Supplementary information for the manuscript:

"Effects of experimental nitrogen deposition on peatland carbon pools and fluxes: a modeling analysis"

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Figure 1 Simulated ratios between annual root and shoot growth (gC m^{-2} yr^{-1}) (a) and GPP (gC m^{-2} yr^{-1}) (b) in graminoids with the original parameterization and in modification 3.

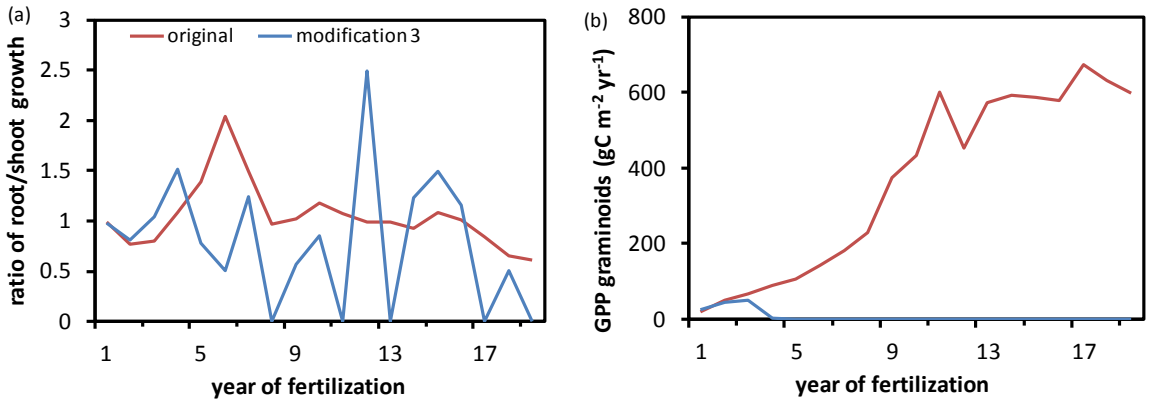


Figure 2 (a) Simulated C/N ratio (g C g N^{-1}) of the upper 40cm peat and the (b) annual average net ecosystem carbon balance (unit: g C m^{-2} yr^{-1}) in the Mer Bleue Bog subject to 130 years of fertilization at 6.4 g N m^{-2} yr^{-1}.

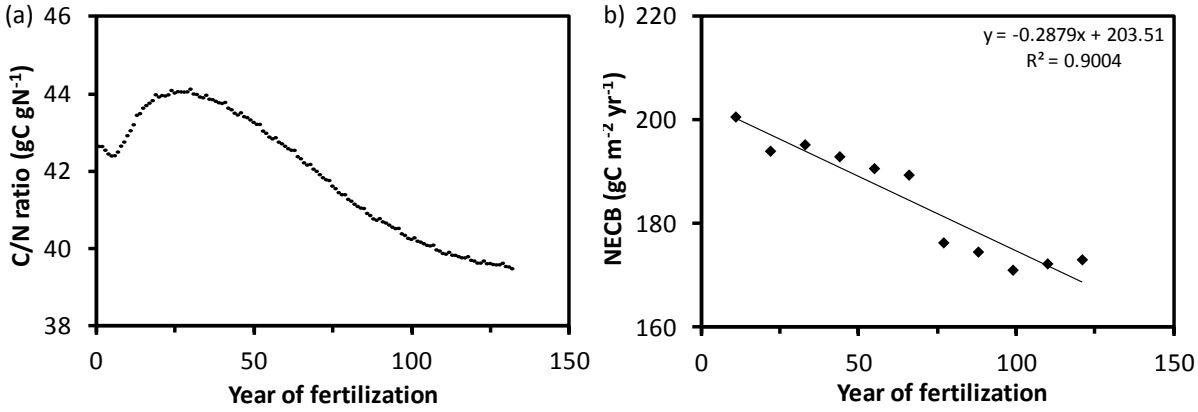


Table 1 The dependency of GEP_{max} on leaf N content in graminoids and shrubs in the original and modified model in Figure 8.

N content (gN m^{-2}) (N_{foliar})	N factor on GEP_{max} (fN_{GEP}) for graminoids			N factor on GEP_{max} for shrubs	
	Original and modification 1*	Modification 2†	Modification 3†	Original*	Modification 1 to 3†
0	0	0	0	0	0
0.25	0	0	0	0	0.25
0.5	0	0	0	0	0.5
0.75	0.325	0.038	0.038	0.167	0.335
1	0.55	0.25	0.25	0.333	0.21
1.25	0.775	0.463	0.463	0.5	0.11
1.5	1	0.675	0.675	0.667	0.08
1.75	1	0.9	0.9	0.833	0.06
2	1	1	1	1	0.05
2.25	1	1	0.97	1	0.04
2.5	1	0.945	0.86	1	0.035
2.75	1	0.825	0.01	1	0.03
3	1	0.645	0.01	1	0.025
3.25	1	0.5	0.01	1	0.01
3.5	1	0.39	0.01	1	0.01
3.75	1	0.325	0.01	1	0.01
4	1	0.275	0.01	1	0.01

* The original equations of the N factor on GEP_{max} (fN_{GEP}) for graminoids and shrubs are linear:

$$fN_{GEP} = \begin{cases} 0 & if \quad 0 \le N_{foliar} < N_{min} \\ aN_{foliar} - b & if \quad N_{min} \le N_{foliar} < N_{opt} \\ 1 & if \quad N_{opt} \le N_{foliar} \end{cases} \qquad \textbf{Eqn. 1}$$

Parameter a and b are the slope and the interception of the linear equation. The values of a and b for the graminoids and the shrubs are listed in Table 2. The parameters of equation 1 are derived from Figure 1 in Hikosaka et al. (2004).

Table 2: Parameter values of GEPmax as a linear function of foliar N content (N_{foliar})

Parameter	Description	Graminoids	Shrubs
a	Slope of the linear function	0.90	0.67
b	Interception of the linear function	-0.35	0.00
N_{min} (gN m^{-2})	Minimum N content in leaves	0.50	0.00
N_{opt} (gN m^{-2})	Optimal N content in leaves	1.50	2.00

† The modified equations of the N factors on GEP_{max} for graminoids and shrubs are hyperbolic:

$$fN_{GEP} = \begin{cases} 0 & if \quad 0 \le N_{foliar} < N_{min} \\ 1 - \tanh\left(\alpha_1 (N_{opt} - N_{foliar})/N_{opt}\right)^{\beta_1} & if \quad N_{min} \le N_{foliar} < N_{opt} \\ 1 - \tanh\left(\alpha_2 (N_{foliar} - N_{opt})/N_{opt}\right)^{\beta_2} & if \quad N_{opt} \le N_{foliar} < N_{max} \\ 0 & if \quad N_{max} \le N_{foliar} \end{cases} \qquad \textbf{Eqn. 2}$$

The curvature parameter α and β determines the sensitivity of the photosynthetic capacity (GEP_{max}) to the N content in leaves (N_{foliar}). Large values of α indicate low GEP_{max} and slow change of GEP_{max} approaching the minimum and the highest N content (N_{min} and N_{max}). Large values of β indicate slow change of GEP_{max} approaching the optimal N content N_{opt}. For example, larger α_2 and β_2 in Modification 3 than in Modification 2 for graminoids imply a faster decline of GEP_{max} above the N_{opt} in modification 3. The minimum and optimal foliar N content for photosynthesis is lower in the shrubs than in the graminoids, indicating that shrubs are more limited to N and more conservative in their N consumption. The parameter values in equation 2 for the modifications are shown in Table 3.

Table 3: Parameter values of GEPmax as hyperbolic functions of foliar N content (N_{foliar})

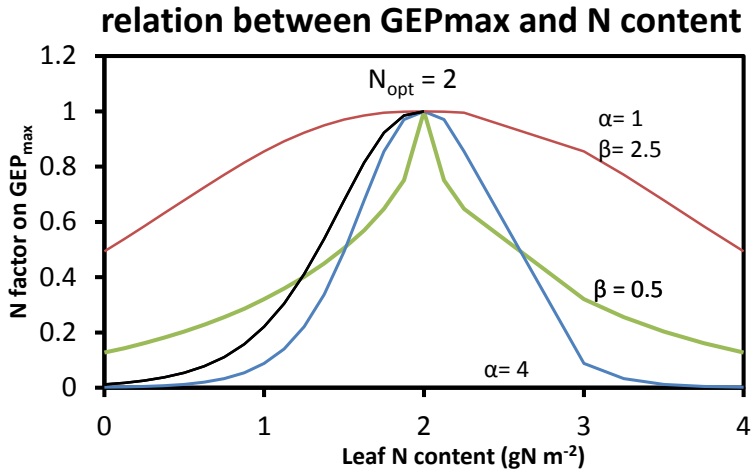
Parameter	Description	Graminoids Modification 2	Graminoids Modification 3	Shrubs Modification 1 to 3
α_1	Curvature parameter	4	3	2
β_1	Curvature parameter	8	2.5	2
α_2	Curvature parameter	1.5	4	1
β_2	Curvature parameter	1.7	8	2
N_{min}	Minimum N content in leaves	0.5	0.5	0
N_{max}	Maximum N content in leaves	/	2.5	/
N_{opt}	Optimal N content in leaves	2.2	2	0.5

Conceptual relations between GEPmax and leaf N content

Based on Table 2, a relation between GEP_{max} and leaf N content can be expressed as:

$$GEP_{max} = \tanh\left(\frac{\alpha|N_{opt}-N_{foliar}|}{N_{opt}}\right)^{\beta}$$

The N_{opt} represents the optimal N level in the leaves for the photosynthetic capacity. The curvature parameters α and β determine the sensitivity of the photosynthetic capacity (GEP_{max}) to the N content in leaves (N_{foliar}). Large values of α indicate low GEP_{max} and slow change of GEP_{max} approaching the low and high end of N content. Large values of β indicate slow change of GEP_{max} approaching the optimal N content N_{opt}. Small α and large β values characterize a high ability utilize foliar N on photosynthesis and vise verse. While the N_{opt} level has been often identified from empirical data, α and β values are highly uncertain. In order to predict the effect of N on C fluxes and vegetation in peatlands, the α and β parameters need to be determined for different PFTs and a growth strategy to be identified.



References:

Hikosaka, K.: Interspecific difference in the photosynthesis-nitrogen relationship: patterns, physiological causes, and ecological importance, Journal of Plant Research, 117, 481-494, 10.1007/s10265-004-0174-2, 2004.