**Article title:** Water vapor adsorption by dry soils: a potential link between the water and carbon cycles

**Journal name:** Science of the Total Environment

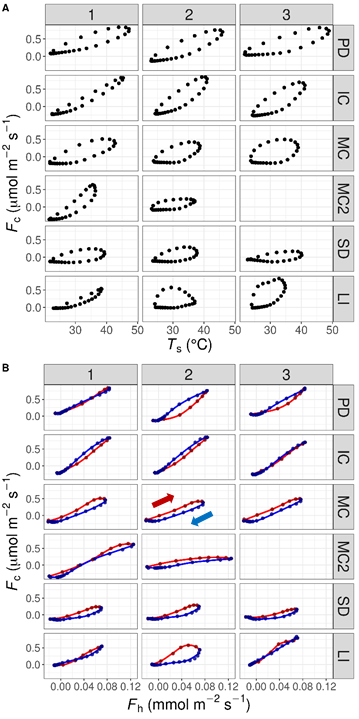
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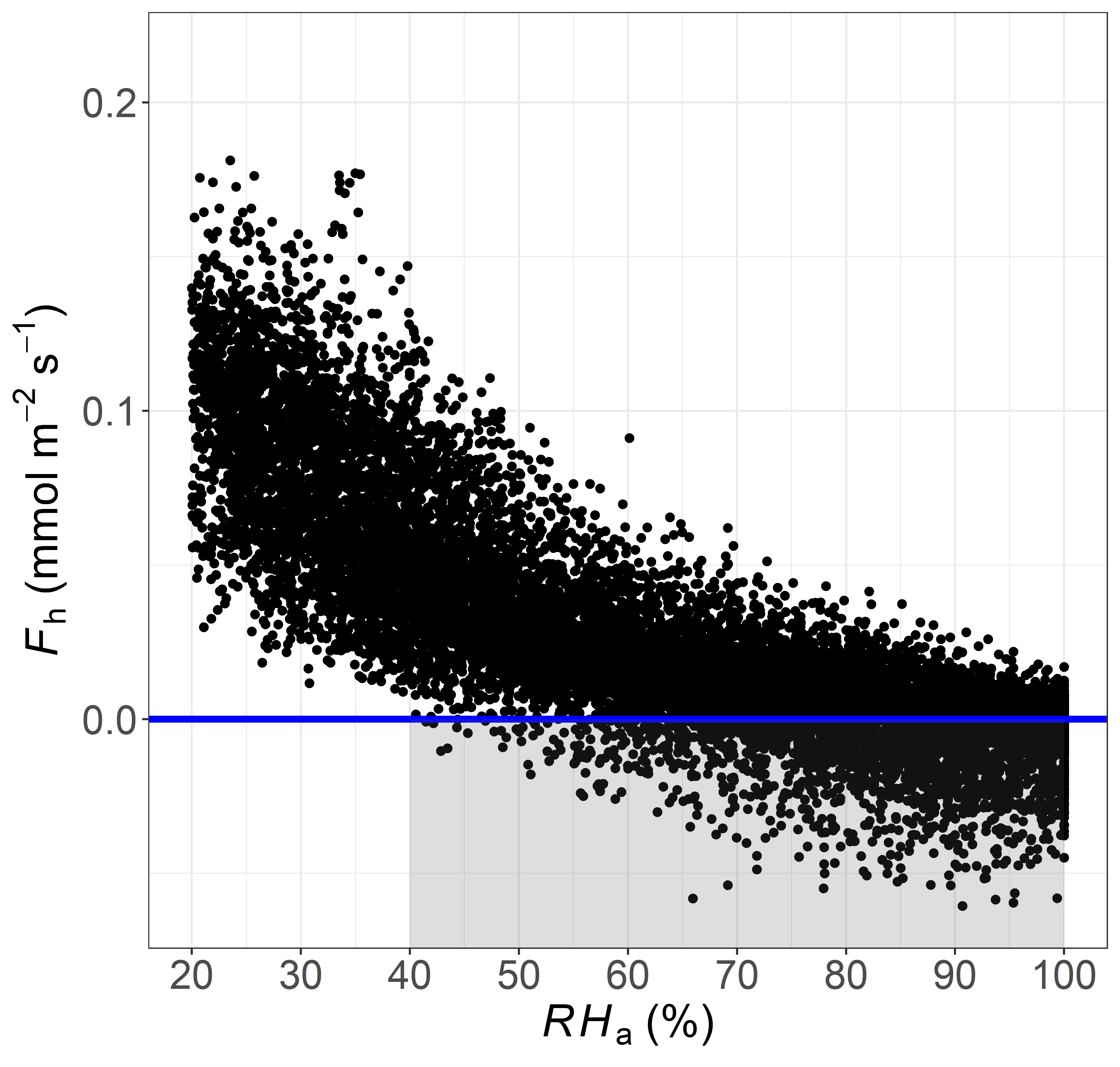
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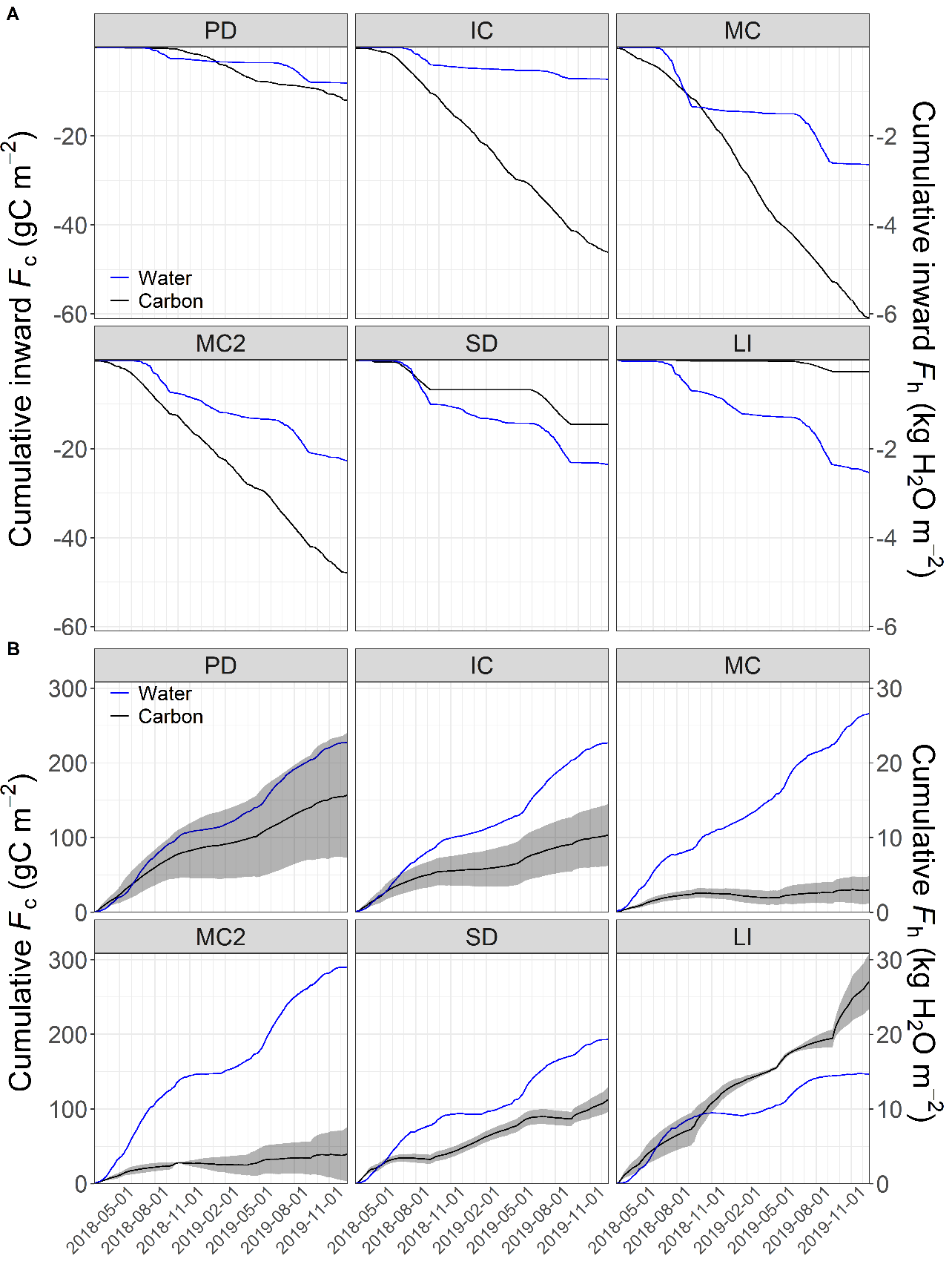
**Figure S1** Location of the experimental site.



**Figure S2** Diel hysteresis between the soil-atmosphere CO2 flux (*F*c) and (A) soil temperature (*T*s), and (B) the soil-atmosphere water vapor flux (*F*h). The blue line represents the decrease from *F*h maximum (during daytime) to minimum (during nighttime) and *vice-versa* for the red line. Stages of the biocrusts succession are labeled as: physical depositional crust (PD), incipient *Cyanobateria* (IC), mature *Cyanobacteria* (MC), lichen community dominated by *Squamarina lentigera* and *Diploschistes diacapsis* (SD), lichen community characterized by *Lepraria isidiata* (LI), and *Cyanobacteria* patches within the SD microsite (MC2).



**Figure S3** Relationship between the soil-atmosphere water vapor flux and the relative humidity in atmosphere (*RH*a)within the mature *Cyanobacteria* site (MC2).



**Figure S4** Cumulative (A) inward and (B) total fluxes of water vapor (*F*h) and carbon (*F*c). The shaded areas delimit the spatial standard variation. Represented water vapor fluxes were estimated with the diffusion model of Bittelli et al. (2015) while carbon fluxes were calibrated empirically. Stages of the biocrusts succession are labeled as: physical depositional crust (PD), incipient *Cyanobateria* (IC), mature *Cyanobacteria* (MC), lichen community dominated by *Squamarina lentigera* and *Diploschistes diacapsis* (SD), lichen community characterized by *Lepraria isidiata* (LI), and *Cyanobacteria* patches within the SD microsite (MC2).

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| **Table S1** Continuous environmental measurements and associated instruments | | | | |
| Measurement | Height/depth (m) | Variable | Instrument(s) | Manufacturer |
| Atmosphere CO2 molar fraction | 0.02 | *χ*c | GMP252 | Vaisala |
| Soil CO2 molar fraction | -0.05 | *χ*c | GMP252 |
| GMM222 |
| Soil water content | -0.05 | *ϑ*w | EC-5 | Meter Group |
| 5TM |
| Soil temperature | -0.05 | *T*s | 5TM |
| Thermistors 108 | Campbell Scientific |
| Soil relative humidity | -0.05 | *RH*s | iButton® DS1923 logger | Maxim Integrated |
| Atmosphere relative humidity | 0 | *RHa* | iButton® DS1923 logger |
| 0.3 | *RHa* | S-THB-M00x Smart Sensor | Onset Computer Corporation |
| Atmosphere temperature | 0.3 | *T*a | S-THB-M00x Smart Sensor |
| Surface temperature | 0 | *T*surf | S-TMB-M0xx Smart Sensor |
| Photosynthetically active radiation | 0 | PAR | S-LIA-M003 Smart Sensor |
| Precipitation | 1.5 | - | Rain-O-Matic-Pro tipping-bucket rain gauge | Pronamic |
| All variables were measured every 30 seconds and stored as 20-minute averages by data-loggers CR1000 (Campbell Scientific) and H21 (Onset), except the rain gauge which was connected to an on–off Hobo Event data logger (Onset). | | | | |

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| **Table S2A** Summary of fixed effects of non-linear models of the diel hysteresis between CO2 and water vapor fluxes | | | | | | | |
|  |  | Diel decrease model | | | Diel increase model | | |
| Parameter | Crust | Value | SE | p-value | Value | SE | p-value |
| *φ1* | PD | 0.892 | 0.056 | <0.001 | 1.284 | 0.099 | <0.001 |
|  | IC | 0.749 | 0.078 | 0.07 | 0.817 | 0.125 | <0.001 |
|  | MC | 0.546 | 0.080 | <0.001 | 0.611 | 0.126 | <0.001 |
|  | MC2 | 0.395 | 0.087 | <0.001 | 0.488 | 0.136 | <0.001 |
|  | SD | 0.451 | 0.131 | <0.001 | 0.283 | 0.126 | <0.001 |
|  | LI | 1.182 | 0.125 | <0.05 | 0.736 | 0.126 | <0.001 |
| *φ2* | PD | -0.077 | 0.045 | 0.09 | 0.068 | 0.039 | 0.08 |
|  | IC | -0.216 | 0.063 | <0.05 | -0.189 | 0.054 | <0.001 |
|  | MC | -0.195 | 0.063 | 0.06 | -0.191 | 0.055 | <0.001 |
|  | MC2 | -0.240 | 0.070 | <0.05 | -0.248 | 0.062 | <0.001 |
|  | SD | -0.079 | 0.062 | 0.98 | -0.059 | 0.054 | <0.05 |
|  | LI | 0.054 | 0.063 | <0.05 | 0.073 | 0.054 | 0.94 |
| *φ3* | PD | 0.041 | 0.009 | <0.001 | 0.084 | 0.007 | <0.001 |
|  | IC | 0.032 | 0.013 | 0.53 | 0.040 | 0.010 | <0.001 |
|  | MC | 0.047 | 0.014 | 0.68 | 0.032 | 0.010 | <0.001 |
|  | MC2 | 0.051 | 0.015 | 0.51 | 0.030 | 0.011 | <0.001 |
|  | SD | 0.095 | 0.017 | <0.01 | 0.049 | 0.010 | <0.001 |
|  | LI | 0.113 | 0.015 | <0.001 | 0.045 | 0.010 | <0.001 |
| *φ4* | PD | 0.028 | 0.002 | <0.001 | 0.032 | 0.002 | <0.001 |
|  | IC | 0.019 | 0.002 | <0.001 | 0.021 | 0.003 | <0.001 |
|  | MC | 0.033 | 0.003 | 0.06 | 0.031 | 0.003 | 0.88 |
|  | MC2 | 0.034 | 0.003 | <0.05 | 0.033 | 0.003 | 0.79 |
|  | SD | 0.030 | 0.004 | 0.61 | 0.020 | 0.003 | <0.001 |
|  | LI | 0.043 | 0.004 | <0.001 | 0.020 | 0.003 | <0.001 |
| **Table S2B** Summary of the non-linear relationship between CCE and SOC contents | | | |  |  |  |  |
| Parameter | Value | SE | p-value |  |  |  |  |
| *φ1* | 0.318 | 0.005 | <0.001 |  |  |  |  |
| *φ2* | 0.183 | 0.005 | <0.001 |  |  |  |  |
| *φ3* | 0.646 | 0.004 | <0.001 |  |  |  |  |
| *φ4* | 0.028 | 0.005 | <0.01 |  |  |  |  |
| SE, standard error, *φ*n are the fitted parameters of the four-parameter logistic model *(y = φ1 + (φ2 - φ1)*/ (1 + *exp[*(*φ*3 − *x*)/*φ4*)], with *ϕ*1 the horizontal asymptote as *x* 🡪 ∞, *ϕ*2 the horizontal asymptote as *x* 🡪 -∞, *ϕ*3 the *x* value at the inflection point of the sigmoid (the value of *x* for which the response variable *y* = *ϕ*1/2), and *ϕ*4 a scale parameter on the *x*-axis. SE is the standard error. | | | | | | | |