

## Supplementary Material

### **Carbon dioxide fertilisation and suppressed respiration induce enhanced spring biomass production in a mixed species temperate meadow exposed to moderate carbon dioxide enrichment**

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### Supplementary Material

**Table S1.** Gas exchange parameters of six temperate grassland species grown FACE of 480 ppm [CO<sub>2</sub>] relative to ambient [CO<sub>2</sub>] of 400 ppm. Values are the mean of nine measurements per [CO<sub>2</sub>] treatment (three plants per FACE ring)

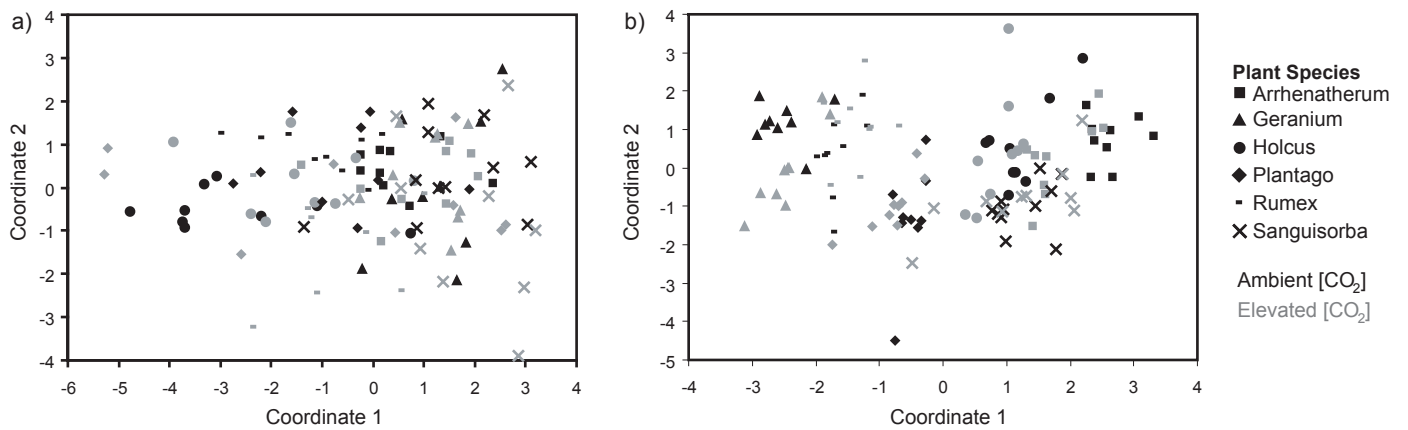
	LSP (μmol m <sup>-2</sup> s <sup>-1</sup> )		Γ (μmol m <sup>-2</sup> s <sup>-1</sup> )		ΦCO <sub>2</sub> (mol photon <sup>-1</sup> )		V <sub>Cmax</sub> (μmol m <sup>-2</sup> s <sup>-1</sup> )		J <sub>max</sub> (μmol m <sup>-2</sup> s <sup>-1</sup> )		V <sub>Cmax</sub> : J <sub>max</sub>		TPU (μmol m <sup>-2</sup> s <sup>-1</sup> )		A <sub>max</sub> (μmol m <sup>-2</sup> s <sup>-1</sup> )		R <sub>d</sub> (μmol m <sup>-2</sup> s <sup>-1</sup> )		R <sub>n</sub> (μmol m <sup>-2</sup> s <sup>-1</sup> )		R <sub>d</sub> : R <sub>n</sub>		Fv/Fm		Nitrogen (mg g <sup>-1</sup> )		Carbon (mg g <sup>-1</sup> )		C:N ratio		PNUE <sub>set</sub> (mol mol <sup>-1</sup> s <sup>-1</sup> )		PNUE <sub>amb</sub> (mol mol <sup>-1</sup> s <sup>-1</sup> )		
	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]
<b>Arrhenatherum elatius</b>	Mean	1863.2	1955.8	9.3	9.5	0.028	0.025	76.0	74.7	164.6	183.8	0.462	0.406	14.1	13.8	41.3	42.1	-1.447	-1.452	-1.491	-1.524	0.937	0.864	0.814	0.758	34.017	32.693	360.802	375.961	11.372	12.036	187.552	244.483	100.652	84.278
	Standard Error	47.0	37.5	1.0	0.4	0.001	0.002	2.3	4.0	7.5	16.0	0.022	0.031	0.4	0.7	1.2	1.4	0.14	0.23	0.14	0.27	0.02	0.08	0.006	0.017	2.025	1.234	16.112	4.532	0.852	0.393	2.6	6.0	6.5	8.8
	Standard Deviation	141.0	112.6	3.1	1.2	0.004	0.007	6.9	12.1	22.6	48.0	0.066	0.094	1.2	2.0	3.7	4.2	0.43	0.69	0.41	0.80	0.05	0.24	0.017	0.052	4.529	2.759	36.029	10.134	1.906	0.880	7.7	17.9	15.9	21.5
	Relative Change (%)		5.0		2.0		-11.1		-1.7		11.7		-12.0		-2.0		1.9		0.4		2.2		-7.7		-6.9		-3.9		4.2		5.8		30.4		-16.3
	ANOVA (Ring): F <sub>4,15</sub> ; P-value	1.146; 0.382		0.0564; 0.993		<b>4.343; 0.021</b>		2.702; 0.082		0.675; 0.622		2.728; 0.0796		<b>5.606; 0.00881</b>		1.689; 0.217		0.777; 0.561		1.720; 0.210		1.338; 0.312		<b>20.219; 0.0000290</b>		0.997; 0.373		1.159; 0.332		1.0229; 0.368		<b>5.442; 0.00981</b>		2.433; 0.149	
	ANOVA (CO <sub>2</sub> Treatment): F <sub>1,4</sub> ; P-value	2.144; 0.217		0.399; 0.562		0.645; 0.467		0.042; 0.848		1.602; 0.274		0.678; 0.456		0.0478; 0.838		0.121; 0.745		0.000497; 0.983		0.292; 0.618		0.623; 0.474		2.704; 0.175		3.729; 0.115		0.636; 0.664		5.679; 0.0605		<b>29.837; 0.00546</b>		0.906; 0.442	
<b>Geranium pratense</b>	Mean	1851.1	1830.8	14.4	14.0	0.029	0.031	75.7	80.2	201.4	194.9	0.376	0.412	14.9	14.5	42.0	40.9	-1.627	-1.684	-2.622	-2.150	0.648	0.688	0.823	0.814	41.200	40.689	361.829	374.665	9.078	9.356	139.371	193.395	46.236	64.904
	Standard Error	179.7	90.1	1.6	0.8	0.003	0.003	3.5	3.4	6.3	5.2	0.015	0.017	0.6	0.3	2.4	1.7	0.13	0.32	0.19	0.23	0.07	0.11	0.010	0.010	3.151	1.865	11.441	8.878	0.433	0.314	10.4	7.6	6.4	7.8
	Standard Deviation	539.1	270.3	4.7	2.4	0.010	0.008	10.6	10.2	18.9	15.7	0.046	0.051	1.9	0.9	7.3	5.2	0.40	0.95	0.58	0.70	0.21	0.32	0.030	0.031	7.717	4.569	28.024	21.745	1.061	0.789	31.2	22.9	14.2	19.0
	Relative Change (%)		-1.1		-3.0		9.3		6.0		-3.2		9.5		-2.7		-2.6		3.5		-18.0		6.3		-1.1		-1.2		3.5		3.1		38.8		40.4
	ANOVA (Ring): F <sub>4,15</sub> ; P-value	1.667; 0.222		0.583; 0.681		<b>3.946; 0.029</b>		0.605; 0.667		0.299; 0.873		0.534; 0.714		2.108; 0.143		0.203; 0.932		2.636; 0.0865		0.116; 0.974		0.893; 0.498		<b>4.955; 0.0140</b>		0.0171; 0.902		0.535; 0.505		0.239; 0.651		<b>43.623; 0.00272</b>		0.335; 0.849	
	ANOVA (CO <sub>2</sub> Treatment): F <sub>1,4</sub> ; P-value	0.007; 0.937		0.091; 0.779		0.178; 0.695		1.286; 0.320		1.698; 0.262		4.107; 0.113		0.205; 0.674		0.524; 0.509		0.0146; 0.910		<b>16.458; 0.0154</b>		0.112; 0.755		0.150; 0.718		1.474; 0.319		2.119; 0.196		1.222; 0.393		<b>43.623; 0.00272</b>		1.216; 0.385	
<b>Holcus lanatus</b>	Mean	1065.6	1215.5	12.0	10.0	0.027	0.028	48.7	62.0	126.3	148.3	0.386	0.418	10.6	12.2	25.8	32.2	-1.090	-0.533	-1.300	-0.644	0.723	0.812	0.832	0.814	26.404	24.250	368.572	358.637	14.031	14.835	148.406	225.674	128.856	101.720
	Standard Error	85.2	110.3	1.5	0.3	0.001	0.002	3.2	3.4	14.5	9.5	0.025	0.026	1.4	0.9	1.3	1.8	0.12	0.08	0.08	0.06	0.04	0.11	0.005	0.008	0.755	0.901	5.570	11.016	0.445	0.263	9.1	11.3	4.8	13.1
	Standard Deviation	255.5	330.9	4.5	1.0	0.003	0.007	9.5	10.1	43.6	28.5	0.076	0.077	4.3	2.6	3.8	5.5	0.36	0.25	0.23	0.19	0.12	0.34	0.016	0.024	1.689	2.207	12.456	26.984	0.995	0.643	27.3	33.8	11.7	32.1
	Relative Change (%)		14.1		-16.5		5.9		27.2		17.4		8.3		14.9		24.5		-51.1		-50.4		12.4		-0.5		-8.2		-2.7		5.7		52.1		-21.1
	ANOVA (Ring): F <sub>4,15</sub> ; P-value	0.575; 0.686		0.262; 0.897		1.126; 0.390		0.930; 0.479		0.532; 0.715		0.286; 0.881		0.466; 0.759		0.229; 0.917		2.641; 0.0862		2.852; 0.0712		2.612; 0.0885		4.955; 0.136		2.579; 0.184		0.601; 0.481		1.854; 0.245		0.287; 0.881		<b>5.971; 0.0259</b>	
	ANOVA (CO <sub>2</sub> Treatment): F <sub>1,4</sub> ; P-value	1.800; 0.251		5.244; 0.084		0.322; 0.601		<b>8.646; 0.042</b>		2.665; 0.178		0.811; 0.419		<b>28.356; 0.00599</b>		<b>7.776; 0.0494</b>		<b>22.604; 0.00894</b>		0.293; 0.617		0.150; 0.718		2.289; 0.174		1.290; 0.371		3.388; 0.0890		<b>81.460; 0.000835</b>		1.260; 0.378			
<b>Plantago lanceolata</b>	Mean	1526.3	1609.1	10.9	12.0	0.032	0.026	67.7	63.8	164.2	146.5	0.413	0.435	12.0	11.8	35.7	40.2	-2.286	-0.911	-2.828	-1.988	0.777	0.489	0.805	0.806	36.253	33.286	392.115	377.406	10.937	11.401	145.609	179.747	81.299	60.969
	Standard Error	81.1	193.3	1.4	0.7	0.002	0.004	4.0	9.1	10.1	22.7	0.015	0.038	0.7	1.7	1.7	2.3	0.37	0.13	0.23	0.14	0.09	0.08	0.015	0.016	1.787	0.986	5.274	4.219	0.525	0.431	4.5	11.9	5.9	8.4
	Standard Deviation	243.4	579.9	4.3	2.0	0.006	0.011	12.0	27.3	30.2	68.0	0.045	0.113	2.0	5.2	5.1	6.9	1.11	0.38	0.69	0.42	0.26	0.25	0.046	0.049	4.377	2.416	12.919	10.335	1.285	1.056	13.6	35.6	14.5	20.7
	Relative Change (%)		5.4		10.4		-18.2		-5.9		-10.8		5.5		-1.5		12.7		-60.1		-29.7		-37.1		0.1		-8.2		-3.8		4.2		23.4		-25.0
	ANOVA (Ring): F <sub>4,15</sub> ; P-value	<b>4.608; 0.017</b>		0.391; 0.812		0.726; 0.591		<b>10.315; 0.000739</b>		<b>14.469; 0.000153</b>		0.662; 0.630		<b>9.871; 0.000898</b>		<b>4.198; 0.0236</b>		0.209; 0.929		0.711; 0.600		0.534; 0.713		1.798; 0.189		0.997; 0.373		1.159; 0.332		1.023; 0.368		<b>4.510; 0.0187</b>		<b>4.538; 0.0499</b>	
	ANOVA (CO <sub>2</sub> Treatment): F <sub>1,4</sub> ; P-value	0.064; 0.812		1.094; 0.355		2.364; 0.199		0.051; 0.832		0.153; 0.716		0.938; 0.388		0.00327; 0.957		1.070; 0.359		<b>47.411; 0.00233</b>		<b>12.807; 0.0232</b>		<b>9.473; 0.0370</b>		0.03555; 0.860		3.729; 0.115		0.636; 0.664		5.679; 0.0605		3.0124; 0.158		2.0651; 0.224	
<b>Rumex acetosa</b>	Mean	1672.0	1555.0	14.3	20.0	0.027	0.025	84.9	84.8	197.5	202.9	0.430	0.418	15.3	16.1	43.2	42.1	-2.907	-1.186	-3.014	-1.700	0.930	0.710	0.841	0.841	31.799	31.383	350.970	361.069	11.142	11.631	173.175	208.554	60.578	76.688
	Standard Error	56.5	71.9	1.2	2.5	0.002	0.003	3.7	3.2	8.1	7.4	0.013	0.009	0.6	0.6	1.5	1.6	0.24	0.09	0.15	0.09	0.04	0.07	0.004	0.005	1.624	1.519	7.837	4.558	0.439	0.543	7.8	8.3	3.8	8.5
	Standard Deviation	187.5	227.4	3.9	8.0	0.007	0.008	12.4	10.1	26.9	23.3	0.044	0.027	1.9	2.0	5.1	5.1	0.76	0.29	0.49	0.29	0.11	0.21	0.011	0.014	3.979	2.422	19.196	11.166	1.074	1.330	26.0	26.1	9.3	22.4
	Relative Change (%)		-7.0		40.0		-9.4		-0.1		2.7		-2.8		4.7		-2.6		-59.2		-43.6		-23.6		0.0		-1.3		2.9		4.4		20.4		26.6
	ANOVA (Ring): F <sub>4,15</sub> ; P-value	2.267; 0.110		1.146; 0.373		2.970; 0.0543		1.469; 0.261		1.614; 0.222		0.662; 0.630		<b>3.871; 0.0236</b>		0.549; 0.703		<b>3.206; 0.0459</b>		2.341; 0.102		0.447; 0.773		0.735; 0.586		0.0202; 0.894		1.141; 0.346							

**Table S2.** Stomatal morphology and leaf gas exchange parameters of grassland species growing under FACE of 480 ppm [CO<sub>2</sub>] relative to control [CO<sub>2</sub>] of 400 ppm. Point measurements of leaf gas exchange were conducted under ambient climatic conditions of PAR and temperature and set cuvette conditions of 2000 μmol m<sup>-2</sup> s<sup>-1</sup> and 20°C temperature. V<sup>-2</sup> values are the mean of nine measurements per [CO<sub>2</sub>] treatment (three plants per FACE ring)

		Stomatal Density (mm <sup>-2</sup> )				Stomatal Pore Length (μm)				Cuvette Set PAR and Temperature						Cuvette Ambient PAR and Temperature					
		Abaxial		Adaxial		Abaxial		Adaxial		G <sub>s set</sub>		P <sub>N set</sub>		WUE <sub>I set</sub>		G <sub>s amb</sub>		P <sub>N amb</sub>		WUE <sub>I amb</sub>	
		Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]
<i>Arrhenatherum elatius</i>	Mean	37.8	36.0	75.2	70.5	63.1	55.8	58.9	59.1	491.6	332.2	21.0	26.8	16.2	7.3	573.4	414.8	11.3	9.3	6.3	6.1
	Standard Error	0.5	0.6	3.7	2.0	1.9	2.2	5.5	2.8	37.4	35.9	0.3	0.7	2.2	0.6	26.1	20.7	0.4	0.5	0.3	0.6
	Standard Deviation	1.3	1.4	9.0	5.0	4.5	5.3	13.5	6.8	112.2	107.8	0.9	2.0	6.6	1.8	113.6	88.0	1.6	2.2	1.2	2.7
	Relative Change (%)	-4.8		-6.3		-11.6		0.3		-32.4		28.0		-55.2		-27.7		-18.1		-3.6	
	ANOVA (Ring): F; P-value	1.047; 0.456		3.289; 0.0940		<b>7.126; 0.0182</b>		<b>18.853; 0.00151</b>		0.679; 0.620		<b>5.393; 0.0101</b>		<b>11.173; 0.000515</b>		0.942; 0.429		<b>7.020; 0.0174</b>		<b>9.993; 0.00668</b>	
	ANOVA ([CO <sub>2</sub> ] Treatment): F;P-value	5.277; 0.0832		0.738; 0.439		3.200; 0.148		0.000369; 0.986		<b>12.795; 0.0232</b>		<b>26.267; 0.00686</b>		4.800; 0.0936		6.973; 0.118		0.864; 0.451		0.00933; 0.932	
<i>Geranium pratense</i>	Mean	287.9	347.5	-	-	35.5	30.9	-	-	864.4	455.2	20.5	27.0	9.3	10.2	507.6	923.8	7.0	9.1	7.1	4.9
	Standard Error	23.5	16.4	-	-	0.9	1.0	-	-	50.6	18.0	1.5	1.1	1.0	0.9	64.0	52.6	0.4	0.5	0.5	0.4
	Standard Deviation	57.5	40.1	-	-	2.2	2.5	-	-	151.8	53.9	4.6	3.2	2.9	2.8	286.3	235.4	1.9	2.4	2.2	1.8
	Relative Change (%)	20.7		-		-13.1		-		-47.3		31.6		8.7		82.0		30.5		-30.9	
	ANOVA (Ring): F; P-value	4.007; 0.0643		-		0.697; 0.621		-		0.555; 0.700		0.329; 0.853		1.072; 0.412		0.921; 0.442		<b>9.197; 0.0110</b>		1.674; 0.255	
	ANOVA ([CO <sub>2</sub> ] Treatment): F;P-value	2.383; 0.198		-		<b>14.645; 0.0187</b>		-		<b>93.117; 0.000645</b>		<b>30.534; 0.00524</b>		0.357; 0.583		6.773; 0.118		0.922; 0.438		1.455; 0.349	
<i>Holcus lanatus</i>	Mean	64.3	56.2	86.7	89.1	48.5	42.3	45.1	37.2	507.0	360.4	13.4	19.2	8.1	10.6	955.2	324.1	11.8	8.6	6.6	5.9
	Standard Error	4.4	3.8	2.5	3.3	2.9	3.2	1.5	1.6	58.7	20.7	0.8	1.0	0.7	0.7	56.9	19.6	0.3	0.6	0.5	0.9
	Standard Deviation	10.7	9.3	6.2	8.0	7.0	7.8	3.7	3.8	176.1	62.2	2.5	2.9	2.1	2.1	266.7	83.2	1.2	2.6	2.5	4.0
	Relative Change (%)	-12.6		2.8		-12.9		-17.6		-28.9		42.6		31.6		-66.1		-27.0		-11.6	
	ANOVA (Ring): F; P-value	<b>27.044; 0.000558</b>		0.666; 0.638		<b>78.770; 0.0000257</b>		<b>10.176; 0.00766</b>		2.070; 0.148		0.305; 0.869		1.695; 0.216		<b>11.642; 0.00428</b>		<b>5.877; 0.0269</b>		<b>5.732; 0.0285</b>	
	ANOVA ([CO <sub>2</sub> ] Treatment): F;P-value	0.821; 0.416		0.436; 0.545		0.878; 0.402		6.196; 0.0675		3.395; 0.139		<b>55.614; 0.00173</b>		4.518; 0.101		6.634; 0.123		2.163; 0.279		0.0805; 0.803	
<i>Plantago lanceolata</i>	Mean	216.7	249.6	188.5	161.0	30.7	32.0	34.4	33.6	560.9	503.9	18.5	23.1	7.7	8.6	1186.5	542.3	10.2	8.1	5.1	5.0
	Standard Error	2.0	16.7	8.7	8.0	0.6	0.6	1.6	0.7	44.4	56.0	0.6	1.5	0.4	0.7	182.0	37.0	0.4	0.6	0.3	0.3
	Standard Deviation	4.9	41.0	21.4	19.5	1.5	1.4	4.0	1.8	133.1	168.0	1.7	4.6	1.2	2.1	833.9	148.1	1.9	2.6	1.4	1.2
	Relative Change (%)	15.2		-14.6		4.4		-2.3		-10.2		24.9		11.7		-54.3		-20.6		-3.2	
	ANOVA (Ring): F; P-value	<b>8.813; 0.0110</b>		<b>21.786; 0.00102</b>		0.495; 0.741		<b>6.718; 0.0210</b>		0.946; 0.471		<b>4.532; 0.0184</b>		0.882; 0.503		2.079; 0.188		4.138; 0.0584		0.749; 0.503	
	ANOVA ([CO <sub>2</sub> ] Treatment): F;P-value	1.781; 0.253		2.311; 0.203		4.265; 0.108		0.0964; 0.772		0.662; 0.461		3.324; 0.142		1.377; 0.306		2.112; 0.283		1.397; 0.359		0.487; 0.558	
<i>Rumex acetosa</i>	Mean	95.9	85.0	69.2	54.2	52.1	53.1	59.0	54.9	345.8	428.9	19.0	23.1	12.6	9.6	753.5	956.1	6.7	9.2	4.4	5.2
	Standard Error	2.7	7.4	6.3	1.7	2.7	4.1	1.9	2.0	28.3	55.6	0.9	0.9	1.8	0.9	83.9	40.1	0.2	0.6	0.2	0.3
	Standard Deviation	6.6	18.1	15.4	4.2	6.5	10.1	4.7	5.0	93.8	175.8	2.8	2.9	5.9	2.9	375.4	200.7	0.9	2.8	0.9	1.7
	Relative Change (%)	-11.4		-21.7		1.8		-7.0		24.0		21.9		-23.8		26.9		38.3		20.0	
	ANOVA (Ring): F; P-value	<b>11.261; 0.00592</b>		<b>9.972; 0.00807</b>		<b>7.639; 0.0155</b>		<b>7.855; 0.0145</b>		0.976; 0.450		0.608; 0.663		0.582; 0.680		3.221; 0.0881		<b>5.019; 0.0343</b>		3.507; 0.0748	
	ANOVA ([CO <sub>2</sub> ] Treatment): F;P-value	0.877; 0.402		2.452; 0.192		0.0170; 0.903		1.039; 0.366		2.319; 0.201		<b>15.255; 0.0162</b>		4.229; 0.106		0.330; 0.624		1.306; 0.371		0.575; 0.527	
<i>Sanguisorba officinalis</i>	Mean	213.8	202.9	-	-	37.3	34.8	-	-	327.5	362.5	16.5	18.0	6.7	9.6	769.6	558.6	6.6	8.5	5.8	6.5
	Standard Error	5.1	7.6	-	-	1.8	1.6	-	-	18.4	60.5	0.3	0.8	0.2	0.8	71.4	53.7	0.4	0.3	0.4	0.5
	Standard Deviation	12.6	18.7	-	-	4.4	4.0	-	-	55.2	181.5	0.8	2.4	0.7	2.4	342.4	228.0	1.8	1.5	1.7	2.2
	Relative Change (%)	-5.1		-		-6.7		-		10.7		8.9		42.7		-27.4		28.8		12.8	
	ANOVA (Ring): F; P-value	3.508; 0.0833		-		2.858; 0.121		-		0.272; 0.890		0.623; 0.655		0.265; 0.895		1.025; 0.402		2.457; 0.147		0.395; 0.686	
	ANOVA ([CO <sub>2</sub> ] Treatment): F;P-value	0.790; 0.424		-		0.643; 0.468		-		0.920; 0.393		4.388; 0.104		<b>37.316; 0.00364</b>		1.325; 0.369		1.238; 0.382		0.415; 0.585	

**Table S3.** Leaf area index, plant dry biomass and soil moisture values for ambient (~400 ppm) and elevated (480 ppm) [CO<sub>2</sub>] FACE rings over the duration of the measurement period at the GiFACE facility

	Ambient [CO <sub>2</sub> ]	Elevated [CO <sub>2</sub> ]	ANOVA ([CO <sub>2</sub> ] Treatment): <i>F</i> ; <i>P</i> -value
<i>LAI</i> (m <sup>2</sup> m <sup>-2</sup> )	5.3 ± 0.113	5.4 ± 0.173	0.737; 0.439
Grass Biomass (g / m <sup>2</sup> )	219.7 ± 52.3	266.3 ± 39.2	1.601; 0.274
Forb Biomass (g / m <sup>2</sup> )	123.9 ± 34.6	144.2 ± 32.0	0.922; 0.391
Total Biomass (g / m <sup>2</sup> )	373.9 ± 68.5	459.9 ± 59.6	<b>5.388; 0.0427</b>
Soil Moisture (vol%)	37.5 ± 3.9	35.9 ± 6.3	0.379; 0.571



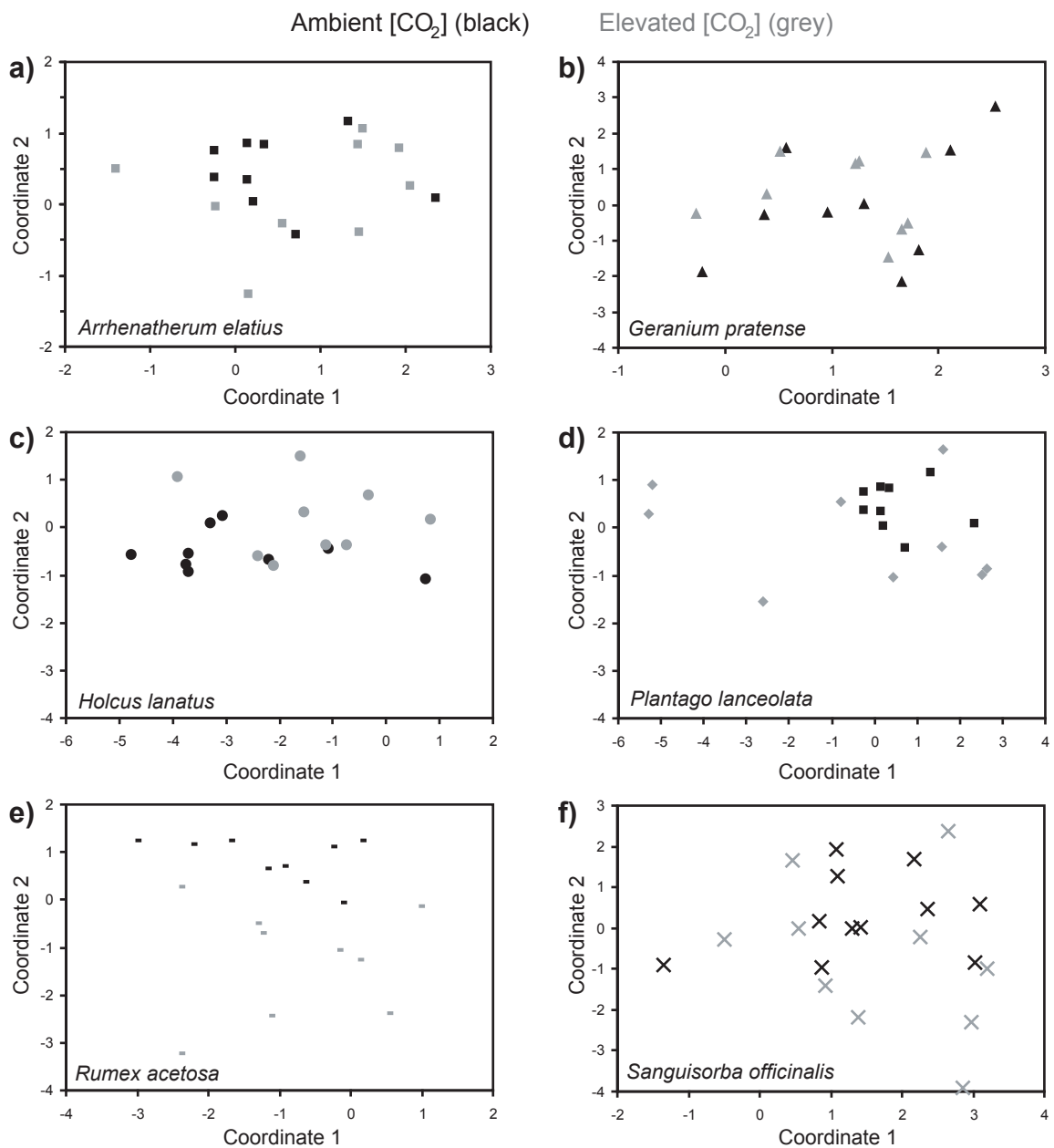
**Fig. S1.** Principal component analysis of (a) photosynthetic physiology and (b) leaf gas exchange parameters of six temperate grassland species exposed to >14-years continuous moderate [CO<sub>2</sub>] enrichment at GiFACE. Photosynthetic physiology and leaf gas exchange parameters from Tables S1 and S2. Species grown in ambient [CO<sub>2</sub>] (black symbols) and elevated [CO<sub>2</sub>] (grey symbols) do not form statistically distinct groupings in multivariate space. Statistical testing of eigenvalues is available in Tables S4 and S5.

**Table S4.** ANOVA of PCA coordinates of plant photosynthetic physiological (Table 1) parameters of six temperate grassland species to 14-years of growth at moderate FACE of 470 ppm [CO<sub>2</sub>]

Species	Coordinate 1	Coordinate 2
<i>Arrhenatherum elatius</i>	0.658	0.579
<i>Geranium pratense</i>	0.846	0.572
<i>Holcus lanatus</i>	0.056	0.175
<i>Plantago lanceolata</i>	0.871	0.223
<i>Rumex acetosa</i>	0.718	0.0299
<i>Sanguisorba officinalis</i>	0.638	0.0000668

Coordinate 1 = 52.326% variation  
 Coordinate 2 = 19.513% variation

**Fig. S2.** PCA plots of plant photosynthetic physiological parameters of individual temperate grassland species to 14-years of growth at moderate FACE of 470 ppm [CO<sub>2</sub>] from Figure 1a.



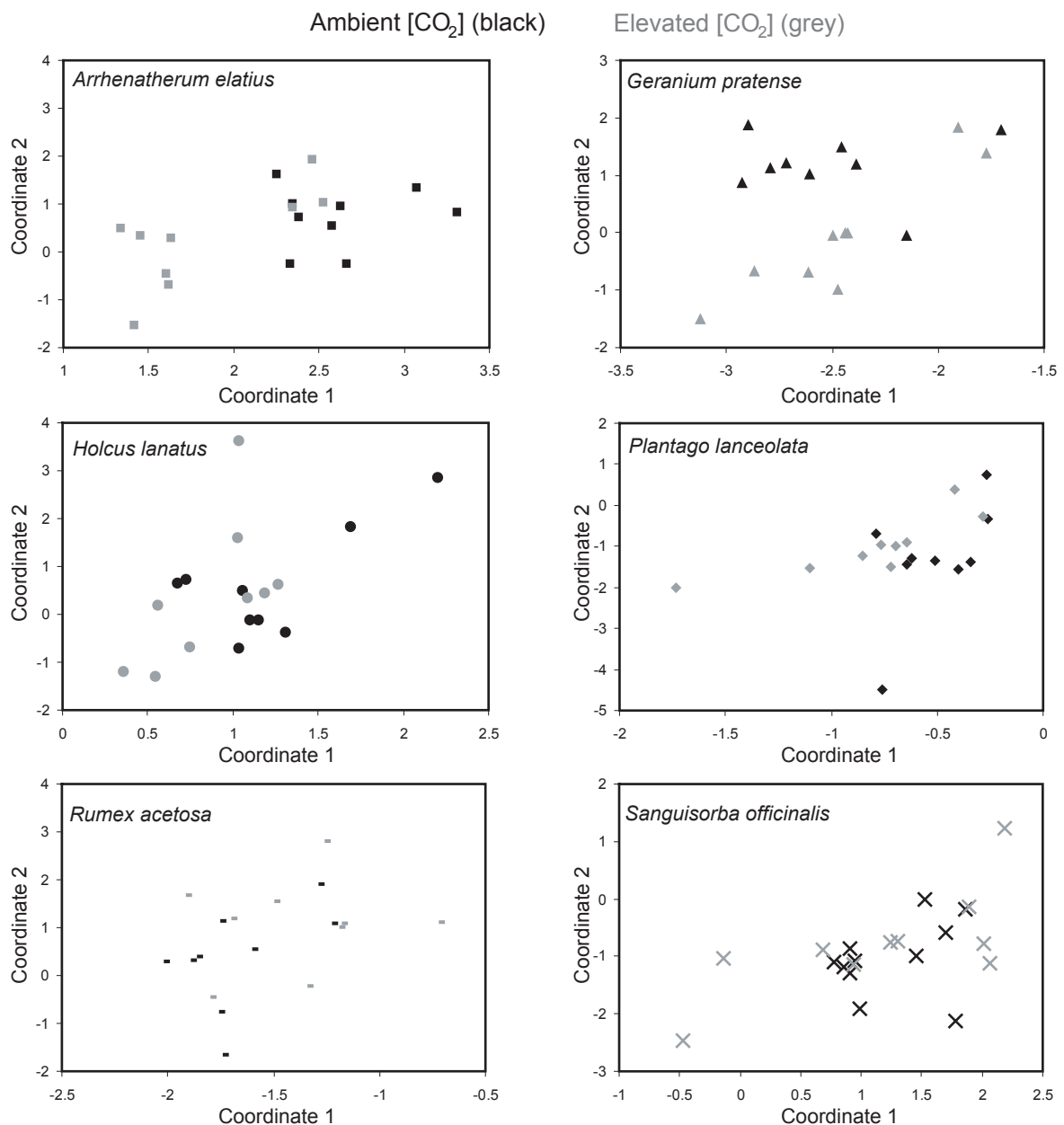
**Table S5.** ANOVA of PCA coordinates of leaf gas exchange parameters (Table 2) parameters of six temperate grassland species to 14-years of growth at moderate FACE of 470 ppm [CO<sub>2</sub>].

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Species	Coordinate 1	Coordinate 2
<i>Arrhenatherum elatius</i>	0.000406	0.332
<i>Geranium pratense</i>	0.796	0.348
<i>Holcus lanatus</i>	0.112	0.703
<i>Plantago lanceolata</i>	0.184	0.513
<i>Rumex acetosa</i>	0.716	0.576
<i>Sanguisorba officinalis</i>	0.198	0.135

Coordinate 1 = 29.642% variation  
 Coordinate 2 = 15.993% variation

**Fig. S3.** PCA plots of leaf gas exchange parameters of individual temperate grassland species to 14-years of growth at moderate FACE of 470 ppm [CO<sub>2</sub>] from Figure 1b. <sup>2</sup>



**Table S6.** Results of random effects meta-analyses of the photosynthetic, stomatal morphology and leaf gas exchange responses of six temperate grassland species to long-term 20% FACE. Between group heterogeneity is non-significant for all parameters ( $Q_{1,5} = 5.00$ ,  $P = >0.05$ ). See Figure 2.

Variable	$\hat{\tau}^2$	95% Confidence Intervals for r			z	P-value
		Lower	Mean	Upper		
$R_d$	0.190	0.160	0.513	0.750	2.743	0.006
$R_n$	0.261	0.809	0.582	0.204	2.845	0.004
$R_d$ to $R_n$ ratio	0.000	-0.256	-0.055	0.150	0.521	0.602
LSP	0.002	-0.013	0.195	0.386	1.842	0.061
LCP	0.121	-0.120	0.222	0.312	1.275	0.202
$V_{Cmax}$	0.029	-0.203	0.042	0.282	0.335	0.737
$J_{max}$	0.000	-0.057	0.148	0.342	1.417	0.156
$V_{Cmax} \cdot J_{max}$	0.008	-0.213	0.003	0.219	0.031	0.975
$A_{max}$	0.054	-0.139	0.137	0.393	0.972	0.331
$Fv/Fm$	0.762	-0.306	-0.013	0.281	0.087	0.931
$G_s$ set	0.323	-0.717	-0.382	0.097	1.578	0.114
$G_s$ amb	0.436	-0.710	-0.309	0.243	1.104	0.270
$P_N$ set	0.061	0.499	0.683	0.808	5.710	0.001
$P_N$ amb	0.294	-0.492	-0.058	0.399	0.236	0.813
SD	0.185	-0.488	-0.219	0.088	1.401	0.161
SPL	0.154	-0.563	-0.333	-0.056	2.336	0.020
Nitrogen	0.836	-0.595	0.075	0.683	0.193	0.847
Carbon	0.117	-0.500	-0.203	0.136	1.176	0.239
C:N ratio	0.000	-0.009	0.195	0.383	1.873	0.061
PNUE <sub>set</sub>	0.091	0.506	0.704	0.832	5.400	0.0001
PNUE <sub>amb</sub>	0.266	-0.447	-0.019	0.416	0.081	0.936

**Table S7.** Mean ground water heights for FACE ring pairs during measurement period of 25th April to 25 May 2012. A = ambient [ $CO_2$ ]; E = elevated [ $CO_2$ ].

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FACE Ring Pair	Mean Ground water depth (cm)	Standard Deviation
E1 and A1	-128.6	1.6
E2 and A2	-80.2	1.3
E3 and A3	-72.6	1.5