



Supplement of

Forest liming in the face of climate change: the implications of restorative liming for soil organic carbon in mature German forests

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Supplementary information

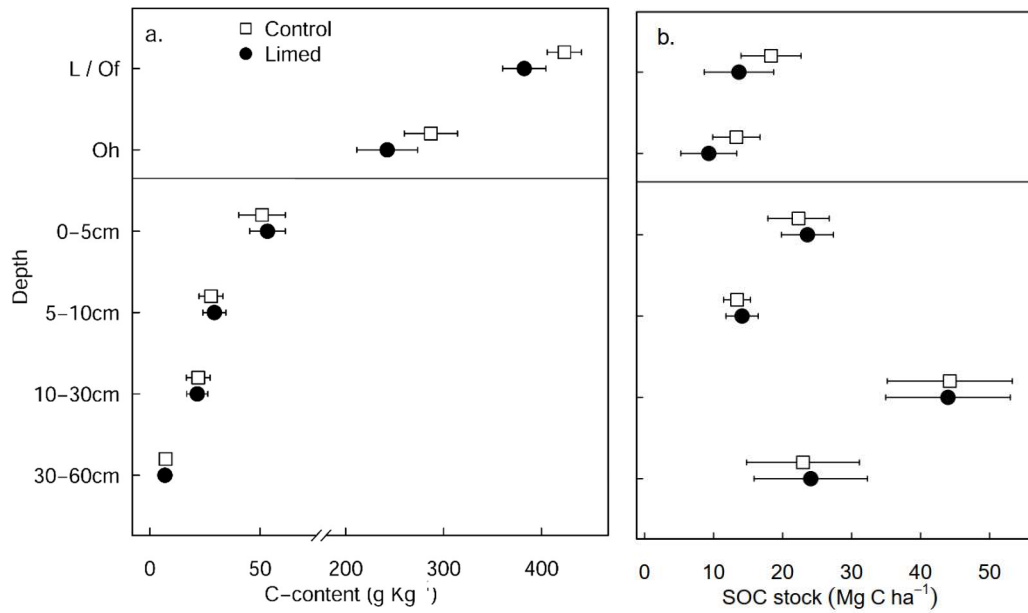


Figure S1: (a) Mean SOC contents in the limed and control plots and (b) mean SOC stocks in the limed and control plots (forest floor layer n=28, mineral soil n=26). Error bars indicate the 95 % confidence intervals based on Student's T distribution.

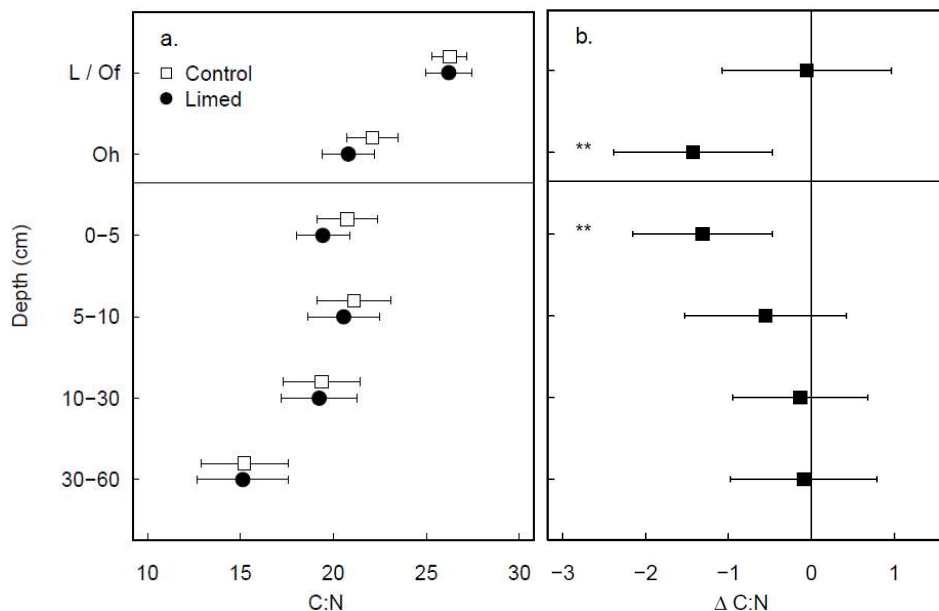


Figure S2: (a) Mean C:N ratio of limed and control plots and (b) treatment difference at different depths in the 60 cm soil profile. Error bars indicate the 95 % confidence intervals based on Student's T distribution. Forest floor layer n=28, Mineral soil n=26. Statistical significance was tested using LME models for each respective soil depth / layer at $P \leq 0.05$ (*) and $P \leq 0.01$ (**).

Table S1: Years when forest floor and mineral soil samples were collected from the different sites.

Site name	Species	Forest floor	Mineral soil
Dassel 325	Spruce	1990, 1998, 2004, 2011, 2015	1998, 2011, 2015
Dassel 4227	Beech	1998, 2004, 2012, 2015, 2018	1998, 2012, 2018
Eutin 402	Spruce	1990, 1998, 2010	1998, 2010,
Göhrde 129	Spruce	1990, 1998, 2010, 2015	1990, 1998, 2010, 2015
Göhrde 140	Oak	1990, 1998, 2010, 2015	1990, 1998, 2010, 2015
Göhrde 155	Spruce	1990, 1998, 2013	-
Göhrde 157	Beech	1990, 1998, 2015, 2018	1990, 1998, 2018
Grünenplan 142	Beech	1990, 1998, 2009, 2015, 2018	1998, 2009, 2018
Grünenplan 51	Beech	1990, 2019	-
Hess. Lichtenau 2680	Beech	-	2012, 2018
Lauterberg 2023	Spruce	2000, 2009, 2015	-
Lauterberg 75	Spruce	-	1998, 2005, 2015
Rantzau 50	Spruce	2000, 2010, 2017	2000, 2010, 2017
Segeberg 244	Spruce	1990, 1998, 2004, 2017	-
Segeberg 517	Spruce	2000, 2010, 2017	2000, 2010, 2017
Sellhorn 34	Beech	1990, 1998, 2010, 2015, 2018	1998, 2010, 2018
Sellhorn 66	Beech	1990, 1998, 2010, 2015	1998, 2010, 2015

Table S2: Spearman correlation coefficients of SOC stock in the control plots at different soil depths with explanatory variables (forest floor layer n = 28, mineral soil n = 26).

	L/O _f	O _h	0-5 cm	5-10 cm	10-30 cm	30-60 cm
Precipitation (mm a ⁻¹)	-0.10	-0.21	0.11	0.07	0.14	0.29
Temperature (°C)	-0.26	-0.06	-0.16	-0.24	-0.37	-0.31
Elevation (m.asl)	-0.23	-0.26	-0.10	-0.06	0.32	0.13
N-deposition (kg N ha ⁻¹)	0.41*	0.31	0.30	0.38	0.13	0.26
Clay (%)	-	-	0.49	0.51	0.62*	0.23
Sand (%)	-	-	-0.62*	-0.56*	-0.43	-0.35
C:N ratio	-0.01	0.65**	-0.05	0.11	0.13	0.32
Base saturation (%)	0.07	0.07	-0.07	-0.33	-0.38	-0.48*
pH (H ₂ O)	-0.79**	-0.67**	-0.27	-0.29	-0.41*	-0.63**

* Indicates a P-value of ≤0.05, and ** indicates a P-value of <0.01

Table S3: Spearman correlation coefficients of SOC stock changes (limed minus control) at different soil depths with explanatory variables (forest floor layer n = 28, mineral soil n= 26).

	L/O _f	O _h	0-5 cm	5-10 cm	10-30 cm	30-60 cm
Climate and site characteristics						
Precipitation (mm a ⁻¹)	0.29	0.13	0.08	-0.23	0.01	-0.25
Temperature (°C)	0.06	-0.28	0.12	0.09	0.19	-0.09
Elevation (m. asl)	0.05	-0.10	0.00	-0.27	-0.08	-0.12
Acid neutralization capacity (kmol _c ha ⁻¹)	-0.44 *	-0.46 *	-0.08	-0.34 §	0.08	0.01
Nitrogen deposition (kg N ha ⁻¹)	0.04	0.29	-0.34 §	0.02	-0.40 *	-0.17
Soil properties of the control plot						
Clay (%) †	-	-	-0.53 *	0.00	-0.31	-0.16
Sand (%) †	-	-	0.43	0.13	0.50 §	0.04
SOC stock (Mg C ha ⁻¹)	-0.38 *	-0.06	-0.55 **	-0.32	-0.28	-0.28
C:N ratio	-0.00	0.03	0.15	0.34 §	0.14	0.02
Base saturation (%) ‡	0.11	0.04	-0.27	-0.08	0.00	0.15
pH (H ₂ O)	0.14	-0.16	-0.12	0.11	-0.17	0.11
Changes in soil properties as a result of liming						
Δ H ⁺	0.27	0.06	0.04	0.47 *	0.26	0.49 *
Δ Base saturation ‡	-0.23	-0.40	0.11	-0.33 §	-0.12	-0.26

Levels of significance: § p < 0.10, * P ≤ 0.05, ** P ≤ 0.01, † n=15, ‡ n=11 in the forest floor layers