Table S1. Minimum, average and maximum values of soda-lime sample mass increase (% of the initial dry mass) for the 2018 and 2019 campaigns in the three study regions of the *Biodiversity Exploratories* project. Mass gain did not exceed the limit of 9.0% proposed by Janssen et al. [34].

Study region	Year	Average	Min	Max
Schwäbische-Alb	2018	2.2	0.4	4.9
	2019	3.1	1.5	6.6
Hainich-Dün	2018	2.8	0.54	4.9
	2019	3.3	0.4	8.5
Schorfheide-Chorin	2018	2.0	0.5	5.3
	2019	3.5	1.0	6.6

Table S2. Soil temperature and volumetric water content per month from March to July for the 10-year-average (2008-17) and the two sampling years 2018 and 2019 in the three study regions.

Region	Month	Soil temperature (°C)			Volumetric water content (%)		
		2008-17	2018	2019	2008-17	2018	2019
ALB	March	3.8±1.4	2.5±1.5	4.7±1.1	39.2±5.4	39.3±7.2	33.5±7.1
	April	6.9±1.4	8.0±2.2	7.2±1.5	38.1±6.3	35.2±8.6	31.9±7.8
	May	9.7±1.1	10.9±1.5	8.4±1.5	37.2±5.9	31.1±7.4	33.3±7.8
	June	12.5±1.1	13.6±1.1	13.5±1.8	33.6±6.0	29.7±7.9	28.9±7.3
	July	14.5±0.9	14.7±1.2	15.0±1.6	30.7±6.1	22.4±6.4	23.1±6.8
HAI	March	3.7±1.2	1.7±1.5	5.2±1.1	36.8±5.0	37.2±8.4	33.8±6.2
	April	7.5±1.3	8.3±2.4	7.1±1.6	35.1±5.5	37.0±7.4	32.2±6.1
	May	10.3±1.1	11.0±1.9	8.8±1.8	32.5±6.0	28.4±7.1	33.1±6.2
	June	12.7±0.9	13.9±1.7	14.0±1.7	28.7±6.4	21.5±6.5	29.6±7.1
	July	14.7±1.0	18.4±5.3	14.3±2.1	26.1±6.4	18.4±5.3	21.1±5.4
SCH	March	4.2±1.2	1.4±1.3	6.0±0.9	15.8±3.2	17.0±4.8	14.4±3.5
	April	7.5±1.1	8.3±2.6	8.3±1.5	15.2±3.4	17.4±4.0	12.8±3.1
	May	10.8±1.3	12.3±1.6	10.4±1.6	13.8±3.5	12.7±3.4	12.8±3.4
	June	13.7±1.0	15.1±1.0	16.2±1.2	12.6±3.5	11.6±3.6	12.0±3.7
	July	15.9±0.9	16.2±1.4	16.1±1.5	11.9±3.0	11.1±4.0	8.2±1.9

Schwäbische-Alb: ALB, Hainich-Dün: HAI and Schorfheide-Chorin: SCH. Values represent mean values and standard deviations. Soil temperature and volumetric water content for the 10-year-average (2008-17) and the two sampling years (2018 and 2019) for every month and study region can be found in Figure S3.

Table S3. ANCOVA models for mineral soil CO_2 efflux in 2018 and in 2019. Full models were stepwise reduced. Study region effects are given relative to the Schwäbische-Alb region.

Mineral soil CO_2 efflux	2018		2019	
	df	=18	df	=19
	adj. R^2	=0.53	adj. R^2	=0.28
	Model p	=0.002	Model p	=0.024
	vif	=3.1	vif	=3.4
Explanatory variable	t-value	p-value	t-value	p-value
Intercept	3.47	0.003	0.219	0.829
Region Hainich-Dün	2.94	0.009	-	-
Region Schorfheide-Chorin	-0.71	0.489	-	-
Soil temperature	-1.52	0.146	-0.149	0.883
Soil water content	-	-	-	-
Age	-	-	-	-
Tree density	-0.69	0.502	-1.898	0.071
Basal area	-3.61	0.002	-	-
Mean diameter at breast height	-	-	-	-
Conifer share	-	-	-	-
Tree species richness	-	-	-	-
Fine root biomass	-	-	-	-
Organic layer OC stock	1.33	0.201	-	-

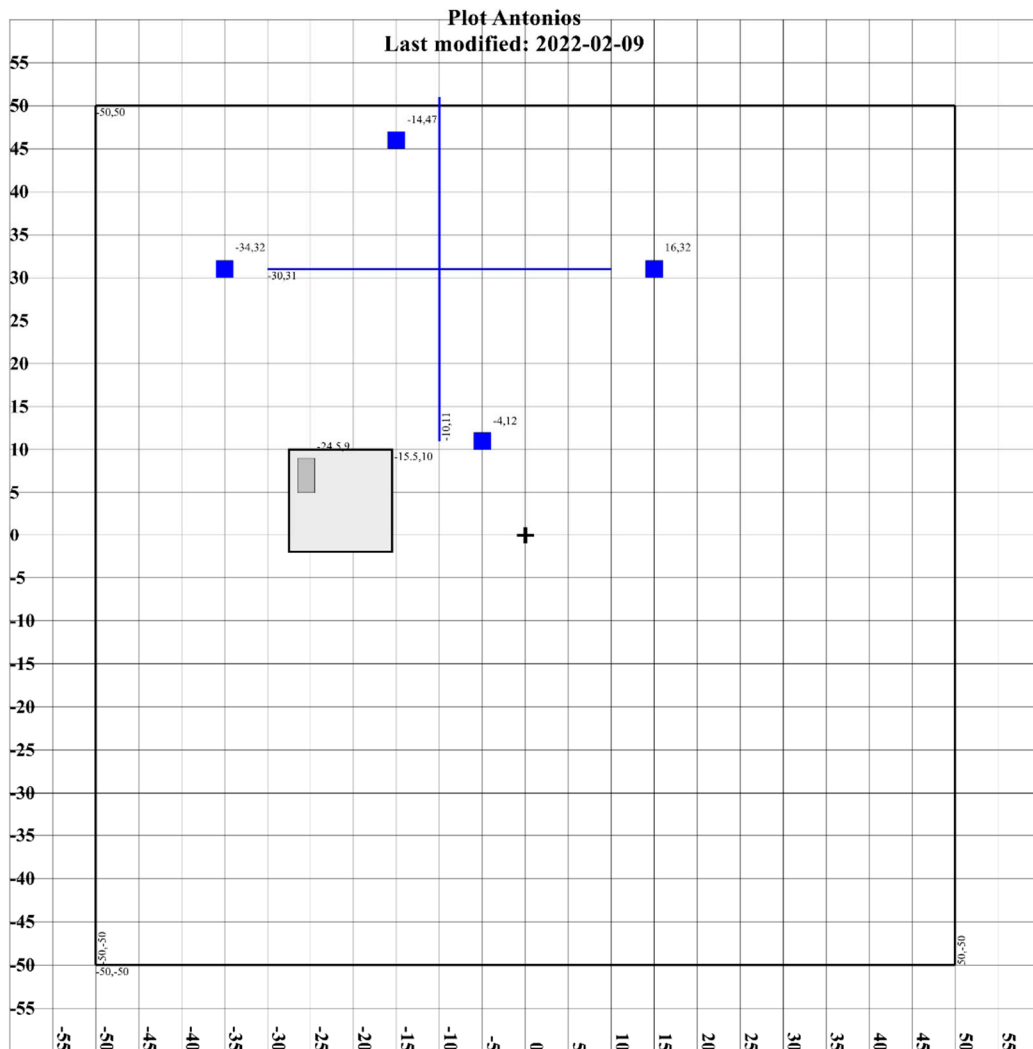|				
Mineral soil OC stock	-	-	-	-
Soil C:N ratio	-1.55	0.139	-	-
Silt content	-	-	0.604	0.552
Soil pH	0.93	0.364	2.557	0.018

Figure S1. Representative map a forest plot (black square of 100 m × 100 m) showing the subplots of i) soil sampling (blue cross of 40 m length), ii) soil CO_2 efflux measurements (blue square: 2 m × 2 m), iii) fence of weather station (black square: 12 m × 12 m) and iv) climate sensors (grey rectangles: 4 m × 2 m). This map is based on the forest site AEW01 in Schwäbische-Alb.
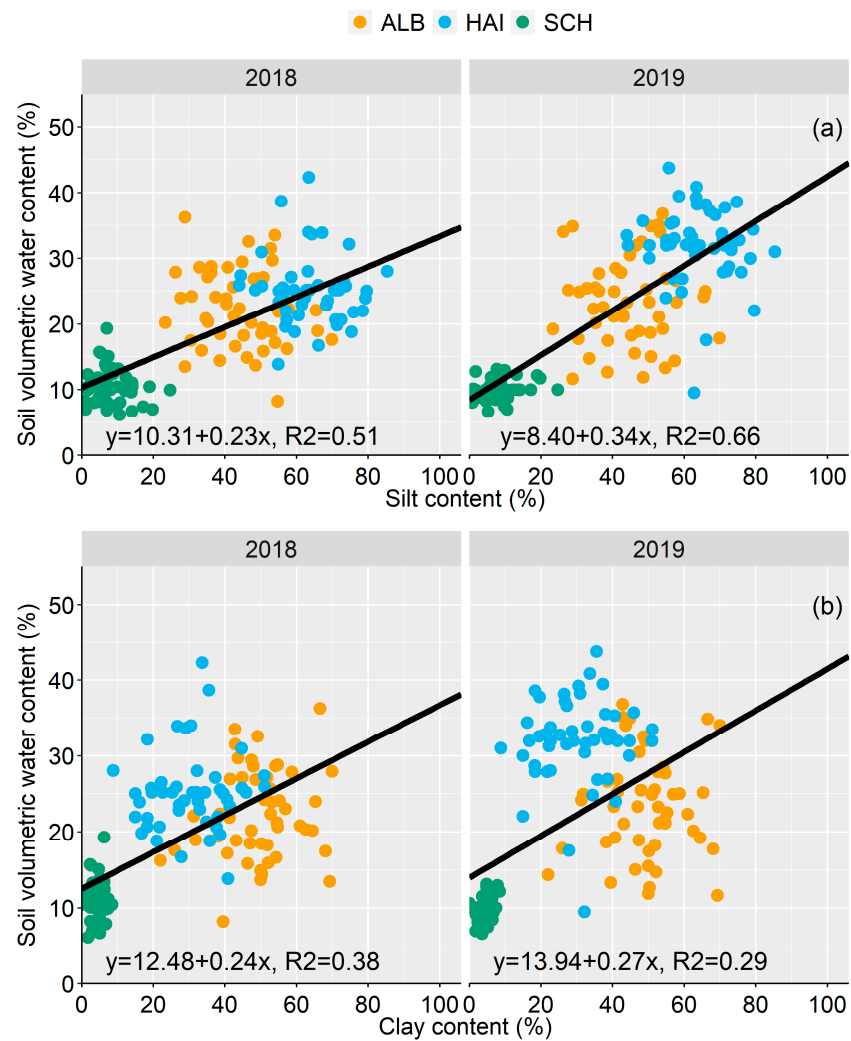
Figure S2. Correlation between soil volumetric water content and (a) silt and (b) clay content for the two sampling years (i.e. 2018 and 2019) and the three study regions (i.e. Schwäbische-Alb: ALB, Hainich-Dün: HAI and Schorfheide-Chorin: SCH). Equation and R^2 describe the linear relationship of soil volumetric water content and silt and clay content over all study regions.
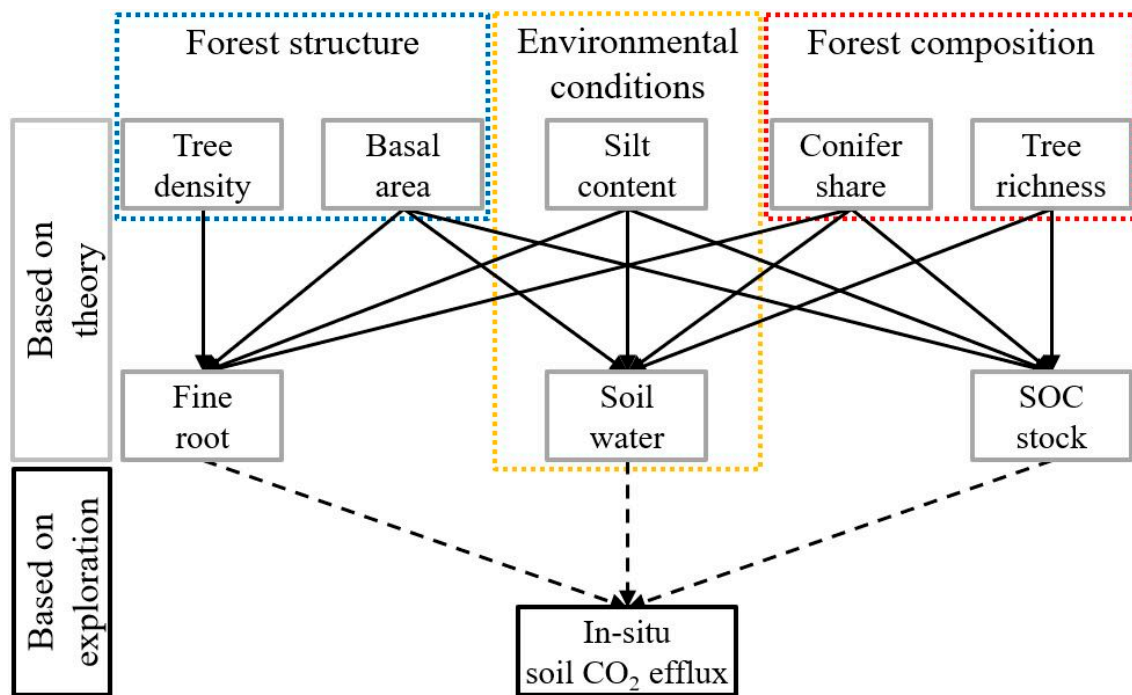
Figure S3. Hypothetical structure to test forest structure and composition effects on soil CO_2 efflux through fine root biomass, total soil OC stocks and soil water content.
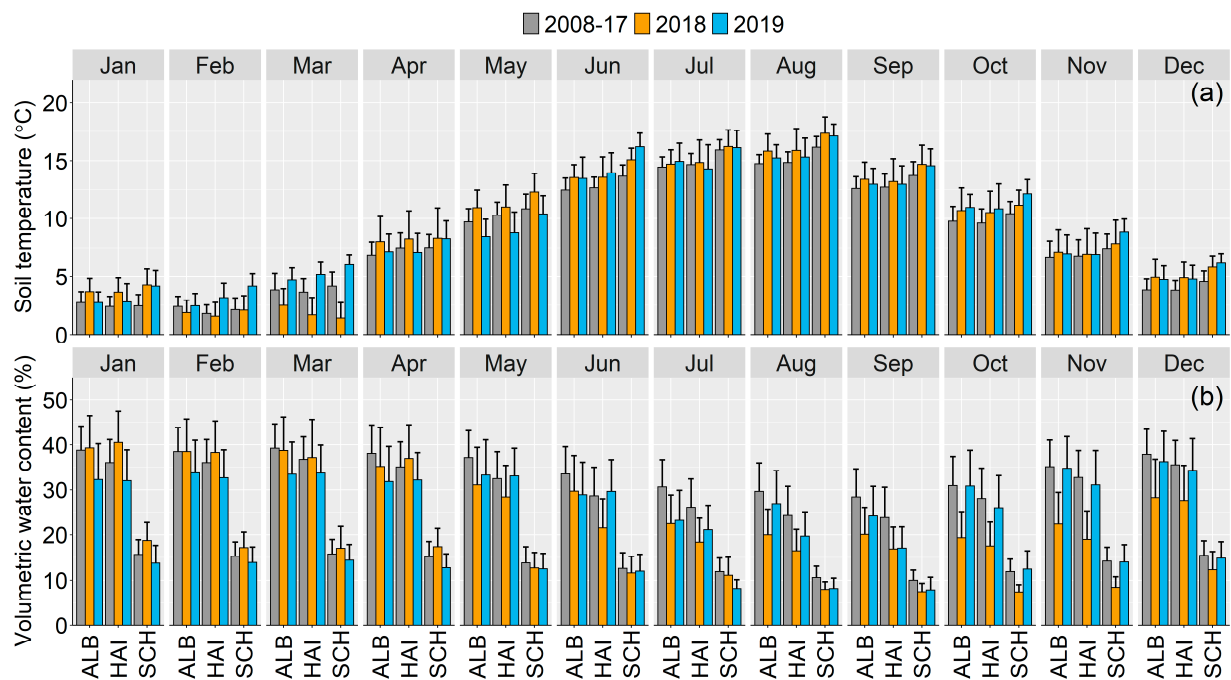

Figure S4. Mean (a) soil temperature (°C) and (b) volumetric water content (%) per month for the 10-year-mean (2008-17) and the two study years i.e. 2018 and 2019, for the three study regions (Schwäbische-Alb: ALB, Hainich-Dün: HAI and Schorfheide-Chorin: SCH). Error bars represent standard deviations around the mean.
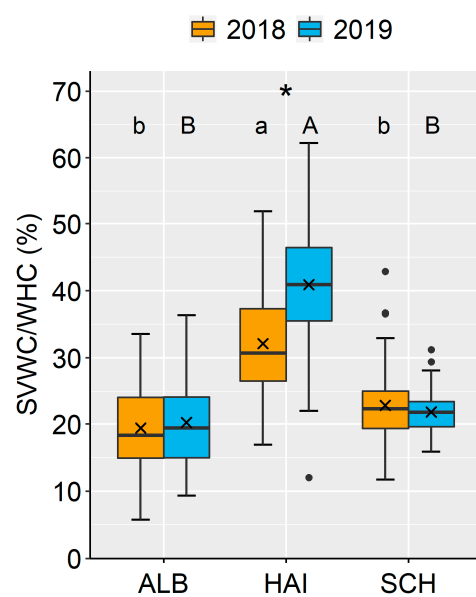
Figure S5. Soil volumetric water content (SVWC) during the soil respiration measurements over Water holding capacity (WHC) for the three study regions (i.e. Schwäbische-Alb: ALB, Hainich-Dün: HAI and Schorfheide-Chorin: SCH) and the two years (i.e. 2018 and 2019). Asterisks indicate differences between the two years for a given study site. Lower-case letters indicate differences between the tree study regions in 2018 and upper-case letters indicate differences between the tree study regions in 2019.
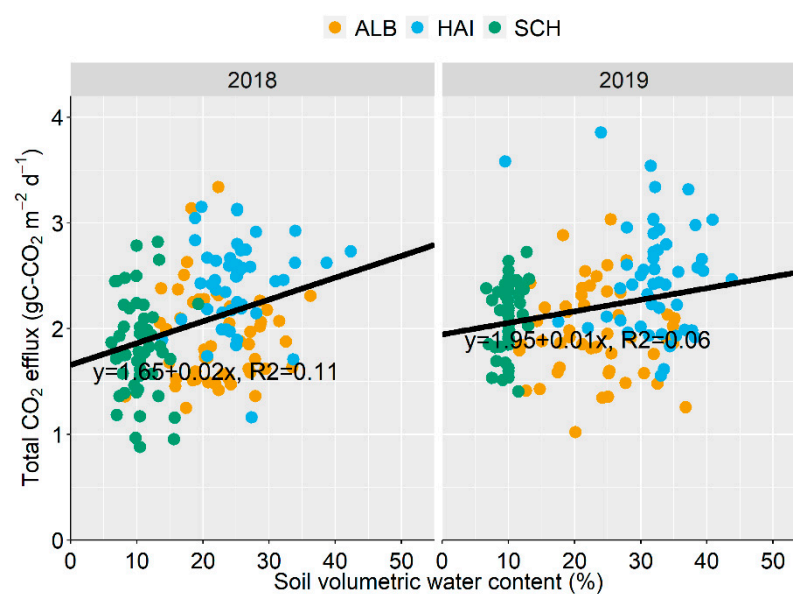
Figure S6. Correlation between total in-situ soil respiration and soil volumetric water content for the two sampling years (i.e. 2018 and 2019) and the three study regions (i.e. Schwäbische-Alb: ALB, Hainich-Dün: HAI and Schorfheide-Chorin: SCH). Equations and coefficient of determinations describe the linear relationship of total in-situ soil respiration and soil volumetric water content over all study regions.