S1: Experimental design

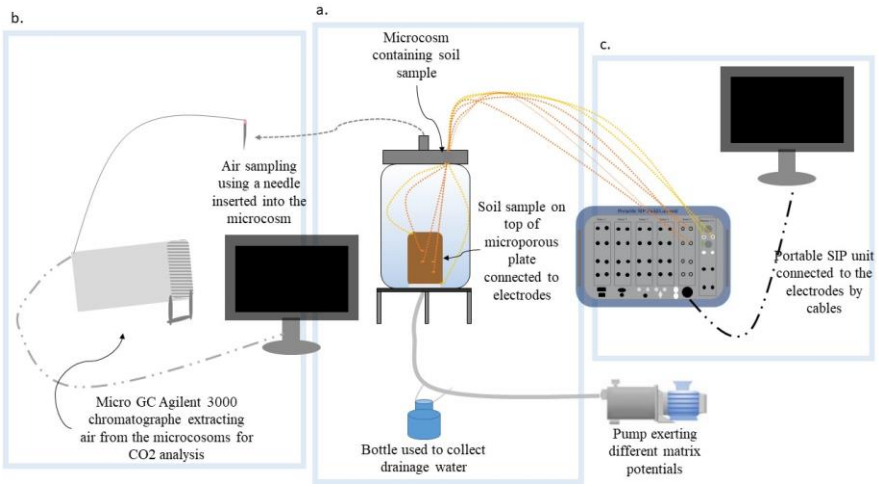

Fig. S1: Experimental set-up used to measure electrical conductivity and soil respiration rate at different matric potentials. (a) Samples are placed on microporous plates inside an air-tightly closed microcosm. The microcosms are connected to a pump that exerts different matric potentials through drainage collecting bottles placed inside an 8°C fridge. (b) Micro GC Agilent 3000 connected to a needle used to directly take 20 ml from the microcosms for CO2 analysis. (c) Electrical conductivity is measured by a PSIP unit, current injection and potential measurements is performed through electrodes connected to the PSIP unit by cables sealed by silicone at the top of the microcosm.

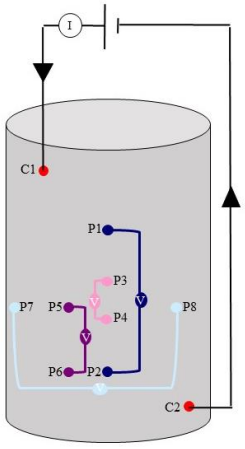

Fig. S2: Sketch of the electrode configuration used for the electrical conductivity measurements: C1 and C2 are the current electrodes (injection), while P1 to P8 are potential electrodes (potential measurements). Measurement pair 1 to 4 correspond to P1-P2, P3-P4, P5-P6, and P7-P8, respectively (see Table S1).

Table S1: Table showing the electrode pairs, their names indicated in Figure 3, the distance between the electrodes and the geometric factor calculated for each pair.

Electrode Pairs	Electrode names	Distance/angle between electrodes	Geometric factor (in m)
Pair 1	P1-P2	4 cm, vertical	0.060
Pair 2	P3-P4	1 cm, vertical	0.199
Pair 3	P5-P6	2 cm, vertical	0.199
Pair 4	P7-P8	45°, horizontal	0.284

S2: Additional results of the paper

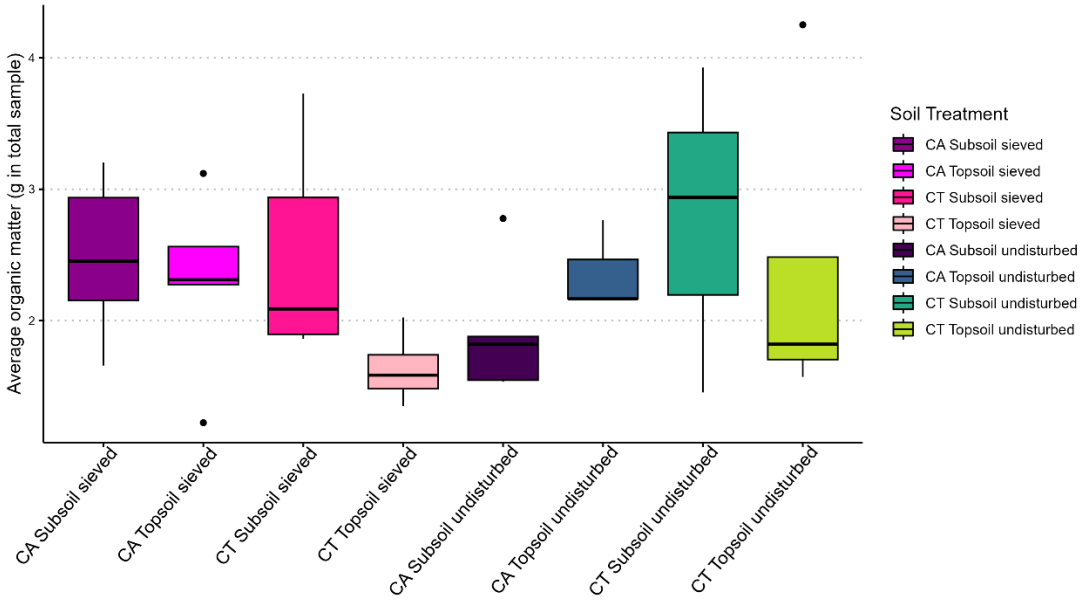

Fig. S3: Boxplot showing the organic matter content of each study site based on soil treatment. Each soil treatment consists of the triplicate samples with one of the triplicates being tested thrice to allow analytical verification of the laboratory results. CA stands for conservation agriculture while CT stands for conventional tillage. The undisturbed samples are undisturbed soil cores while the sieved samples were sieved down to a 2 mm particle size and packed to a bulk density of 1.73 g/cm^{3}.

Table S2: Average net respiration flux (in µmol/hour/grams of organic matter) at the highest measured saturation of -70hPa. CT stands for conventional tillage and CA stands for conservation agriculture. The sieved samples were sieved down to a 2 mm particle size and packed to a bulk density of 1.73 g/cm^3.

Soil Treatment	Mean Flux	Standard error of mean
CA Subsoil undisturbed	13.98	4.25
CT Subsoil undisturbed	7.38	4.75
CA Topsoil undisturbed	31.55	2.12
CT Topsoil undisturbed	19.46	1.79
CA Subsoil sieved	47.17	40.29
CT Subsoil sieved	88.14	52.700
CA Topsoil sieved	36.34	25.54
CT Topsoil sieved	32.42	0.14

Table S3: Average relative respiration flux and standard error of the mean relative respiration of each soil treatment type. The data was normalized to the values at -70hPa and is graphically represented in Fig.1 of the main body of the article. CT stands for conventional tillage and CA stands for conservation agriculture.

Treatment	Soil structure	Applied suction	Average respiration	Standard error of the mean
CA Subsoil	sieved	-70	1	0
CA Subsoil	sieved	-100	6.184	5.466
CA Subsoil	sieved	-250	0.400	0.035
CA Subsoil	sieved	-350	0.055	0.009
CA Subsoil	sieved	-450	0.157	0.050
CA Subsoil	sieved	-630	0.046	0.012
CA Subsoil	sieved	-996	0.145	0.065
CA Subsoil	undisturbed	-70	1	0
CA Subsoil	undisturbed	-100	0.975	0.291
CA Subsoil	undisturbed	-250	0.609	0.283
CA Subsoil	undisturbed	-350	0.100	0.020

CA Subsoil	undisturbed	-450	0.065	0.026
CA Subsoil	undisturbed	-630	0.049	0.020
CA Subsoil	undisturbed	-996	0.031	0.018
CA Topsoil	sieved	-70	1	0
CA Topsoil	sieved	-100	2.647	2.426
CA Topsoil	sieved	-250	0.550	0.001
CA Topsoil	sieved	-350	1.140	1.126
CA Topsoil	sieved	-450	0.110	0.091
CA Topsoil	sieved	-630	0.072	0.039
CA Topsoil	sieved	-996	0.147	0.001
CA Topsoil	undisturbed	-70	1	0
CA Topsoil	undisturbed	-100	0.759	0.498
CA Topsoil	undisturbed	-250	4.452	3.556
CA Topsoil	undisturbed	-350	1.212	0.100
CA Topsoil	undisturbed	-450	0.184	0.139
CA Topsoil	undisturbed	-630	0.167	0.1340
CA Topsoil	undisturbed	-996	0.071	0.024
CT Subsoil	sieved	-70	1	0
CT Subsoil	sieved	-100	5.977	1.498
CT Subsoil	sieved	-250	2.368	1.964
CT Subsoil	sieved	-350	2.267	1.569

CT Subsoil	sieved	-450	0.137	0.048
CT Subsoil	sieved	-630	0.137	0.106
CT Subsoil	sieved	-996	0.161	0.078
CT Subsoil	undisturbed	-70	1	0
CT Subsoil	undisturbed	-100	0.256	0.072
CT Subsoil	undisturbed	-250	0.362	0.092
CT Subsoil	undisturbed	-350	0.073	0.020
CT Subsoil	undisturbed	-450	0.060	0.014
CT Subsoil	undisturbed	-630	0.024	0.010
CT Subsoil	undisturbed	-996	0.040	0.015
CT Topsoil	sieved	-70	1	0
CT Topsoil	sieved	-100	1.039	0.724
CT Topsoil	sieved	-250	0.502	0.134
CT Topsoil	sieved	-350	0.077	0.060
CT Topsoil	sieved	-450	0.056	0.002
CT Topsoil	sieved	-630	0.046	0.013
CT Topsoil	sieved	-996	0.081	0.006
CT Topsoil	undisturbed	-70	1	0
CT Topsoil	undisturbed	-100	0.368	0.176
CT Topsoil	undisturbed	-250	1.235	1.133
CT Topsoil	undisturbed	-350	0.204	0.164

CT Topsoil	undisturbed	-450	0.100	0.024
CT Topsoil	undisturbed	-630	0.040	0.014
CT Topsoil	undisturbed	-996	0.017	0.008

Table S4: Mean ionic conductivity and standard error of mean of the water drainage. CA identifies the conservation agriculture fields and CT identifies the conventional tillage fields.

Soil Treatment	Soil structure	Mean	Standard error of mean
CA Topsoil	undisturbed	637.33	12.41
CA Subsoil	undisturbed	463.67	22.51
CT Topsoil	undisturbed	433.00	15.57
CT Subsoil	undisturbed	413.67	38.89
CA Topsoil	sieved	481.00	58.24
CA Subsoil	sieved	597.67	48.90
CT Topsoil	sieved	1052.33	8.69
CT Subsoil	sieved	742.33	28.67

Table S5: Average relative electrical conductivity of the Electrode Pair 1 and standard error of the mean relative respiration of each soil treatment type. The data was normalized to the values at -70hPa and is graphically represented in Fig.2 of the main body of the article. CT stands for conventional tillage and CA stands for conservation agriculture. The sieved samples were sieved down to a 2 mm particle size and packed to a bulk density of 1.73 g/cm^3.

Treatment	Soil structure	Applied suction	Electrical Conductivity	Standard error of the mean
CA Subsoil	sieved	-70	1.00	0.00
CA Subsoil	sieved	-100	0.65	0.00
CA Subsoil	sieved	-250	0.55	0.00
CA Subsoil	sieved	-350	0.53	0.00
CA Subsoil	sieved	-450	0.46	0.00

CA Subsoil	sieved	-630	0.36	0.00
CA Subsoil	undisturbed	-70	1.00	0.02
CA Subsoil	undisturbed	-100	1.15	0.02
CA Subsoil	undisturbed	-250	1.32	0.02
CA Subsoil	undisturbed	-350	0.89	0.02
CA Subsoil	undisturbed	-450	0.79	0.02
CA Subsoil	undisturbed	-630	0.67	0.02
CA Subsoil	undisturbed	-996	0.00	0.02
CA Topsoil	sieved	-70	1.00	0.00
CA Topsoil	sieved	-100	1.17	0.00
CA Topsoil	sieved	-250	0.71	0.00
CA Topsoil	sieved	-350	0.59	0.00
CA Topsoil	sieved	-450	0.47	0.00
CA Topsoil	sieved	-630	0.36	0.00
CA Topsoil	sieved	-996	0.00	0.00
CA Topsoil	undisturbed	-70	1.00	0.02
CA Topsoil	undisturbed	-100	1.05	0.02
CA Topsoil	undisturbed	-250	0.78	0.02
CA Topsoil	undisturbed	-350	0.76	0.02
CA Topsoil	undisturbed	-450	0.71	0.02
CA Topsoil	undisturbed	-630	0.59	0.02
CA Topsoil	undisturbed	-996	0.00	0.02
CT Subsoil	sieved	-70	1.00	0.00
CT Subsoil	sieved	-100	1.07	0.00
CT Subsoil	sieved	-250	0.87	0.00
CT Subsoil	sieved	-350	0.95	0.00
CT Subsoil	sieved	-450	0.76	0.00
CT Subsoil	sieved	-630	0.60	0.00
CT Subsoil	sieved	-996	0.47	0.00
CT Subsoil	undisturbed	-70	1.00	0.02
CT Subsoil	undisturbed	-100	0.98	0.02
CT Subsoil	undisturbed	-250	0.86	0.02
CT Subsoil	undisturbed	-350	0.76	0.02
CT Subsoil	undisturbed	-450	0.64	0.02
CT Subsoil	undisturbed	-630	0.88	0.02
CT Subsoil	undisturbed	-996	0.00	0.02
CT Topsoil	sieved	-70	1.00	0.00
CT Topsoil	sieved	-100	1.28	0.00
CT Topsoil	sieved	-250	0.97	0.00

CT Topsoil	sieved	-350	0.83	0.00
CT Topsoil	sieved	-450	0.62	0.00
CT Topsoil	sieved	-630	0.51	0.00
CT Topsoil	sieved	-996	0.14	0.00
CT Topsoil	undisturbed	-70	1.00	0.02
CT Topsoil	undisturbed	-100	2.18	0.02
CT Topsoil	undisturbed	-250	1.69	0.02
CT Topsoil	undisturbed	-350	1.10	0.02
CT Topsoil	undisturbed	-450	1.02	0.02
CT Topsoil	undisturbed	-630	1.14	0.02
CT Topsoil	undisturbed	-996	0.00	0.02

40 **Table S6: Average relative electrical conductivity of the Electrode Pair 2 and standard error of the mean relative respiration of each soil treatment type. The data was normalized to the values at -70hPa and is graphically represented in Fig.2 of the main body of the article. CT stands for conventional tillage and CA stands for conservation agriculture. The sieved samples were sieved down to a 2 mm particle size and packed to a bulk density of 1.73 g/cm^3.**

Treatment	Soil structure	Applied suction	Electrical Conductivity	Standard error of the mean
CA Subsoil	sieved	-70	1.000	0.015
CA Subsoil	sieved	-100	0.891	0.015
CA Subsoil	sieved	-250	0.771	0.015
CA Subsoil	sieved	-350	0.799	0.015
CA Subsoil	sieved	-450	0.780	0.015
CA Subsoil	sieved	-630	0.498	0.015
CA Subsoil	undisturbed	-70	1.000	0.009
CA Subsoil	undisturbed	-100	0.986	0.009
CA Subsoil	undisturbed	-250	0.845	0.009
CA Subsoil	undisturbed	-350	0.737	0.009
CA Subsoil	undisturbed	-450	0.524	0.009
CA Subsoil	undisturbed	-630	0.431	0.009
CA Subsoil	undisturbed	-996	0.000	0.009
CA Topsoil	sieved	-70	1.000	0.015
CA Topsoil	sieved	-100	1.137	0.015
CA Topsoil	sieved	-250	0.818	0.015
CA Topsoil	sieved	-350	0.771	0.015
CA Topsoil	sieved	-450	0.566	0.015
CA Topsoil	sieved	-630	0.362	0.015
CA Topsoil	sieved	-996	0.000	0.015
CA Topsoil	undisturbed	-70	1.000	0.009

CA Topsoil	undisturbed	-100	1.066	0.009
CA Topsoil	undisturbed	-250	0.791	0.009
CA Topsoil	undisturbed	-350	0.763	0.009
CA Topsoil	undisturbed	-450	0.714	0.009
CA Topsoil	undisturbed	-630	0.591	0.009
CA Topsoil	undisturbed	-996	0.000	0.009
CT Subsoil	sieved	-70	1.000	0.015
CT Subsoil	sieved	-100	1.108	0.015
CT Subsoil	sieved	-250	0.975	0.015
CT Subsoil	sieved	-350	1.017	0.015
CT Subsoil	sieved	-450	0.992	0.015
CT Subsoil	sieved	-630	0.716	0.015
CT Subsoil	sieved	-996	0.001	0.015
CT Subsoil	undisturbed	-70	1.000	0.009
CT Subsoil	undisturbed	-100	0.958	0.009
CT Subsoil	undisturbed	-250	0.776	0.009
CT Subsoil	undisturbed	-350	0.834	0.009
CT Subsoil	undisturbed	-450	0.665	0.009
CT Subsoil	undisturbed	-630	0.470	0.009
CT Subsoil	undisturbed	-996	0.003	0.009
CT Topsoil	sieved	-70	1.000	0.015
CT Topsoil	sieved	-100	1.321	0.015
CT Topsoil	sieved	-250	1.501	0.015
CT Topsoil	sieved	-350	0.291	0.015
CT Topsoil	sieved	-450	1.163	0.015
CT Topsoil	sieved	-630	1.524	0.015
CT Topsoil	sieved	-996	0.183	0.015
CT Topsoil	undisturbed	-70	1.000	0.009
CT Topsoil	undisturbed	-100	1.053	0.009
CT Topsoil	undisturbed	-250	0.754	0.009
CT Topsoil	undisturbed	-350	0.548	0.009
CT Topsoil	undisturbed	-450	0.453	0.009
CT Topsoil	undisturbed	-630	0.477	0.009
CT Topsoil	undisturbed	-996	0.000	0.009

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Table S7: Average relative electrical conductivity of the Electrode Pair 3 and standard error of the mean relative respiration of each soil treatment type. The data was normalized to the values at -70hPa and is graphically represented in Fig.2 of the main body of the article. CT stands for conventional tillage and CA stands for conservation agriculture. The sieved samples were sieved down to a 2 mm particle size and packed to a bulk density of 1.73 g/cm^3.

Treatment	Soil structure	Applied suction	Electrical Conductivity	Standard error of the mean
CA Subsoil	sieved	-70	1.000	0.003
CA Subsoil	sieved	-100	0.939	0.003
CA Subsoil	sieved	-250	0.726	0.003
CA Subsoil	sieved	-350	0.695	0.003
CA Subsoil	sieved	-450	0.585	0.003
CA Subsoil	sieved	-630	0.455	0.003
CA Subsoil	undisturbed	-70	1.000	0.005
CA Subsoil	undisturbed	-100	0.990	0.005
CA Subsoil	undisturbed	-250	0.865	0.005
CA Subsoil	undisturbed	-350	0.757	0.005
CA Subsoil	undisturbed	-450	0.542	0.005
CA Subsoil	undisturbed	-630	0.424	0.005
CA Subsoil	undisturbed	-996	0.000	0.005
CA Topsoil	sieved	-70	1.000	0.003
CA Topsoil	sieved	-100	1.249	0.003
CA Topsoil	sieved	-250	0.842	0.003
CA Topsoil	sieved	-350	0.705	0.003
CA Topsoil	sieved	-450	0.560	0.003
CA Topsoil	sieved	-630	0.414	0.003
CA Topsoil	sieved	-996	0.000	0.003
CA Topsoil	undisturbed	-70	1.000	0.005
CA Topsoil	undisturbed	-100	1.093	0.005
CA Topsoil	undisturbed	-250	0.837	0.005
CA Topsoil	undisturbed	-350	0.822	0.005
CA Topsoil	undisturbed	-450	0.770	0.005
CA Topsoil	undisturbed	-630	0.629	0.005
CA Topsoil	undisturbed	-996	0.000	0.005
CT Subsoil	sieved	-70	1.000	0.003
CT Subsoil	sieved	-100	1.049	0.003
CT Subsoil	sieved	-250	0.827	0.003
CT Subsoil	sieved	-350	0.882	0.003
CT Subsoil	sieved	-450	0.715	0.003
CT Subsoil	sieved	-630	0.568	0.003

CT Subsoil	sieved	-996	0.072	0.003
CT Subsoil	undisturbed	-70	1.000	0.005
CT Subsoil	undisturbed	-100	0.954	0.005
CT Subsoil	undisturbed	-250	0.839	0.005
CT Subsoil	undisturbed	-350	0.843	0.005
CT Subsoil	undisturbed	-450	0.683	0.005
CT Subsoil	undisturbed	-630	1.206	0.005
CT Subsoil	undisturbed	-996	0.004	0.005
CT Topsoil	sieved	-70	1.000	0.003
CT Topsoil	sieved	-100	0.810	0.003
CT Topsoil	sieved	-250	0.842	0.003
CT Topsoil	sieved	-350	1.147	0.003
CT Topsoil	sieved	-450	0.914	0.003
CT Topsoil	sieved	-630	0.814	0.003
CT Topsoil	sieved	-996	0.325	0.003
CT Topsoil	undisturbed	-70	1.000	0.005
CT Topsoil	undisturbed	-100	0.779	0.005
CT Topsoil	undisturbed	-250	0.578	0.005
CT Topsoil	undisturbed	-350	0.224	0.005
CT Topsoil	undisturbed	-450	0.000	0.005
CT Topsoil	undisturbed	-630	0.000	0.005
CT Topsoil	undisturbed	-996	0.000	0.005

Table S8: Average relative electrical conductivity of the Electrode Pair 4 and standard error of the mean relative respiration of each soil treatment type. The data was normalized to the values at -70hPa and is graphically represented in Fig.2 of the main body of the article. CT stands for conventional tillage and CA stands for conservation agriculture. The sieved samples were sieved down to a 2 mm particle size and packed to a bulk density of 1.73 g/cm^3.

Treatment	Soil structure	Applied suction	Electrical Conductivity	Standard error of the mean
CA Subsoil	sieved	-70	1.000	0.015
CA Subsoil	sieved	-100	0.891	0.015
CA Subsoil	sieved	-250	0.771	0.015
CA Subsoil	sieved	-350	0.799	0.015
CA Subsoil	sieved	-450	0.780	0.015
CA Subsoil	sieved	-630	0.498	0.015
CA Subsoil	undisturbed	-70	1.000	0.009
CA Subsoil	undisturbed	-100	0.989	0.009
CA Subsoil	undisturbed	-250	0.937	0.009
CA Subsoil	undisturbed	-350	0.784	0.009
CA Subsoil	undisturbed	-450	0.591	0.009
CA Subsoil	undisturbed	-630	0.537	0.009
CA Subsoil	undisturbed	-996	0.000	0.009
CA Topsoil	sieved	-70	1.000	0.015
CA Topsoil	sieved	-100	1.137	0.015
CA Topsoil	sieved	-250	0.818	0.015
CA Topsoil	sieved	-350	0.771	0.015
CA Topsoil	sieved	-450	0.566	0.015
CA Topsoil	sieved	-630	0.362	0.015
CA Topsoil	sieved	-996	0.000	0.015
CA Topsoil	undisturbed	-70	1.000	0.009
CA Topsoil	undisturbed	-100	1.016	0.009
CA Topsoil	undisturbed	-250	0.917	0.009
CA Topsoil	undisturbed	-350	0.921	0.009
CA Topsoil	undisturbed	-450	0.959	0.009
CA Topsoil	undisturbed	-630	0.775	0.009
CA Topsoil	undisturbed	-996	0.000	0.009
CT Subsoil	sieved	-70	1.000	0.015
CT Subsoil	sieved	-100	1.108	0.015
CT Subsoil	sieved	-250	0.975	0.015
CT Subsoil	sieved	-350	1.017	0.015
CT Subsoil	sieved	-450	0.992	0.015
CT Subsoil	sieved	-630	0.716	0.015

CT Subsoil	sieved	-996	0.001	0.015
CT Subsoil	undisturbed	-70	1.000	0.009
CT Subsoil	undisturbed	-100	0.920	0.009
CT Subsoil	undisturbed	-250	0.890	0.009
CT Subsoil	undisturbed	-350	0.884	0.009
CT Subsoil	undisturbed	-450	0.754	0.009
CT Subsoil	undisturbed	-630	0.716	0.009
CT Subsoil	undisturbed	-996	0.000	0.009
CT Topsoil	sieved	-70	1.000	0.015
CT Topsoil	sieved	-100	1.321	0.015
CT Topsoil	sieved	-250	1.501	0.015
CT Topsoil	sieved	-350	0.291	0.015
CT Topsoil	sieved	-450	1.163	0.015
CT Topsoil	sieved	-630	1.524	0.015
CT Topsoil	sieved	-996	0.183	0.015
CT Topsoil	undisturbed	-70	1.000	0.009
CT Topsoil	undisturbed	-100	1.015	0.009
CT Topsoil	undisturbed	-250	0.609	0.009
CT Topsoil	undisturbed	-350	0.468	0.009
CT Topsoil	undisturbed	-450	0.447	0.009
CT Topsoil	undisturbed	-630	0.490	0.009
CT Topsoil	undisturbed	-996	0.000	0.009

S3: Full range of electrical conductivity and soil respiration rate at different matric potentials

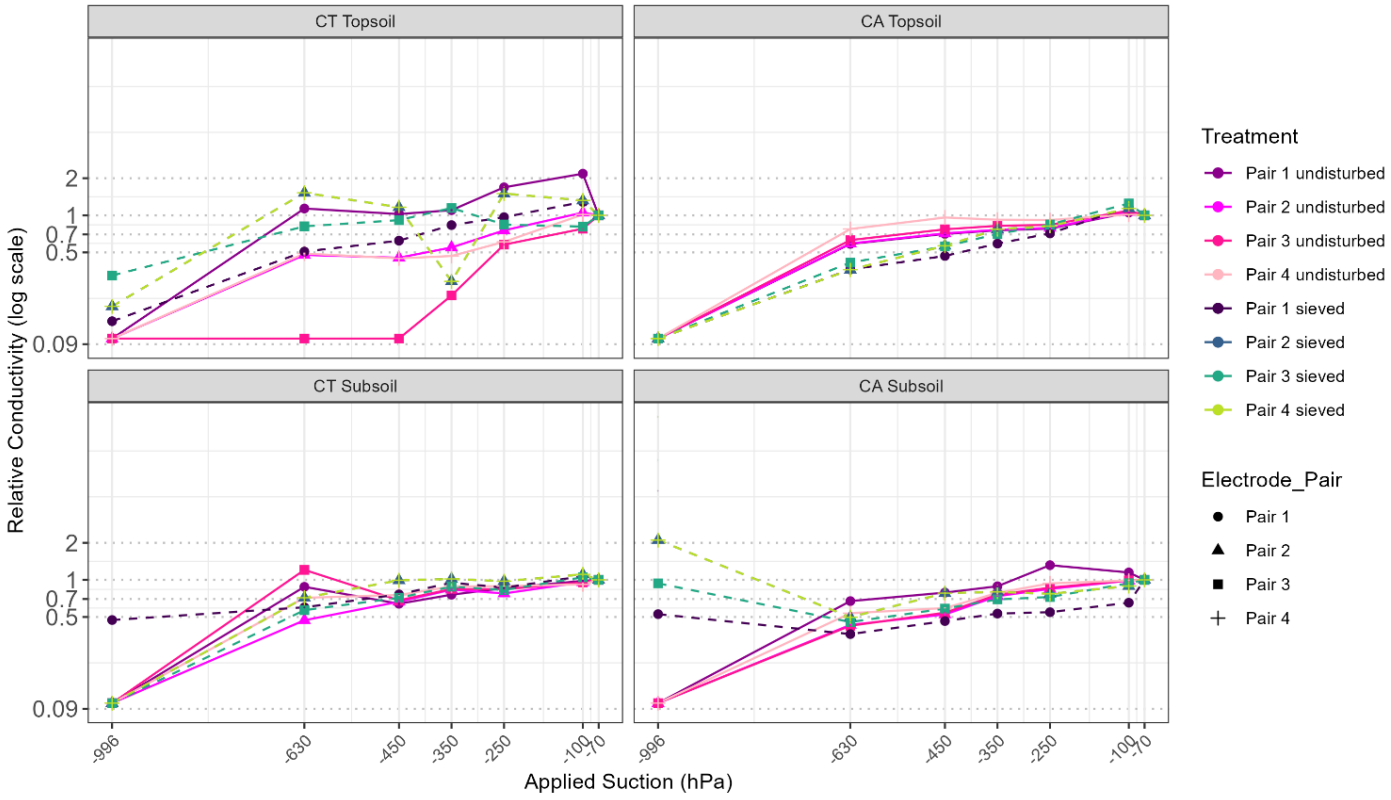

Fig. S4: Mean relative electrical conductivity, normalised to the rate observed at -70 hPa, is shown for sieved (dashed line) and undisturbed (solid line) for the two different sample depths of the two field treatment types across a range of applied suctions (hPa). The field treatment abbreviation CA stands for conservation tillage, while CT stands for conventional tillage. The included standard deviation is not visible given its size did not exceed the size of the symbols.

S4: Correlation between electrical conductivity and soil respiration rate at different matric potentials

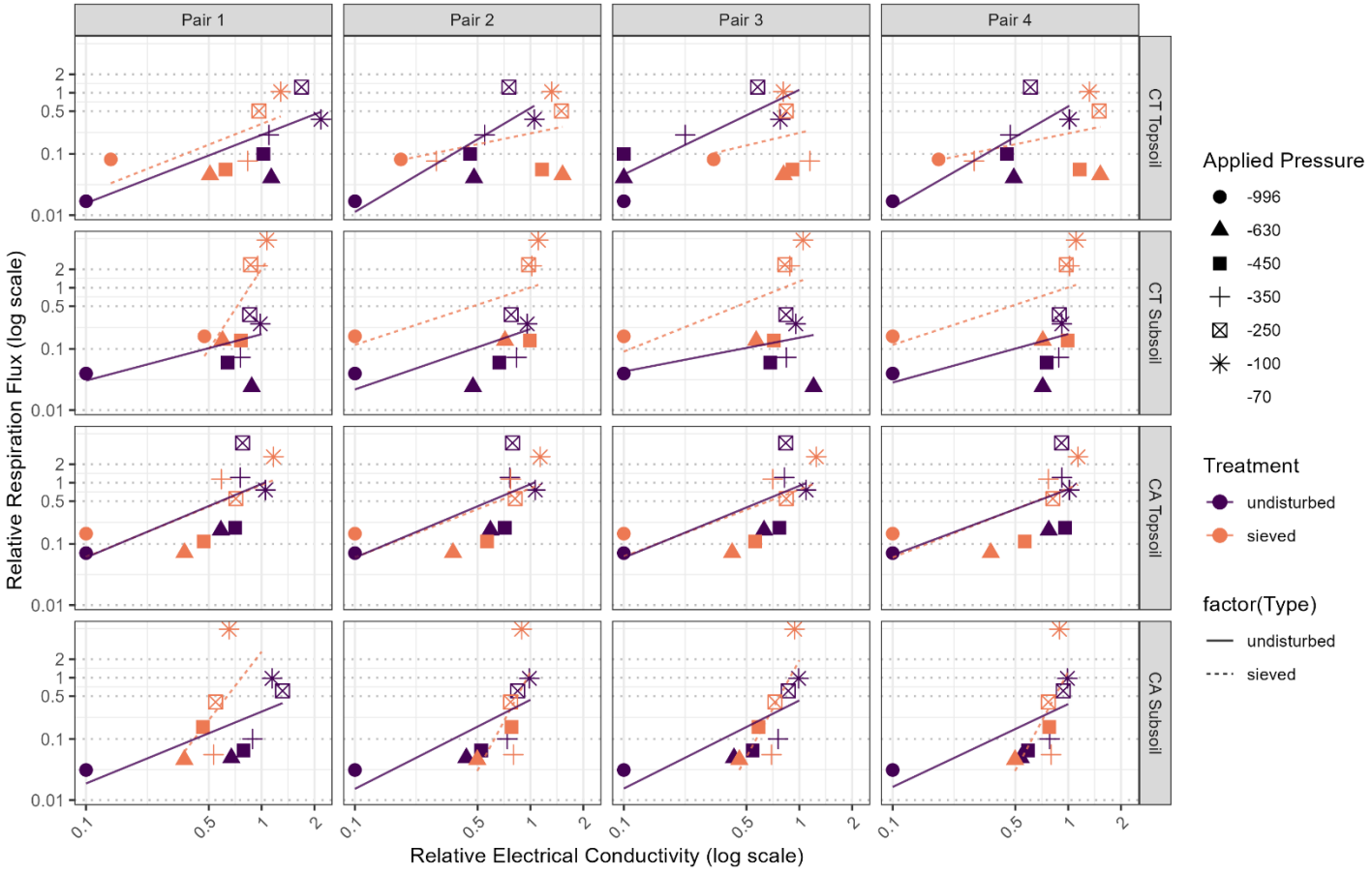

Fig. S5: Mean relative respiration flux after the onset of optimal matric potential at -250 hPa, in relation to the mean relative electrical conductivity, normalised to the rate observed at the value observed at -70 hPa, is shown for sieved (dashed line) and undisturbed (solid line) for the two sample depths of the two different field treatments across a range of applied suctions (hPa) illustrated by different marker points for the electrode pair 1 and 2. The relationship between the two parameters is visualized in the form of an exponential model. The field treatment abbreviation CA stands for conservation tillage, while CT stands for conventional tillage.

Table S9: The R squared values associated with the correlation plots between the relative respiration rate and relative electrical conductivity normalized to the measured values at -70 hPa .CT stands for conventional tillage and CA stands for conservation agriculture. The sieved samples were sieved down to a 2 mm particle size and packed to a bulk density of 1.73 g/cm^3.

Treatment	Soil Type	Electrode Pair	R^2	P-value
CA Subsoil	Sieved	Pair 1	0.34	0.420
CA Subsoil	Undisturbed	Pair 1	0.82	0.035
CA Subsoil	Sieved	Pair 2	0.28	0.474
CA Subsoil	Undisturbed	Pair 2	0.74	0.063
CA Topsoil	Sieved	Pair 1	0.41	0.245
CA Topsoil	Undisturbed	Pair 1	0.54	0.155
CA Topsoil	Sieved	Pair 2	0.52	0.170
CA Topsoil	Undisturbed	Pair 2	0.55	0.153
CT Subsoil	Sieved	Pair 1	0.66	0.094
CT Subsoil	Undisturbed	Pair 1	0.10	0.605
CT Subsoil	Sieved	Pair 2	0.27	0.369
CT Subsoil	Undisturbed	Pair 2	0.34	0.303
CT Topsoil	Sieved	Pair 1	0.31	0.326
CT Topsoil	Undisturbed	Pair 1	0.76	0.054
CT Topsoil	Sieved	Pair 2	0.07	0.676
CT Topsoil	Undisturbed	Pair 2	0.84	0.028