Supplements

Calculation of the share of steppe soils in the global soil OC stocks down to 1m depth

Steppe soils are typically the group of Kastanozems (KS), Chernozems (CH) and Phaeozems (PH; FAO, 2001). Average OC stocks of these soils are found in Batjes (1996) and their global area is estimated in the IUSS Working Group WRB (2014).

5   By multiplying the average OC stock of these soil types by their global area and dividing the result by the global soil OC stock of about 1505 Pg OC (Batjes, 1996), we can estimate the share of steppe soils in the global soil OC stock down to 1m depth. This was done as, to our knowledge, there is no study yet, which modelled the portion of steppe soils on the global soil OC stock. The equation is as following:

$$y = \frac{\text{average OC stock (KS)} \times \text{area (KS)} + \text{average OC stock (CH)} \times \text{area (CH)} + \text{ average OC stock (PH)} \times \text{area (PH)}}{\text{OC stock (worldwide)}}$$

10   where y is the share of steppe soils in the global soil OC stock.

Tables

Table S 1: Geographical coordinates and vegetation cover (pastures only) for the studied plots.

Steppe	Land use	Coordinates		Vegetation (pastures only)
		latitude	longitude	Dominant species (from most to least dominant)
Forest steppe	extensive pasture	53°44'19.53"N	80°41'2.88"E	*Festuca valesiaca - Fillipendula vulgaris - Bromopsis inermis*
	forage crop	53°44'24.92"N	80°40'58.73"E	
	arable 5 yr	53°45'0.19"N	80°40'12.68"E	
	arable 30 yr	53°45'3.32"N	80°40'2.97"E	
Typical steppe	fallow 30 yr (pasture)	52°30'1.43"N	80°44'41.68"E	*Agropyron pectinatum - Bromopsis inermis - Artemisia glauca*
	arable 1 yr	52°30'5.43"N	80°44'25.57"E	
	arable 3 yr	52°30'10.92"N	80°44'44.44"E	
	arable 10 yr	52°29'30.56"N	80°45'5.21"E	

Table S 2: Organic carbon (OC) and total nitrogen (TN) of the three fractions bulk soil, intact macro-aggregates and crushed macro-aggregates for the respective land-use and steppe type.

Steppe	Land-use	Fraction	n	OC mg g^{-1}	TN mg g^{-1}	C : N -
Forest steppe	extensive pasture	bulk	3	54.6 ± 5.4	4.5 ± 0.4	12.2 ± 0.2
		intact	3	53.3 ± 6.5	4.4 ± 0.5	12.0 ± 0.2
		crushed	3	52.2 ± 5.7	4.4 ± 0.4	11.8 ± 0.2
	forage crop	bulk	3	49.3 ± 1.7	4.1 ± 0.2	12.1 ± 0.0
		intact	3	48.7 ± 1.2	4.1 ± 0.1	12.0 ± 0.1
		crushed	3	45.5 ± 1.1	3.9 ± 0.1	11.6 ± 0.1
	arable 5 yr	bulk	3	39.1 ± 1.4	3.3 ± 0.1	11.7 ± 0.2
		intact	3	39.2 ± 2.4	3.3 ± 0.2	12.0 ± 0.1
		crushed	3	38.4 ± 2.6	3.2 ± 0.1	11.8 ± 0.3
	arable 30 yr	bulk	3	40.4 ± 1.6	3.4 ± 0.1	11.8 ± 0.1
		intact	3	39.1 ± 2.3	3.4 ± 0.2	11.6 ± 0.0
		crushed	3	37.4 ± 1.4	3.3 ± 0.1	11.3 ± 0.0
Typical steppe	fallow 30 yr (pasture)	bulk	2	21.6 ± 2.3	2.0 ± 0.2	10.9 ± 0.1
		intact	2	20.6 ± 2.8	1.9 ± 0.2	10.6 ± 0.3
		crushed	2	20.4 ± 2.6	2.0 ± 0.2	10.3 ± 0.3
	arable 1 yr	bulk	3	13.3 ± 0.3	1.3 ± 0.0	10.0 ± 0.1
		intact	3	14.1 ± 0.9	1.4 ± 0.1	10.0 ± 0.2
		crushed	3	13.3 ± 0.5	1.3 ± 0.0	10.2 ± 0.2
	arable 3 yr	bulk	3	14.9 ± 1.6	1.5 ± 0.2	9.8 ± 0.2
		intact	3	16.6 ± 2.6	1.7 ± 0.3	9.9 ± 0.2
		crushed	3	15.6 ± 2.5	1.6 ± 0.2	9.8 ± 0.2
	arable 10 yr	bulk	2	18.8 ± 1.5	1.8 ± 0.1	10.6 ± 0.2
		intact	2	20.0 ± 0.7	1.9 ± 0.0	10.6 ± 0.3
		crushed	2	18.5 ± 0.9	1.8 ± 0.0	10.5 ± 0.2

Figures
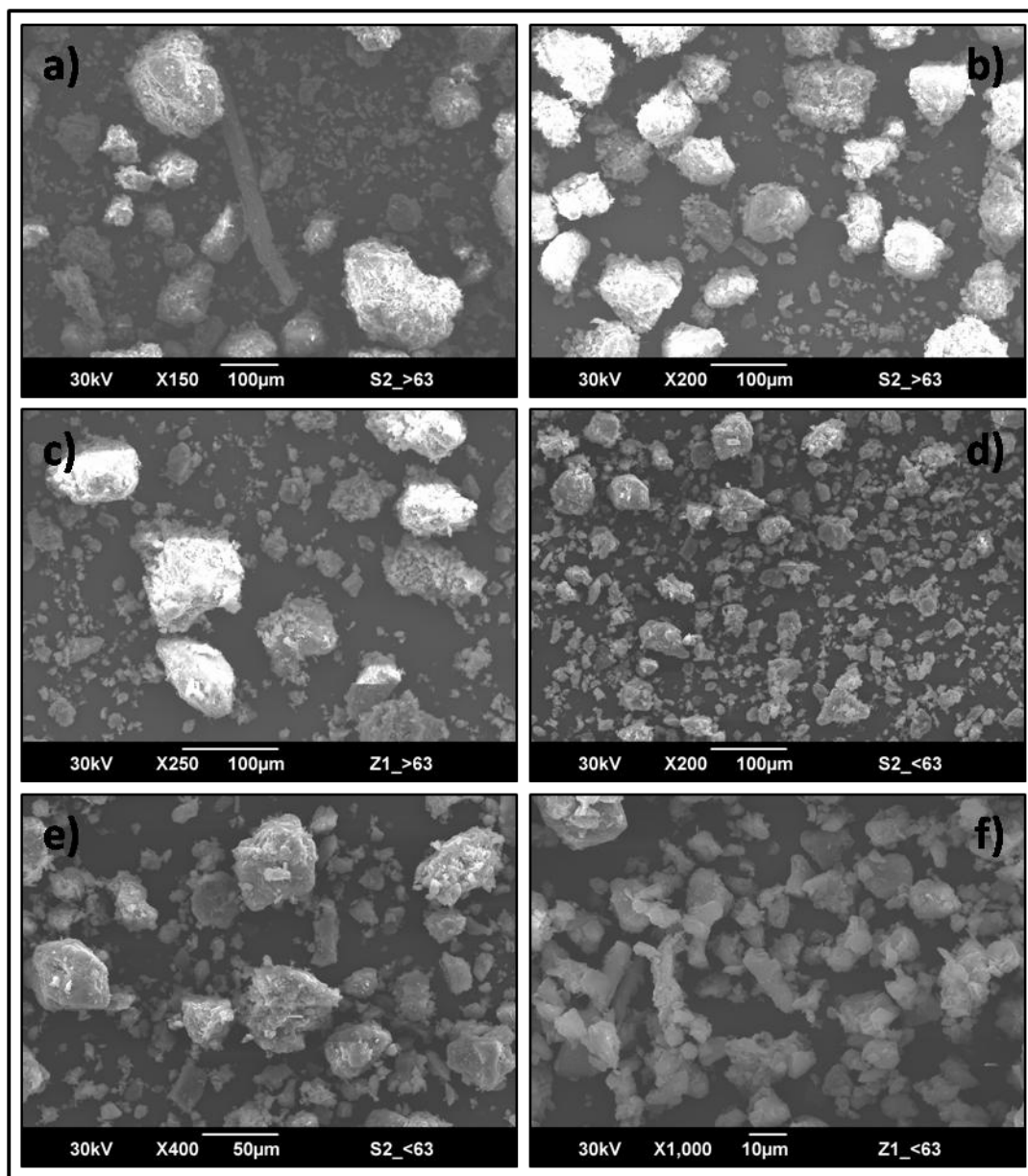
Fig. S 1: Scanning electron micrographs of crushed macro-aggregates (<250 µm). a) fallow 30 yr (pasture) 63–250 µm, b) fallow 30 yr (pasture) 63–250 µm, c) arable 5 yr 63–250 µm, d) fallow 30 yr (pasture) <63 µm, e) fallow 30 yr (pasture) <63 µm, f) arable 5 yr <63 µm.
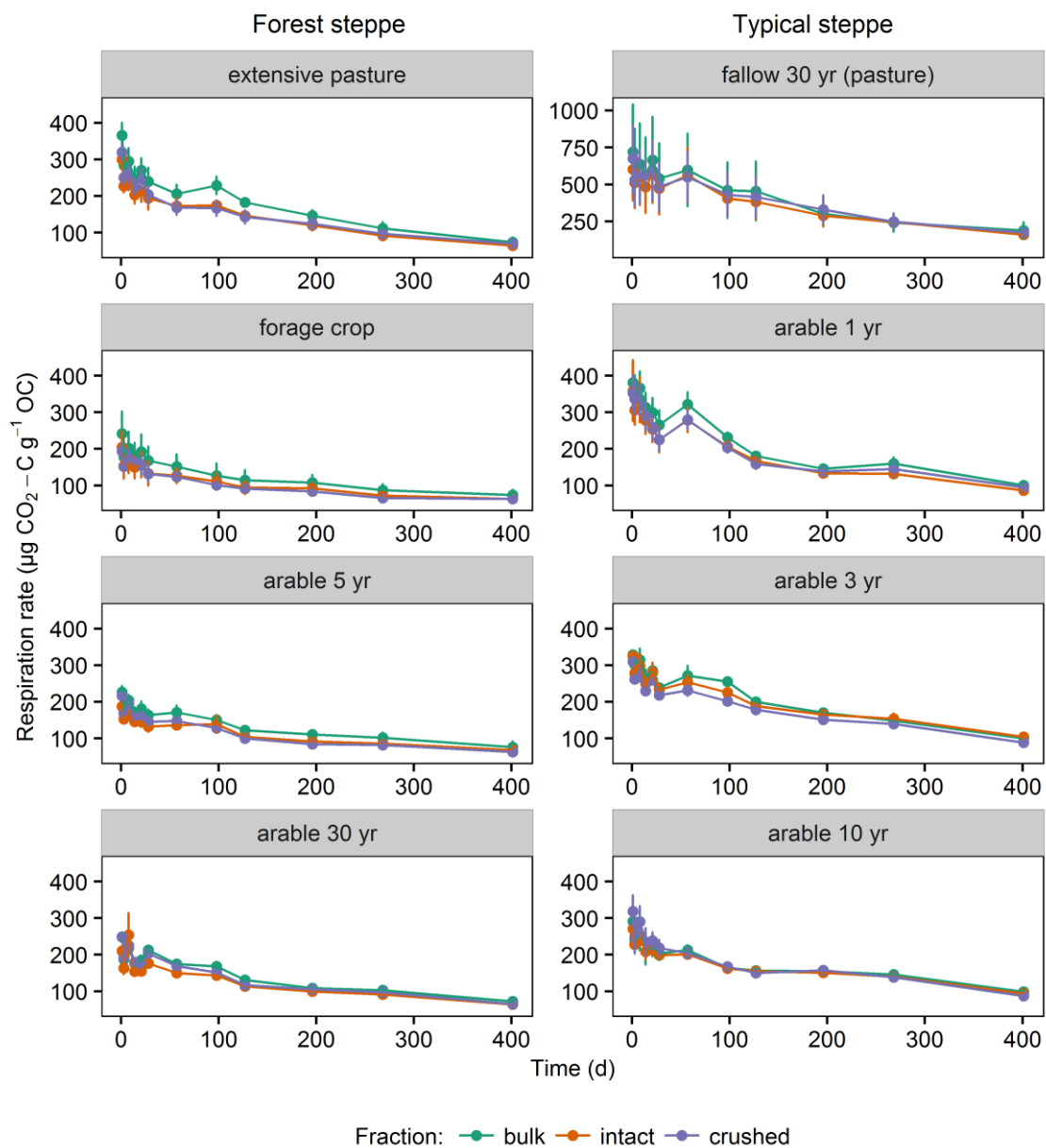
Fig. S 2: Time course of respiration rates (µg CO_2-C g^{-1} OC) for eight plots within two steppe types and for the three fractions bulk soil, intact macro-aggregates and crushed macro-aggregates. Shown are arithmetic means ± SE for all 12 time points where CO_2 gas samples were taken. Note the different scale for the fallow 30 yr (pasture).
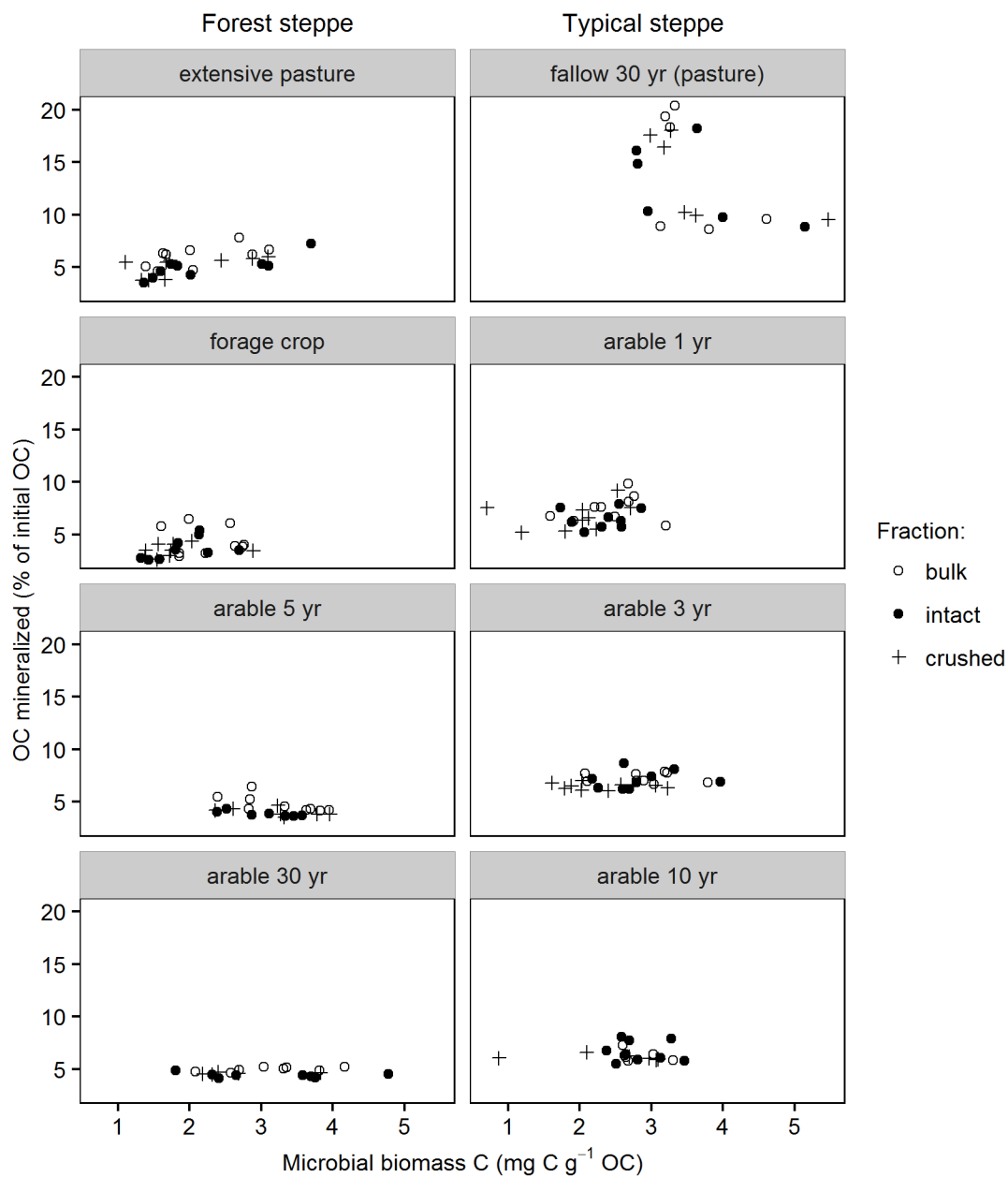
Fig. S 3: Mineralized OC (% of initial OC) plotted against the microbial biomass C normalized to total OC (mg C g^{-1} OC) for eight plots within two steppe types and the three fractions bulk soil, intact macro-aggregates, and crushed macro-aggregates.
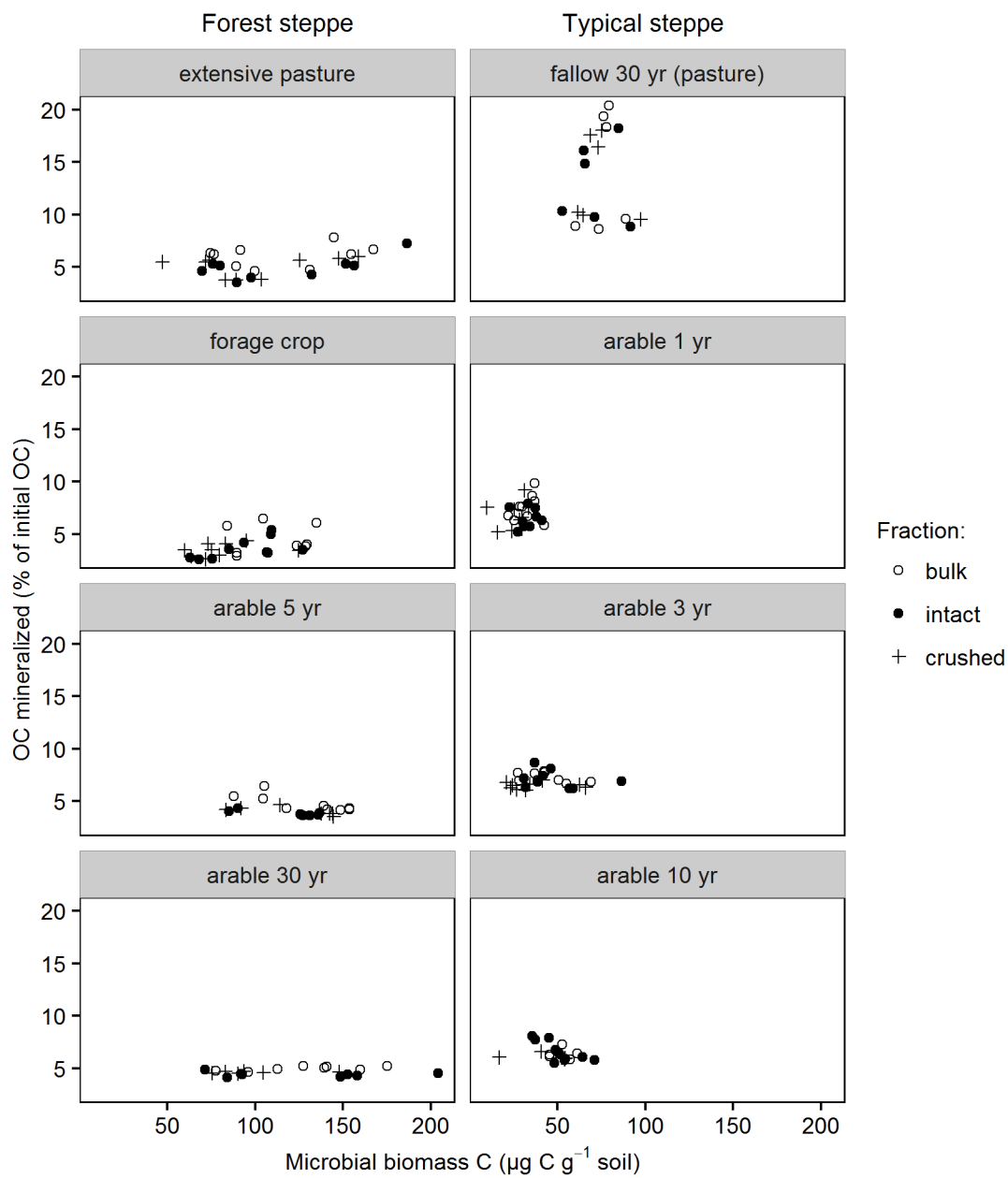
Fig. S 4: Mineralized OC (% of initial OC) plotted against the microbial biomass C per soil mass (µg C g^{-1} soil) for eight plots within two steppe types and the three fractions bulk soil, intact macro-aggregates, and crushed macro-aggregates.

References

Batjes, N. H.: Total carbon and nitrogen in the soils of the world, Eur. J. Soil Sci., 47(2), 151–163, doi:10.1111/j.1365-2389.1996.tb01386.x, 1996.

FAO: Lecture notes on the major soils of the world, edited by P. Driessen, J. Deckers, O. Spaargaren, and F. Nachtergaele, World soil Resour. reports, 94, 336, doi:10.1136/gut.27.11.1400-b, 2001.

IUSS Working Group WRB: World reference base for soil resources 2014. International soil classification system for naming soils and creating legends for soil maps, World Soil Resour. Reports No. 106, 1–191, doi:10.1017/S0014479706394902, 2014.