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Temperature sensitivity of soil respiration rates enhanced by microbial community response

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SUPPLEMENTARY INFORMATION

Supplementary text

Linear regressions were used to calculate control treatment respiration rates at a similar level of C loss, as the re-warmed treatment samples at the time of re-warming, or the cooled treatment samples at the end of incubation (maximum C loss for the cooled samples) (Supplementary Table 1).

Supplementary Table 1. C loss for different treatments in each individual soil.

Site	Cumulative C loss (% of initial C)				Control treatment respiration rate after day 84	R^2	Control treatment normalised respiration rate	R^2
	Control samples		Cooled samples					
	Day 84	end	end	at re-warming	(µg C g soil C^{-1} h^{-1})		(relative to day 84)	
1A	0.20	0.34	0.24	0.23	y = -0.9619x + 0.9366	0.5802	y = -1.2151x + 1.1832	0.5802
1C	1.22	2.38	1.71	1.60	y = -1.2427x + 7.4366	0.9819	y = -0.212x + 1.2687	0.9819
1D	1.72	3.43	2.45	2.27	y = -0.5998x + 9.1542	0.7413	y = -0.074x + 1.129	0.7413
1G	0.61	1.17	0.80	0.76	y = -1.1174x + 3.4392	0.8293	y = -0.4292x + 1.3211	0.8293
1H	1.52	3.09	2.14	1.99	y = -0.9181x + 9.059	0.8514	y = -0.1248x + 1.2318	0.8514
2C	0.54	1.10	0.79	0.73	y = -0.6216x + 3.006	0.8663	y = -0.2306x + 1.1153	0.8663
2D	0.98	1.77	1.37	1.28	y = -1.1659x + 5.1483	0.9698	y = -0.2873x + 1.2688	0.9698
2G	0.26	0.45	0.34	0.32	y = -0.5791x + 1.0362	0.3589	y = -0.6116x + 1.0945	0.3589
2H	0.58	1.10	0.81	0.76	y = -1.0324x + 3.2002	0.9078	y = -0.3853x + 1.1943	0.9078
3A	1.01	1.83	1.42	1.33	y = -1.5208x + 5.8451	0.9671	y = -0.3562x + 1.3692	0.9671
3C	0.90	1.68	1.27	1.20	y = -1.2891x + 5.133	0.912	y = -0.3262x + 1.299	0.912
3D	0.72	1.85	1.32	1.24	no decrease in r. rate	0.0003	no decrease in r. rate	0.0003
3G	1.72	3.11	2.37	2.22	y = -2.2659x + 12.309	0.9738	y = -0.2738x + 1.4872	0.9738
3H	1.73	3.51	2.50	2.30	y = -0.4558x + 9.8028	0.6698	y = -0.0498x + 1.0715	0.6698
4A	1.31	2.10	1.68	1.60	y = -2.0315x + 7.1417	0.6974	y = -0.4267x + 1.4999	0.6974
4C	3.23	5.10	4.37	4.14	y = -2.578x + 19.719	0.9812	y = -0.2233x + 1.7077	0.9812
4D	1.38	2.20	1.72	1.65	y = -2.7158x + 8.6982	0.9654	y = -0.5257x + 1.6836	0.9654
4G	3.90	6.04	5.08	4.84	y = -3.2462x + 26.187	0.994	y = -0.2376x + 1.9166	0.994
4H	4.61	7.77	6.29	5.94	y = -2.103x + 27.916	0.9733	y = -0.1135x + 1.5067	0.9733
5E_1	3.40	6.29	4.98	4.61	y = -0.0573x + 1.2765	0.5136	y = -0.0573x + 1.2765	0.5136
5E_2	1.65	3.22	2.32	2.18	y = -0.4687x + 8.2855	0.5839	y = -0.0635x + 1.1218	0.5839
5E_3	1.20	2.09	1.65	1.54	y = -1.4751x + 6.4976	0.9209	y = -0.3026x + 1.333	0.9209

x = cumulative C loss (% of initial C).

Statistical significance of enhancing or compensatory response for each soil was tested using one-sample t-tests (Supplementary Table 2). T-test and *P*-values are given to determine whether relative control vs. cooled and absolute control vs. re-warmed respiration rates differ from each other at similar C loss (**P*<0.05, ***P*>0.01, ****P*<0.001). To determine the potential for Type 1 statistical errors, *P* values of these tests were compared to the Bonferroni corrected *P* value of *P* =

0.05/22=0.0023. Enhancing community level responses were 11 times (11/1) more common than compensatory responses using the $Ratio_{MT}$ method (without Bonferroni correction). Enhancing community level responses were >3 times (10 versus 3) more common than compensatory responses using the $Ratio_{CT}$ method (without Bonferroni correction). Soils showing a statistically significant enhancing or compensatory response at $p<0.05$ level after Bonferroni correction are indicated by bold text, with a separate column showing the direction of the response (E=Enhancing response). After the Bonferroni correction no significant compensatory responses remained, but there were 5 ($Ratio_{CT}$) to 7 ($Ratio_{MT}$) statistically significant cases of enhancing responses.

Similarly, we present one-sample t-test results for the biomass specific respiration rates, and give biomass specific $Ratio_{MT}$ values for each soil (Supplementary Table 3). T-test and *P*-values were used to determine whether relative biomass specific control vs. cooled respiration rates differ from each other at similar C loss (**P*<0.05, ***P*>0.01, ****P*<0.001). *P* values of these tests were compared to the Bonferroni corrected *P* value of *P*=0.05/21=0.0024 to control for Type 1 statistical errors. There were 11 statistically significant enhancing community level responses, and 0 compensatory responses using the $Ratio_{\_MT\_MS\_CFE}$ method (without Bonferroni correction). Enhancing community level responses were > 3 times (7 versus 2) more common than compensatory using the $Ratio_{\_MT\_MS\_qPCR}$ method (without Bonferroni correction). Due to greater variability, only two responses remained statistically significant after Bonferroni correction; these soils are indicated by bold text, and a separate column showing the direction of the responses (E=Enhancing response, C=Compensatory response).

Supplementary Table 2. $Ratio_{MT}$ and $Ratio_{CT}$ values for each individual soil.

Site	Comparing control vs. cooled treatment relative respiration rates at a similar C loss %				Comparing control vs. re-warmed treatment respiration rates at a similar C loss %			
	$Ratio_{MT}$	t †	P	Direction	$Ratio_{CT}$	t ‡	P	Direction
1A	0.99	0.226	0.833		0.87	1.947	0.123	
1C	**1.31**	**-16.123*** **	**0.000**	**E**	**1.19**	**-10.702*** **	**0.000**	**E**
1D	**1.53**	**-22.676*** **	**0.000**	**E**	**1.17**	**-7.394** **	**0.002**	**E**
1G	1.27	-6.131**	0.004		1.04	*0.254*	*0.812*	
1H	**1.36**	**-10.714*** **	**0.000**	**E**	1.13	-5.227**	0.006	
2C	1.07	-3.197*	0.033		1.01	-0.593	0.585	
2D	0.98	1.256	0.277		0.94	3.728*	0.020	
2G	1.19	-2.769	0.050		0.99	0.410	0.703	
2H	1.22	-5.857**	0.004		0.97	1.689	0.166	
3A	0.79	4.330*	0.012		0.90	4.173*	0.014	
3C	0.98	1.374	0.242		0.94	3.335*	0.029	
3D	1.10	-1.392	0.258		1.04	-1.724	0.183	
3G	1.03	-1.528	0.201		**1.07**	**-8.254** **	**0.001**	**E**
3H	0.97	1.435	0.225		1.07	-4.234*	0.013	
4A	0.98	0.339	0.752		1.02	-0.414	0.700	
4C	**1.17**	**-7.144** **	**0.002**	**E**	1.06	-6.004**	0.004	
4D	1.27	-5.158**	0.007		**1.25**	**-16.31*** **	**0.000**	**E**
4G	1.01	-0.236	0.825		1.11	-4.069*	0.015	
4H	1.13	-2.017	0.114		1.07	-2.623	0.059	
5E_1	**1.16**	**-11.012*** **	**0.000**	**E**	0.95	2.152	0.098	
5E_2	**1.32**	**-8.415** **	**0.001**	**E**	**1.24**	**-47.71*** **	**0.000**	**E**
5E_3	**1.18**	**-8.863** **	**0.001**	**E**	1.09	-5.147**	0.007	

†t-test to determine whether the cooled treatment relative respiration rates differed from the control treatment regression line value at a similar C loss (one-sample t-test, 2-sided, N=5, df=4). ‡t-test to determine whether the -warmed sample respiration rates differed from the control treatment regression line value at a similar C loss (one-sample t-test, 2-sided, N=5, df=4).

Supplementary Table 3. $Ratio_{MT\_MS\_CFE}$ and $Ratio_{MT\_MS\_qPCR}$ values for each individual soil.

Site	Comparing control vs. cooled treatment relative biomass specific respiration rates at a similar C loss %							
	$Ratio_{MT\_MS\_CFE}$	t †	P	Direction	$Ratio_{MT\_MS\_qPCR}$	t †	P	Direction
1A	1.31	-1.723	0.227		0.39	4.415*	0.048	
1C	1.63	-10.109*	0.010		0.96	1.014	0.417	
1D	1.43	-6.828*	0.021		2.50	-12.676**	0.006	
1G	1.54	-15.664**	0.004		0.62	2.793	0.108	
1H	1.11	-4.014	0.057		3.11	-7.593*	0.017	
2C	1.00	0.369	0.747		0.98	0.270	0.812	
2D	0.98	1.542	0.263		0.68	1.303	0.323	
2G	1.05	-0.488	0.674		5.93	**-33.376****	**0.001**	**E**
2H	1.20	-8.288*	0.014		1.59	-3.026	0.094	
3A	0.44	1.473	0.279		0.73	1.101	0.386	
3C	1.06	-3.563	0.071		1.05	-0.385	0.737	
3D	N.A.				N.A.			
3G	1.11	-4.663*	0.043		0.61	1.410	0.294	
3H	1.01	-4.397*	0.048		1.57	-5.849*	0.028	
4A	1.44	-7.518*	0.017		0.70	1.342	0.312	
4C	1.55	-11.645**	0.007		3.77	-17.165**	0.003	
4D	1.30	-6.890*	0.020		0.68	1.658	0.239	
4G	1.03	-1.022	0.414		1.45	-2.108	0.170	
4H	**1.37**	**-43.931****	**0.001**	**E**	1.82	-4.716*	0.042	
5E_1	N.A				0.92	0.364	0.751	
5E_2	1.21	-3.303	0.081		2.18	-11.932**	0.007	
5E_3	**1.62**	**-24.709****	**0.002**	**E**	0.49	**47.121*****	**0.000**	**C**

† t -test for determining whether the cooled treatment mass specific relative respiration rate differs from control treatment regression line value at a similar C loss (one-sample t-test, 2-sided, N=3, df=2).