Supplementary to Simulating soil atmosphere exchanges and CO_2 fluxes for a restored peatland

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Supplementary section A. Parameters values used in the reference model run

Table S1 List of model parameters used in the model run that differs from the model default for the BDB restored peatland, for details of the parameter, equations see Jansson and Karlberg (2011)

Symbol	Parameters	Value	Unite	References
p_{cmax}	Surface max cover, shrub-trees/sedges/moss	0.5/0.5/1	-	Nugent et al. (2018)
k_{rn}	Beer's extinction coefficient, shrub-trees/sedges/moss	0.5/0.5/1	-	Frolking et al. (2002)
p_{ck}	The sensitivity of reach max cover on LAI, shrub-trees/sedges/moss	1/2/4	-	Moore et al. (2002)
z_r	The lowest shrub rooting depth, shrub-trees/sedges/moss	0.5/0.35/0	m	Assumed
ε	Light use efficiency, shrub-trees/sedges/moss	1.15/1/0.65	g C MJ^{-1}	Kross et al. (2016)
θ_{Amin}	The minimum amount of air that is necessary to prevent a reduction of root water uptake, shrub-trees/sedges/moss	5/2/0	vol %	Silvola et al. (1996)
ψ_c	Critical pressure head for reduction of potential water uptake, shrub-trees/sedges/moss	100/60/40	cm water	
p_l	Coefficient determines how fast the reduction of potential water uptake when ψ_c is reached, shrub-trees/sedges/moss	1/0.5/4	day^{-1}	
p_{mn}	Threshold Air temperature when photosynthesis starts, shrub-trees/sedges/moss	5/5/0	^{0}C	Moore et al. (2006)

$p_{rl,sp}$	Specific leaf area, shrub-trees/sedges/moss	75/45/45	g C m^{-2}	Assumed
r_{alai}	LAI Scale factor for r_a of the shrub layer	100	m s^{-1}	
l_{c1}	Leaf allocation parameter, shrub-trees/sedges/moss	0.25/0.35/0.9	-	He et al. (2023)
r_{wc1}	Root allocation parameter, shrub-trees/sedges/moss	0.3/0.35/0.00	-	
l_{Lc}	Leaf litterfall rate, shrub-trees/sedges/moss	0.004/0.004/0.02	d^{-1}	Calculated based on literature pool turnover rates
l_{Rc}	Root litterfall rate, shrub-trees/sedges/moss	0.00175	d^{-1}	
l_{CRc}	Coarse root litterfall rate, shrub-trees/sedges/moss	0.0001	d^{-1}	
l_{Sc}	Stem litterfall rate, shrub-trees/sedges/moss	0.0005/0.0005/0.0001	d^{-1}	
z_o	The surface roughness length	0.001	m	Campbell et al. (2002)
ε_s	The emissivity of the ground	0.95	-	Kettridge and Baird (2008)
α_{dry}	Soil albedo when tension >10^4 cm H_2O	15	%	Kellner (2001)
α_{wet}	Soil albedo when tension <10 cm H_2O	5	%	
kB^{-1}	Difference between the natural logarithm of surface roughness length for momentum and heat	2.3	-	Humphreys et al. (2006)
ψ_g	The empirical correction factor compensates for the difference between the mean soil moisture potential in the top-soil layer and the soil moisture potential at the surface	2.1	-	Assumed
M_T	The snow melting coefficients for air temperature	2	kg C m^{-2} d^{-1}	Gustafsson et al. (2001)
M_R	The snow melting coefficients for radiation	2×10^{-7}	kg J^{-1}	
θ_{sat}	Total porosity *	98.8 - 90	vol %	Measured
$n_{tortuosity}$	Tortuosity	1	-	Default
θ_m	Macroporosity *	30-10	vol %	Liu and Lennartz (2019)
k_{minus}	The minimum hydraulic conductivity	1×10^{-5}	mm d^{-1}	Alvenäs and Jansson (1997)
k_{sat}	Total saturated hydraulic conductivity*	100000 - 600	mm d^{-1}	McCarter and Price (2015) and Gauthier et al. (2022)
θ_r	Residual water content*	10-30	vol %	Schwärzel et al. (2002); Menberu et al. (2021) and McCarter and Price (2013)
θ_{wilt}	Wilting point *	10-30	vol %	
a_{scale}	The sorption scaling coefficient to calculate macropore flow	0.05	-	Assumed
a_{surf}	The first-order coefficient for surface runoff	0.05	-	Assumed
d_{space}	The distance between drainage ditches	500	m	Measured
z_{ditch}	Drainage ditch depth	0.7	m	
p_{max}	The maximum surface water pool cover	0.3	-	Assumed
$f_{wcovtot}$	The maximum amount of water on the soil surface pool	50	mm	Mustamo et al. (2016)
k_l	First-order decomposition coefficient for labile C	0.25	yr^{-1}	Frolking et al. (2010)
k_{ref}	First-order decomposition coefficient for refractory C	0.004	yr^{-1}	

C_{tot}	Total soil C at 1.5 m profile	101800	g C m^{-2}	Calculated from measured bulk density and C concentration
$C_{tot,\ layer}$	Total soil C for each simulated layer*	625-56000	g C m^{-2}	
Q_{10}	Q_{10} value for decomposition	3	-	Lafleur et al. (2005)
$p_{\theta Low}$	Lower range for moisture response	50	vol %	Or et al. (2007)
$p_{\theta Upp}$	Upper range for moisture response	30	vol %	
$p_{\theta p}$	Shape coefficient for the response function	1	-	
$p_{\theta satact}$	Anaerobic activity	0.1	-	Scanlon and Moore (2000)
h_1	Thermal conductivity coefficient for peat soil	0.01	W m^{-1} C^{-1}	Lai, (2022)
h_2	Thermal conductivity coefficient for peat soil	0.0075	W m^{-1} C^{-1}	
c_f	The coefficient for frozen surface conduction damping function	0.2	C^{-1}	Assumed

* Note different values were used for the simulated 9 soil layers, the range from top to bottom layer was given.

Supplementary section B. Time series of surface energy fluxes and soil temperature profiles, used for model evaluation and validation, and additional simulation results for future climate change impact

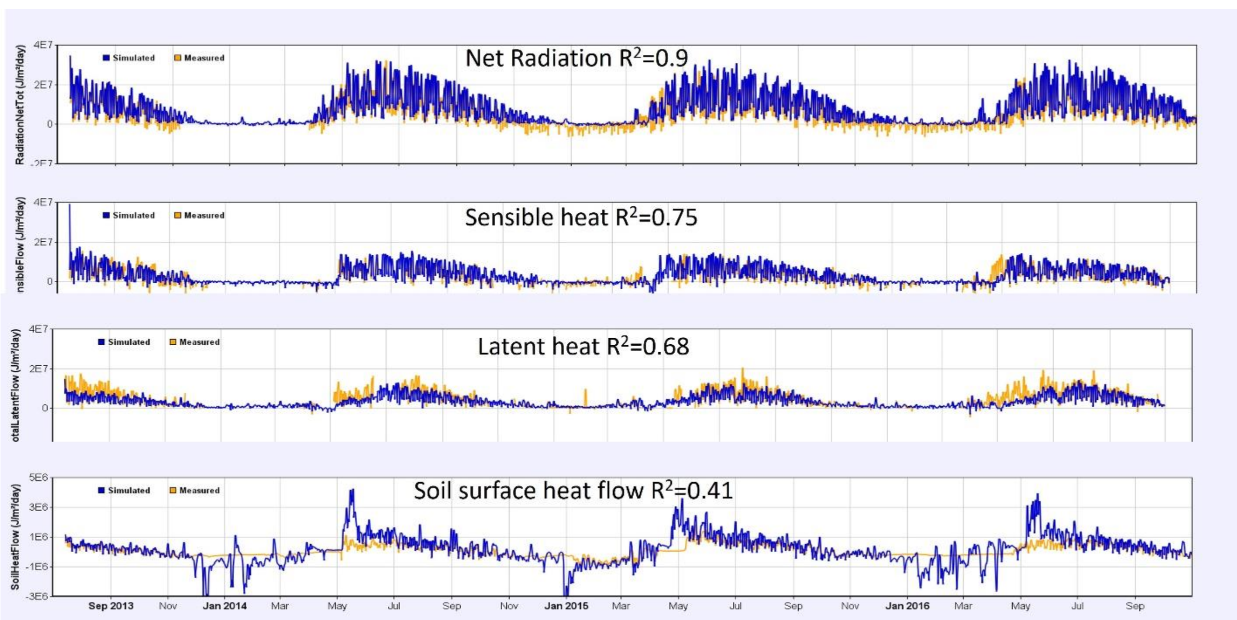

Fig. S1 Measured (orange) and simulated (blue) daily total net radiation, sensible heat, latent heat and soil surface heat flux.

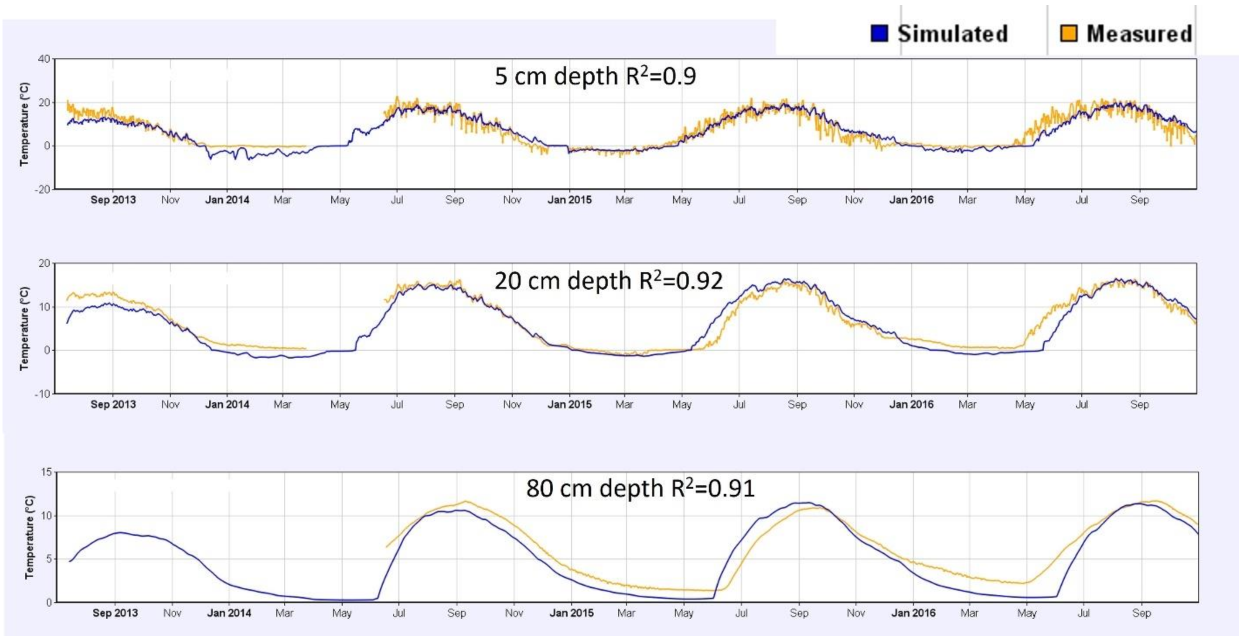

Fig. S2. Measured (orange) and simulated (blue) 30-minute soil temperature profiles

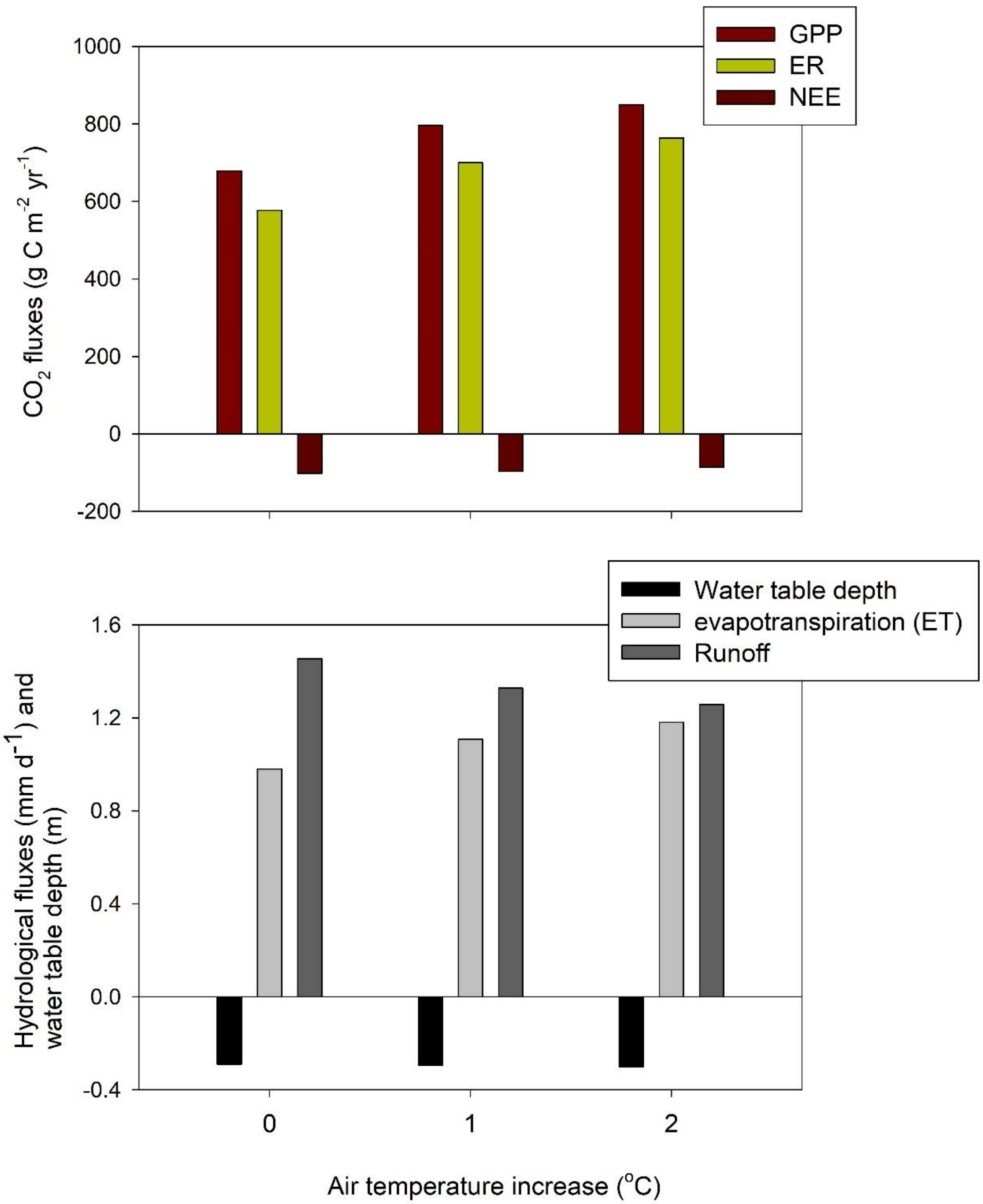

Fig S3. Simulated mean annual CO_2 fluxes and hydrological fluxes (evapotranspiration and runoff) and water table depth under future year around temperature increase; scenario 0 is the reference run. Equilibrium model runs use BDB 2013-2016 setup and Rivière-du-Loup 1994-2021 climate data.

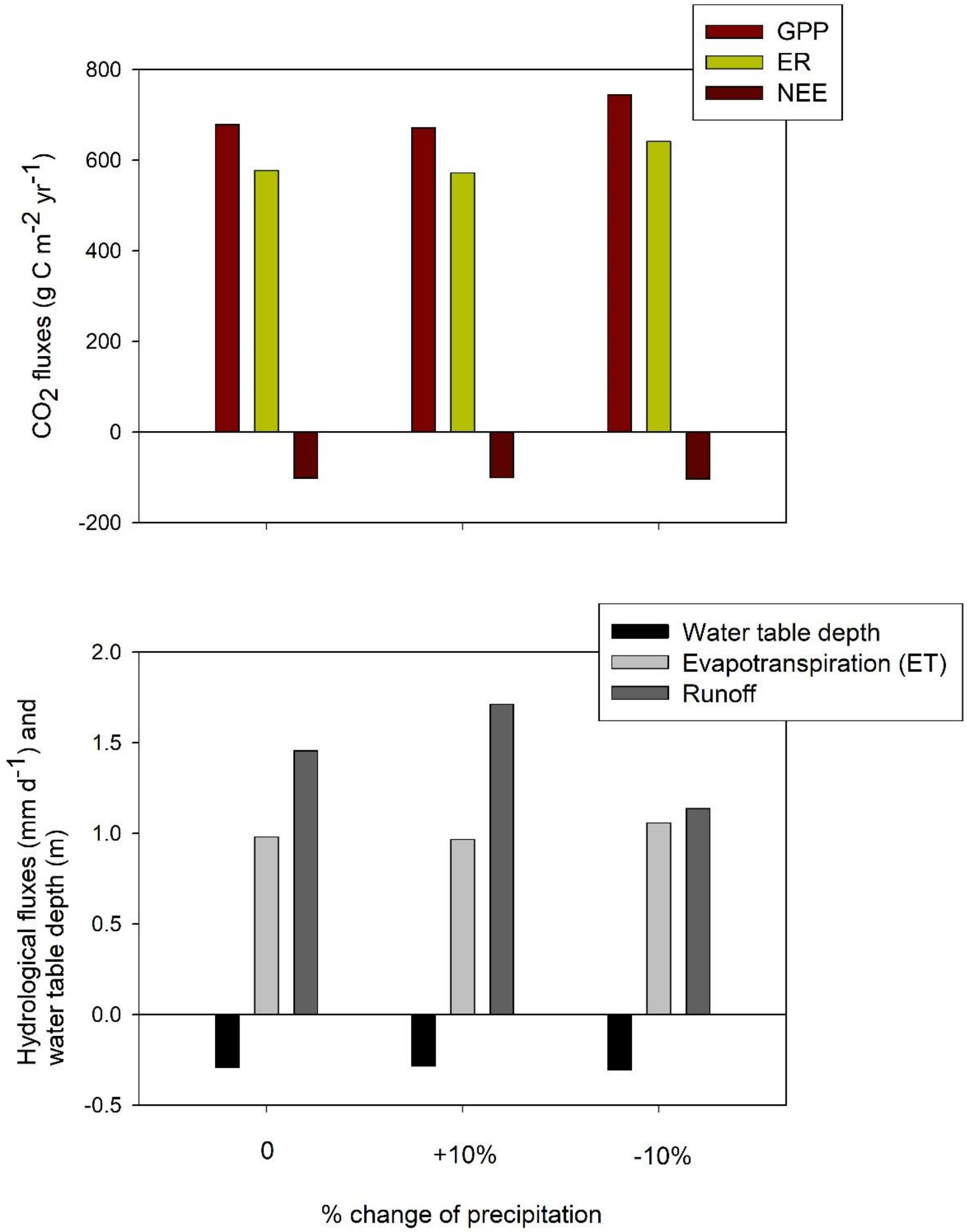

Fig S4. Simulated mean annual CO_2 fluxes and hydrological fluxes (evapotranspiration and runoff) and water table depth under future year around precipitation increase or decrease by 10%; scenario 0 is the reference run. Equilibrium model runs use BDB 2013-2016 setup and Rivière-du-Loup 1994-2021 climate data.

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