Global variation of soil microbial carbon-use efficiency in relation to growth temperature and substrate supply

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Supplemental Materials

Table S1. Papers from which the dataset was extracted.

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Table S2. List of data source experiments.

No.	Incubation temperature (ºC)	Substrate addition	Incubation time (d)	Calculate method	Data location	Mean CUE ±SD	Reference number
1	not mention	litter	>30	Directly extracted	Table1	0.22±0.03	1
2	22	glucose	1-7	Directly extracted	Table2	0.47±0.07	2
3	20	soil leachate	not mention	Directly extracted	Fig. 2	0.41±0.17	3
4	25	glucose	not mention	Directly extracted	article	0.39	4
5	22	glucose	1-7	Directly extracted	Table3	0.30±0.10	5
6	22	glucose, glutamate, oxalate, phenol	1-7	Directly extracted	Table2	0.38±0.28	6
7	21	glucose	>30	Eq. 4	Fig.1, Fig.2	0.20±0.10	7
8	25	glucose, starch, legume, wheat	>30	Directly extracted	Table4	0.41±0.19	8
9	28.5	glucose	7-30	Eq. 4	Table3, Table4, Table5	0.18±0.06	9
10	5, 15, 25	rice straw	not mention	Directly extracted	Table3	0.44±0.11	10
11	20	glucose, sodium, pyruvate	not mention	Directly extracted	Table2	0.72±0.01	11
12	21	glycogen, synthesis,	not mention	Directly extracted	Table1	0.71±0.15	12
13	4, 20	glucose, pyruvate	not mention	Directly extracted	Table3	0.74±0.01	13
14	25	glucose, $(NH_4)_2SO_4$	1-7	Directly extracted	Table3, Table4	0.48±0.13	14
15	10	alanine, dialanine, trialanine	not mention	Directly extracted	Table5, Fig.3	0.72±0.11	15

16	22	glucose, fructose, sucrose, oxalate, phenylalanine	7	Directly extracted	Fig.5	0.76±0.19	16
17	20	glucose, glutamic	1	Eq. 4	Fig.9	0.49±0.14	17
18	22	not mention	not mention	Directly extracted	Table6	0.28±0.06	18
19	25	glucose	<1d	Directly extracted	Table5	0.52±0.12	19
20	5, 15, 25	glucose, glutamic, phenol, oxalic acid	not mention	Directly extracted	Fig.1, Fig.2	0.29±0.22	20
21	24	glucose, NH_4NO_3, litter	1-7	Directly extracted	Table2	0.52±0.19	21
22	25	litter, $(NH_4)_2SO_4$	>30	Eq. 5	Fig.1, Fig.3	0.15±0.15	22
23	5, 10, 15, 20	glucose, pyruvate	not mention	Directly extracted	Fig.1	0.72±0.01	23
24	25	glucose, $LaCl_3$	1-7	Eq. 4	Table2	0.63±0.04	24
25	25	not mention	>30	Directly extracted	Fig.7	0.38±0.19	25
26	not mention	acetic acid, NH_3	not mention	Directly extracted	Fig.5	0.50±0.11	26
27	25	glucose	<1	Directly extracted	Fig.5	0.58±0.06	27
28	20	not mention	not mention	Directly extracted	Fig.4	0.71±0.05	28
29	25	glutamic acid	<1	Directly extracted	Fig.1	0.33±0.15	29
30	22	glucose	<1	Directly extracted	Fig.3	0.48±0.10	30
31	12	glucose, protein, cellulose, cell walls	1-7	Directly extracted	Fig.3b	0.30±0.10	31

32	25	glucose, $(NH_4)_2SO_4$	>30	Directly extracted	Table2	0.62±0.17	32
33	25	leucine	1	Directly extracted	Fig.1, Fig.2, Fig.5	0.38±0.08	33
34	14	glucose	not mention	Directly extracted	Fig.2	0.45±0.04	34
35	not mention	glucose, fructose, sucrose, lactose, xylose, glycine, alanine, glutamic acid, phenylalanine, acetic acid, propionic acid, butyric acid, butanol, benzoic acid	not mention	Directly extracted	Table1	0.63±0.14	35
36	25	glucose	1-7	Directly extracted	Fig.7	0.67±0.10	36
37	22	glucose	1-7	Directly extracted	Table2	0.81±0.13	37
38	not mention	glucose	1-7	Directly extracted	Fig.1	0.57±0.10	38
39	1, 5, 10, 15	glucose, glucosamine	1	Directly extracted	Fig.2	0.94±0.03	39
40	not mention	glucose	1-7	Directly extracted	Table3	0.64±0.13	40
41	25	$(NH_4)_2SO_4$	not mention	Directly extracted	Table3	0.41±0.09	41
42	18	glucose	7-30	Eq. 4	Fig.4	0.54±0.18	42
43	25	wheat residues	>30	Directly extracted	Fig.3	0.91±0.01	43
44	27	glucose	7-30	Directly extracted	article	0.57±0.13	44
45	not mention	glucose	>30	Eq. 3	Table1, Table2	0.35±0.25	45
46	15	H_2O	1	Directly extracted	Fig.4	0.24±0.08	46

47	15	H_2O	1	Directly extracted	Fig.3	0.38±0.06	47
48	15, 25	cellobiose	>30	Directly extracted	Table1	0.70±0.07	48
49	11	glucose, benzoic acid,	1-7	Directly extracted	article	0.55±0.23	49
50	25	litter	>30	Eq. 5	Fig.1, Fig.2	0.18±0.10	50
51	25	not mention	>30	Eq. 5	Fig.1, Fig.2	0.09±0.02	51
52	25	glucose	<1	Directly extracted	Table1	0.67±0.07	52
53	1.5, 10, 22.5	dextrose	1-7	Directly extracted	Fig.8	0.76±0.14	53
54	14, 16	residue	not mention	Eq. 4	Fig.2	0.31±0.11	54
55	20	glucose, pyruvate	not mention	Directly extracted	Fig.5	0.77±0.01	55
56	5	glucose	7-30	Directly extracted	Fig.1	0.63±0.12	56

170 **Table S3.** Coefficients of variables based on the multiple stepwise regression analysis.

	Unstandardized Coefficients		Standardized Coefficients	t	Sig
	B	Std. Error	Beta		
Constant	0.319	0.057	-	5.557	0.000
Temperature	-0.025	0.002	-0.551	-13.952	0.000
Glucose	0.172	0.019	0.306	8.845	0.000
Latitude	-0.006	0.001	-0.454	-11.609	0.000
Longitude	-0.001	0.000	-0.327	-9.195	0.000
MAP	0.000	0.000	0.259	7.065	0.000
pH	0.032	0.008	0.138	3.825	0.000
Organic acid	-	-	-	-0.492	0.623
Plant residue	-	-	-	1.929	0.054
Inorganic substrate	-	-	-	-1.731	0.084

Table S4. CUE formula including all environmental factors (i.e., Temperature, Latitude, Substrate type, Longitude, MAP, and pH) based on different substrate type.

Substrate type	CUE formula	R^2
Glucose	CUE=0.491-0.025×(T-20)-0.006×Latitude-0.001×Longitude+0.0002×MAP+0.032×pH	0.612
Other	CUE=0.319-0.025×(T-20)-0.006×Latitude-0.001×Longitude+0.0002×MAP+0.032×pH	0.612

Figure S1. The CUE changes with latitude (a), longitude (b), mean annual temperature (MAT, c), mean annual precipitation (MAP, d), soil pH (e) and the ratio of soil carbon to nitrogen content (soil C/N, f) of the given site.

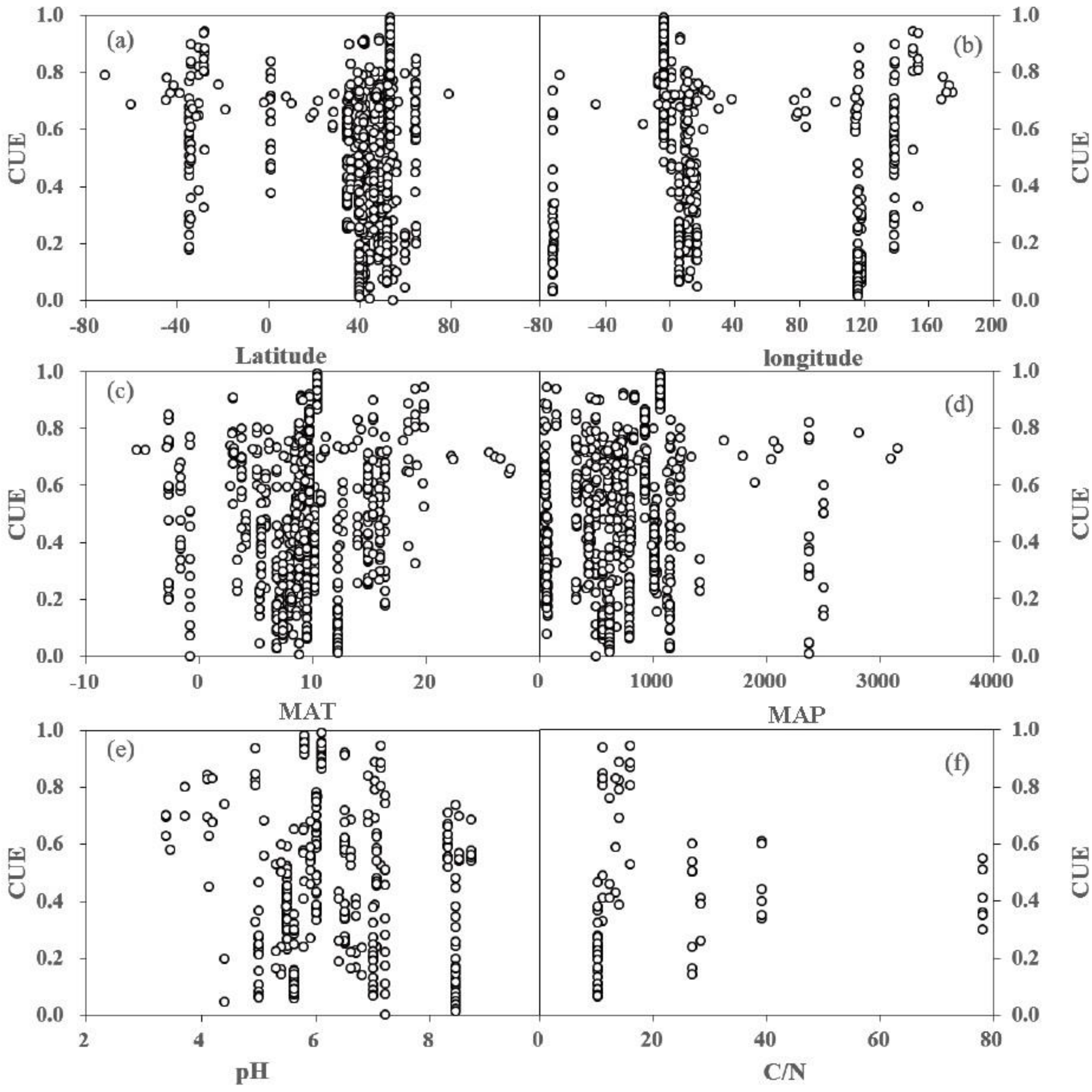


Figure S2. Principal Component Analysis (PCA) for all the single factor (Latitude, Longitude, Temperature, MAP, pH).

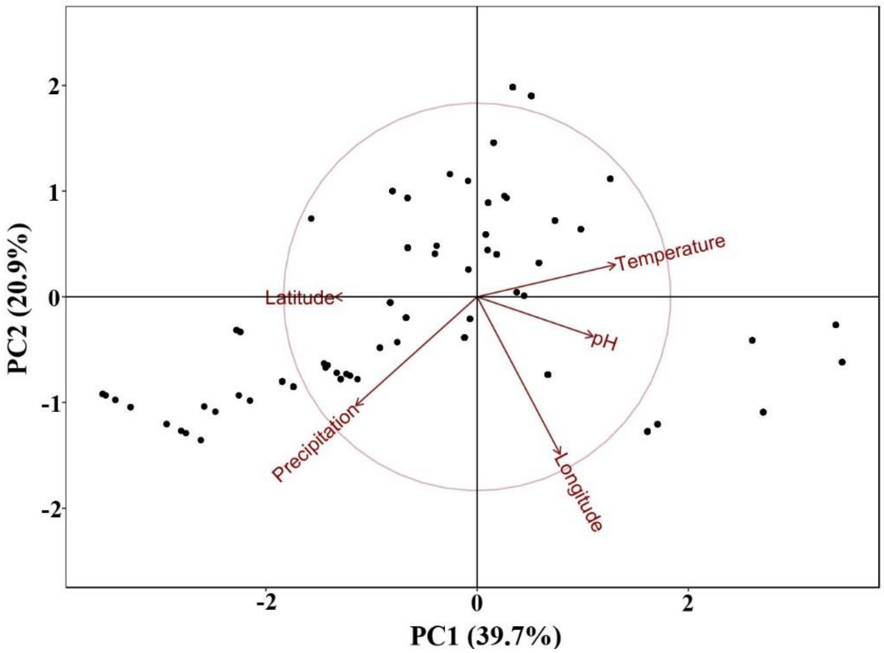
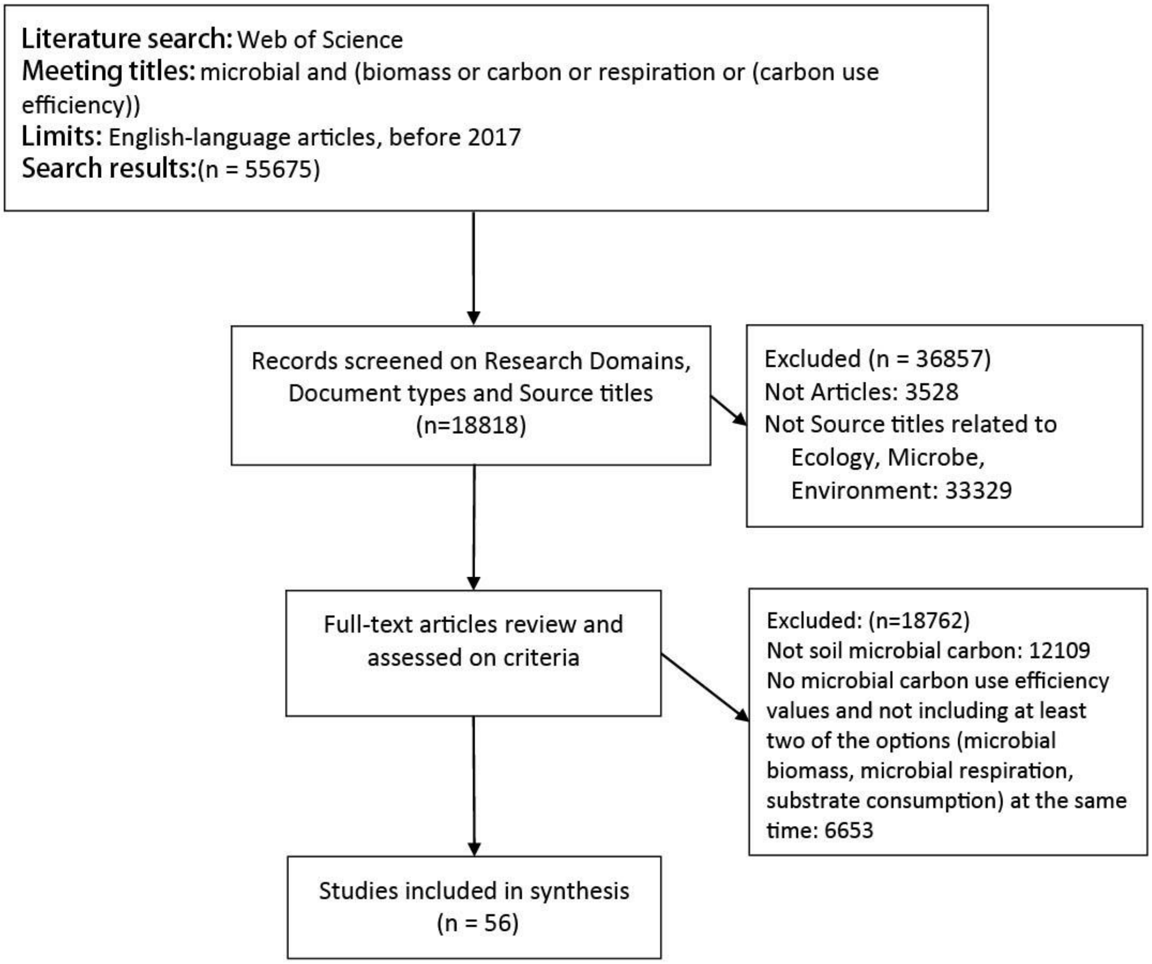


Figure S3. PRISMA flow-diagram of literature search and study selection.



MCMC code for evaluation of CUE_0 and m.

```
clear all;
close all;
format long e;

mydata=xlsread('cue2.xlsx');
T = mydata(:,1);
CUE = mydata(:,2);
C = [0.31;-0.016;18];
Cmin = [0;-0.1;10];
Cmax = [1;0;30];

Diff = Cmax-Cmin;
L_P = length(C);
DJ = 2*var(CUE);
J_last = 30000;
upgraded = 0;
nsimu = 1000000;

for simu = 1:nsimu
counter = simu;
upgraded = upgraded;
    while true
        Cnew = C + (rand(3,1)-0.5).*Diff;
        Logic = Cnew>Cmin&Cnew<Cmax;
          if sum(Logic) == L_P
              break;
          end
    end

    CUEsimu = Cnew(1) + Cnew(2).*(T-Cnew(3));
    J = (norm(CUE-CUEsimu))^2;
    J_new = J/DJ;
    %J_new    = J/DJ*200;              %for every year
    delta_J = J_new-J_last;
        if min(1,exp(-delta_J)) >rand
          C_op = Cnew;
          J_last = J_new;
          upgraded = upgraded + 1;
          C_upgraded(:,upgraded) = C_op;
          J_upgraded(:,upgraded) = J_last;
        end
end

C_upgraded = C_upgraded';
```