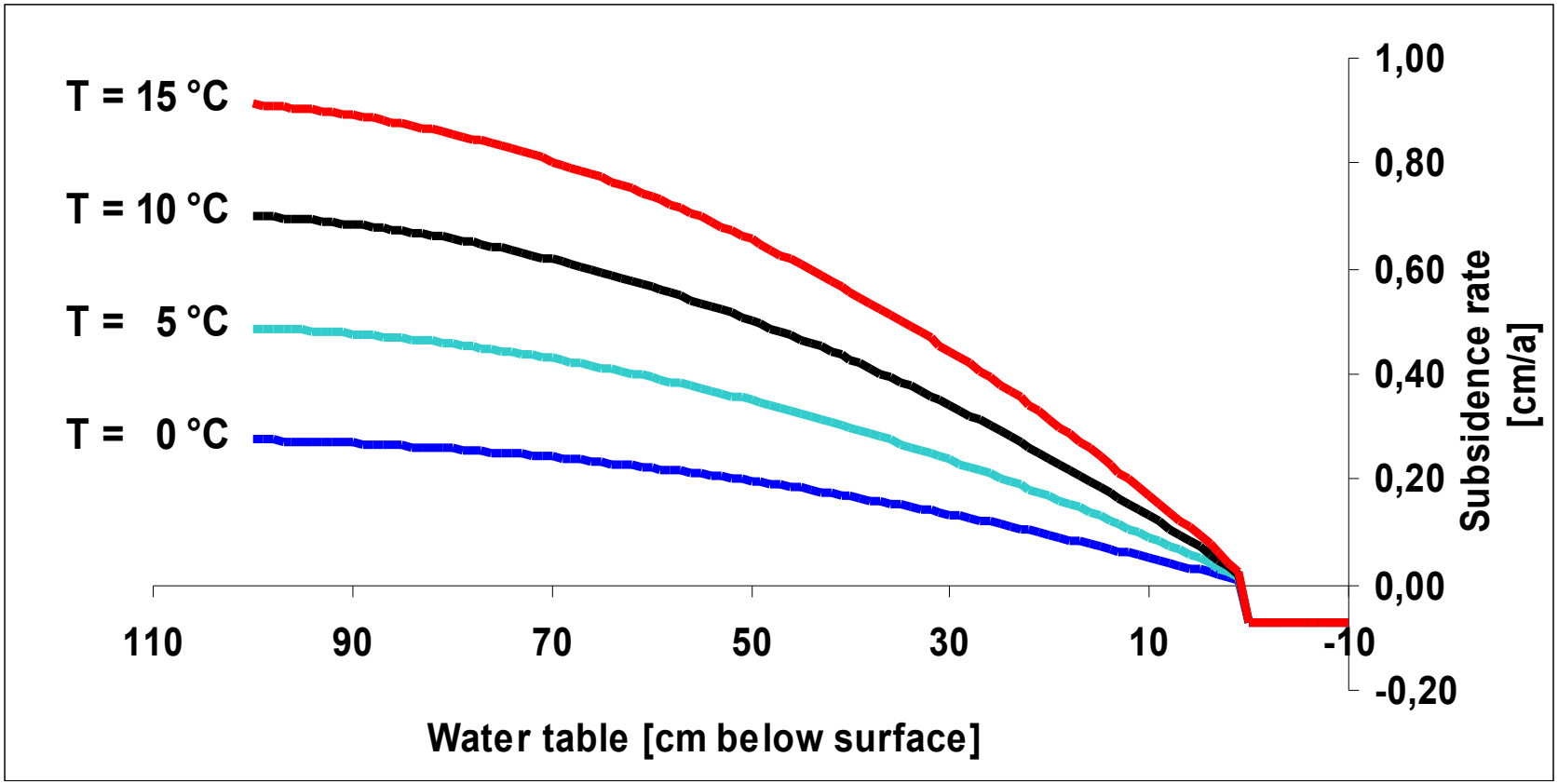
Realisation of the DSS

- 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



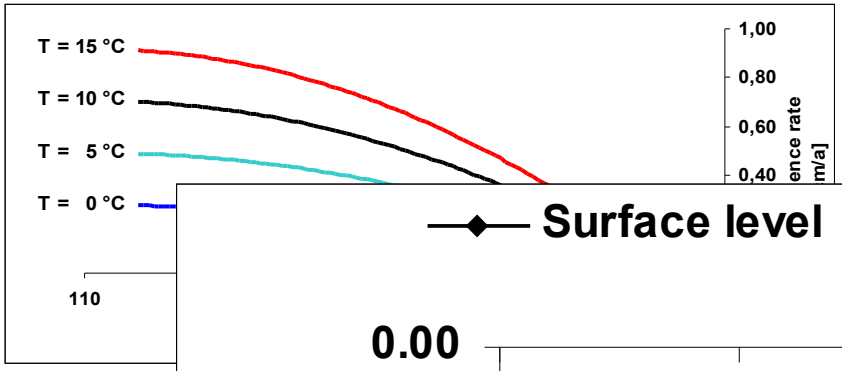

Land use, Water management
Hydrology
(under development)
Land use
Subsidence/
Water table
Vegetation
Nitrogen
GWP
Carbon

Subsidence/ water table

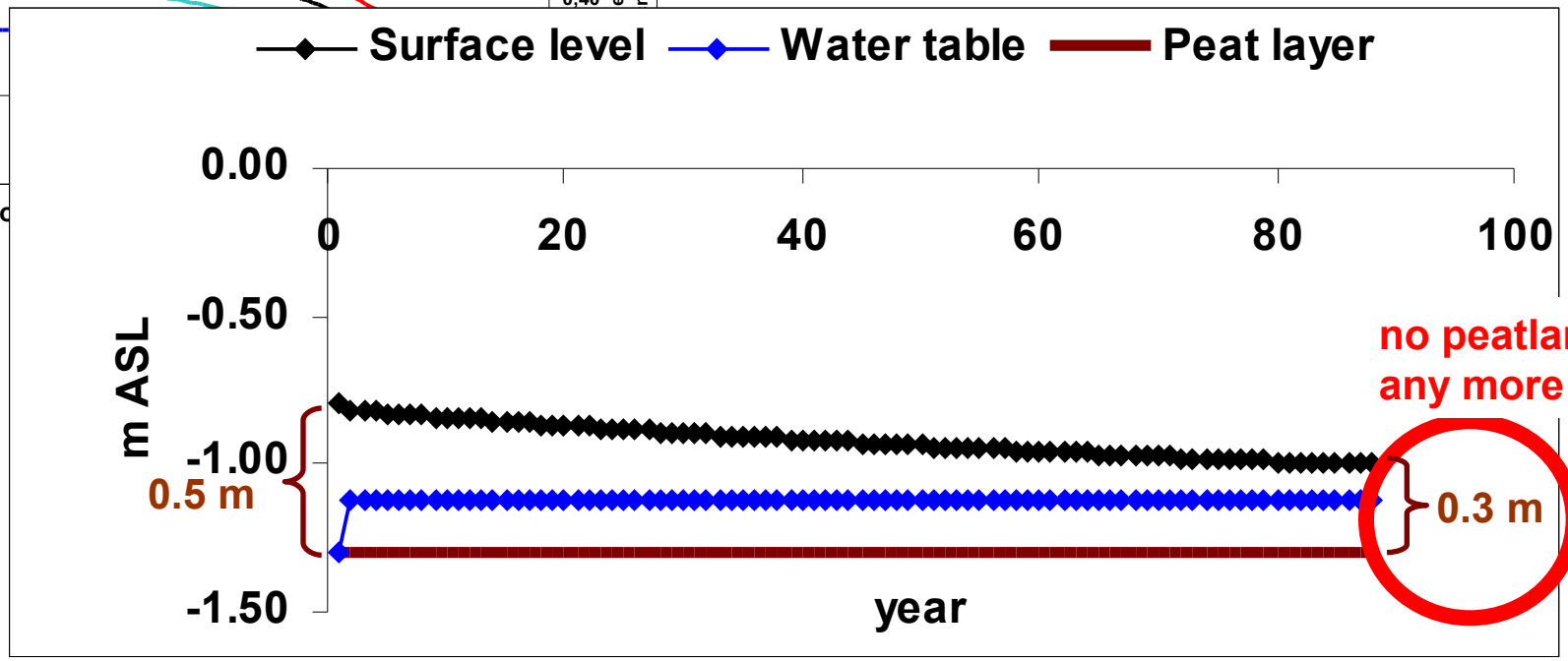


equation from Renger et al. (2002) extended

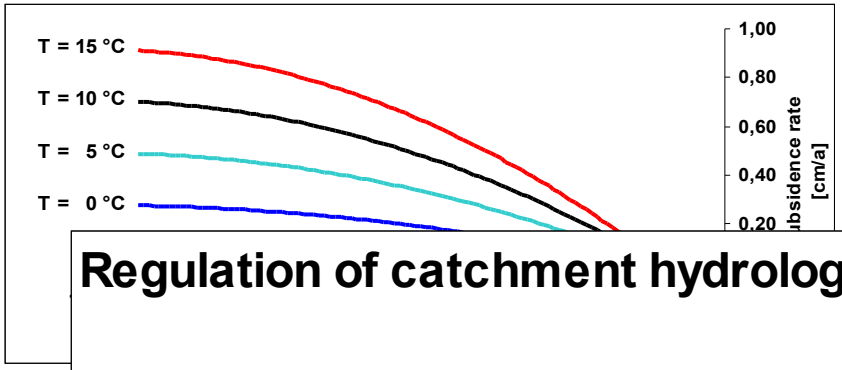
Subsidence/ water table

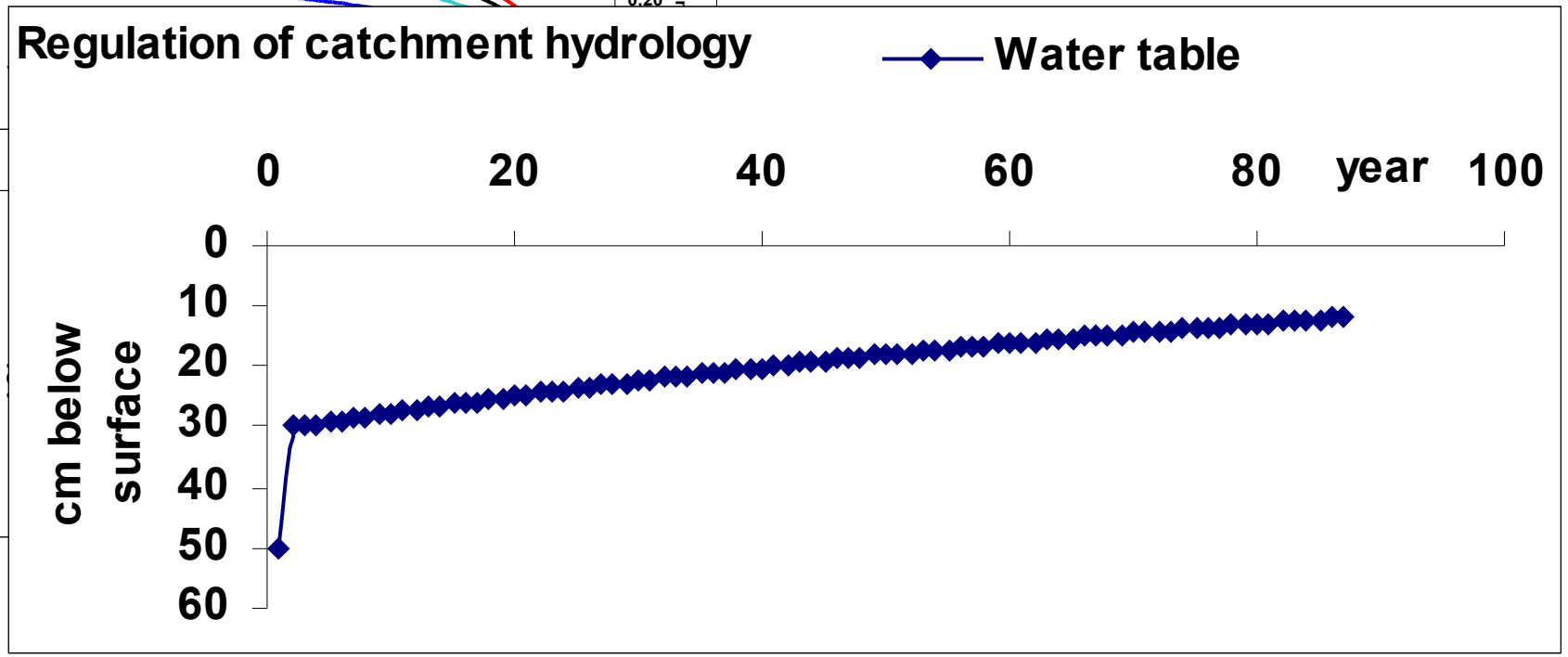


equation fro

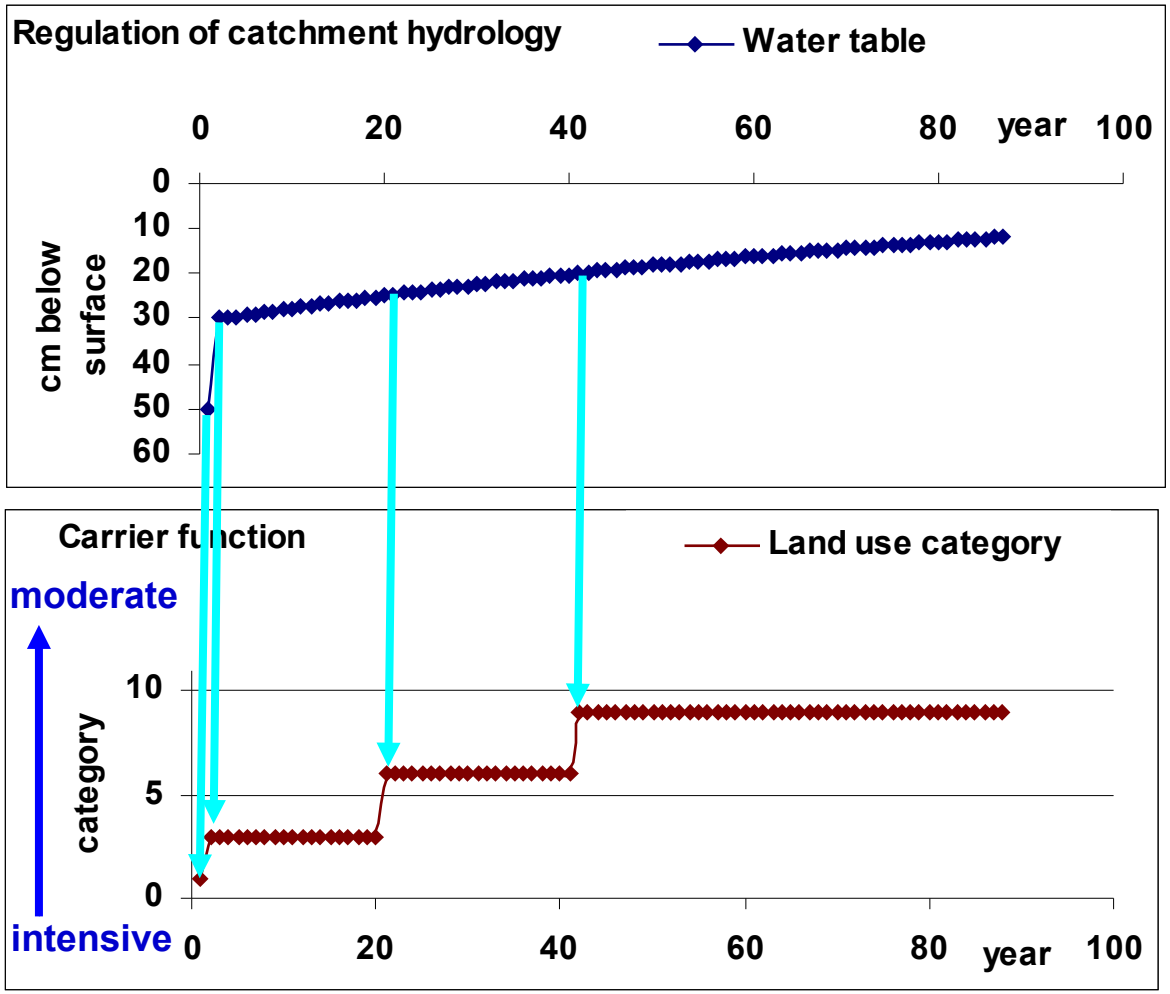


Subsidence/ water table

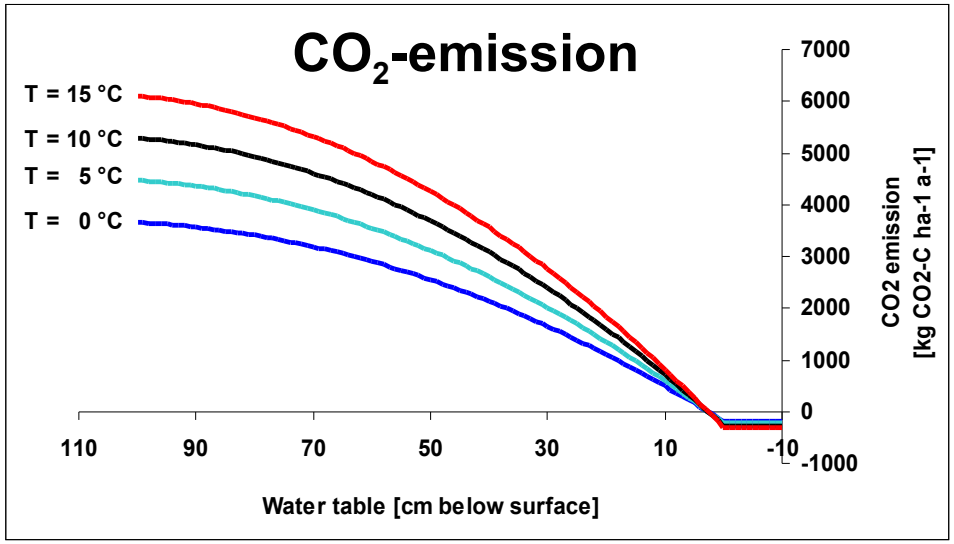


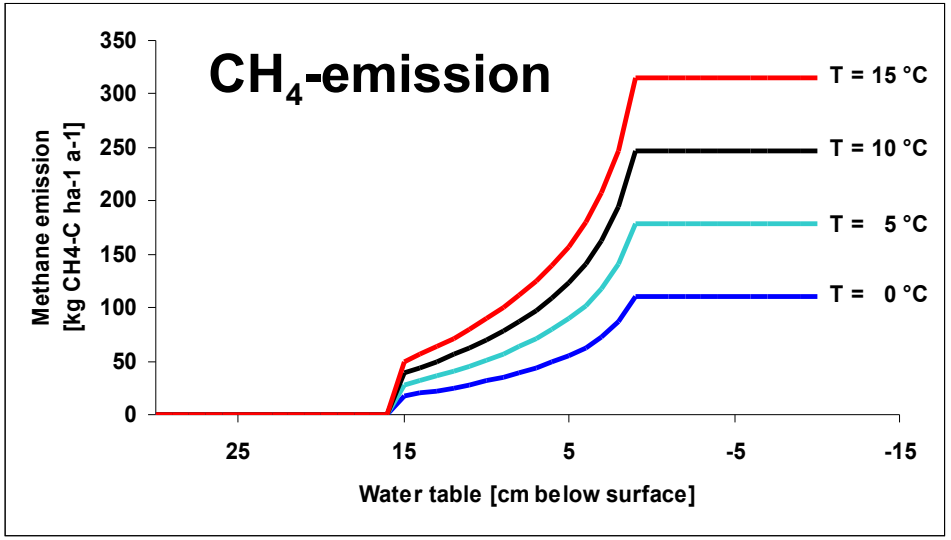


Subsidence/ water table

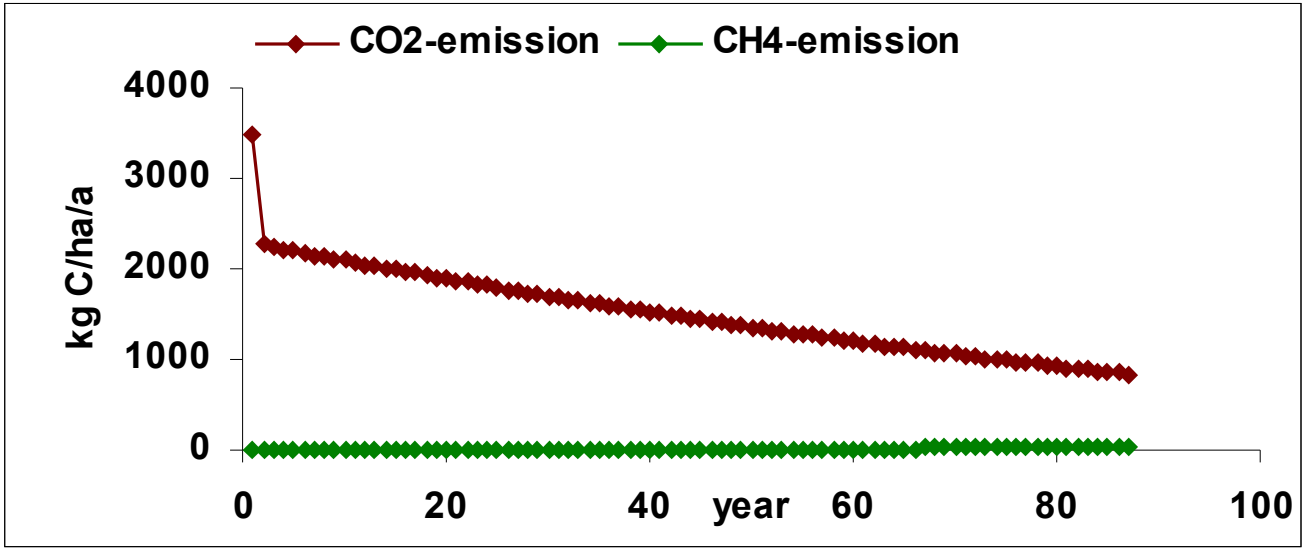


Carbon





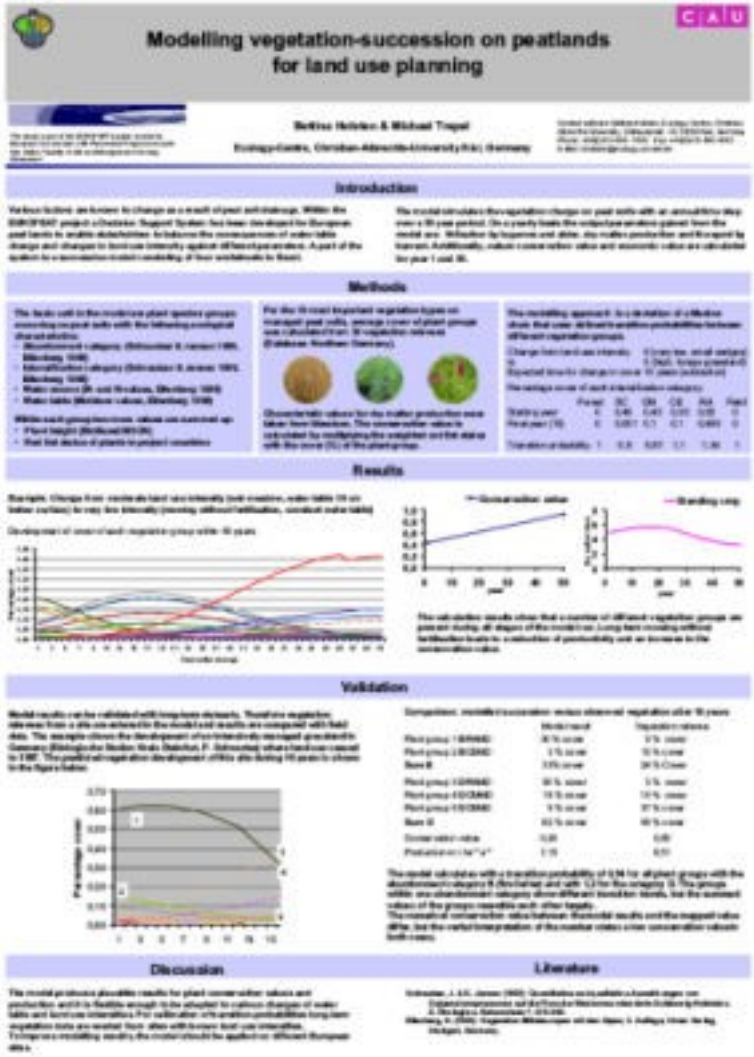
equation from Renger et al. (2002) extended



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”



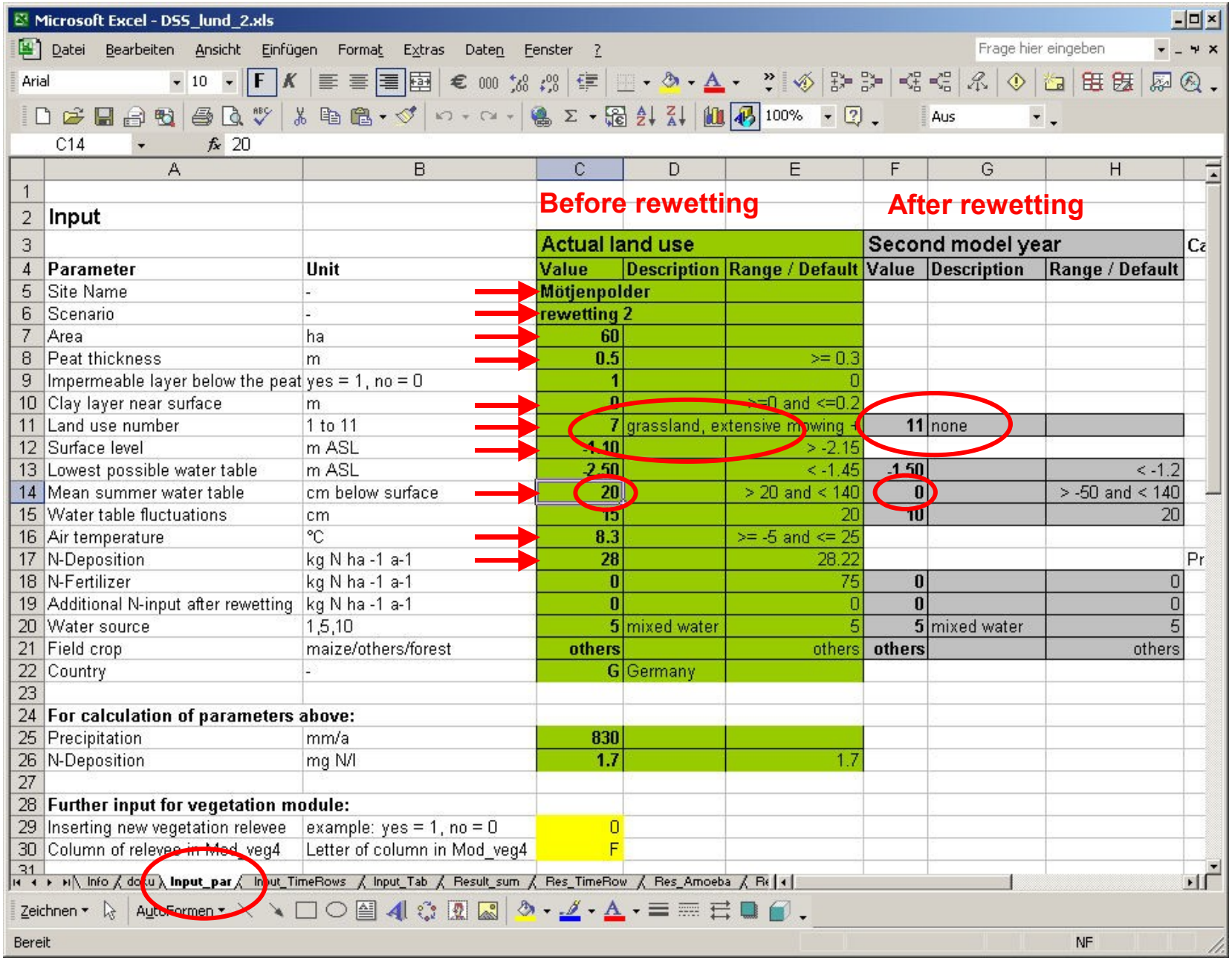
Application example: Mötjenpolder (Northern Germany)

Example Mötjenpolder

- 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

Input

Before rewetting

After rewetting

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

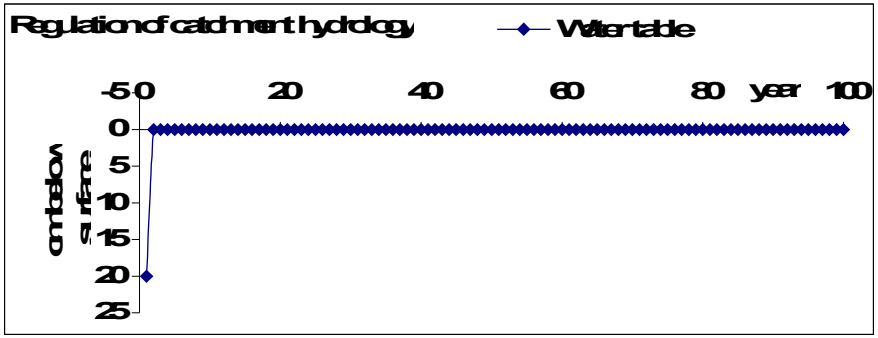
Info | docu | Input_par | Input_TimeRows | Input_Tab | Result_sum | Res_TimeRow | Res_Amoeba

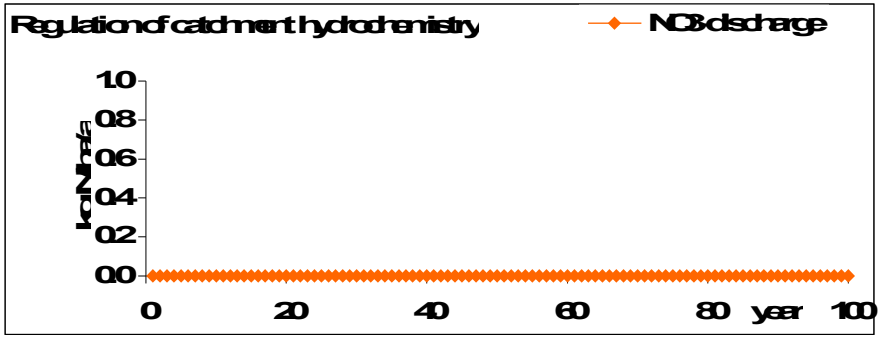
Bereit

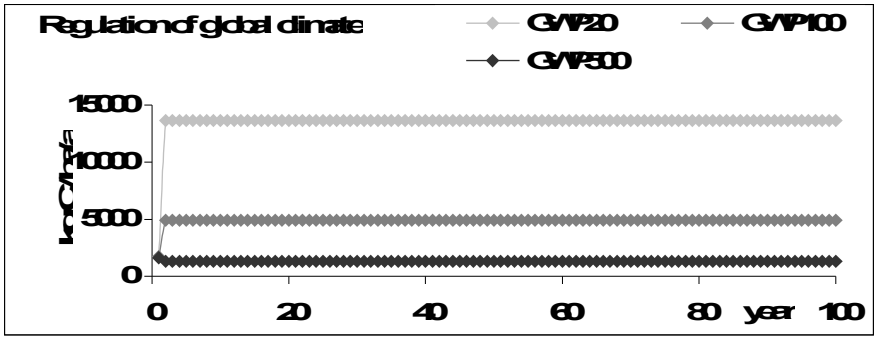
Example: Results

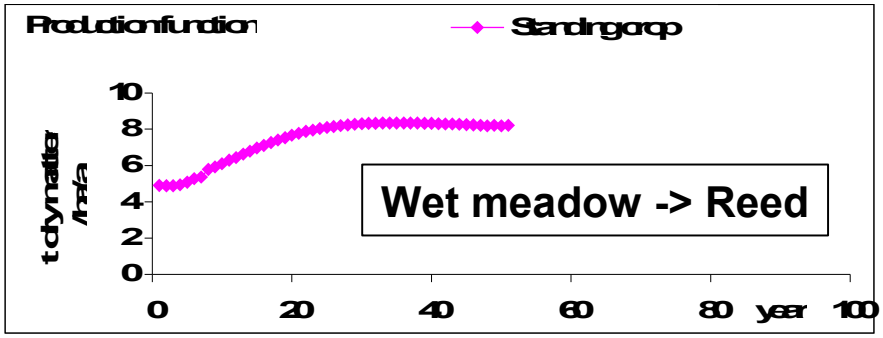
2

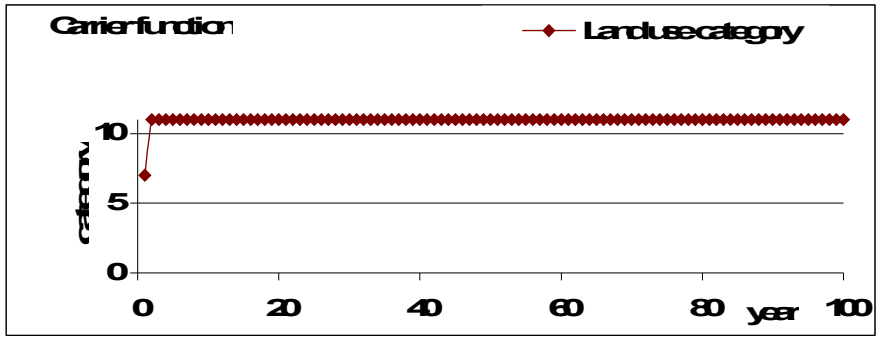
- Land use: extensive grassland to abandonment
- Peat thickness: 0.5 m

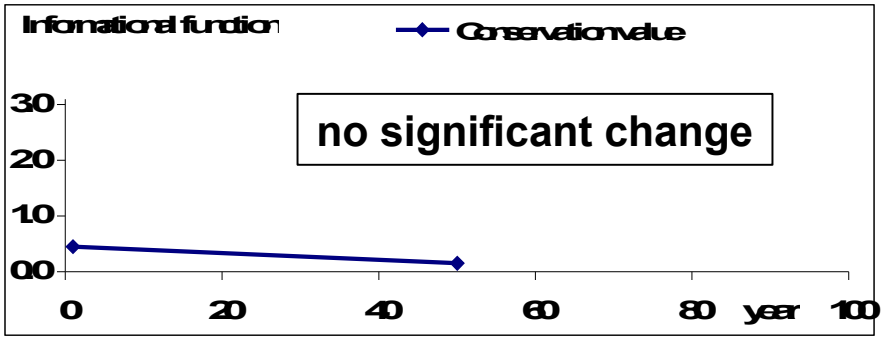








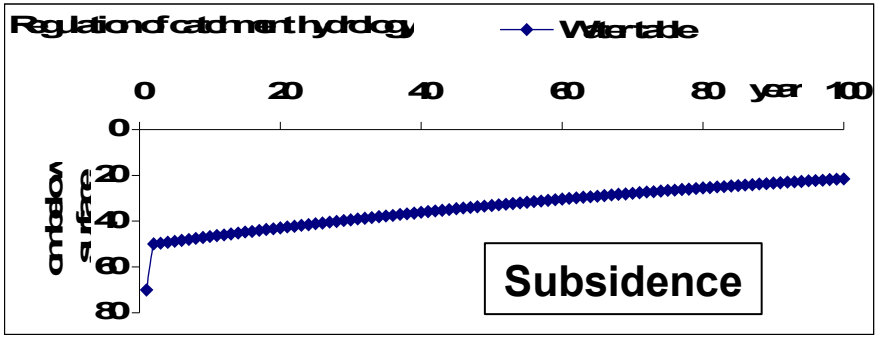


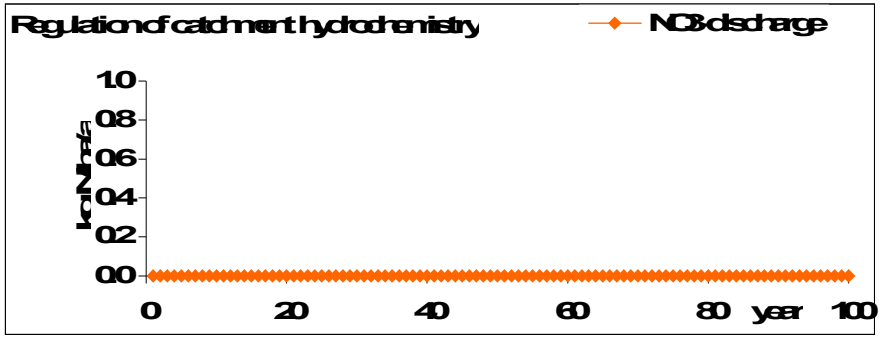


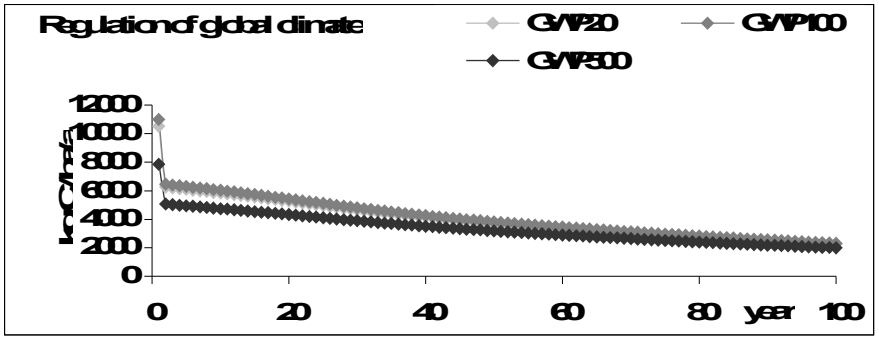
Example: Results

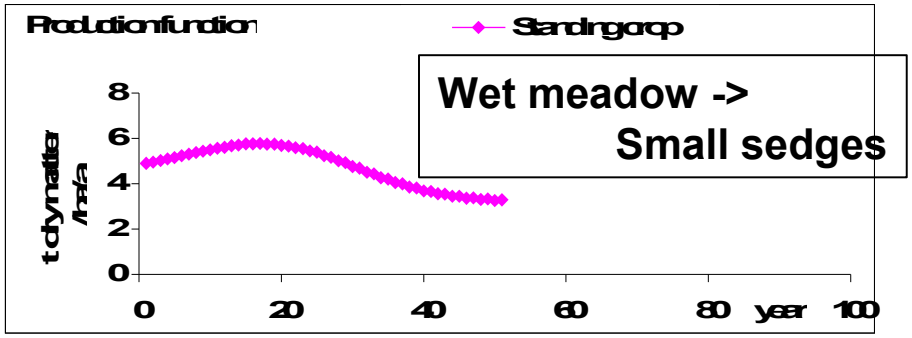
6

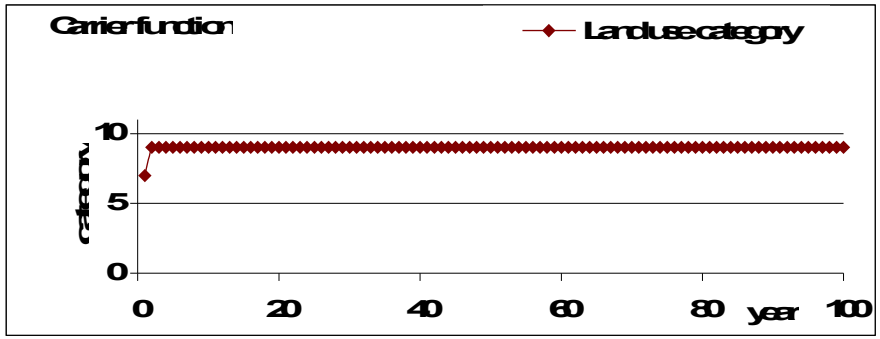
- Land use: extensive grassland to very extensive meadow
- Peat thickness: 0.8 m

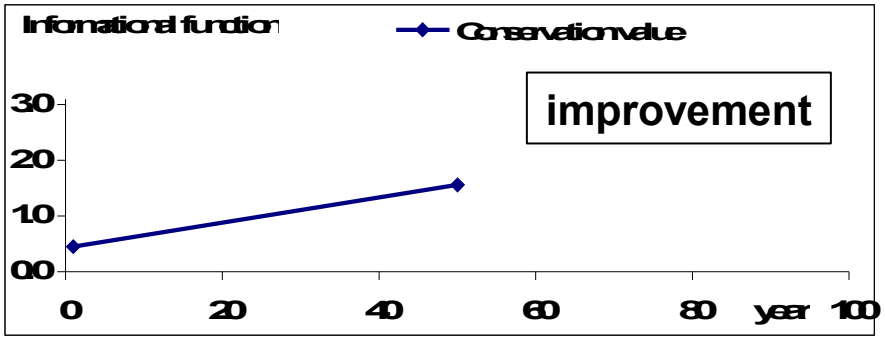




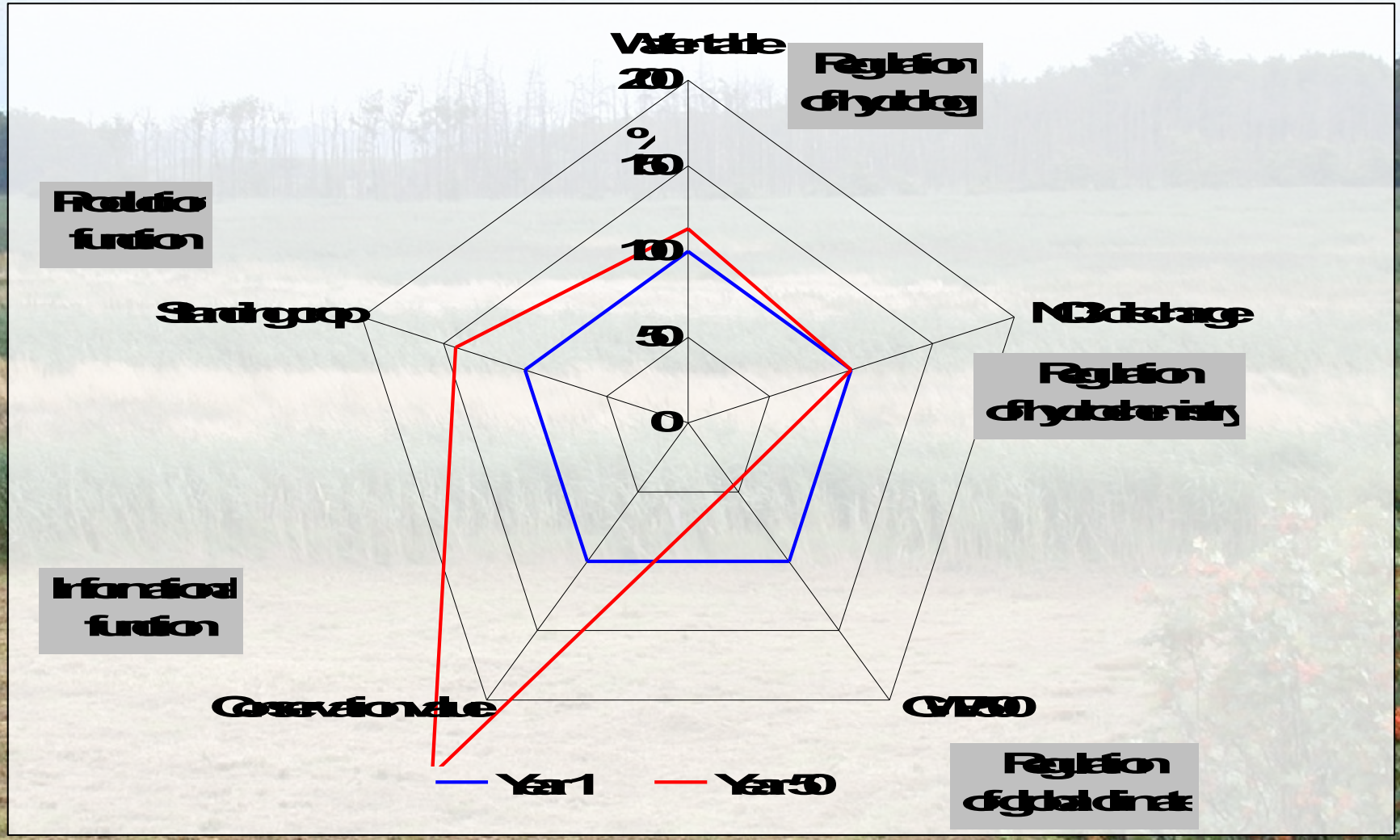




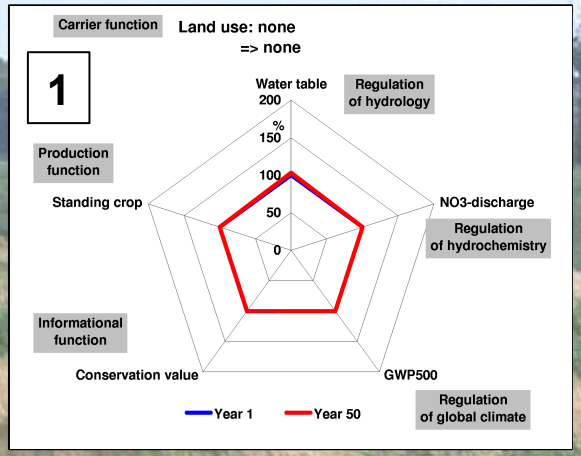


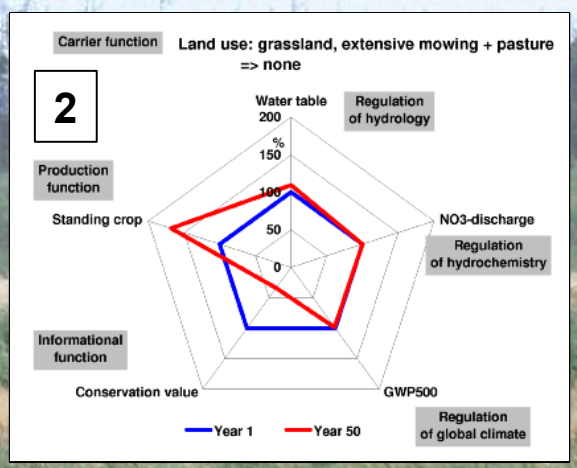


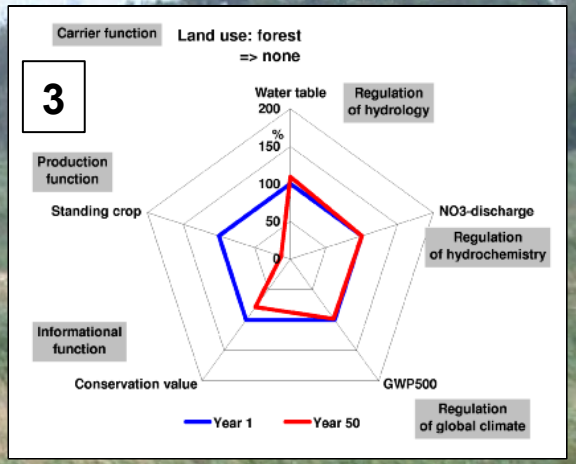
Relative change of peatland functions after rewetting of Mötjenpolder

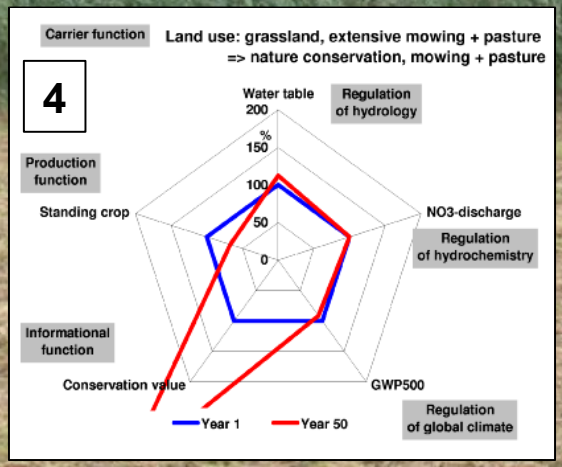


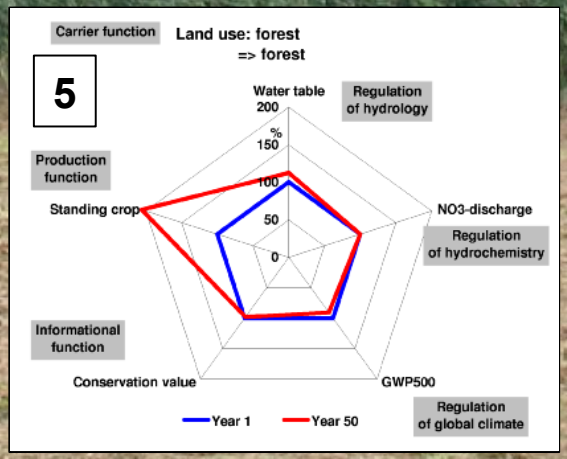
Relative change of peatland functions after rewetting in different parts of Mötjenpolder

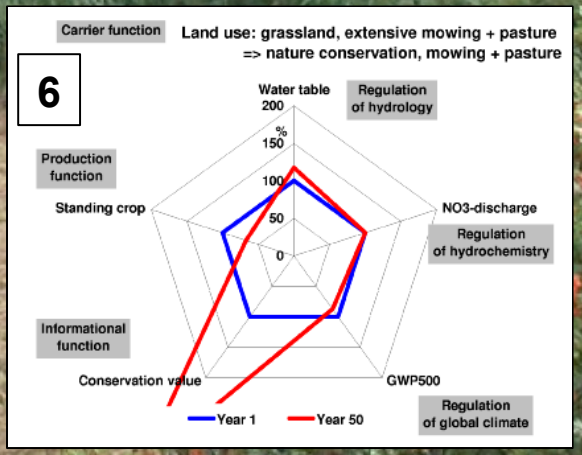












Conclusion

- **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 !