Soil depth and nutrient status are stronger drivers for short-term production and decomposition in temperate fens than water regime in a climatically dry year

Supplement

Table S1: Hydrological status, geographical position, vegetation, water level and cover-weighted Ellenberg moisture indicator value of the 39 research sites.

Site ID	**Region**	**Country**	**Drainage status**	**Longitude** **Latitude**	**Vegetation type [porewater pH] – dominant vascular plant and moss species**	**Rewetting year** **Water level (cm soil surface; negative value is below soil surface)** **H = highest,** **L = lowest** **S = spring 2018**	**E = cover weighted Ellenberg moisture value**
1	Arlon	BE	Undrained	5.71758 49.68723	**Fen** [6.43] – *Carex appropinquata, Comarum palustre, Calliergonella cuspidata*	NA H = -1, L = -27, S = 3.2	7.91
2	Arlon	BE	Drained	5.66434 49.6591	**Fen** [5.88] – *Filipendula ulmaria, Juncus acutiflorus, Persicaria bistorta, Calliergonella cuspidata, Brachythecium spec.*	NA H = -7, L = -38, S = -10.4	7.88
3	Arlon	BE	Rewetted	5.69653 49.67478	**Fen** [6.45] – *Carex acutiformis, Sphagnum subnitens*	Gradually since 1963 H = -6, L = -9, S = -8.4	7.77
4	Zwarte Beek	BE	Undrained	5.2858 51.08014	**Fen** [6.38] – *Carex rostrata, Equisetum fluviatile, Juncus acutiflorus, Lotus uliginosus, Calliergonella cuspidata, Calliergon cordifolium*	NA H = 11, L = -8, S = 6.2	8.33
5	Zwarte Beek	BE	Drained	5.27309 51.07441	**Wet grassland** [5.64] – *Anthoxanthum odoratum, Carex nigra, Holcus lanatus, Brachythecium rutabulum*	NA H = -1, L = -54, S = -5.8	7.30
6	Zwarte Beek	BE	Rewetted	5.32251 51.09108	**Fen** [5.8] – *Caltha palustris, Carex rostrata, Juncus acutiflorus*	1990 H = 4, L = -42, S =-2.2	9.13
7	Binnenveld	NL	Undrained	5.57093 52.0123	**Fen** [6.57] – *Calliergonella cuspidata, Plagiomnium species, Sphagnum subnitens*	NA H = -1, L = -32, S = -4.1	8.50
8	Binnenveld	NL	Drained	5.60049 51.99292	**Wet grassland** [5.74] – *Carex acuta, Holcus lanatus, Phalaris arundinacea, Poa pratensis, Poa trivialis*	NA H = -10, L = -50, S = -25.8	7.38

Site ID	Region	Country	Drainage status	Longitude Latitude	Vegetation type [porewater pH] – dominant vascular plant and moss species	Rewetting year Water level (cm soil surface; negative value is below soil surface) H = highest, L = lowest S = spring 2018	E = cover weighted Ellenberg moisture value
9	Binnenveld	NL	Rewetted	5.58189 52.01083	**Fen** [6.67] – *Carex rostrata, Comarum palustre*	2003 H = 8, L = -40, S = 2.7	8.68
10	Drentse Aa	NL	Undrained	6.66381 53.04981	**Fen** [6.59] – *Menyanthes trifoliata, Calliergonella cuspidata*	NA H = 4, L = -37, S = 2.3	8.20
11	Drentse Aa	NL	Drained	6.66665 53.00443	**Wet grassland** [5.97] – *Agrostis stolonifera, Poa trivialis, Ranunculus repens*	NA H = -1, L = -53, S = -17.0	7.18
12	Drentse Aa	NL	Rewetted	6.66862 53.02187	**Fen** [6.85] – *Carex rostrata, Calliergonella cuspidata, Fontinalis spec.*	Gradually since 1995 H = 4, L = -42, S = 0.2	8.47
13	Gützkow	DE	Undrained	13.4078 53.9696	**Fen** [6.59] – *Carex appropinquata, Carex nigra, Carex panicea, Juncus subnodulosus, Calliergonella cuspidata*	NA H = 17, L = -51, S = 6.5	8.22
14	Gützkow	DE	Drained	13.4321 53.9786	**Wet grassland** [6.98] – *Carex nigra, Holcus lanatus, Phalaris arundinacea, Poa pratensis, Rhinanthus angustifolius*	NA H = 4, L = -63, S = -6.4	7.67
15	Gützkow	DE	Rewetted	13.5751 53.8004	**Fen** [6.8] – *Carex acuta, Juncus subnodulosus*	1994 H = 6, L = -28, S = -0.5	8.23
16	Peene mouth	DE	Undrained	13.6487 53.8834	**Fen** [6.84] – *Agrostis stolonifera, Carex appropinquata, Carex nigra, Juncus subnodulosus, Calliergonella cuspidata, Drepanocladus aduncus*	NA H = 10, L = -41, S = 5.9	8.37

Site ID	Region	Country	Drainage status	Longitude Latitude	Vegetation type [porewater pH] – dominant vascular plant and moss species	Rewetting year Water level (cm soil surface; negative value is below soil surface) H = highest, L = lowest S = spring 2018	E = cover weighted Ellenberg moisture value
17	Peene mouth	DE	Drained	13.7173 53.8701	**Wet grassland** [6.92] – *Carex acutiformis, Juncus effusus, Scirpus sylvaticus*	NA H = 6, L = -69, S = 1.3	7.33
18	Peene mouth	DE	Rewetted	13.7072 53.837	**Fen** [7.12] – *Caltha palustris, Carex acuta, Carex disticha, Carex nigra*	Before 2007 H = 7, L = -47, S = 0.3	8.42
19	Kiel	DE	Undrained	10.34016 54.20532	**Fen** [6.38] – *Filipendula ulmaria, Calliergonella cuspidata, Rhytidiadelphus squarrosus*	NA H = -4, L = -70, S = -6.8	7.66
20	Kiel	DE	Drained	10.08809 54.2747	**Wet grassland** [6.58] – *Agrostis stolonifera, Alopecurus geniculatus, Poa trivialis, Ranunculus repens*	NA H = 3, L = -155, S = -7.8	6.56
21	Kiel	DE	Rewetted	10.0299 54.2273	**Wet grassland** [6.1] – *Ranunculus repens, Rhinanthus angustifolius, Calliergonella cuspidata, Rhytidiadelphus squarrosus*	Before 2009 H = 4, L = -46, S = 2.3	7.46
22	Recknitz	DE	Undrained	12.5103 54.1846	**Fen** [6.33] – *Carex nigra, Equisetum fluviatile, Lysimachia thyrsiflora, Menyanthes trifoliata, Comarum palustre*	NA H = 12, L = -29, S = 8.2	8.58
23	Recknitz	DE	Drained	12.62869 54.13185	**Wet grassland** [6.35] – *Poa pratensis, Ranunculus repens*	NA H = 4, L = -72, S = -5.1	6.33
24	Recknitz	DE	Rewetted	12.7395 54.10105	**Fen** [6.64] – *Carex acutiformis*	Before 2007 H = 15, L = -24, S = 6.9	9.33

Site ID	Region	Country	Drainage status	Longitude Latitude	Vegetation type [porewater pH] – dominant vascular plant and moss species	Rewetting year Water level (cm soil surface; negative value is below soil surface) H = highest, L = lowest S = spring 2018	E = cover weighted Ellenberg moisture value
25	Biebrza	PL	Undrained	23.32948 53.73428	**Fen** [6.50] – *Carex diandra, Menyanthes trifoliata, Hamatocaulis vernicosus*	NA H = 18, L = -36, S = 6.9	8.55
26	Biebrza	PL	Drained	23.23166 53.75858	**Wet grassland** [6.21] – *Festuca rubra, Poa trivialis, Ranunculus repens, Rumex acetosa, Brachythecium rutabulum*	NA H = 7, L = -81, S = -23.1	7.25
27	Biebrza	PL	Rewetted	23.2331 53.75875	**Fen** [5.94] – *Carex acuta, Carex nigra, Drepanocladus aduncus*	Between 2011-2014 H = 16, L = -88, S = -11.3	8.38
28	Rospuda	PL	Undrained	22.9537 53.90399	**Fen** [6.56] – *Carex rostrata, Festuca rubra, Menyanthes trifoliata, Aulacomnium palustre, Hamatocaulis vernicosus, Tomentypnum nitens*	NA H = 16, L = 1, S = 6.9	8.27
29	Rospuda	PL	Drained	22.68317 53.8101	**Wet grassland** [7.1] – *Carex cespitosa, Filipendula ulmaria, Holcus lanatus*	NA H = -4, L = -56, S = -15.2	7.08
30	Rospuda	PL	Rewetted	22.69392 53.80973	**Fen** [6.58] – *Carex paniculata, Carex rostrata, Equisetum fluviatile, Calliergonella cuspidata*	Before 1983 H = 9, L = -1, S = 1.2	8.48
31	Suwalszczyzna	PL	Undrained	22.82706 54.21241	**Fen** [7.03] – *Carex rostrata, Eriophorum angustifolium, Aulacomnium palustre, Calliergonella cuspidata, Drepanocladus aduncus, Helodium blandowii, Marchantia polymorpha, Plagiomnium ellipticum*	NA H = 20, L = 1, S = 2.6	8.04

Site ID	Region	Country	Drainage status	Longitude Latitude	Vegetation type [porewater pH] – dominant vascular plant and moss species	Rewetting year Water level (cm soil surface; negative value is below soil surface) H = highest, L = lowest S = spring 2018	E = cover weighted Ellenberg moisture value
32	Suwalszczyzna	PL	Drained	22.66418 54.3171	**Wet grassland** [6.50] – *Anthoxanthum odorarum, Helictotrichon pubescens, Carex cespitosa, Cirsium rivulare, Filipendula ulmaria, Geum rivale, Climacium dendroides*	NA H = 0, L = -57, S = -19.4	7.59
33	Suwalszczyzna	PL	Rewetted	22.66035 54.32749	**Wet grassland** [6.54] – *Carex acutiformis, Cirsium rivulare, Deschampsia cespitosa, Festuca rubra, Filipendula ulmaria, Galium rivale, Geum rivale, Ranunculus repens*	2016 H = 1, L = -62, S = NA, site was again drained after sampling	7.12
34	Mazury	PL	Undrained	21.23354 53.68418	**Fen** [6.48] – *Menyanthes trifoliata, Calliergon giganteum, Calliergonella cuspidata, Hamatocaulis vernicosus, Plagiomnium spec.*	NA H = 5, L = -3, S = 2.2	8.48
35	Mazury	PL	Drained	21.52789 53.77411	**Wet grassland** [6.14] – *Anthoxanthum odoratum, Festuca rubra, Geum rivale, Poa trivialis, Ranunculus repens*	NA H = 5, L = -38, S = -7.4	7.40
36	Mazury	PL	Rewetted	21.52884 53.77382	**Fen** [6.61] – *Carex appropinquata, Carex rostrata, Epilobium palustre, Calliergonella cuspidata, Drepanocladus aduncus*	Before 2013 H = 6, L = -2, S = 1.6	8.77
37	Anglesey	UK	Undrained	-4.266 53.30528	**Fen** [6.47] – *Menyanthes trifoliata, Calliergon giganteum, Calliergonella cuspidata*	NA H = 3, L = -8, S = 0.0	8.87

Site ID	Region	Country	Drainage status	Longitude Latitude	Vegetation type [porewater pH] – dominant vascular plant and moss species	Rewetting year Water level (cm soil surface; negative value is below soil surface) H = highest, L = lowest S = spring 2018	E = cover weighted Ellenberg moisture value
38	Anglesey	UK	Drained	-4.30639 53.31783	**Wet grassland** [6.23] – *Carex acuta, Holcus lanatus, Juncus acutiflorus, Calliergonella cuspidata*	NA H = 6, L = -91, S = 2.5	7.27
39	Anglesey	UK	Rewetted	-4.29388 53.32041	**Fen/Wet grassland** [6.17] – *Juncus subnodulosus, Molinia caerula, Myrica gale*	Gradually between 1982-1993 H = 1, L = -42, S = 0.0	7.31

Table S2: Overview of variables used for Random forest analyses, with different explanatory variable groups used depending on the dependent variables investigated. Codes for dependent variables: RT = belowground vascular plant biomass, AV = aboveground vascular plant biomass, RB = Rooibos tea. Codes for horizons: S = at soil surface; 0-5, 15-20 and 45-50 indicates cm soil depth below surface. Codes for explanatory variable groups: Y = included, N = not included. Note that frame shift was included only in analysis of decomposition data as it quantifies the shift in litterbag frames in the soil over the exposition time in the field. Due to sensor malfunctions, soil temperature data was available only for a subset of sites.

Dependent variable	**productivity**									
	AV	**RT**	**RT**							
Horizon	**S**	**0-50 cm**	**0-5, 15-20, 45-50 cm**	**0-5 cm**	**15-20 cm**	**45-50 cm**	**0-5, 15-20, 45-50 cm**	**0-5 cm**	**15-20 cm**	**45-50 cm**
Frame shift	N	N	N	N	N	N	N	N	N	N
Soil depth	N	N	Y	N	N	N	Y	N	N	N
Water level	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Soil pore water chemistry	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Soil temperature	N	N	N	N	N	N	Y	Y	Y	Y
Soil bulk properties	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Functional plant groups	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Nutrients in aboveground vascular plant biomass	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Soil microbial biomass	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Dependent variable	**decompostion**									
	AV+RT	**AV**	**RT**			**AV+RT**	**AV**	**RT**		
Horizon	**S, 0-5, 15-20, 45-50 cm**	**S**	**0-5 cm**	**15-20 cm**	**45-50 cm**	**S, 0-5, 15-20, 45-50 cm**	**S**	**0-5 cm**	**15-20 cm**	**45-50 cm**
Frame shift	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Soil depth	Y	N	N	N	N	Y	N	N	N	N
Water levels	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Soil pore water chemistry	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Soil temperature	N	N	N	N	N	Y	Y	Y	Y	Y
Soil bulk properties	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Functional plant groups	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Nutrients in aboveground vascular plant biomass	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Soil microbial biomass	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Dependent variable	decompostion									
	RB					RB				
	S, 0-5, 15-20, 45-50 cm	S	0-5 cm	15-20 cm	45-50 cm	S, 0-5, 15-20, 45-50 cm	S	0-5 cm	15-20 cm	45-50 cm
t	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Y	N	N	N	N	Y	N	N	N	N
ls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
ater chemistry	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
rature	N	N	N	N	N	Y	Y	Y	Y	Y
roperties	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
plant groups	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Nutrients in aboveground vascular plant biomass	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
ɔial biomass	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Table S3: Overview of the explanatory variables used for analyzing the effect of abiotic and biotic variables on production and decomposition. Hierarchical cluster numbers indicates groups of variables which are highly correlated within the total data set.

Explanatory variables	**Additional info**	**Hierarchical cluster number**
soil depth (cm below soil level)		3
vertical shift (cm)		2
Water level (negative values below surface layer (SL))		
median water level (cm SL)		4
high water level (cm SL)	0.95 percentile	4
low water level (cm SL)	0.05 percentile	4
duration water level > -40 cm (y/y)	duration height relative to reference (soil level or depth of measurement)	4
duration water level > -30 cm (y/y)		4
duration water level > -20 cm (y/y)		4
duration water level > -10 cm (y/y)		4
duration water level > 0 cm (y/y)		4
duration water level > -5 cm (y/y)		4
duration water level > +10 cm (y/y)		4
Soil pore water chemistry		
pore water pH (-)		9
pore water EC (µS/cm)		9
pore water NH_4^+ (µmol/l)		10
pore water P (µmol/l)		10
pore water SO_4^{2-} (µmol/l)		11
pore water Cl (µmol/l)		9
pore water HCO_3^- (µmol/l)		9
pore water TIC (µmol/l)		9
pore water Ca^{2+} (µmol/l)		9
pore water K^+ (µmol/l)		12
pore water Mg^{2+} (µmol/l)		13
pore water Na^+ (µmol/l)		9
pore water Al (µmol/l)		14
pore water Fe (µmol/l)		15
pore water Mn^{2+} (µmol/l)		9
Soil temperature		
average soil T (°C)		26
median soil T (°C)		26

Explanatory variables	Additional info	Hierarchical cluster number
0.10 percentile soil T (°C)		26
0.25 percentile soil T (°C)		26
0.75 percentile soil T (°C)		3
0.90 percentile soil T (°C)		3
average diurnal fluctuation soil T (°C)		3
duration soil T >5°C (%)		26
duration soil T >10°C (%)		26
duration soil T >15°C (%)		3
duration soil T >20°C (%)		3
Soil bulk properties		
soil organic matter (% DW)		6
dry bulk density (kg/l)		5
humification degree (Von Post)		5
fraction easily degradable (% DW SOM)		7
fraction cellulose (% DW SOM)		6
fraction lignin (% DW SOM)		6
fraction rest (% DW SOM)		5
soil N (% DW)		6
soil C (% DW)		6
soil S (% DW)		8
ratio soil C:N (% DW)		6
Functional plant groups		
standing crop aboveground vascular biomass (g/m^2)		17
cover vascular plant (%)		17
cover mosses (%)		22
cover aboveground litter (%)		24
cover grasses (%)		17
cover Cyperaceae (%)	cumulative cover of species	11
cover Equisetaceae (%)	cumulative cover of species	20
cover Juncaceae (%)	cumulative cover of species	19
cover herbs (%)	cumulative cover of species being vascular plants not woody, Gramineae or Cyperaceae	18
cover woody plants (%)	cumulative cover of species	19

Explanatory variables	Additional info	Hierarchical cluster number
cover nutrient rich Cyperaceae (%)	cumulative cover of *Carex acuta, C. acutiformis, C. disticha, C. elata, C. x elytroides, C. paniculata, C. pseudocyperus, C. rostrata, Eleocharis palustris, Scirpus lacustris s. tabernaemontani, Scirpus sylvaticus*	11
cover nutrient poor Cyperaceae (%)	cumulative cover of Cyperaceae indicative for nutrient poor conditions (*Carex appropinquata, C. cespitosa, C. curta, C. diandra, C. dioica, C. echinata, C. lasiocarpa, C. lepidocarpa, C. limosa, C. nigra, C. panicea, Eriophorum angustifolium, E. gracile*)	21
cover N_2-fixing plants (%)	cumulative cover of species	19
cover feather mosses (%)	cumulative cover of *Brachythecium, Calliergon, Calliergonella cuspidata, Climacium dendroides, Drepanocladus, Philonotis, Hamatocaulis, Tomentypnum nitens*	22
cover of Sphagna (%)	cumulative cover of species	23
ratio cover grass:vascular plant (-)		17
ratio cover herb:vascular plant (-)		18
ratio cover woody:vascular plant (-)		19
ratio cover Cyperaceae:vascular plant (-)		11
ratio cover Equisetaceae:vascular plant (-)		20
ratio cover Juncaceae:vascular plant (-)		19
ratio cover nutrient poor Cyperaceae:vascular plant (-)		21
Nutrients in aboveground vascular plant biomass		
aboveground biomass K (% DW)		20

Explanatory variables	Additional info	Hierarchical cluster number
aboveground biomass C (% DW)		21
aboveground biomass C:N (g/g)		19
aboveground biomass C:P (g/g)		19
aboveground biomass N:P (g/g)		19
aboveground biomass K:P (g/g)		19
aboveground biomass N:K (g/g)		25
Soil microbial biomass		
PLFA total microbial biomass (mg/l soil)		16
PLFA total bacterial biomass (mg/l soil)		16
PLFA actinobacterial biomass (mg/l soil)		16
PLFA Gram-positive bacterial biomass (mg/l soil)		16
PLFA Gram-negative bacterial biomass (mg/l soil)		16

Table S4: Effects of explanatory variables on production of aboveground (AV), and belowground (RT) vascular plant biomass. For each repeated Random forest analysis, the mean, RSME, and MEA of the cross-validated r^2 and the selected explanatory variables with its relative Altmann variable importance (highest is set to 1) are listed (low to high values of Altmann variable importance are indicated with respectively light to dark blue colour), and the direction of response of the dependent variable (+ = increase, - = decrease) are provided. Grey shading indicates variables not included in the Random forest analyses. Clusters of explanatory variables resulting from the hierarchical clustering are indicated by green rectangles. Codes for horizons: S = at soil surface; 0-5, 15-20 and 45-50 indicates cm soil depth below surface.

Dependent variable	AV	RT	RT	RT	RT	RT	RT	RT	RT	RT
Figure # partial plots	S1	S2	S3	S4	S5	S6	S7	S8	S9	NA
Horizon	S	0-50 cm	0-5, 15-20, 45-50 cm	0-5 cm	15-20 cm	45-50 cm	0-5, 15-20, 45-50 cm	0-5 cm	15-20 cm	45-50 cm
Soil temperature variables included	N	N	N	N	N	N	Y	Y	Y	Y
mean cross validated r^2	0.44	0.24	0.58	0.23	0.25	0.24	0.59	0.23	0.28	NA
RMSE of cross validated r^2	179.3	170.6	30.9	47.5	23.4	5.2	29.0	43.3	12.4	NA
MAE of cross validated r^2	138.3	131.9	20.1	35.0	17.9	4.2	20.8	34.8	10.4	NA
Depth (cm below soil surface)			1.00 +				1.00 +			
Water level (cm, below soil level is negative value)										
median WL (cm)			0.54 -				0.34 -			
high WL (cm)			0.65 -				0.45 -			
duration WL > 0 cm (y/y)			0.31 -							
duration WL > +10 cm (y/y)			0.66 -				0.49 -			
duration WL > +5 cm (y/y)			0.37 -				0.25 -			
Soil pore water chemistry										
pore water Cl (umol/l)				0.78 +	0.86 +					
pore water Cl (umol/l)/ A		0.49 +								
pore water Cl (umol/l)/ B		0.62 +								
pore water Cl (umol/l)/ C		0.21 +								
pore water Na (umol/l)					1.00 +					
pore water Na (umol/l)/ A		0.97 +								
pore water Na (umol/l)/ B		1.00 +								
pore water Na (umol/l)/ C		0.51 +								
pore water Mn (umol/l)/ C		0.29 -								
pore water Mg (umol/l)				0.92 -				0.93 -		
pore water P (umol/l)									0.84 -	
pore water NH4 (umol/l)			0.23 -	0.65 -						
pore water NH4 (umol/l)/ A		0.45 -								
Soil temperature										
duration soil T >20°C (y/y)							0.62 +		0.44 -	
0.90 percentile soil T (°C)							0.37 +			
diurnal fluctuation soil T (°C)							0.94 +			
Soil bulk properties										
humification degree (Von Post)/ A	0.12 +									
humification degree (Von Post)/ B	0.41 +									
dry bulk density (kg/l)			0.28 -							
dry bulk density (kg/l)/ B	0.35 +									
soil organic matter (% DW)/ B	0.23 -									
soil C (% DW)/ B	0.24 -									
fraction cellulose (% DW SOM)								1.00 +		
fraction cellulose (% DW SOM)/ C		0.30 -								
fraction lignin (% DW SOM)/ B	0.25 -									
Functional plant groups										
standing crop aboveground bioma	1.00 +									
cover vascular plant (%)				1.00 -						
ratio cover herb:vascular (-)	0.70 -									
cover Juncaceae (%)	0.14 +	0.28 +			0.18 +	0.78 +			0.93 +	
ratio cover Jun:vascular (-)	0.13 +					1.00 +			1.00 +	
cover N2-fixating plants (%)					0.15 +					
cover mosses (%)	0.47 -									
cover of Sphagna (%)			0.07 +	0.46 +						
Nutrients in aboveground vascular plant biomass										
abovegr. biomass C:N (g/g)	0.21 +									
Soil microbial biomass										
total microb. biomass (mg/l soil)			0.76 +				0.36 +			
total bact. biomass (mg/l soil)			0.66 +				0.21 +			
Gram- bact. biomass (mg/l soil)			0.74 +				0.23 +			
Gram+ bact. biomass (mg/l soil)	0.23 +		0.49 +				0.18 +			
actinobact. biomass (mg/l soil)			0.31 +		0.30 +					

Table S5: Effects of explanatory variables on the decomposition of aboveground (AV), and belowground (RT) vascular plant biomass. See Table S3 for further explanation.

Dependent variable	**AV+RT**		**AV**		**RT**		**RT**		**RT**		**AV+RT**		**AV**		**RT**		**RT**		**RT**	
Figure # partial plots	**S10**		**S11**		**S12**		**S13**		**S14**		**S15**		**S16**		**S17**		**S18**		**NA**	
Horizon	**S, 0-5, 15-20, 45-50 cm**		**S**		**0-5 cm**		**15-20 cm**		**45-50 cm**		**S, 0-5, 15-20, 45-50 cm**		**S**		**0-5 cm**		**15-20 cm**		**45-50 cm**	
Soil temperature variables included	**N**		**N**		**N**		**N**		**N**		**Y**		**Y**		**Y**		**Y**		**Y**	
mean cross validated r^2	**0.66**		**0.32**		**0.20**		**0.25**		**0.39**		**0.48**		**0.42**		**0.35**		**0.24**		**NA**	
RMSE of cross validated r^2	**0.12**		**0.07**		**0.14**		**0.15**		**0.13**		**0.14**		**0.06**		**0.13**		**0.14**		**NA**	
MAE of cross validated r^2	**0.10**		**0.05**		**0.12**		**0.13**		**0.12**		**0.11**		**0.05**		**0.11**		**0.13**		**NA**	
Vertical shift (cm)	1.00	-									0.99	-								
Depth (cm below soil surface)	1.00	+									1.00	+								
Soil pore water chemistry																				
pore water Cl (umol/l)	0.16	-					0.43	-	0.20	-	0.06	-								
pore water Na (umol/l)	0.07	-					0.28	-												
pore water EC (uS/cm)									0.39	-										
pore water Ca (umol/l)	0.08	-					0.31	-	0.66	-										
pore water P (umol/l)	0.16	+			0.48	+	1.00	+	1.00	+	0.08	+					0.83	+		
Soil temperature																				
median soil T (°C)													0.81	+						
Soil bulk properties																				
dry bulk density (kg/l)															0.66	-				
fraction lignin (% DW SOM)			0.69	-																
Functional plant groups																				
cover herbs (%)	0.06	+																		
ratio cover herb:vascular (-)													0.79	+						
cover Juncaceae (%)	0.04	-											0.98	-	0.71	-				
ratio cover Jun:vascular (-)	0.05	-																		
cover Equisetaceae (%)	0.03	+																		
ratio cover Equ:vascular (-)	0.04	+																		
cover mosses (%)															0.67	+				
cover feather mosses (%)															1.00	+				
Nutrients in aboveground vascular plant biomass																				
abovegr. biomass C (% DW)			1.00	-																
abovegr. biomass C:N (g/g)			0.59	-									1.00	-						
abovegr. biomass C:P (g/g)	0.15	-	0.91	-			0.39	-	0.46	-										
abovegr. biomass N:P (g/g)	0.14	-					0.28	-	0.58	-										
abovegr. biomass K:P (g/g)	0.10	-			0.58	-														
Soil microbial biomass																				
total microb. biomass (mg/l soil)					0.60	-														
total bact. biomass (mg/l soil)					0.52	-														
Gram- bact. biomass (mg/l soil)					1.00	-														
Gram+ bact. biomass (mg/l soil)															0.75	-				
actinobact. biomass (mg/l soil)																	1.00	-		

Table S6: Effects of explanatory variables on mass loss of incubated Rooibos tea (RB). See Table S3 for further explanation.

Dependent variable	**RB**	**RB**	**RB**	**RB**	**RB**	**RB**	**RB**	**RB**	**RB**	**RB**
Figure # partial plots	**S19**	**S20**	**S21**	**S22**	**S23**	**S24**	**S25**	**S26**	**S27**	**NA**
Horizon	**S, 0-5, 15-20, 45-50 cm**	**S**	**0-5 cm**	**15-20 cm**	**45-50 cm**	**S, 0-5, 15-20, 45-50 cm**	**S**	**0-5 cm**	**15-20 cm**	**45-50 cm**
Soil temperature variables included	**N**	**N**	**N**	**N**	**N**	**Y**	**Y**	**Y**	**Y**	**Y**
mean cross validated r^2	**0.12**	**0.21**	**0.36**	**0.33**	**0.53**	**0.14**	**0.28**	**0.48**	**0.40**	**NA**
RMSE of cross validated r^2	**0.04**	**0.04**	**0.05**	**0.03**	**0.02**	**0.05**	**0.04**	**0.05**	**0.03**	**NA**
MAE of cross validated r^2	**0.03**	**0.03**	**0.04**	**0.02**	**0.02**	**0.03**	**0.03**	**0.04**	**0.03**	**NA**
Depth (cm below soil surface)	0.45 +					0.55 +				
Management undrained	0.38 +		0.16 +	0.09 +				0.08 +		
Water level (cm, below soil level is negative value)										
median WL (cm)				0.41 +						
low WL (cm)					1.00 +					
duration WL > +10 cm (y/y)					0.99 +					
duration WL > +5 cm (y/y)					0.85 +					
Soil pore water chemistry										
pore water Cl (umol/l)								0.51 +		
pore water EC (uS/cm)					0.22 -					
pore water HCO3 (umol/l)					0.28 -					
pore water Ca (umol/l)					0.43 -					
pore water Mn (umol/l)					0.74 -					
pore water NH4 (umol/l)	1.00 -		1.00 -			0.73 -		1.00 -		
Soil temperature										
median soil T (°C)							1.00 +			
duration soil T >15°C (%)						1.00 +				
duration soil T >20°C (%)						0.78 +	0.94 -			
0.90 percentile soil T (°C)						0.47 +				
0.75 percentile soil T (°C)						0.47 +				
diurnal fluctuation soil T (°C)						0.64 +				
Soil bulk properties										
dry bulk density (kg/l)	0.94 -			1.00 -		0.98 -			0.79 -	
fraction rest (% DW SOM)				0.39 -					0.53 -	
soil organic matter (% DW)		0.43 -		0.41 +						
soil C (% DW)				0.74 +					1.00 +	
fraction cellulose (% DW SOM)			0.52 +	0.43 +					0.39 +	
fraction lignin (% DW SOM)				0.49 +					0.34 +	
soil S (% DW)				0.43 +					0.46 +	
Functional plant groups										
standing crop aboveground bioma	0.65 -		0.50 -			0.45 -			0.41 -	
cover vascular plant (%)	0.70 -			0.45 -						
cover mosses (%)		0.66 -					0.56 -			
Nutrients in aboveground vascular plant biomass										
abovegr. biomass C (% DW)		1.00 -								
Soil microbial biomass										
actinobact. biomass (mg/l soil)					0.52 -					

Table S7: Results of Generalized Additive Models (GAM) for the relationship of water level, soil temperature, and bacterial biomass variables with soil depth. Based on measurements at 0-5, 15-20 and 45-50 cm soil depth.

dependent variable	**GAM r_{adj}^2**	**AICc**	**p of smooth terms**
Water level			
median water level (cm)	0.88	781	<0.001
high water level (cm)	0.93	717	<0.001
low water level (cm)	0.33	978	<0.001
duration water level > -40 cm (y/y)	0.16	1004	<0.001
duration water level > -30 cm (y/y)	0.22	995	<0.001
duration water level > -20 cm (y/y)	0.28	988	<0.001
duration water level > -10 cm (y/y)	0.30	982	<0.001
duration water level > 0 cm (y/y)	0.37	970	<0.001
duration water level > +5 cm (y/y)	0.54	933	<0.001
duration water level > +10 cm (y/y)	0.67	897	<0.001
Soil temperature			
average soil T (°C)	0.25	499	<0.001
diurnal fluctuation soil T (°C)	0.79	431	<0.001
0.10 percentile soil T (°C)	0.02	515	0.156
0.25 percentile soil T (°C)	0.01	517	0.726
median soil T (°C)	0.28	497	<0.001
0.75 percentile soil T (°C)	0.45	481	<0.001
0.90 percentile soil T (°C)	0.60	462	<0.001
duration soil T >10°C (%)	0.23	503	0.002
duration soil T >15°C (%)	0.32	495	<0.001
duration soil T >20°C (%)	0.43	493	<0.001
Bacterial biomass			
PLFA total bacterial biomass (mg/l soil)	0.85	809	<0.001
PLFA actinobacterial biomass (mg/l soil)	0.60	921	<0.001
PLFA Gram+ bacterial biomass (mg/l soil)	0.80	844	<0.001
PLFA Gram- bacterial biomass (mg/l soil)	0.86	800	<0.001

Fig. S1-S27: Partial plots of selected explanatory variables of the Random forest analyses. The plots show the median (black line) and confidence interval (gray area, calculated from 100 repeated Random forest analyses). For belowground dependent variables distinction is made in analyses which ex- or included soil temperature variables as independent variables (respectively “without soil T” and “with soil T”).

Fig. S1

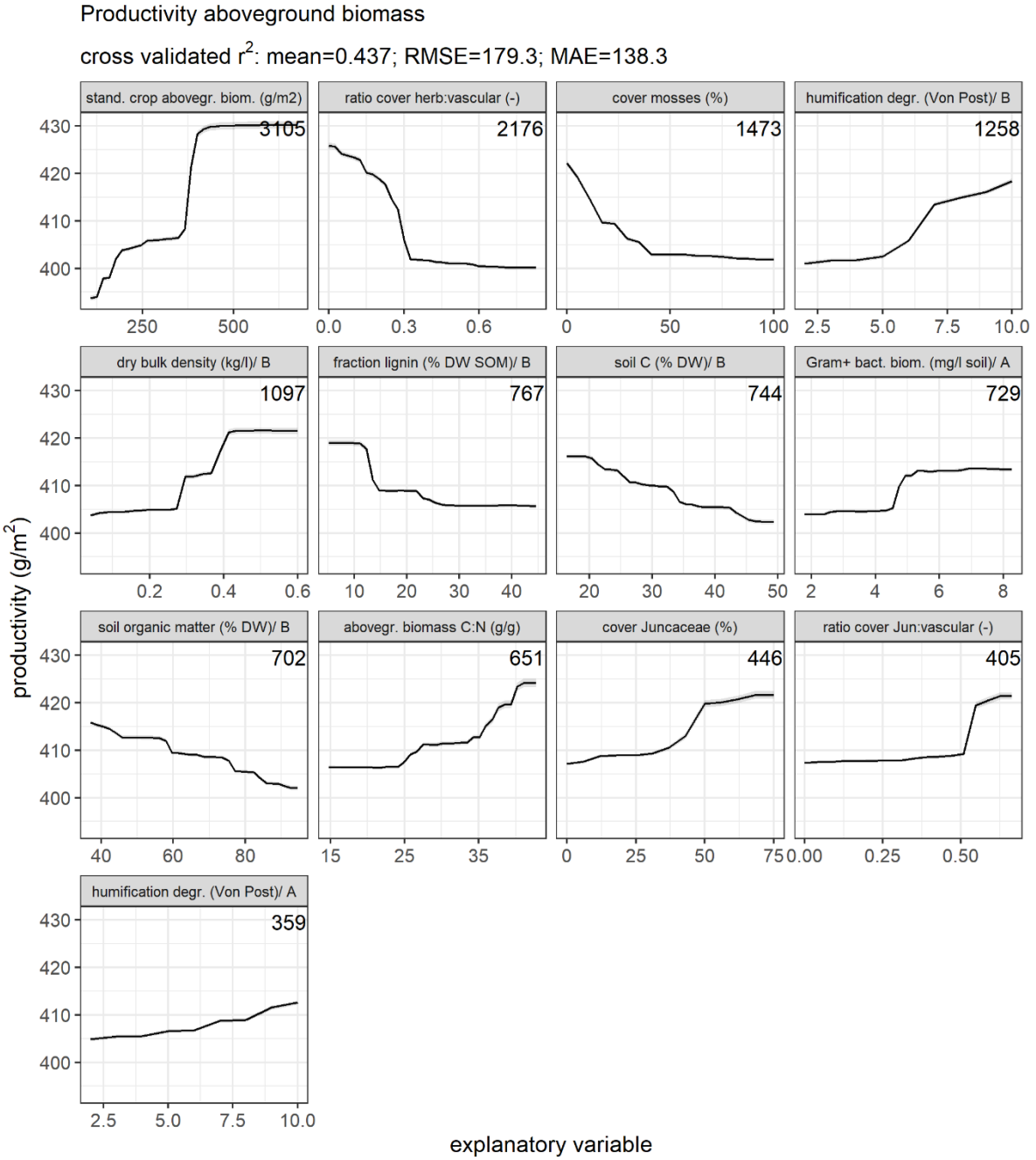

Fig. S2

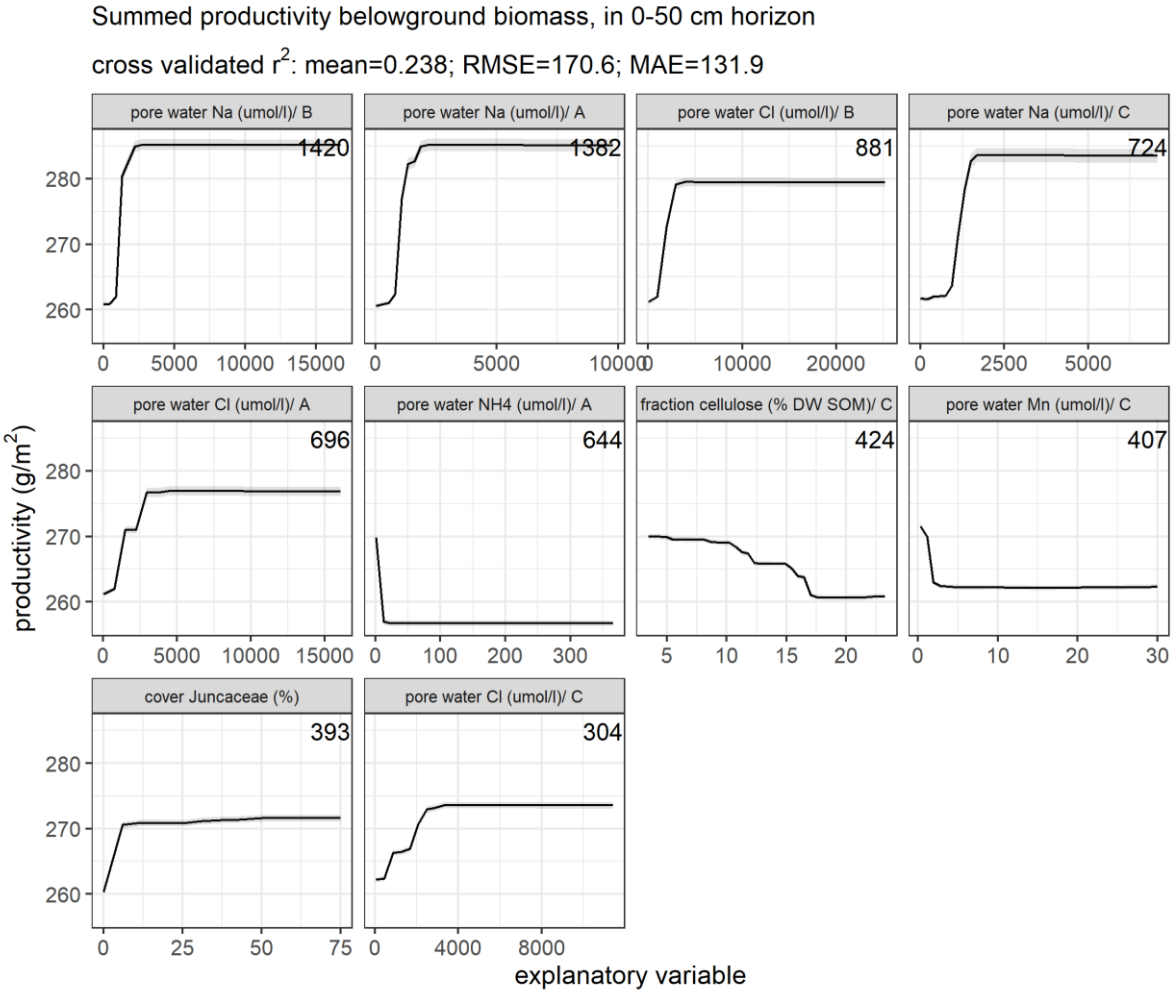
Summed productivity belowground biomass, in 0-50 cm horizon
cross validated r2: mean=0.238; RMSE=170.6; MAE=131.9
pore water Na (umol/l)/ B
1420
pore water Na (umol/l)/ A
1382
pore water Cl (umol/l)/ B
881
pore water Na (umol/l)/ C
724
pore water Cl (umol/l)/ A
696
pore water NH4 (umol/l)/ A
644
fraction cellulose (% DW SOM)/ C
424
pore water Mn (umol/l)/ C
407
cover Juncaceae (%)
393
pore water Cl (umol/l)/ C
304
productivity (g/m2)
explanatory variable

Fig. S3

Productivity belowground biomass, in 0-5, 15-20, and 45-50 cm horizons, without soil T

r^2=0.581; RSME r^2=30.9; MAE r^2=20.1

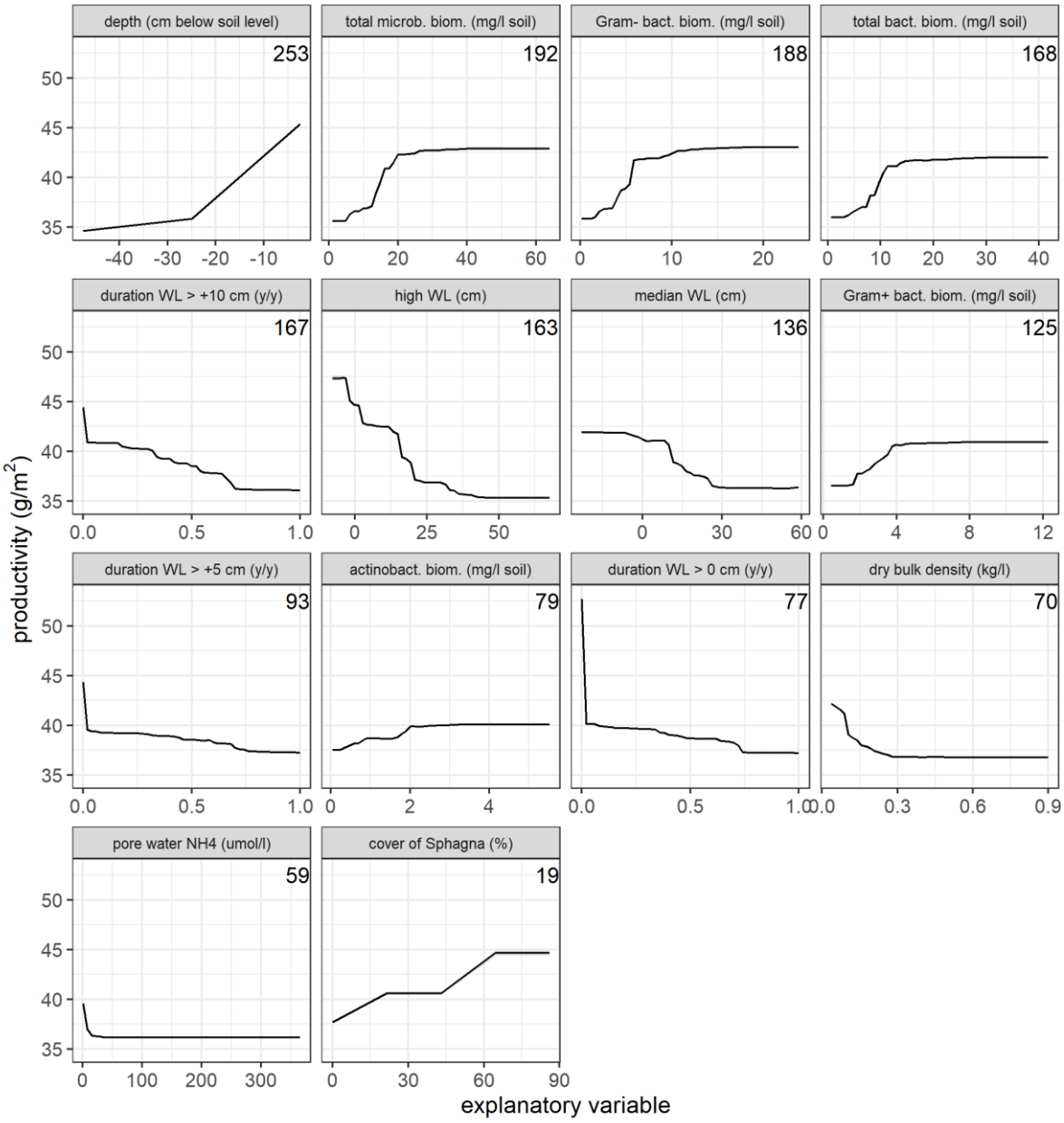

Fig. S4

Productivity belowground biomass, in 0-5 cm horizon, without soil T

cross validated r^2: mean=0.230; RMSE=47.5; MAE=35.0

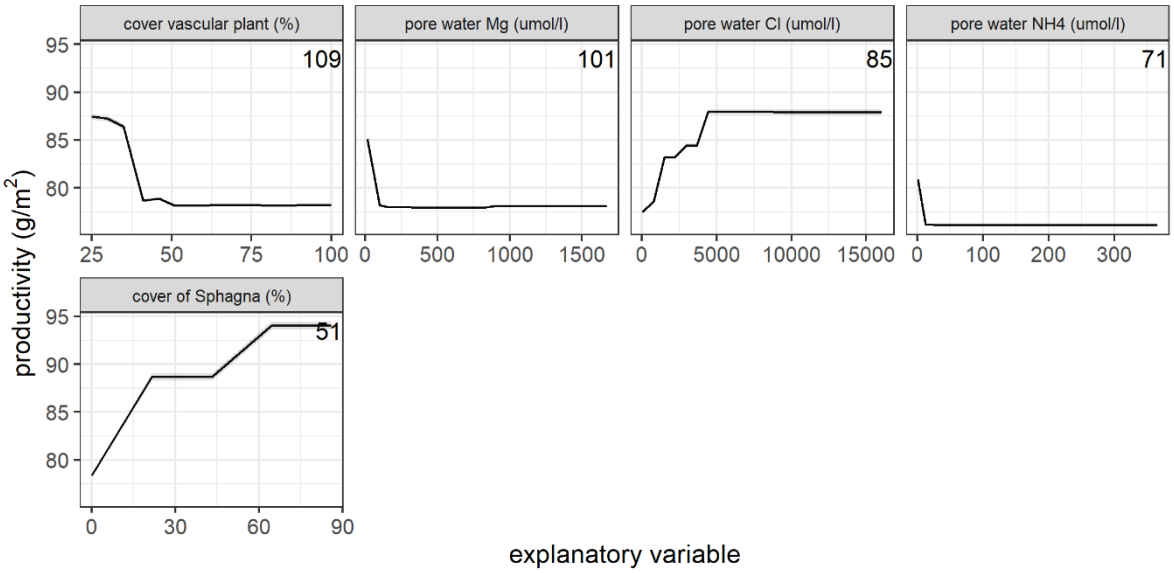

Fig. S5

Productivity belowground biomass, in 15-20 cm horizon, without soil T

cross validated r^2: mean=0.246; RMSE=23.4; MAE=17.9

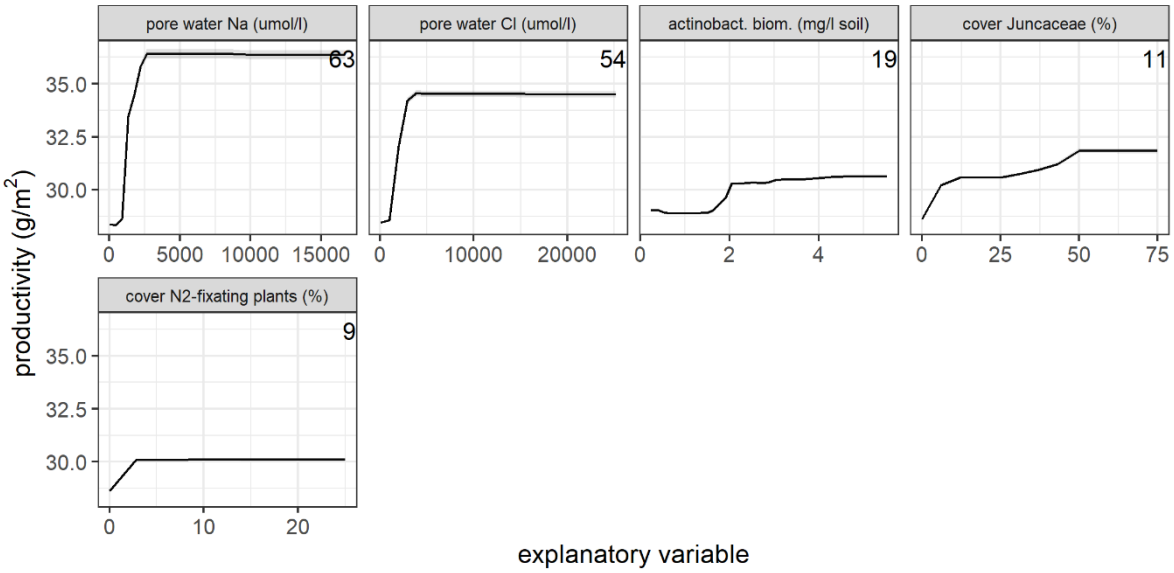

Fig. S6

Productivity belowground biomass, in 45-50 cm horizon, without soil T

cross validated r^2: mean=0.240; RMSE=5.2; MAE=4.2

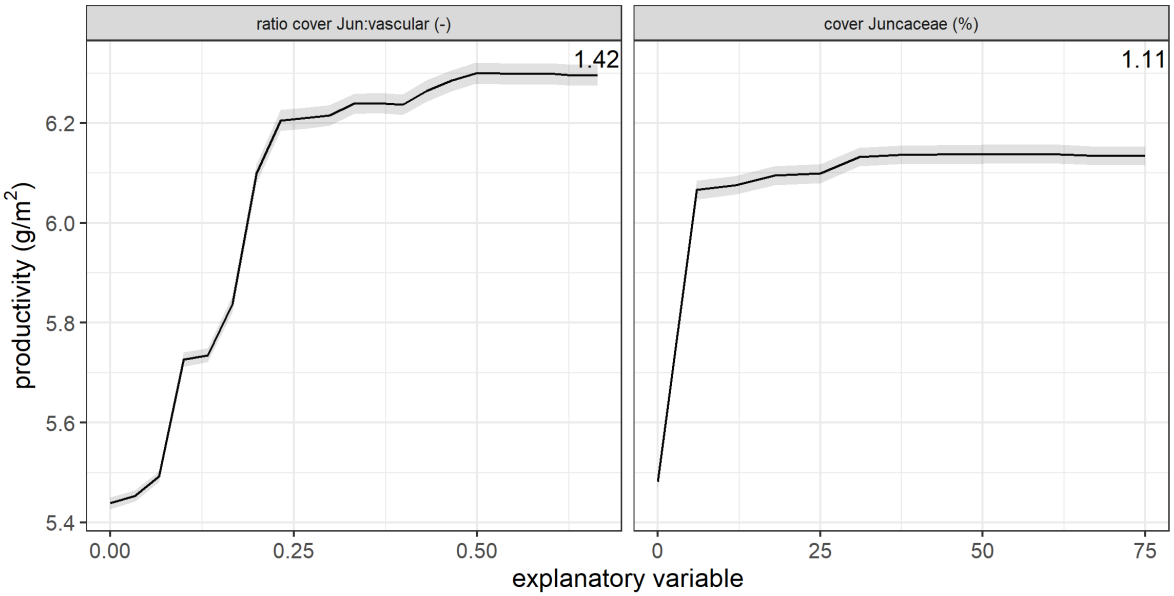

Fig. S7

Productivity belowground biomass, in 0-5, 15-20, and 45-50 cm horizons, with soil T

cross validated r^2: mean=0.588; RMSE=29.0; MAE=20.8

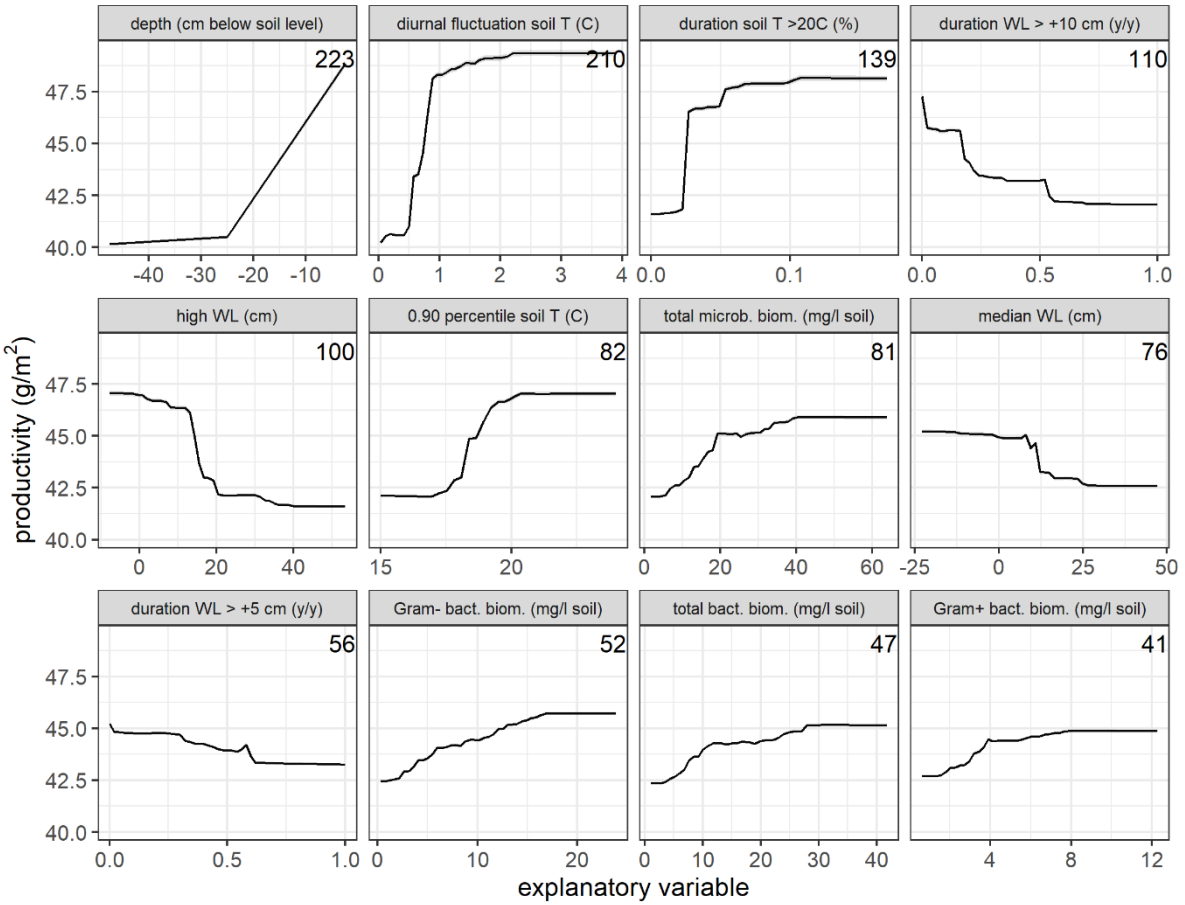

Fig. S8

Productivity belowground biomass, in 0-5 cm horizon, with soil T

cross validated r^2: mean=0.227; RMSE=43.3; MAE=34.8

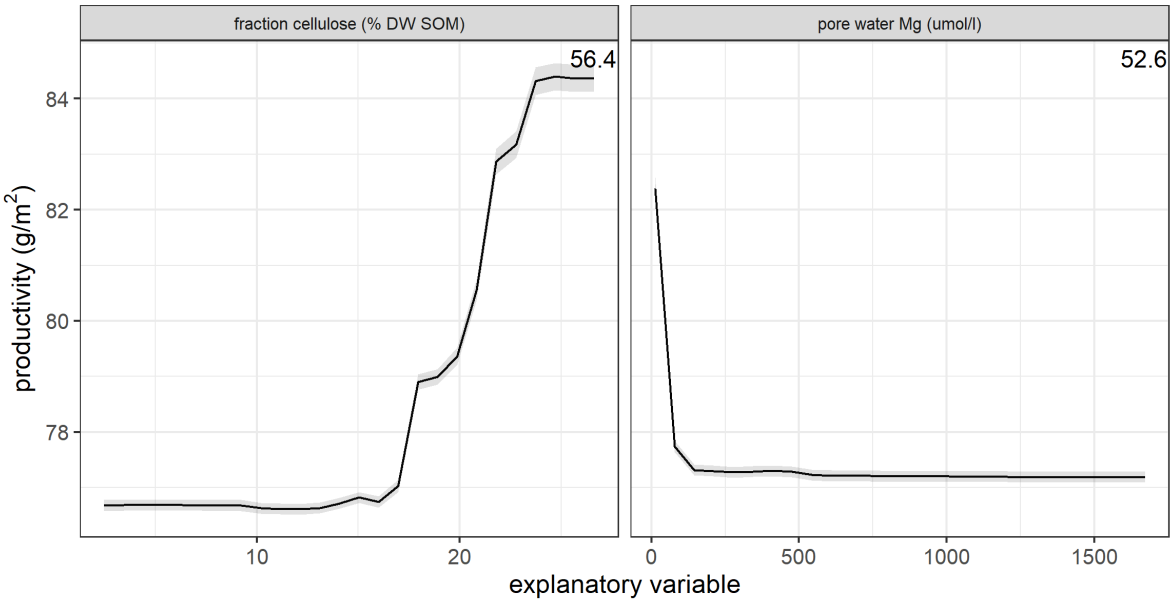

Fig. S9

Productivity belowground biomass, in 15-20 cm horizon, with soil T

cross validated r^2: mean=0.276; RMSE=12.4; MAE=10.4

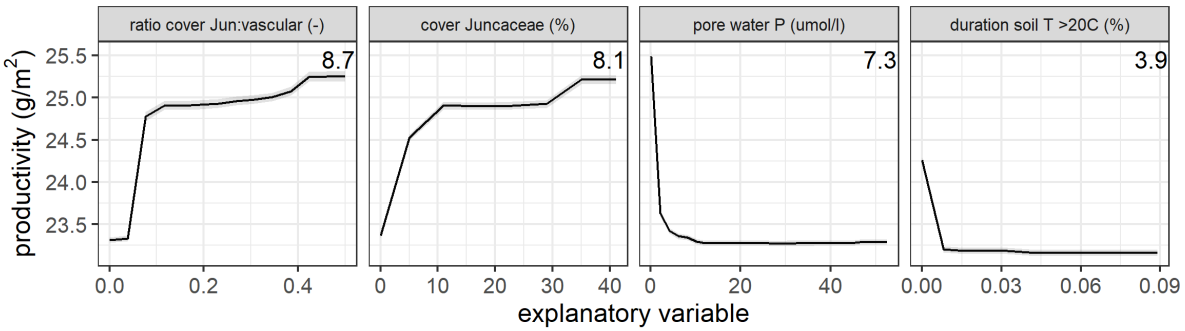

Fig. S10

Decomposition biomass, at soil surface, in 0-5, 15-20, and 45-50 cm horizons, without soil T

cross validated r^2: mean=0.659; RMSE=0.12; MAE=0.12

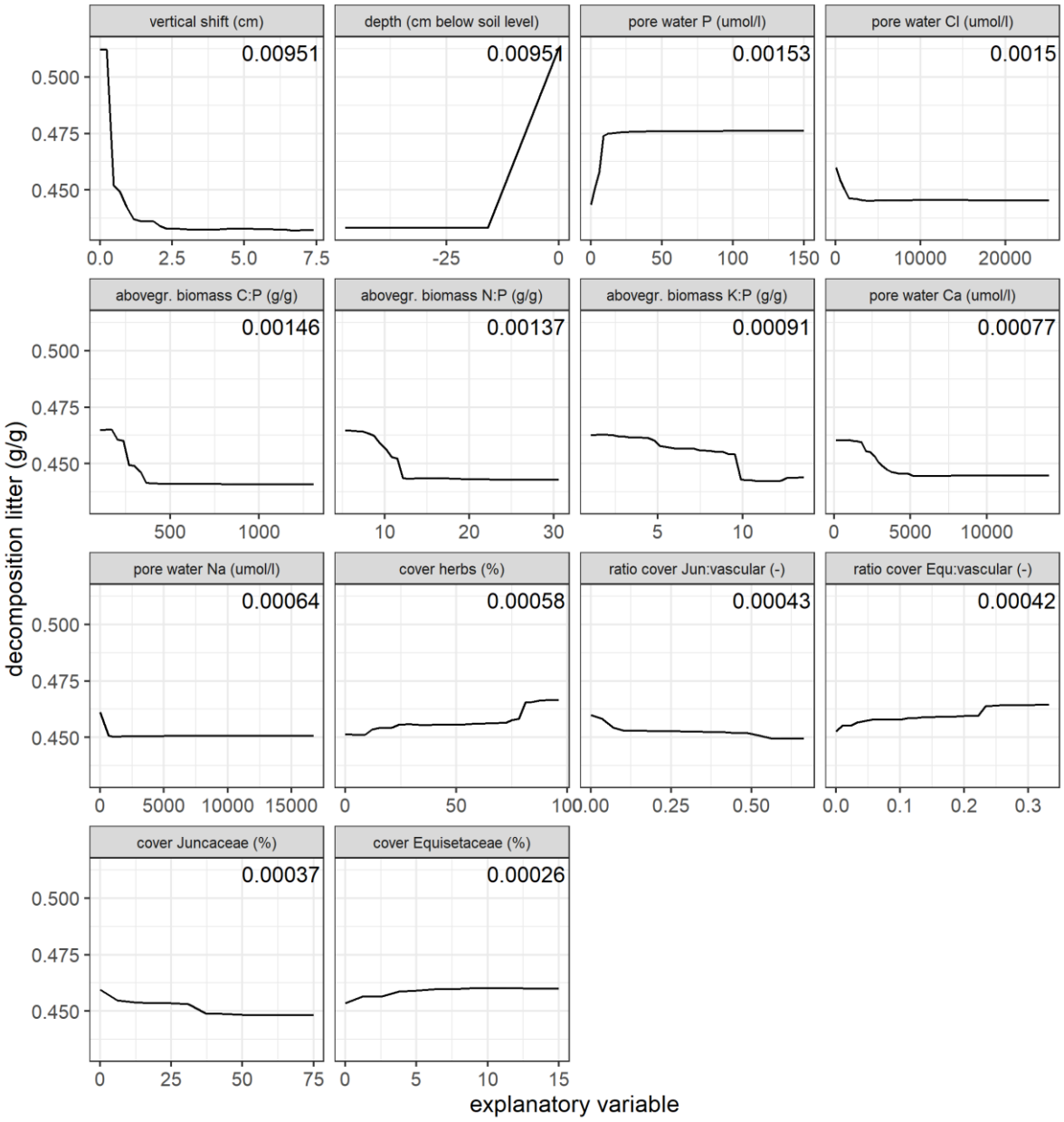

Fig. S11

Decomposition aboveground biomass, at soil surface, without soil T

cross validated r^2: mean=0.323; RMSE=0.07; MAE=0.05

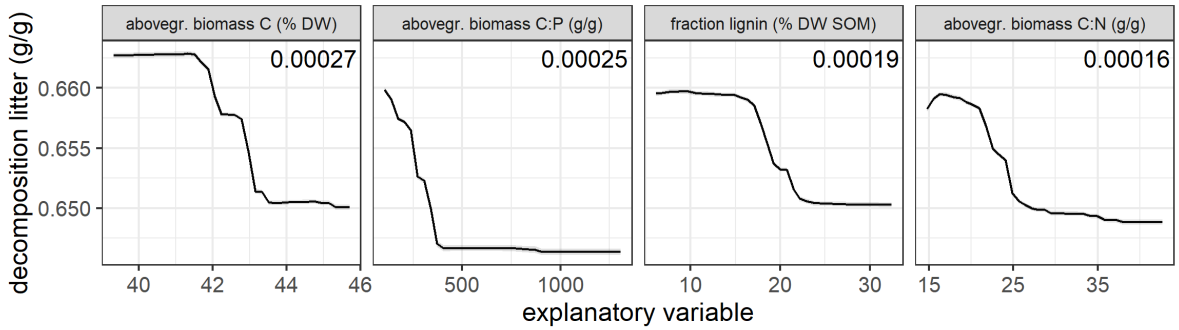

Fig. S12

Decomposition belowground biomass, in 0-5 cm horizon, without soil T

cross validated r^2: mean=0.203; RMSE=0.14; MAE=0.12

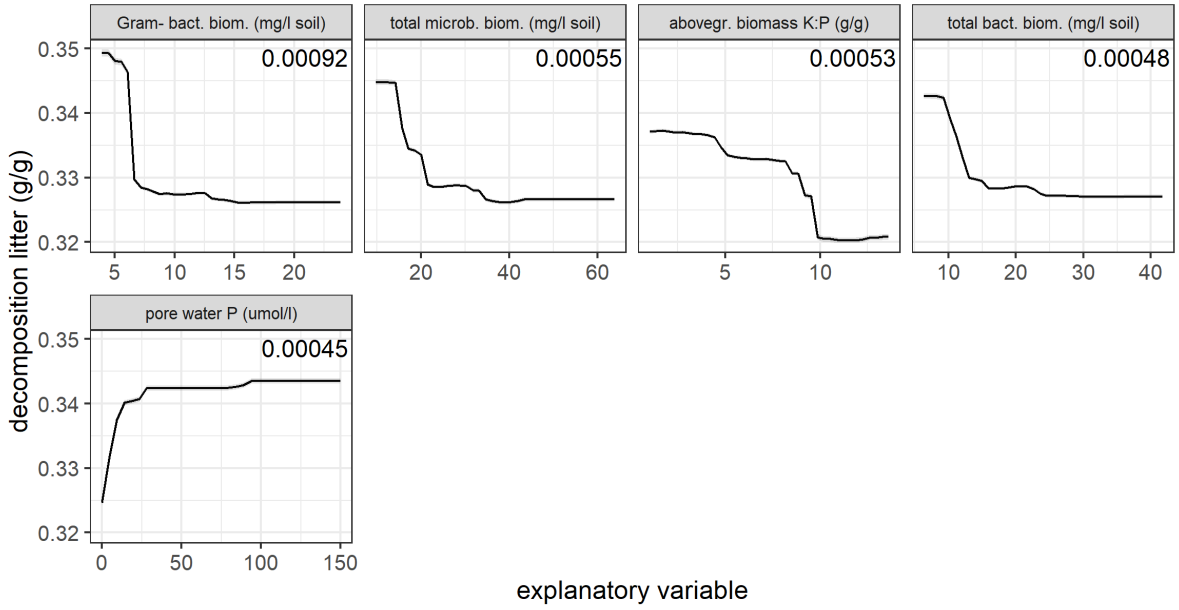

Fig. S13

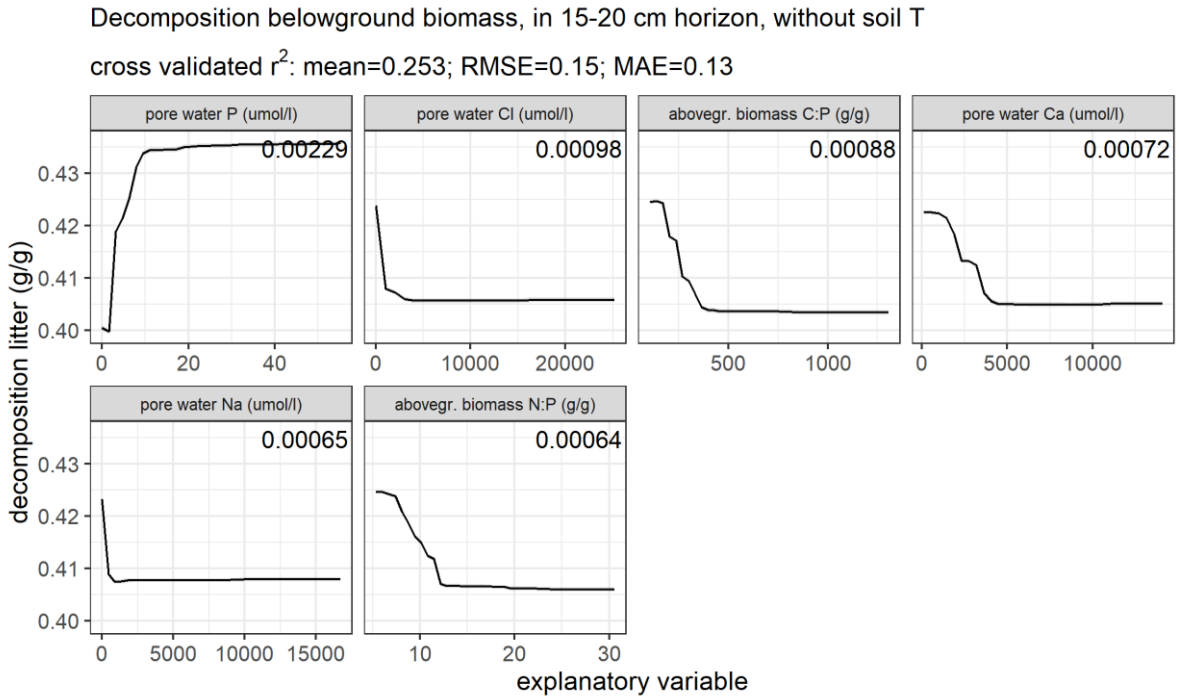

Fig. S14

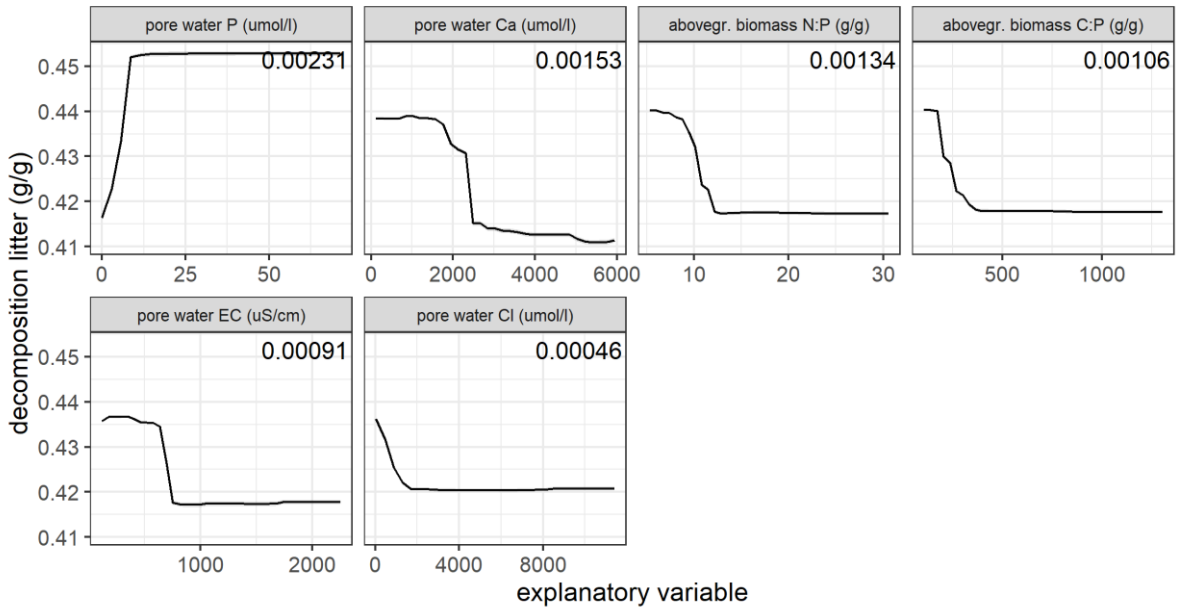

Fig. S15

Decomposition biomass, at soil surface, in 0-5, 15-20, and 45-50 cm horizons, with soil T

cross validated r^2: mean=0.484; RMSE=0.14; MAE=0.11

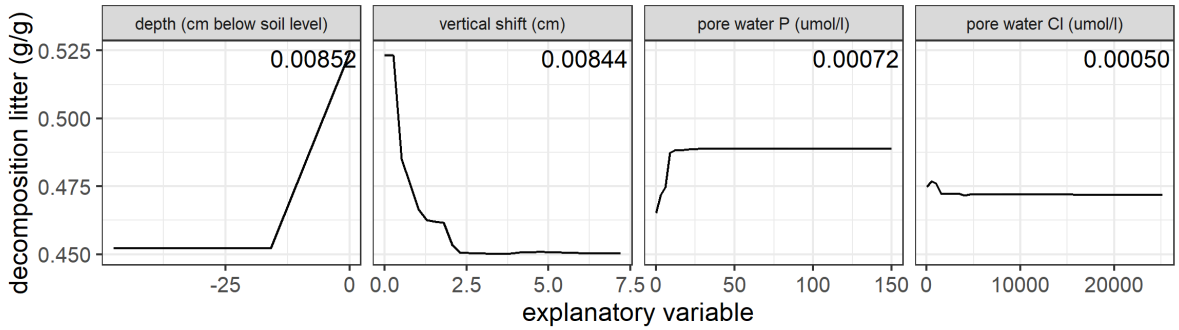

Fig. S16

Decomposition aboveground biomass, at soil surface, with soil T

cross validated r^2: mean=0.416; RMSE=0.06; MAE=0.05

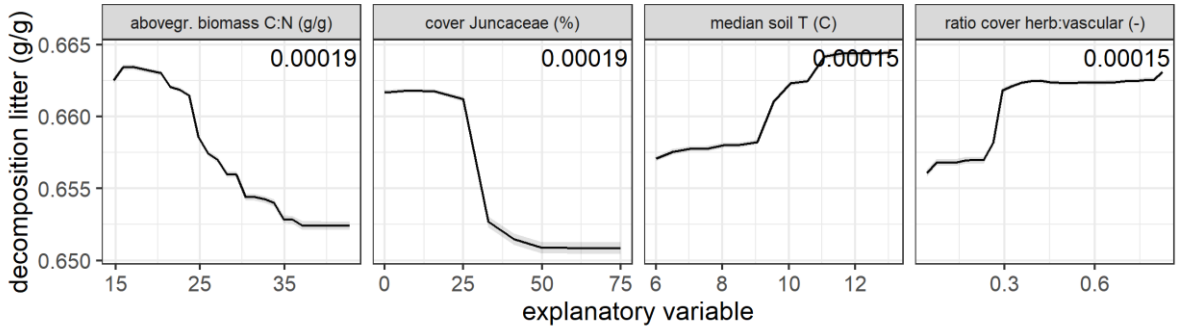

Fig. S17

Decomposition belowground biomass, in 0-5 cm horizon, with soil T

cross validated r^2: mean=0.348; RMSE=0.13; MAE=0.11

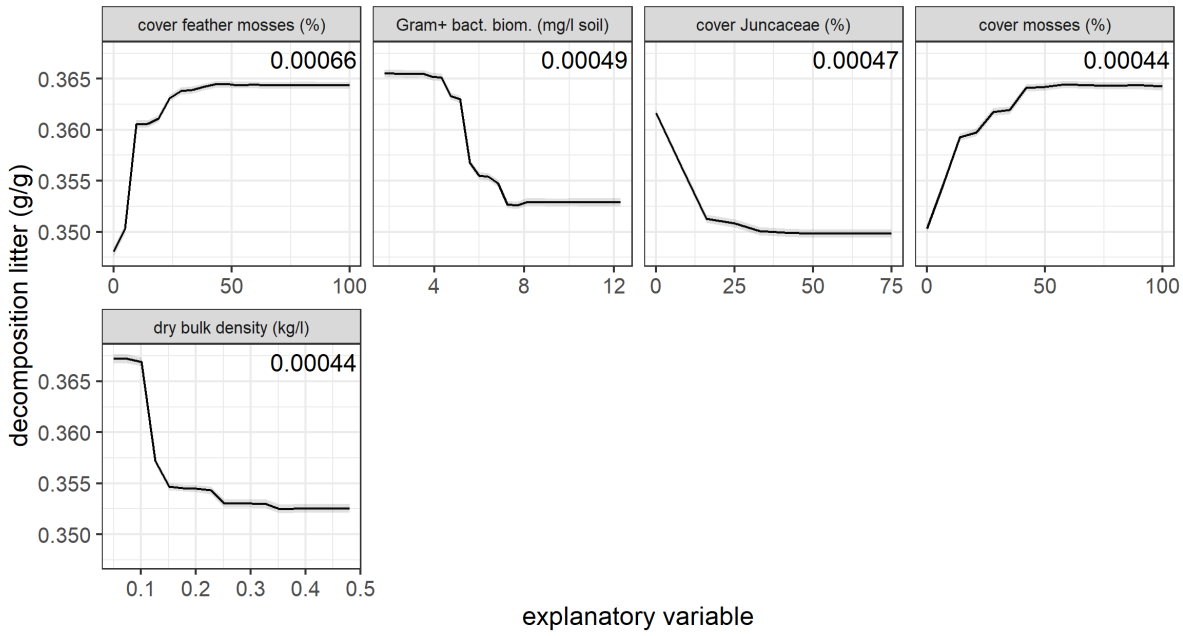

Fig. S18

Decomposition belowground biomass, in 15-20 cm horizon, with soil T

cross validated r^2: mean=0.240; RMSE=0.14; MAE=0.13

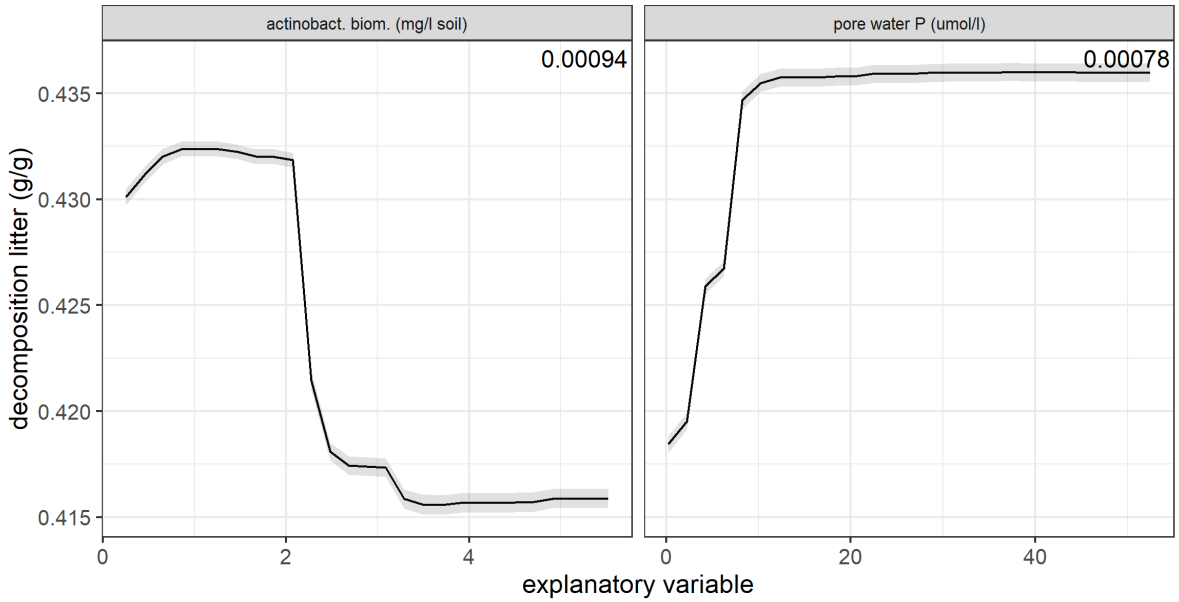

Fig. S19

Decomposition Rooibos tea, at soil surface, and in 0-5, 15-20, and 45-50 cm horizons

without soil T; cross validated r^2: mean=0.123; RMSE=0.04; MAE=0.03

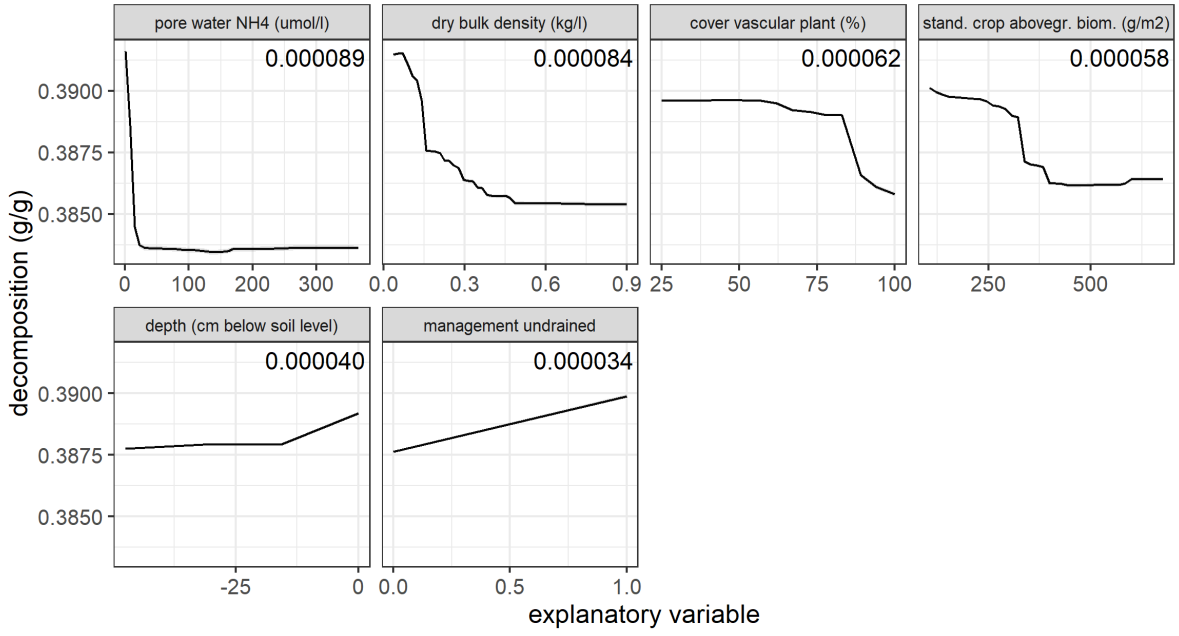

Fig. S20

Decomposition Rooibos tea, at soil surface, without soil T

cross validated r^2: mean=0.210; RMSE=0.04; MAE=0.03

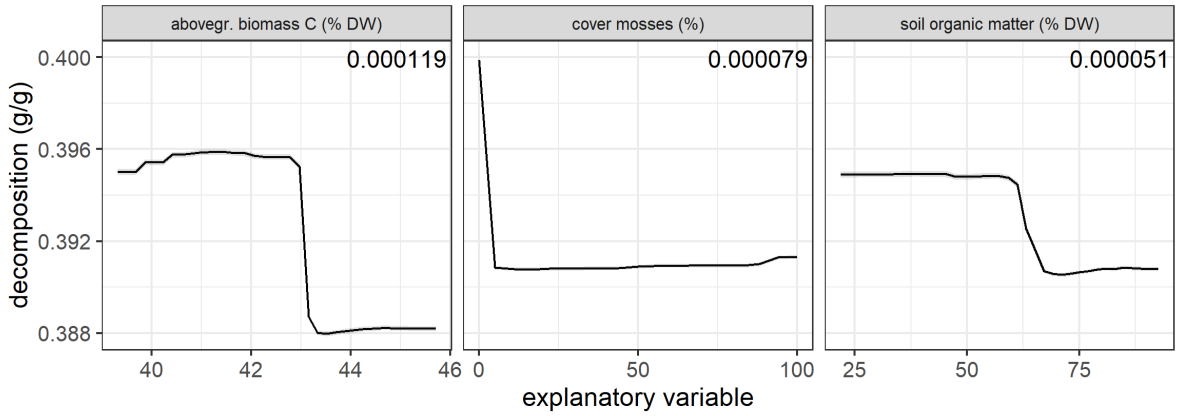

Fig. S21

Decomposition Rooibos tea, in 0-5 cm horizon, without soil T

cross validated r^2: mean=0.362; RMSE=0.05; MAE=0.04

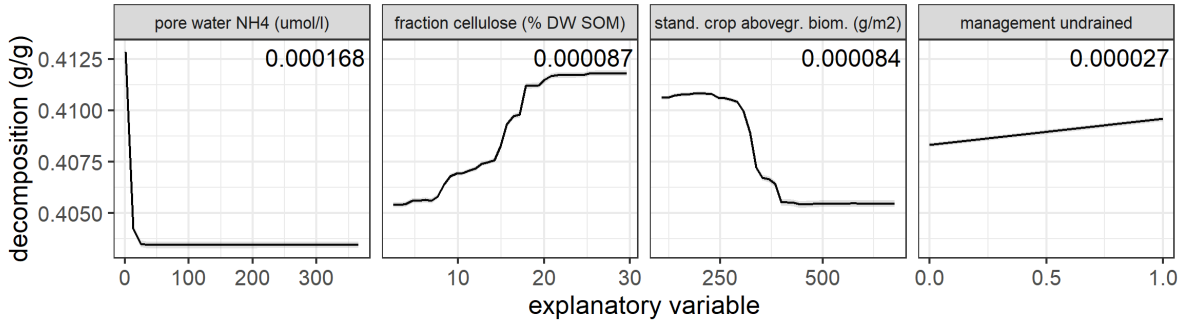

Fig. S22

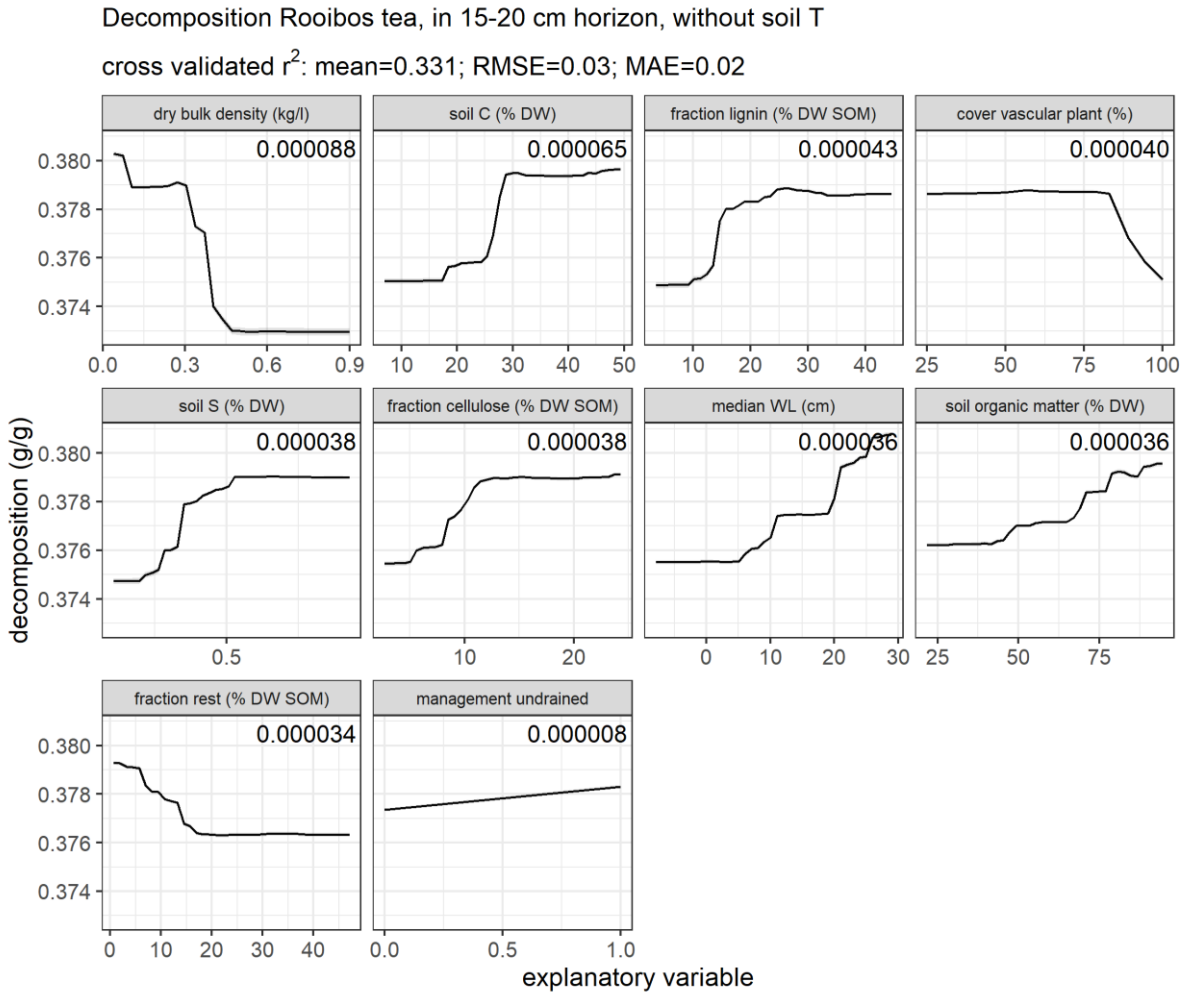
Decomposition Rooibos tea, in 15-20 cm horizon, without soil T
cross validated r2: mean=0.331; RMSE=0.03; MAE=0.02
dry bulk density (kg/l)
0.000088
soil C (% DW)
0.000065
fraction lignin (% DW SOM)
0.000043
cover vascular plant (%)
0.000040
soil S (% DW)
0.000038
fraction cellulose (% DW SOM)
0.000038
median WL (cm)
0.000036
soil organic matter (% DW)
0.000036
fraction rest (% DW SOM)
0.000034
management undrained
0.000008
decomposition (g/g)
explanatory variable

Fig. S23

Decomposition Rooibos tea, in 45-50 cm horizon, without soil T

cross validated r^2: mean=0.527; RMSE=0.02; MAE=0.02

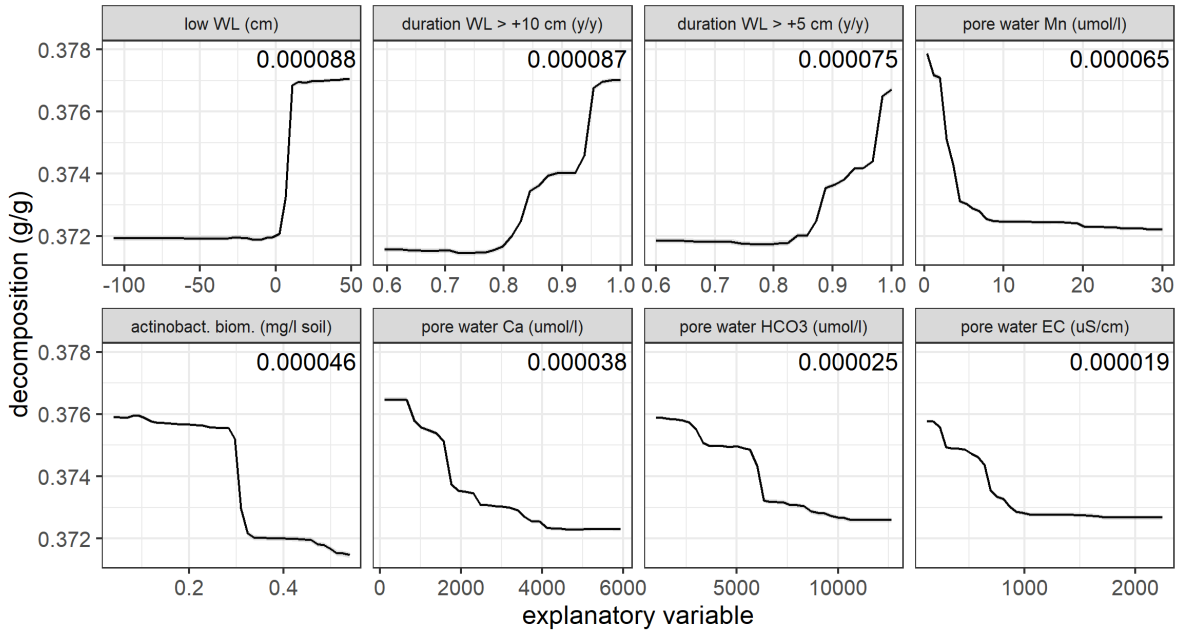

Fig. S24

Decomposition Rooibos tea, at soil surface and in 0-5, 15-20, and 45-50 cm horizons with soil T; cross validated r^2: mean=0.139; RMSE=0.05; MAE=0.03

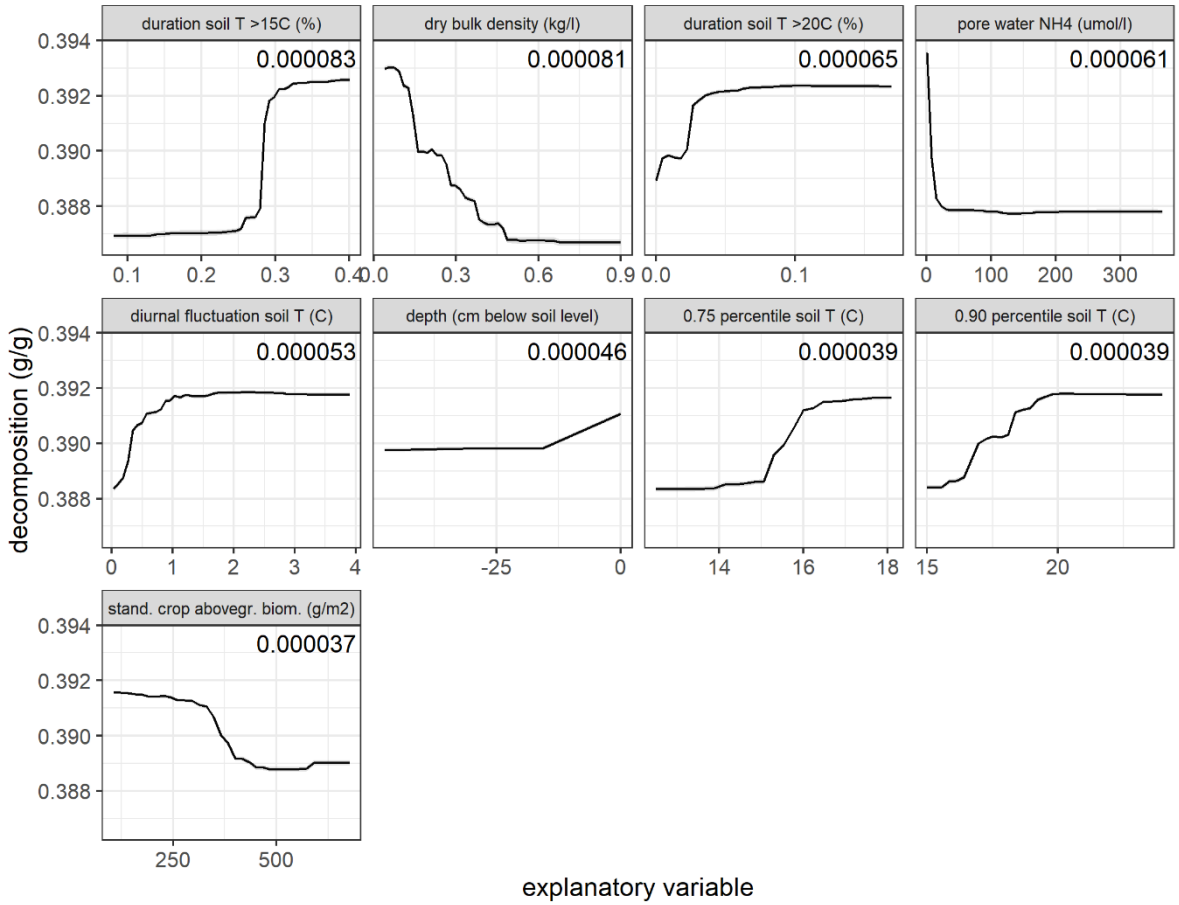

Fig. S25

Decomposition Rooibos tea, at soil surface, with soil T

cross validated r^2: mean=0.279; RMSE=0.04; MAE=0.03

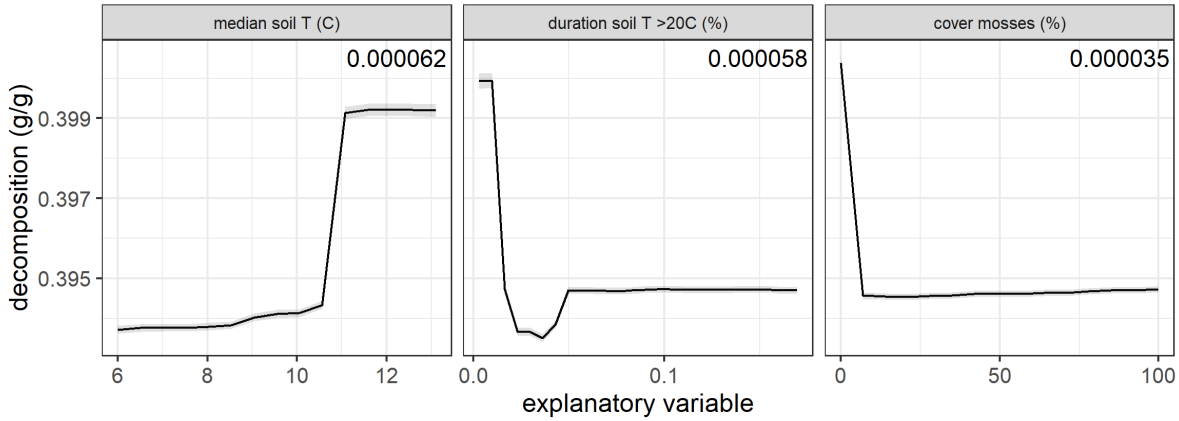

Fig. S26

Decomposition Rooibos tea, in 0-5 cm horizon, with soil T

cross validated r^2: mean=0.479; RMSE=0.05; MAE=0.04

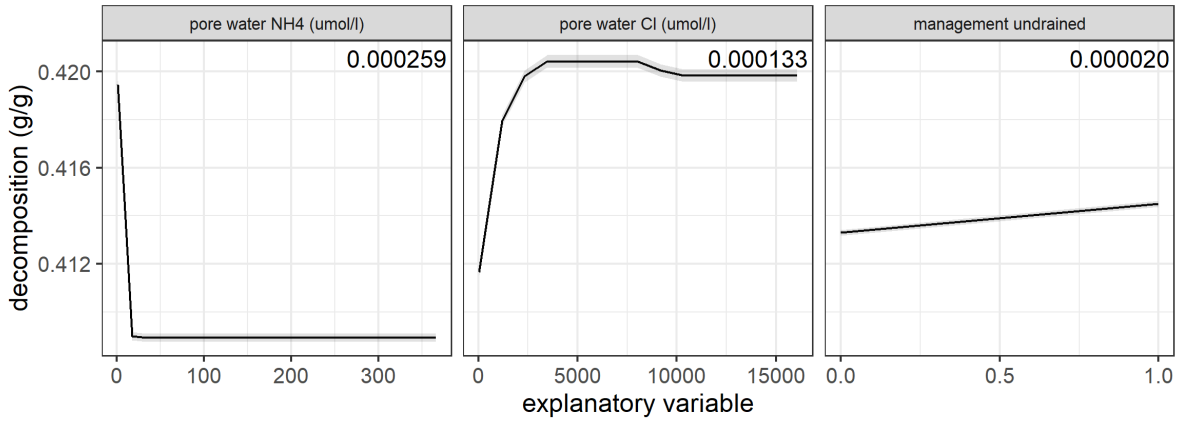

Fig. S27

Decomposition Rooibos tea, in 15-20 cm horizon, with soil T

cross validated r^2: mean=0.398; RMSE=0.03; MAE=0.03

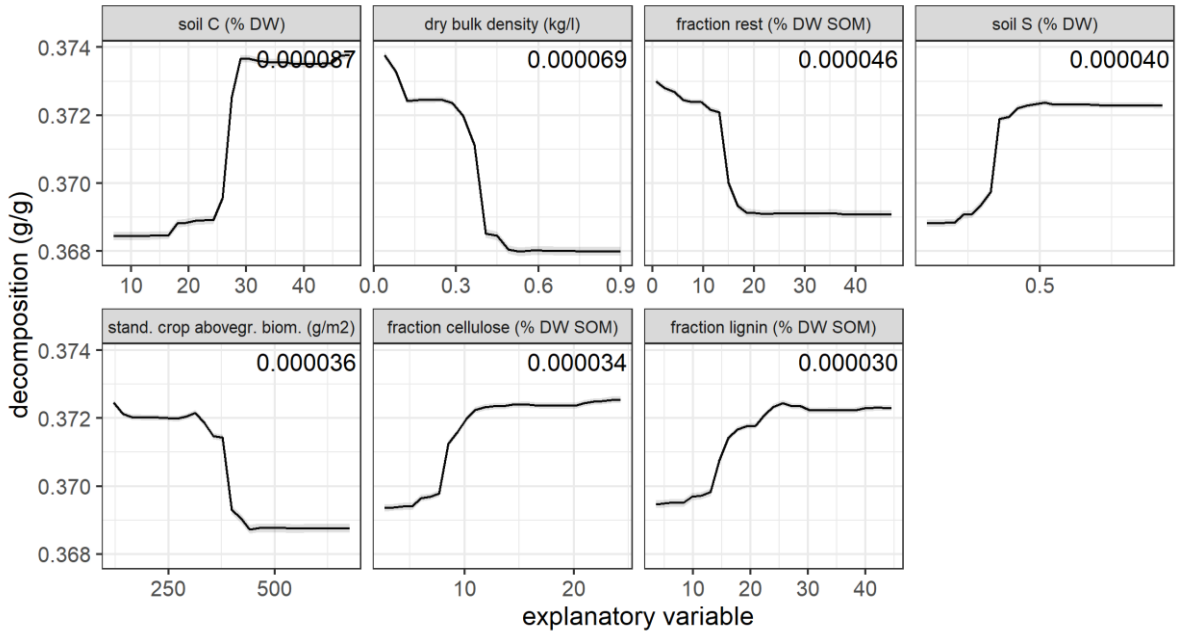

Fig. S28: The inverse relationship between production of aboveground vascular plant biomass and moss cover with distinction for hydrological status. Pearson correlation for all sites r = -0.60 and p = <0.001.