Supplementary Materials for Article: “Use of soil respiration measurements and RothC modelling show effects of catch crops and precision and traditional agriculture on productivity and soil organic carbon dynamics in a 5 year study in Mediterranean climate”

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This document is organized in this way:

- First, we show the statistical analysis conducted to separate the autotrophic and heterotrophic components of soil respiration
- Second, we include all the data used for the simulations with RothC20_N shown in the article

1 Partitioning of soil respiration in its components

The respiration partitioning was conducted as explained in section 2.4 of the main article; that is, soil respiration can be partitioned into its components by analysing how it changes when measured on (a) bare soil, (b) a growing crop, (c) a mature crop. The assumptions are that: on bare soil in winter, the measured respiration is an estimate of basal respiration; the increase in soil respiration in the growing season is related to the increase in root biomass (and exudates); the soil respiration measured after the harvest is representative of the heterotrophic component of respiration.

The respiration dataset is composed from the data of 4 gas chambers measuring soil respiration every hour each; the chambers close at different times, to generate a soil respiration dataset with a measurement every 15 minutes. Here, we decided to use hourly averages instead, so as to account for individual differences between chambers. We also have hourly soil temperature and soil water content datasets, a model of root growth, and hourly meteorological data taken from a nearby 2 m tall weather station (solar net radiation, air temperature, relative humidity, barometric pressure, precipitations, wind speed and direction).

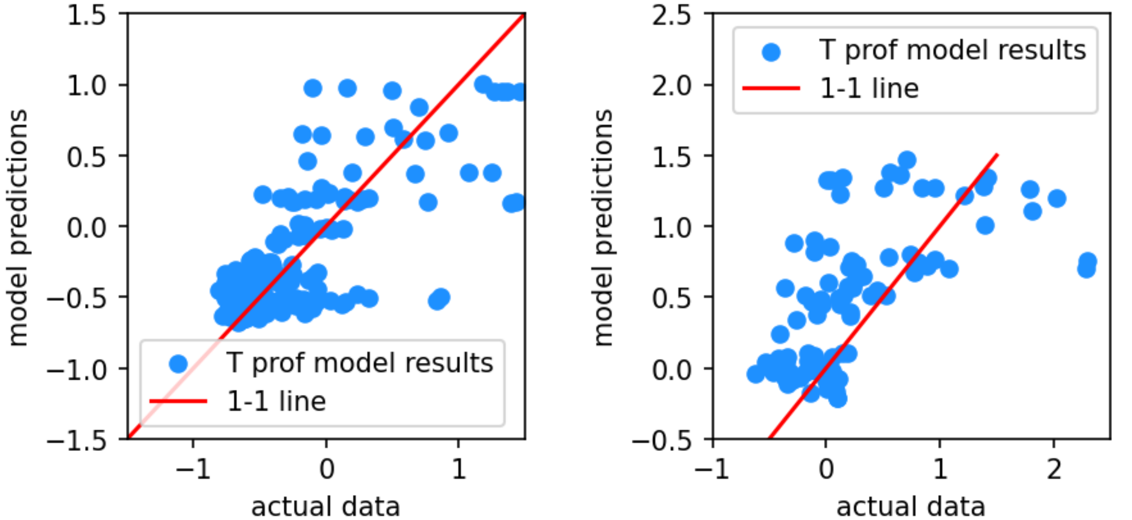
The idea is to: (1) divide the soil respiration dataset into different subsets, first dividing between crop/bare soil, and then between winter and summer period; (2) fit a function $f(T_s, \theta_s)$ to the winter period without crop, to estimate the soil basal respiration; (3) fit a function $g(T_s, \theta_s)$ to the summer period without crop, to estimate the heterotrophic respiration when no autotrophic respiration is present; (4) use the two functions to predict the heterotrophic component of soil respiration in the winter period, for the period in which crop is present, and subtract the measured soil respiration from the estimates from the two fitted function, to get an estimate of the autotrophic component of respiration; (5) fit a function $h(Rad_{net}, Root_{growth}, T_a, \theta_s)$ to the residuals obtained on step (4), to analyse whether the residuals behave as we should expect from the autotrophic component of soil respiration. In the equations, T_s and T_a are soil temperature and air temperatures, θ_s is soil water content, Rad_{net} is the measured net radiation, and $Root_{growth}$ is the estimated growth of the root biomass, from the Hort@ s.r.l. data.

All the analyses were carried out using Python (on various Python Jupyter Notebooks). From a general analysis performed on the whole soil respiration dataset, after subdividing the dataset in 4 subsets (winter+crop, winter+bare, summer+crop, summer+bare), the best fit of soil respiration measurements (from here on R_s) on bare soil with T_s and θ_s was obtained using Numpy polyfit and poly1d functions. The resulting function is linear in T_s (that is, metabolic activity from soil microbial population increases linearly with increasing soil temperature), and a 4th degree polynomial dependence on θ_s (to represent the typical "domed" relationship, with a sharp decline with very dry and very wet soils, and a more "stable" behaviour in unsaturated wet soils). Before analysis, all data was standardized as $O_{stnd} = \frac{O_i - \bar{O}}{\sigma_O}$ where O_i is the individual soil respiration observed, $\bar{O}$ is the average soil respiration in the whole dataset, σ_O is the standard deviation in the whole dataset.

1.1 Ca Bosco (Ravenna)

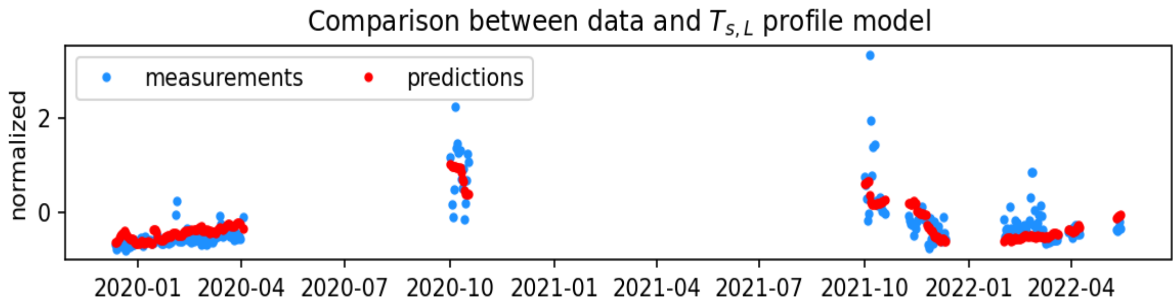
1.1.1 CCS plot 4

The model fit for the winter+bare period results are shown in Figures S1a and S2a; the model fit for the summer+bare period results are shown in Figures S1b and S2b; the whole partitioning is shown in Figure S3.

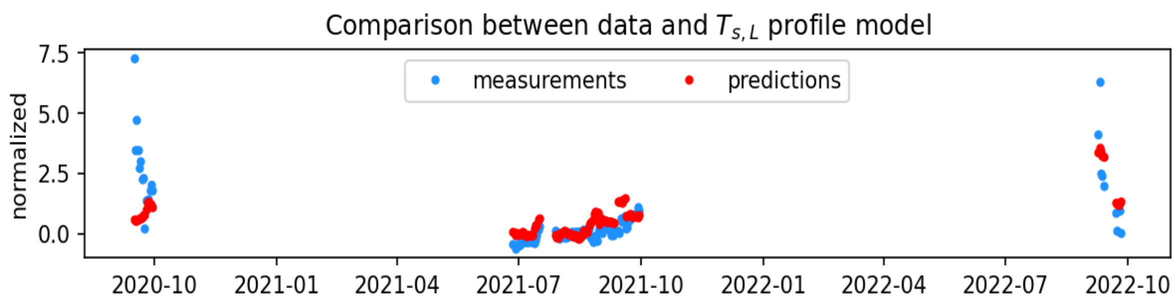


a) b)

Figure S1: comparison between observed soil respiration and soil respiration predicted by the fitted model, shown on standardized data; a) for winter bare period, b) for summer bare period. The fitted model, here, is referred to as T prof model.



a)



b)

Figure S2: comparison between observed soil respiration and soil respiration predicted by the fitted model, shown on standardized data, as a time series. The model fit is acceptable, even though some soil respiration peaks are underestimated; a) for the winter bare period, b) for the summer bare period. The fitted model, here, is referred to as Ts,L profile model.

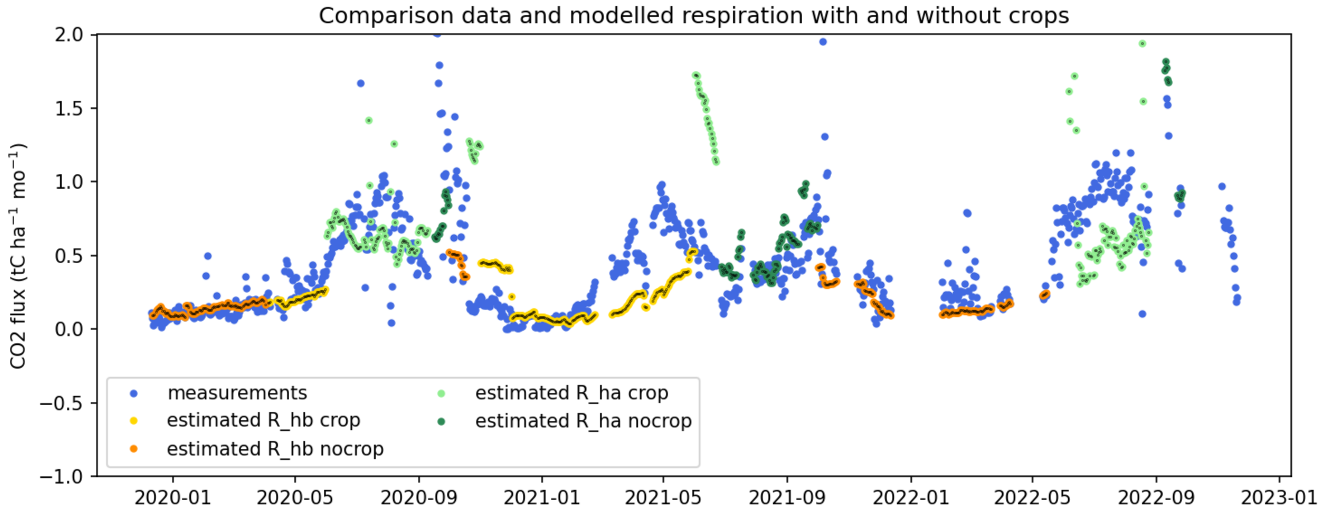
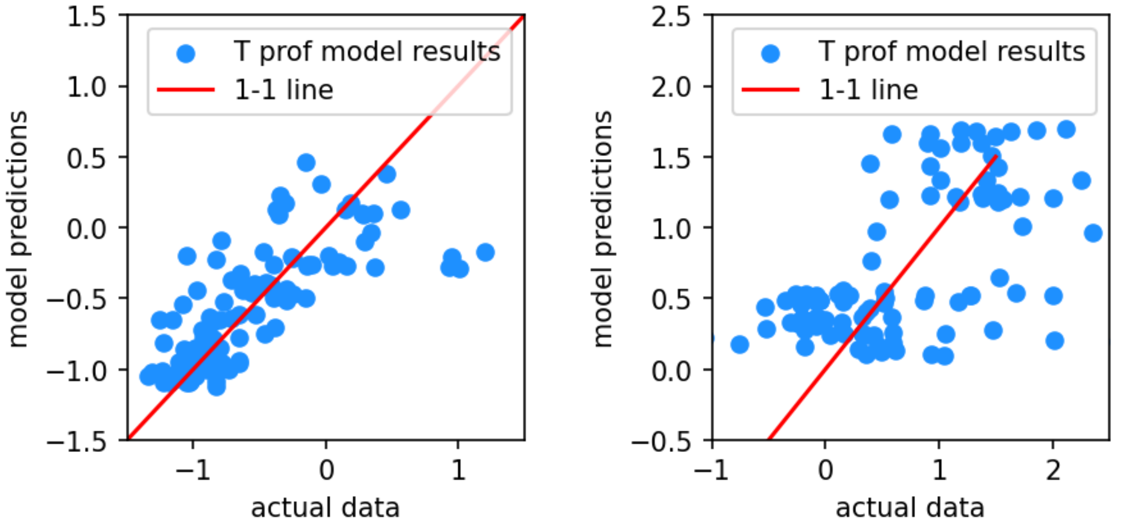


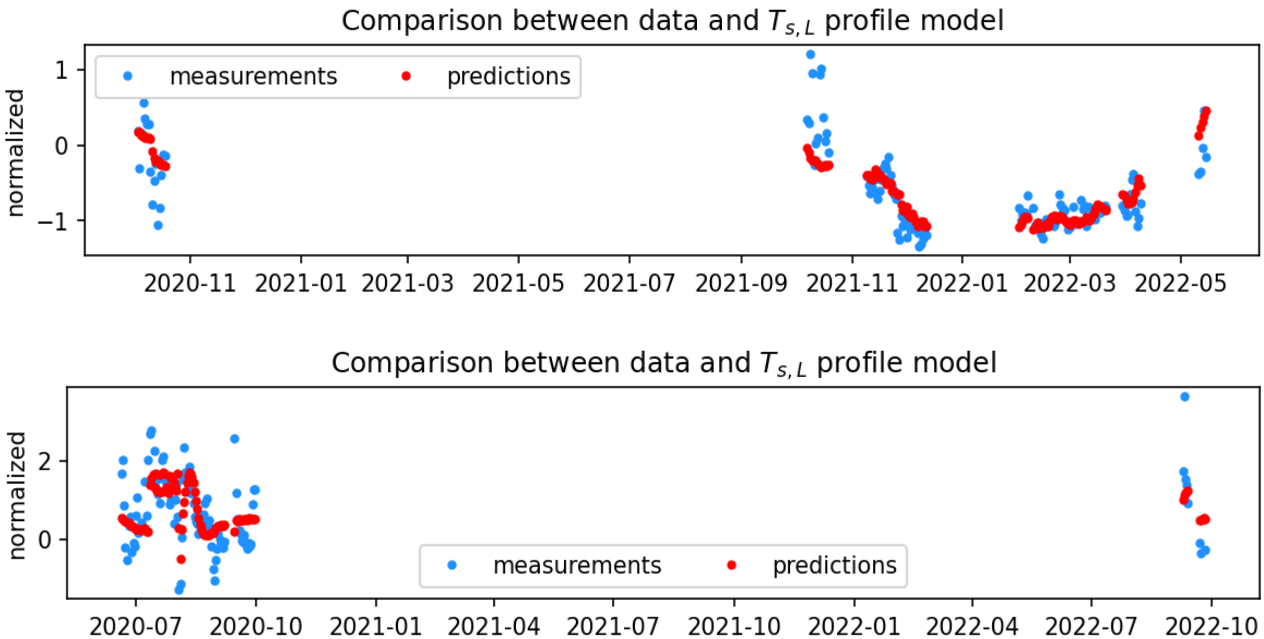
Figure S3: comparison between measured soil respiration and estimated heterotrophic component of soil respiration, directly on flux data. R_hb stands for heterotrophic component, winter period, R_ha stands for heterotrophic component, summer period. The model fits well with expectations, with estimates lower than the observed soil respiration when the crop is present. However, there is a large overestimation of heterotrophic component of soil respiration on June 2021 – thus, that part of the dataset was not used in the analysis shown in the article.

1.1.2 ECS plot 5



a) b)

Figure S4: comparison between observed soil respiration and soil respiration predicted by the fitted model, shown on standardized data; a) for winter bare period, b) for summer bare period. The fitted model, here, is referred to as T prof model.



a)

b)

Figure S5: comparison between observed soil respiration and soil respiration predicted by the fitted model, shown on standardized data, as a time series. The model fit is acceptable, even though some soil respiration peaks are underestimated; a) for the winter bare period, b) for the summer bare period. The fitted model, here, is referred to as Ts,L profile model.

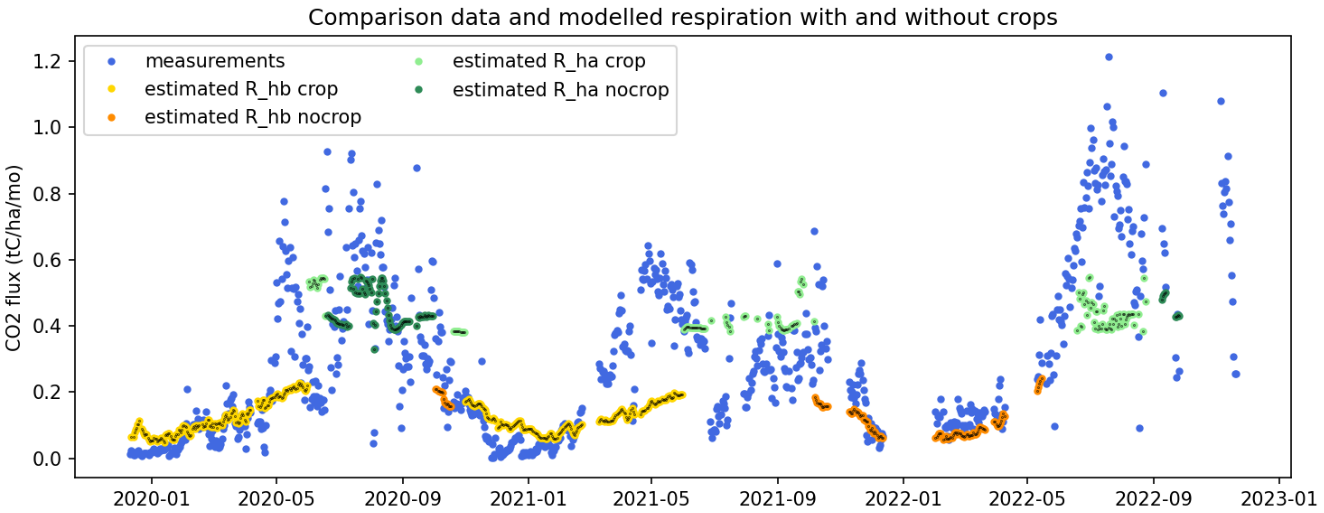
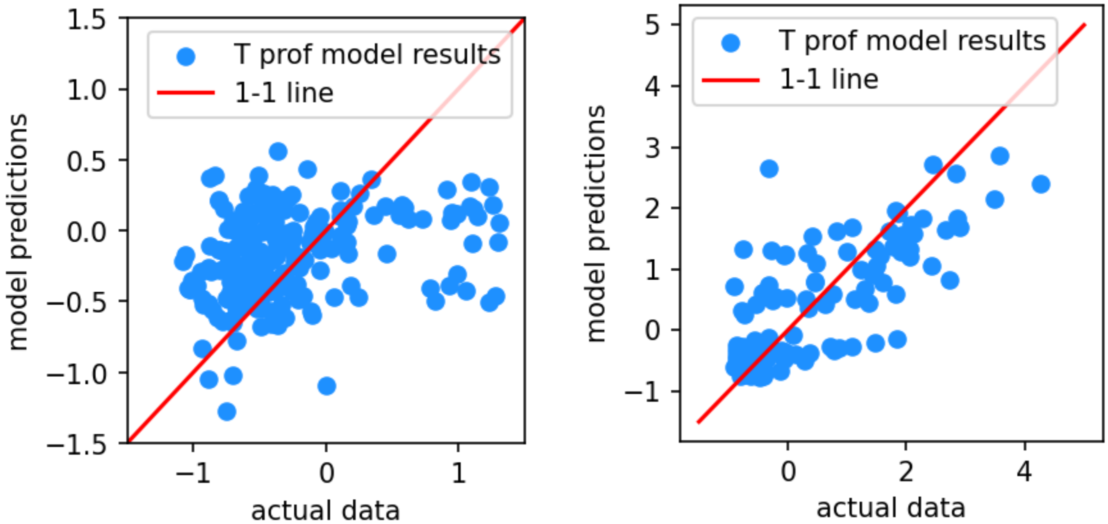


Figure S6: comparison between measured soil respiration and estimated heterotrophic component of soil respiration, directly on flux data. R_hb stands for heterotrophic component, winter period, R_ha stands for heterotrophic component, summer period. The model fits well with expectations, with estimates lower than the observed soil respiration when the crop is present. There is some overprediction for the winter period, when the crop is present, in December, for both years 2020 and 2021, however, the fit was better than in Ca Bosco CCS (Figure S3).

1.2 Ca Ione (Foggia)

1.2.1 CCS plot 4



a) b)

Figure S7: comparison between observed soil respiration and soil respiration predicted by the fitted model, shown on standardized data; a) for winter bare period, b) for summer bare period. The fitted model, here, is referred to as T prof model.

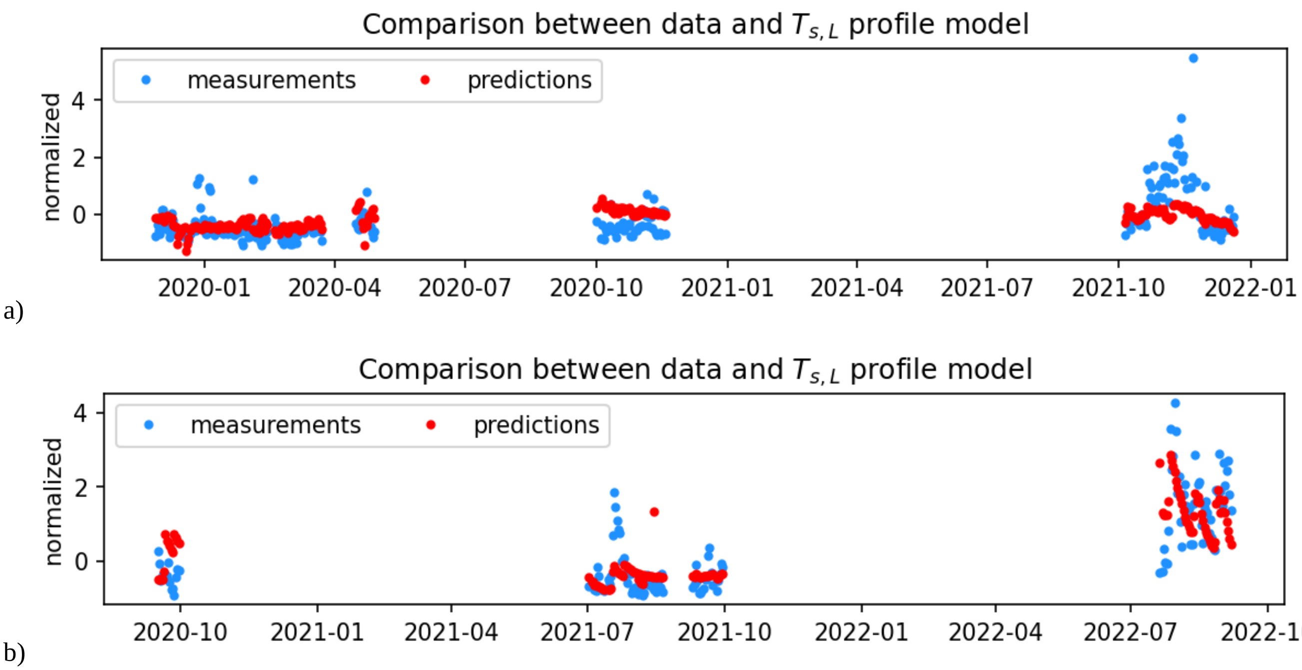


Figure S8: comparison between observed soil respiration and soil respiration predicted by the fitted model, shown on standardized data, as a time series. The model fit is acceptable, even though some soil respiration peaks are underestimated; a) for the winter bare period, b) for the summer bare period. The fitted model, here, is referred to as Ts,L profile model.

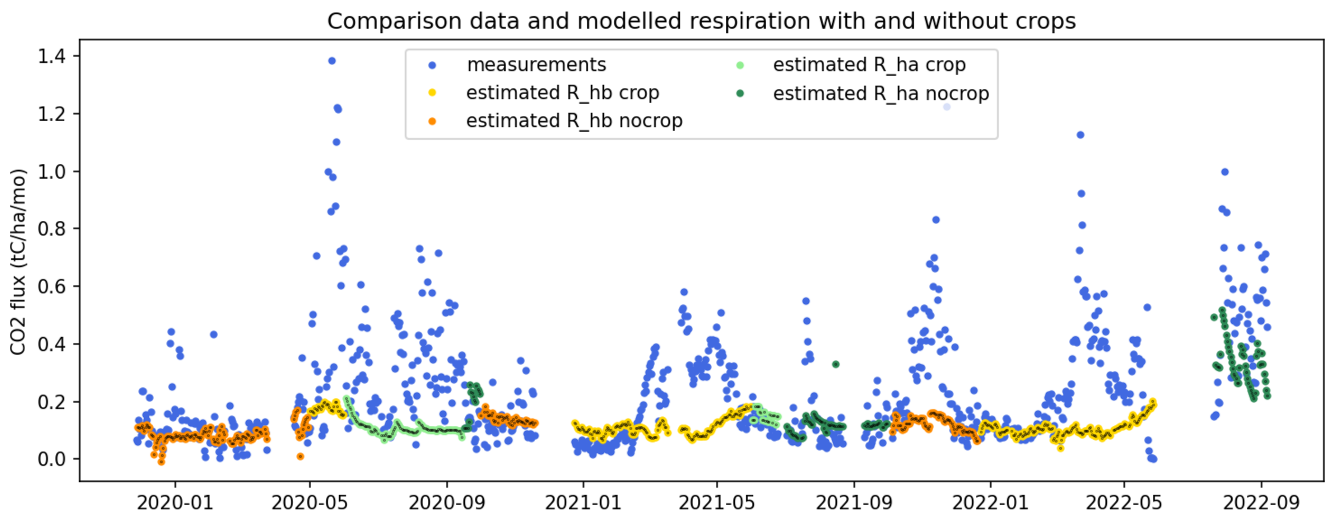
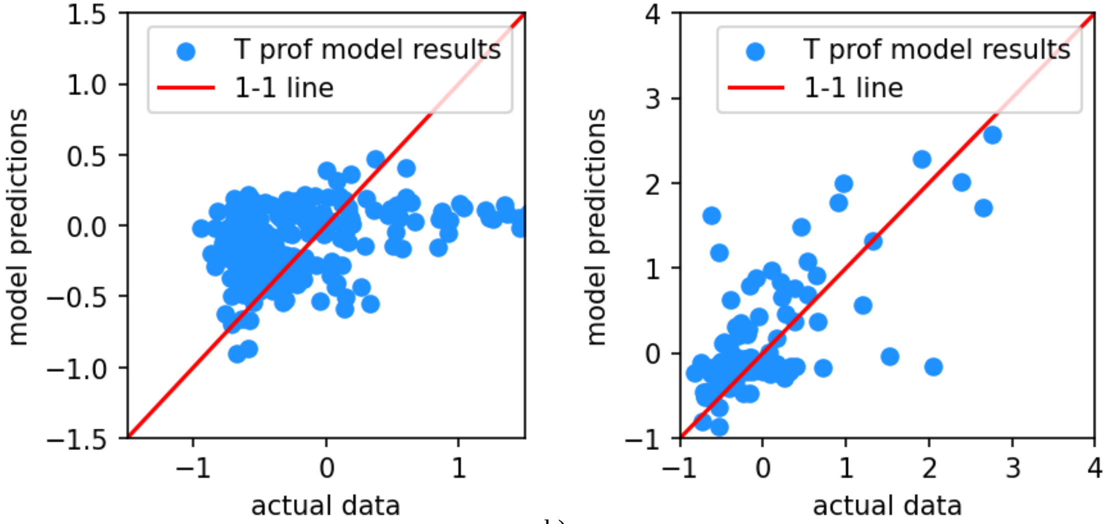


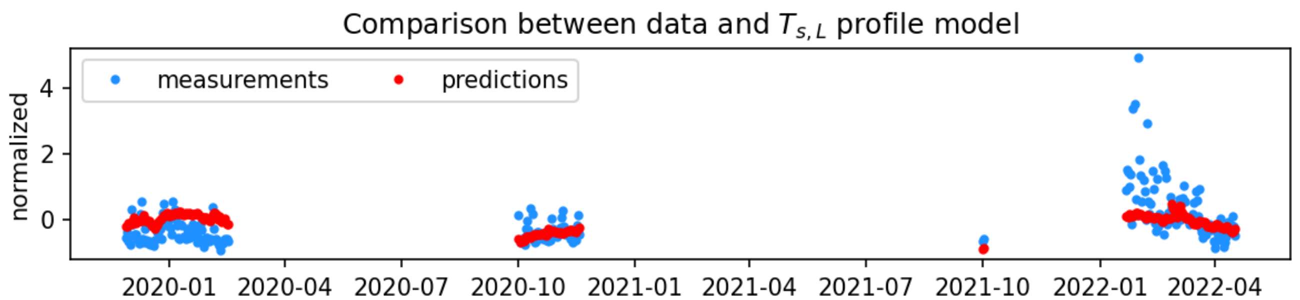
Figure S9: comparison between measured soil respiration and estimated heterotrophic component of soil respiration, directly on flux data. R_hb stands for heterotrophic component, winter period, R_ha stands for heterotrophic component, summer period. The model fits well with expectations, with estimates lower than the observed soil respiration when the crop is present. There is some overprediction for the winter period, in December 2021.

1.2.2 ECS plot 5

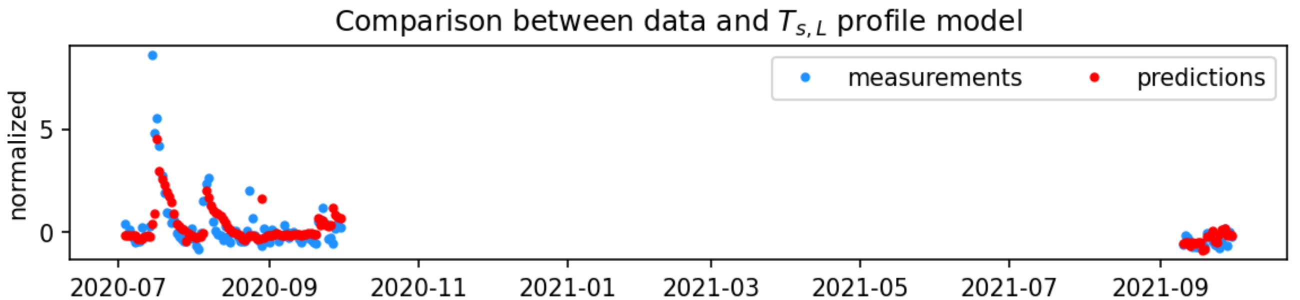


a) b)

Figure S10: comparison between observed soil respiration and soil respiration predicted by the fitted model, shown on standardized data; a) for winter bare period, b) for summer bare period. The fitted model, here, is referred to as T prof model. In this case, it is evident that the winter model fit is poor.



a)



b)

Figure S11: comparison between observed soil respiration and soil respiration predicted by the fitted model, shown on standardized data, as a time series. The model fit is acceptable, even though some soil respiration peaks are underestimated; a) for the winter bare period, b) for the summer bare period. The fitted model, here, is referred to as Ts,L profile model. The poor fitting of the winter model is evident here as well. Possible reasons were the formation of cracks during the very dry winter 2021, resulting in some soil respiration escaping the gas chamber measurements.

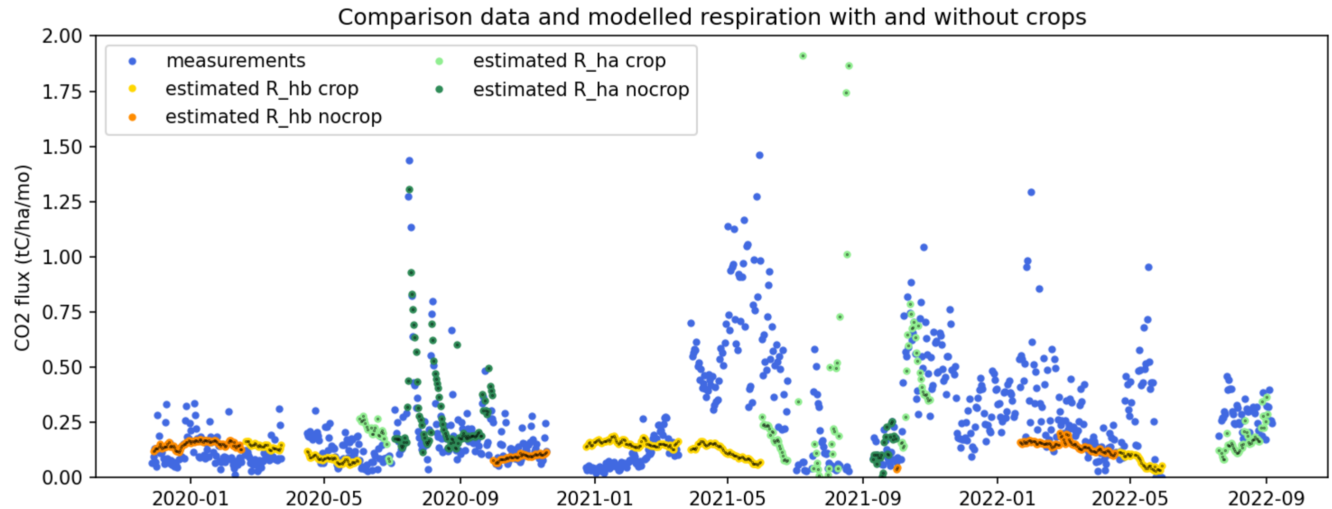


Figure S12: comparison between measured soil respiration and estimated heterotrophic component of soil respiration, directly on flux data. R_hb stands for heterotrophic component, winter period, R_ha stands for heterotrophic component, summer period. As expected, the winter model performs poorly with overestimates of soil respiration in winter 2020 and 2021, both for crop and bare soil. The fit seems acceptable for the summer period though; since the summer soil respiration is much larger than the winter soil respiration, we decided that the overestimation during the winter period was negligible and, in the analysis shown in the article, we used the partitioned respiration for the summer period, and the direct soil respiration measurements for the winter period.

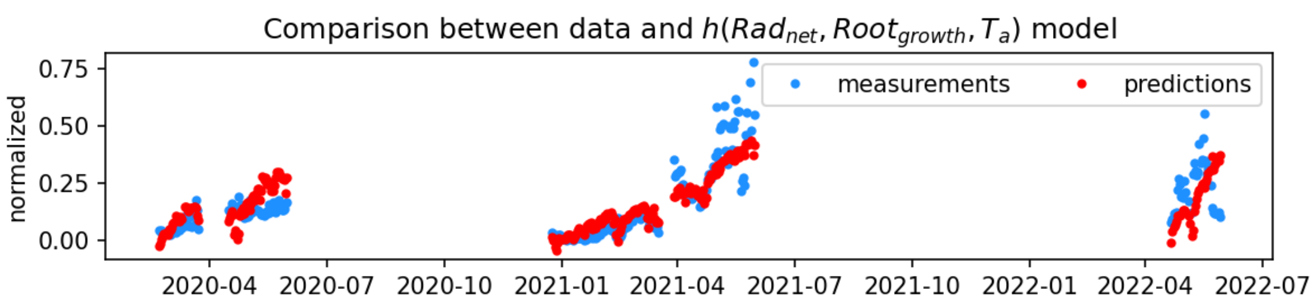


Figure S13: comparison between residuals (observed – estimated from Figure S12) and model fit for the autotrophic component of soil respiration. In this case, we plot the result of the model fit to the residual, to further prove the robustness of the summer estimates of the heterotrophic component of soil respiration. Here, the residuals, which should estimate the autotrophic component, are shown in agreement with the model depending on net solar radiation (Radnet), root biomass (Rootgrowth), air temperature (Ta), as expected from theory. This fit was not shown in the other plots (Ca Bosco CCS and ECS, Ca Ione CCS) since it was redundant, that is, the quality of the fit was already evident in the Figures S3, S6, S9.

2 RothC20_N simulations input

The soil depth used in simulations for Ca Bosco (Ravenna) was 40 cm, while for Ca Ione (Foggia) was 50 cm, corresponding to the depth of maximum soil tillage in the area.

Table S1. Soil parameters used in the simulations.

Site	Plot	SOC (tC ha^{-1})	RPM (tC ha^{-1})	DPM (tC ha^{-1})	HUM (tC ha^{-1})	BIO (tC ha^{-1})	Soil bulk density (g cm^3)	Clay (%)
RA	Plot 4 CCS	29.22	4.09	0.29	24.25	0.58	1.13	33
RA	Plot 5 ECS	27.49	3.85	0.27	22.82	0.55	1.13	31
FG	Plot 4 CCS	40.48	5.67	0.40	33.60	0.81	1.13	39
FG	Plot 5 ECS	41.02	5.74	0.41	34.05	0.82	1.13	37

Table S2. Other inputs used in the simulations of CCS plot 4 in Ravenna.

Time	Month n°	C input below gr (tC ha-1)	C input above gr (tC ha-1)	Vegetation cover	FYM (tC ha-1)	Irrigation (mm)	DPM/RPM	Air temperature (°C)	Rainfall (mm)	ET Penman-Monteith (mm)	ET Hargreaves (mm)
Jan-18	1	0	0	0,6	0	0	1,44	5,09	11,9	21,96	15,53
Feb-18	2	0	0	0,6	0	0	1,44	3,32	215	23,97	20,65
Mar-18	3	0	0	0,6	0	0	1,44	6,80	91,4	53,86	49,05
Apr-18	4	0	0	0,6	0	0	1,44	15,19	12,4	98,78	92,74
May-18	5	0	0	0,6	0	0	1,44	19,04	90,6	130,47	117,85
Jun-18	6	0,23	0	0,6	0	0	1,44	22,64	46,6	159,17	150,17
Jul-18	7	0	0	1	0	0	1,44	25,22	41,4	177,33	171,36
Aug-18	8	0	0	1	0	0	1,44	24,86	117,8	159,18	146,39
Sep-18	9	0,86	0	1	0	0	1,44	20,66	59	105,33	95,93
Oct-18	10	0	0	1	0	0	1,44	15,69	93,4	61,61	51,24
Nov-18	11	0	0	1	0	0	1,44	10,94	111,8	27,64	20,87
Dec-18	12	0	0	0,6	0	0	1,44	3,17	43,6	16,32	8,72
Jan-19	13	0	0	0,6	0	0	1,44	2,11	41,2	20,59	12,06
Feb-19	14	0	0	0,6	0	0	1,44	5,75	15,4	39,86	31,40
Mar-19	15	0	0	0,6	0	0	1,44	9,75	19,2	76,03	68,82
Apr-19	16	0	0	0,6	0	0	1,44	12,80	57,6	91,15	76,50
May-19	17	0	0	0,6	0	0	1,44	15,16	184,6	108,92	93,59
Jun-19	18	0,31	0	0,6	0	0	1,44	24,21	18	177,80	158,41
Jul-19	19	0	0	1	0	0	1,44	25,04	76,8	175,55	152,61
Aug-19	20	1,38	0	1	0	0	1,44	25,05	27,8	149,93	134,77

Sep-19	21	0	0	1	0	0	1,44	19,84	47,8	101,30	81,23
Oct-19	22	0	0	1	0	0	1,44	16,40	67,6	61,81	44,44
Nov-19	23	0	0	1	0	0	1,44	10,97	165,4	28,42	17,87
Dec-19	24	0	0	1	0	0	1,44	5,70	121,8	19,60	11,43
Jan-20	25	0	0	1	0	0	1,44	3,82	21,8	22,07	13,14
Feb-20	26	0	0	1	0	0	1,44	7,51	13,2	42,88	32,64
Mar-20	27	0	0	1	0	0	1,44	8,75	25,2	61,56	53,57
Apr-20	28	0	0	1	0	25	1,44	13,12	23,8	107,87	91,31
May-20	29	0	0	0,6	0	0	1,44	18,00	14,2	135,42	119,75
Jun-20	30	0	0	0,6	0	0	1,44	21,72	33,6	161,36	138,41
Jul-20	31	0	0	0,6	0	50	1,44	23,94	71,8	171,24	151,17
Aug-20	32	0	0	0,6	0	0	1,44	24,75	74	147,71	126,34
Sep-20	33	3,95	0	0,6	0	0	1,44	20,38	54	107,18	85,51
Oct-20	34	0	0	1	0	0	1,44	13,56	64,1	56,93	39,62
Nov-20	35	0	0	1	0	0	1,44	8,88	14	27,25	17,81
Dec-20	36	0	0	0,6	0	0	1,44	6,29	125,3	18,38	13,31
Jan-21	37	0	0	0,6	0	0	1,44	3,11	33,8	20,49	13,57
Feb-21	38	0	0	0,6	0	0	1,44	6,85	8,8	34,73	25,61
Mar-21	39	0	0	0,6	0	0	1,44	8,07	10,2	70,73	55,84
Apr-21	40	0	0	0,6	0	0	1,44	10,91	56,2	87,73	68,13
May-21	41	0	0	0,6	0	0	1,44	16,89	50,4	127,86	108,78
Jun-21	42	0,22	0	0,6	0	0	1,44	23,69	18,6	172,05	145,11
Jul-21	43	0	0	1	0	0	1,44	24,99	21,2	168,71	137,99
Aug-21	44	0	0	1	0	0	1,44	23,91	50,2	152,60	122,65
Sep-21	45	1,09	0	1	0	0	1,44	19,93	104,4	104,12	89,35
Oct-21	46	0	0	1	0	0	1,44	13,54	32,4	57,78	51,90
Nov-21	47	0	0	1	0	0	1,44	9,87	58,4	26,58	18,13
Dec-21	48	0	0	1	0	0	1,44	3,99	68	16,66	11,90
Jan-22	49	0	0	1	0	0	1,44	2,77	47,8	19,67	14,54
Feb-22	50	0	0	1	0	0	1,44	5,71	12	36,94	27,68
Mar-22	51	0	0	1	0	0	1,44	6,98	25,6	64,63	51,69
Apr-22	52	0	0	1	0	0	1,44	11,69	70	91,70	77,65
May-22	53	0	0	1	0	40	1,44	19,22	23	141,21	112,30
Jun-22	54	0	0	0,6	0	103,4	1,44	24,29	23,8	172,87	135,47
Jul-22	55	0	0	0,6	0	181,5	1,44	26,04	6	180,29	161,91
Aug-22	56	0,57	0	0,6	0	64,35	1,44	24,81	101,2	150,34	128,65
Sep-22	57	2,40	0	1	0	0	1,44	20,00	54	99,97	78,47
Oct-22	58	0	0	1	0	0	1,44	17,04	4,4	70,82	47,07

Table S3. Other inputs used in the simulations of ECS plot 5 in Ravenna.

Time	Month n°	C input below gr (tC ha-1)	C input above gr (tC ha-1)	Vegetation cover	FYM (tC ha-1)	Irrigation (mm)	DPM/ RPM	Air temperature (°C)	Rainfall (mm)	ET Penman-Monteith (mm)	ET Hargreaves (mm)
Jan-18	1	0	0	0,6	0	0	1,44	5,09	11,9	21,96	15,53
Feb-18	2	0	0	0,6	0	0	1,44	3,32	215	23,97	20,65
Mar-18	3	0	0	0,6	0	0	1,44	6,80	91,4	53,86	49,05
Apr-18	4	0	0	0,6	0	0	1,44	15,19	12,4	98,78	92,74
May-18	5	0	0	0,6	0	0	1,44	19,04	90,6	130,47	117,85
Jun-18	6	0,23	0	0,6	0	0	1,44	22,64	46,6	159,17	150,17
Jul-18	7	0	0	1	0	0	1,44	25,22	41,4	177,33	171,36
Aug-18	8	0	0	1	0	0	1,44	24,86	117,8	159,18	146,39
Sep-18	9	0,86	0	1	0	0	1,44	20,66	59	105,33	95,93
Oct-18	10	0	0	1	0	0	1,44	15,69	93,4	61,61	51,24
Nov-18	11	0	0	1	0	0	1,44	10,94	111,8	27,64	20,87
Dec-18	12	0	0	0,6	0	0	1,44	3,17	43,6	16,32	8,72
Jan-19	13	0	0	0,6	0	0	1,44	2,11	41,2	20,59	12,06
Feb-19	14	0	0	0,6	0	0	1,44	5,75	15,4	39,86	31,40
Mar-19	15	0	0	0,6	0	0	1,44	9,75	19,2	76,03	68,82
Apr-19	16	0	0	0,6	0	0	1,44	12,80	57,6	91,15	76,50
May-19	17	0	0	0,6	0	0	1,44	15,16	184,6	108,92	93,59
Jun-19	18	0,31	0	0,6	0	0	1,44	24,21	18	177,80	158,41
Jul-19	19	0	0	1	0	0	1,44	25,04	76,8	175,55	152,61
Aug-19	20	1,38	0	1	0	0	1,44	25,05	27,8	149,93	134,77
Sep-19	21	0	0	1	0	0	1,44	19,84	47,8	101,30	81,23
Oct-19	22	0	0	1	0	0	1,44	16,40	67,6	61,81	44,44
Nov-19	23	0	0	1	0	0	1,44	10,97	165,4	28,42	17,87
Dec-19	24	0	0	1	0	0	1,44	5,70	121,8	19,60	11,43
Jan-20	25	0	0	1	0	0	1,44	3,82	21,8	22,07	13,14
Feb-20	26	0	0	1	0	0	1,44	7,51	13,2	42,88	32,64
Mar-20	27	0	0	0,6	0	0	1,44	8,75	25,2	61,56	53,57
Apr-20	28	0	0	0,6	0	25	1,44	13,12	23,8	107,87	91,31
May-20	29	0	0	0,6	0	0	1,44	18,00	14,2	135,42	119,75
Jun-20	30	1,48	0	0,6	0	0	1,44	21,72	33,6	161,36	138,41
Jul-20	31	0	0	1	0	0	1,44	23,94	71,8	171,24	151,17
Aug-20	32	0	0	1	0	0	1,44	24,75	74	147,71	126,34
Sep-20	33	0	0	1	0	0	1,44	20,38	54	107,18	85,51

Oct-20	34	0	0	1	0	0	1,44	13,56	64,1	56,93	39,62
Nov-20	35	0	0	1	0	0	1,44	8,88	14	27,25	17,81
Dec-20	36	0	0	0,6	0	0	1,44	6,29	125,3	18,38	13,31
Jan-21	37	0	0	0,6	0	0	1,44	3,11	33,8	20,49	13,57
Feb-21	38	0	0	0,6	0	0	1,44	6,85	8,8	34,73	25,61
Mar-21	39	0	0	0,6	0	0	1,44	8,07	10,2	70,73	55,84
Apr-21	40	0	0	0,6	0	0	1,44	10,91	56,2	87,73	68,13
May-21	41	0	0	0,6	0	0	1,44	16,89	50,4	127,86	108,78
Jun-21	42	0,22	0	0,6	0	0	1,44	23,69	18,6	172,05	145,11
Jul-21	43	0	0	0,6	0	0	1,44	24,99	21,2	168,71	137,99
Aug-21	44	0	0	0,6	0	0	1,44	23,91	50,2	152,60	122,65
Sep-21	45	0	0	0,6	0	0	1,44	19,93	104,4	104,12	89,35
Oct-21	46	1,26	0	1	0	0	1,44	13,54	32,4	57,78	51,90
Nov-21	47	0	0	1	0	0	1,44	9,87	58,4	26,58	18,13
Dec-21	48	0	0	1	0	0	1,44	3,99	68	16,66	11,90
Jan-22	49	0	0	1	0	0	1,44	2,77	47,8	19,67	14,54
Feb-22	50	0	0	1	0	0	1,44	5,71	12	36,94	27,68
Mar-22	51	0	0	1	0	0	1,44	6,98	25,6	64,63	51,69
Apr-22	52	0	0	1	0,038	0	1,44	11,69	70	91,70	77,65
May-22	53	0	0	1	0	40	1,44	19,22	23	141,21	112,30
Jun-22	54	0	0	0,6	0,002	81,4	1,44	24,29	23,8	172,87	135,47
Jul-22	55	0	0	0,6	0,003	138,6	1,44	26,04	6	180,29	161,91
Aug-22	56	0,86	0	0,6	0,003	50,6	1,44	24,81	101,2	150,34	128,65
Sep-22	57	2,46	0	1	0	0	1,44	20,00	54	99,97	78,47
Oct-22	58	0	0	1	0	0	1,44	17,04	4,4	70,82	47,07

Table S4. Other inputs used in the simulations of CCS plot 4 in Foggia.

Time	Month n°	C input below gr (tC ha^{-1})	C input above gr (tC ha^{-1})	Vegetation cover	FYM (tC ha^{-1})	Irrigation (mm)	DPM/RPM	Air temperature (°C)	Rainfall (mm)	ET Penman-Monteith (mm)	ET Hargreaves (mm)
Jan-18	1	0	0	0.6	0	0	1.44	9.79	22.9	34.15	30.41
Feb-18	2	0	0	0.6	0	0	1.44	7.18	45.4	32.56	31.13
Mar-18	3	0	0	0.6	0	0	1.44	10.79	90.7	68.41	60.96
Apr-18	4	0	0	0.6	0	0	1.44	16.42	9.6	122.26	108.50
May-18	5	0	0	0.6	0	0	1.44	19.59	97.7	142.91	140.50
Jun-18	6	0.15	0	0.6	0	0	1.44	23.35	63.3	178.32	156.61
Jul-18	7	0	0	1	0	0	1.44	26.85	17.6	215.16	178.29
Aug-18	8	0	0	1	0	0	1.44	26.07	52	179.73	156.09
Sep-18	9	0.46	0	1	0.16	120	1.44	22.41	34.5	130.70	112.27
Oct-18	10	0	0	1	0	100	1.44	17.97	80.8	71.39	64.01
Nov-18	11	0	0	1	0	30	1.44	13.01	68	33.67	35.01
Dec-18	12	0	0	0.6	0	0	1.44	9.01	37.2	26.77	25.57
Jan-19	13	1	0	0.6	0	0	1.44	6.20	53.7	28.34	24.16
Feb-19	14	0	0	1	0	0	1.44	8.90	29.4	48.29	39.91
Mar-19	15	0	0	0.6	0	0	1.44	12.17	23.2	88.67	70.32
Apr-19	16	0	0	0.6	0	0	1.44	13.49	56.6	97.08	99.79
May-19	17	0	0	0.6	0	0	1.44	14.91	78	103.41	121.68
Jun-19	18	0.00	0	0.6	0	0	1.44	24.96	4	196.42	204.37
Jul-19	19	1.38	0	1	0	0	1.44	26.29	11.6	212.46	194.86
Aug-19	20	0.74	0	1	0	0	1.44	26.89	10.8	197.68	174.87
Sep-19	21	0	0	1	0	0	1.44	22.23	68.8	125.70	113.86
Oct-19	22	0	0	1	0	0	1.44	17.39	25.8	73.56	80.12
Nov-19	23	0	0	1	0	0	1.44	13.86	94.4	36.56	40.92
Dec-19	24	0	0	1	0	0	1.44	9.36	31.2	28.83	28.96
Jan-20	25	0	0	1	0	0	1.44	7.25	2.2	36.40	34.25
Feb-20	26	0	0	1	0	0	1.44	9.73	26	59.80	51.28
Mar-20	27	0	0	1	0	30	1.44	10.01	80.2	72.98	73.77
Apr-20	28	0	0	1	0	0	1.44	12.80	48.2	98.95	107.21
May-20	29	0	0	0.6	0	0	1.44	18.47	41.6	148.38	150.71
Jun-20	30	0	0	0.6	0	0	1.44	22.42	10.6	177.26	176.07
Jul-20	31	0	0	0.6	0	0	1.44	25.26	40.2	201.30	191.98
Aug-20	32	0	0	0.6	0	0	1.44	26.87	50.8	183.43	175.75
Sep-20	33	0.53	0	0.6	0	0	1.44	22.55	56.4	134.09	112.70
Oct-20	34	0	0	1	0	0	1.44	15.71	34.8	74.35	73.41
Nov-20	35	0	0	1	0	0	1.44	12.33	82.4	31.54	39.06
Dec-20	36	0	0	1	0	0	1.44	9.48	63.8	23.99	27.93

Jan-21	37	0	0	0.6	0	0	1.44	6.96	60.6	28.67	29.33
Feb-21	38	0	0	0.6	0	0	1.44	8.78	31.8	40.57	44.42
Mar-21	39	0	0	0.6	0	0	1.44	8.61	61.6	60.66	69.25
Apr-21	40	0	0	0.6	0	0	1.44	11.16	35	81.05	100.00
May-21	41	0	0	0.6	0	0	1.44	18.42	11.4	149.27	161.04
Jun-21	42	0.16	0	0.6	0	0	1.44	24.77	3.4	179.21	205.91
Jul-21	43	0	0	1	0	0	1.44	27.13	53	203.94	203.60
Aug-21	44	0	0	1	0	0	1.44	26.69	11.2	193.83	177.57
Sep-21	45	0.88	0	1	0	0	1.44	22.13	13.4	126.35	120.32
Oct-21	46	0	0	1	0	0	1.44	15.55	61.8	64.94	64.76
Nov-21	47	0	0	1	0	0	1.44	13.48	133	26.92	32.43
Dec-21	48	0	0	1	0	0	1.44	9.16	53.2	27.45	26.92
Jan-22	49	0	0	0.6	0	0	1.44	6.98	30.2	33.00	32.57
Feb-22	50	0	0	0.6	0	0	1.44	8.76	72.6	45.99	44.87
Mar-22	51	0	0	0.6	0	0	1.44	7.56	38.6	60.28	65.81
Apr-22	52	0	0	0.6	0	0	1.44	12.48	19.8	97.09	101.53
May-22	53	0	0	0.6	0	0	1.44	19.70	51.6	145.15	167.87
Jun-22	54	0	0	0.6	0	0	1.44	25.60	60.2	167.20	201.00
Jul-22	55	0	0	1	0	0	1.44	26.71	45.4	172.70	207.17
Aug-22	56	0.00	0	1	0	0	1.44	25.41	59	140.37	165.29
Sep-22	57	1.98	0	1	0	0	1.44	21.42	58.8	136.19	113.04
Oct-22	58	0	0	1	0	0	1.44	17.65	29.8	86.44	79.48

Table S5. Other inputs used in the simulations of ECS plot 5 in Foggia.

Time	Month n°	C input below gr (tC ha^{-1})	C input above gr (tC ha^{-1})	Vegetation cover	FYM (tC ha^{-1})	Irrigation (mm)	DPM/RPM	Air temperature (°C)	Rainfall (mm)	ET Penman-Monteith (mm)	ET Hargreaves (mm)
Jan-18	1	0	0	0.6	0	0	1.44	9.79	22.9	34.15	30.41
Feb-18	2	0	0	0.6	0	0	1.44	7.18	45.4	32.56	31.13
Mar-18	3	0	0	0.6	0	0	1.44	10.79	90.7	68.41	60.96
Apr-18	4	0	0	0.6	0	0	1.44	16.42	9.6	122.26	108.50
May-18	5	0	0	0.6	0	0	1.44	19.59	97.7	142.91	140.50
Jun-18	6	0.15	0	0.6	0	0	1.44	23.35	63.3	178.32	156.61
Jul-18	7	0	0	1	0	0	1.44	26.85	17.6	215.16	178.29
Aug-18	8	0	0	1	0	0	1.44	26.07	52	179.73	156.09
Sep-18	9	0.46	0	1	0.16	120	1.44	22.41	34.5	130.70	112.27
Oct-18	10	0	0	1	0	100	1.44	17.97	80.8	71.39	64.01
Nov-18	11	0	0	1	0	30	1.44	13.01	68	33.67	35.01
Dec-18	12	0	0	0.6	0	0	1.44	9.01	37.2	26.77	25.57
Jan-19	13	1	0	0.6	0	0	1.44	6.20	53.7	28.34	24.16
Feb-19	14	0	0	1	0	0	1.44	8.90	29.4	48.29	39.91
Mar-19	15	0	0	0.6	0	0	1.44	12.17	23.2	88.67	70.32
Apr-19	16	0	0	0.6	0	0	1.44	13.49	56.6	97.08	99.79
May-19	17	0	0	0.6	0	0	1.44	14.91	78	103.41	121.68
Jun-19	18	0.00	0	0.6	0	0	1.44	24.96	4	196.42	204.37
Jul-19	19	1.38	0	1	0	0	1.44	26.29	11.6	212.46	194.86
Aug-19	20	0.74	0	1	0	0	1.44	26.89	10.8	197.68	174.87
Sep-19	21	0	0	1	0	0	1.44	22.23	68.8	125.70	113.86
Oct-19	22	0	0	1	0	0	1.44	17.39	25.8	73.56	80.12
Nov-19	23	0	0	1	0	0	1.44	13.86	94.4	36.56	40.92
Dec-19	24	0	0	1	0	0	1.44	9.36	31.2	28.83	28.96
Jan-20	25	0	0	1	0	0	1.44	7.25	2.2	36.40	34.25
Feb-20	26	0	0	1	0	0	1.44	9.73	26	59.80	51.28
Mar-20	27	0	0	0.6	0	0	1.44	10.01	80.2	72.98	73.77
Apr-20	28	0	0	0.6	0	30	1.44	12.80	48.2	98.95	107.21
May-20	29	0	0	0.6	0	0	1.44	18.47	41.6	148.38	150.71
Jun-20	30	0.04	0	0.6	0	0	1.44	22.42	10.6	177.26	176.07
Jul-20	31	0	0	1	0	0	1.44	25.26	40.2	201.30	191.98
Aug-20	32	0	0	1	0	0	1.44	26.87	50.8	183.43	175.75
Sep-20	33	0.11	0	1	0	0	1.44	22.55	56.4	134.09	112.70
Oct-20	34	0	0	1	0	0	1.44	15.71	34.8	74.35	73.41
Nov-20	35	0	0	1	0	0	1.44	12.33	82.4	31.54	39.06
Dec-20	36	0	0	1	0	0	1.44	9.48	63.8	23.99	27.93

Jan-21	37	0	0	0.6	0	0	1.44	6.96	60.6	28.67	29.33
Feb-21	38	0	0	0.6	0	0	1.44	8.78	31.8	40.57	44.42
Mar-21	39	0	0	0.6	0	0	1.44	8.61	61.6	60.66	69.25
Apr-21	40	0	0	0.6	0	0	1.44	11.16	35	81.05	100.00
May-21	41	0	0	0.6	0	0	1.44	18.42	11.4	149.27	161.04
Jun-21	42	0.11	0	0.6	0	0	1.44	24.77	3.4	179.21	205.91
Jul-21	43	0	0	1	0	0	1.44	27.13	53	203.94	203.60
Aug-21	44	0	0	1	0	0	1.44	26.69	11.2	193.83	177.57
Sep-21	45	0.58	0	1	0	0	1.44	22.13	13.4	126.35	120.32
Oct-21	46	0	0	1	0	0	1.44	15.55	61.8	64.94	64.76
Nov-21	47	0	0	0.6	0	0	1.44	13.48	133	26.92	32.43
Dec-21	48	0	0	0.6	0	0	1.44	9.16	53.2	27.45	26.92
Jan-22	49	1	0	0.6	0	0	1.44	6.98	30.2	33.00	32.57
Feb-22	50	0	0	1	0	0	1.44	8.76	72.6	45.99	44.87
Mar-22	51	0	0	1	0	0	1.44	7.56	38.6	60.28	65.81
Apr-22	52	0	0	1	0	0	1.44	12.48	19.8	97.09	101.53
May-22	53	0	0	0.6	0	0	1.44	19.70	51.6	145.15	167.87
Jun-22	54	0	0	0.6	0	0	1.44	25.60	60.2	167.20	201.00
Jul-22	55	0	0	0.6	0	0	1.44	26.71	45.4	172.70	207.17
Aug-22	56	0.00	0	0.6	0	0	1.44	25.41	59	140.37	165.29
Sep-22	57	0.86	0	0.6	0	0	1.44	21.42	58.8	136.19	113.04
Oct-22	58	0	0	1	0	0	1.44	17.65	29.8	86.44	79.48