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Supplementary Materials for

The potential of agricultural land management to contribute to lower global surface temperatures

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Supplemental Material

Fig. S1. SimMod emulator climate model transient (solid red) temperature response compared to CMIP5 multimodel mean (black line) and 2.5 to 97.5% spread (gray area) for each RCP scenario. CMIP5 model outputs were obtained from Koninklijk Nederlands Meteorologisch Instituut (KNMI) climate explorer archive (*50*).

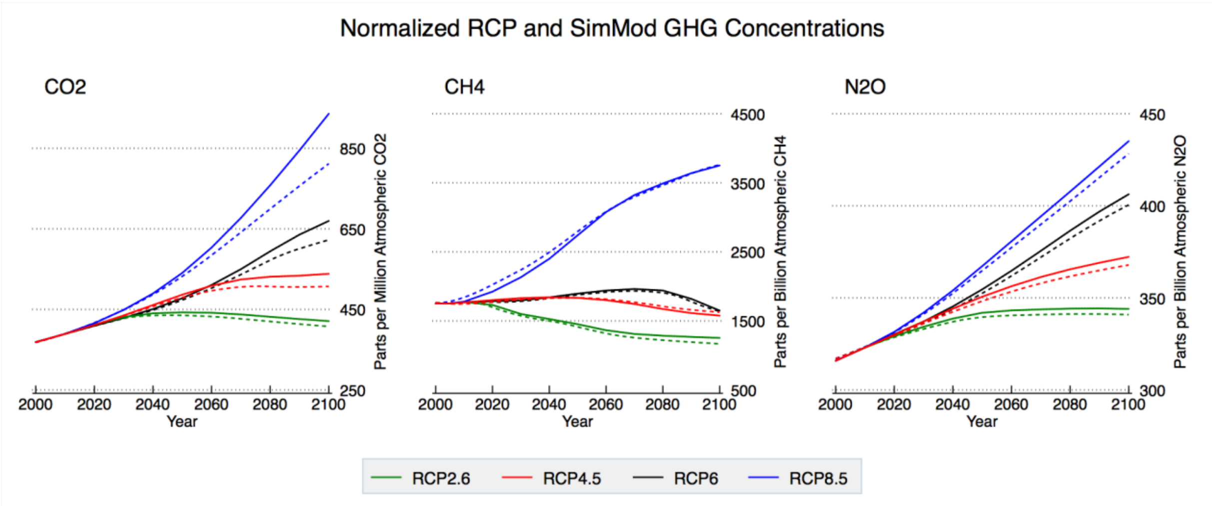

Fig. S2. RCP (solid lines) and SimMod emulator climate model (dashed lines) atmospheric concentrations of CO_2, N_2O, and CH_4 for each scenario (*53*).

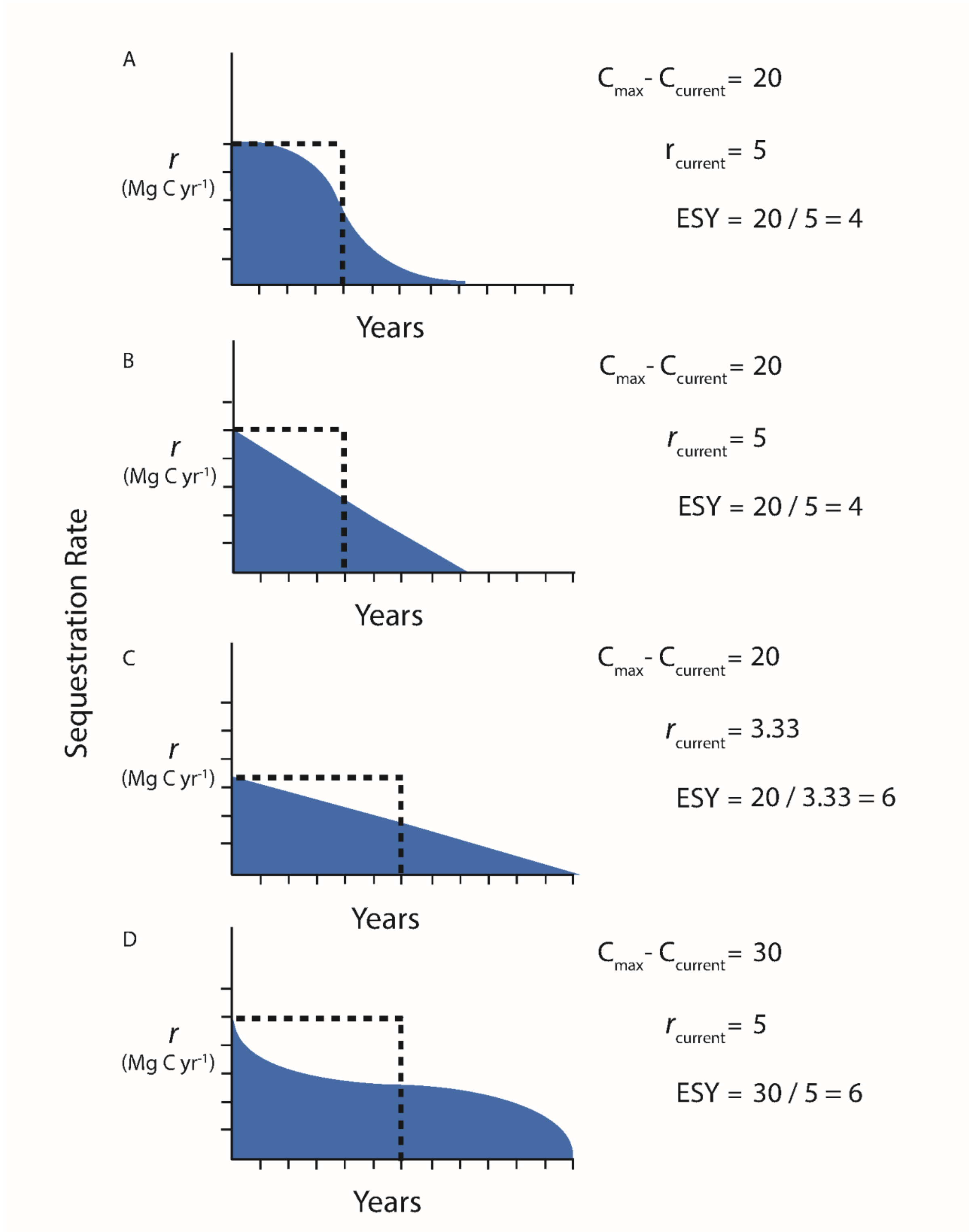

Fig. S3. A schematic illustration of the concept of effective sequestration years (ESY). The figure segments A and B illustrate the same *ESY = 4 years* under two hypothetical trajectories shown with solid blue lines, each of which begin with a current sequestration rate, $r_{current} = 5\ Mg\ C\ yr^{-1}$, and lead to the same additional cumulative sequestration, $C_{max} - C_{current} = 20\ Mg\ C$, over time. The *ESY* associated with each trajectory is defined such that $r_{current} * ESY = C_{max} - C_{current}$. Thus, the blue area under each trajectory, which corresponds to the additional cumulative sequestration $C_{max} - C_{current}$, is equal to the area under each dotted black line. Figure segment C illustrates how a lower $r_{current}$, will extend the number of *ESY* given the same additional cumulative sequestration potential ($C_{max} - C_{current}$) as in segments A and B. Figure segment D has the same $r_{current}$ as segments A and B, yet the same extended number of $ESY = 6$ as segment C, due to the greater potential for additional cumulative sequestration in trajectory D ($C_{max} - C_{current} = 30\ Mg\ C$).

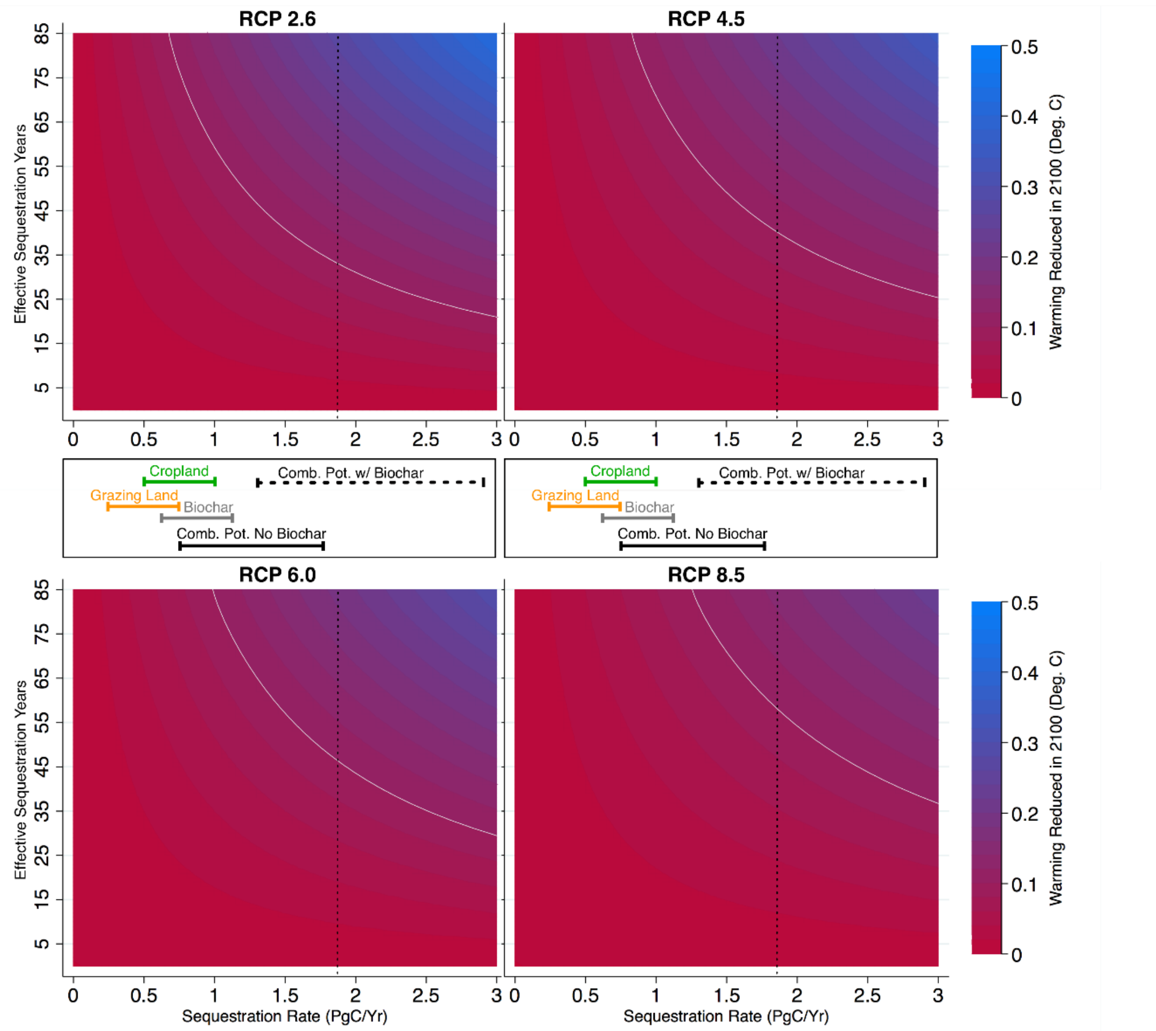

Fig. S4. Same as Fig. 2 in the text but with the inclusion of biochar and for a range of sequestration rates from 0 to 3 Pg C year^{-1}.

Table S1. Summary of global soil C sequestration potential (Pg C year^{-1}) by agricultural land management. Low and high range estimates are mean values of the lower and upper limits of potential sequestration given in the associated sources. Standard errors are given.

Management	Land Type	Mean sequestration potential Pg C yr^{-1}	High range Pg C yr^{-1}	Low range Pg C yr^{-1}	Sources
Biochar	All agriculture	1.05 ± 0.75	1.10 ±	0.59 ± 0.41	Griscom *et al.* (2017),

			0.70		Woolf *et al.* (2010)
Improved Cropland Management	Cropland	0.56 ± 0.14	1.01 ± 0.33	0.48 ± 0.17	Griscom *et al.* (2017), Lal (2010), Paustian *et al.* (2016), Smith *et al.* (2008), Zomer *et al.* (2017)
Improved Grazing land management	Grazing land	0.26 ± 0.05	0.77 ± 0.31	0.26 ± 0.11	Griscom *et al.* (2017), Henderson *et al.* (2015), Lal (2010), Paustian *et al.* (2016), Smith *et al.* (2008)
Combined Potential (excluding biochar)	All agriculture	0.83 ± 0.11	1.78 ± 0.32	0.74 ± 0.14	Griscom *et al.* (2017), Henderson *et al.* (2015), Lal (2010), Paustian *et al.* (2016), Smith *et al.* (2008), Zomer *et al.* (2017)
Combined potential (including biochar)	All agriculture	1.88 ± 0.35	2.89 ± 0.42	1.32 ± 0.13	Griscom *et al.* (2017), Henderson *et al.* (2015), Lal (2010), Paustian *et al.* (2016), Smith *et al.* (2008), Zomer *et al.* (2017), Woolf *et al.* (2010)

Potential of Biochar to sequester C on agricultural land.

We conducted our analyses with and without the inclusion of biochar amendments, which are increasingly being recommended for consideration in soil C sequestration projects (*32*, *33*). Biochar can result in CO_2 emissions reduction by stabilizing C that would have decomposed more rapidly; however, there is considerable uncertainty in the C sequestration potential of biochar when added to soils, and the land area suitable for this practice (*10*, *25*). The sources of biochar considered in this analysis specifically exclude conversion of active agricultural lands for feedstock production, and include non-converting practices such as the use of existing agricultural waste products (*10*, *26*). It is important to note that approximately 26% of the biochar production potential considered comes from the use of abandoned agricultural lands not suitable for other uses (*10*). Including the practice of biochar applications increased the mean sequestration rate to 1.88 Pg C y^{-1}, with an upper value of 2.89 Pg C y^{-1}. This would be sufficient to yield a 0.27 °C and 0.41 °C warming reduction, respectively, using the RCP 2.6 scenario and assuming that these sequestration rates remain effectively constant through the end of the century (Figures S4). Under the RCP 8.5 scenario, 2100 warming reduction declines to 0.15 °C and 0.23 °C under the RCP 8.5 scenario.