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Soil carbon stocks as affected by land-use changes across the Pampa of southern Brazil

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ABSTRACT: The “campos” of the Pampa are unique Brazilian ecosystems, which provide key environmental services, including C storage. These grassy ecosystems have been rapidly converted to intensive land-uses, mainly intensive grain crops (soybeans) and Eucalyptus silviculture. These new land-uses could decrease soil C stocks, depending on soil management. This study aimed to assess soil organic carbon (SOC) changes after the conversion of native grasslands to cropland (soybeans/cover crops under no-tillage) and forestry (Eucalyptus). Eight representative sites in this biome were selected for soil sampling (Alegrete-ALE, Aceguá-ACE, Jari-JAR, Jaguarão-JAG, Pinheiro Machado-PIM, Lavras-LAV, Santo Antônio das Missões-SAM, São Gabriel-SAG). Soil sampling was conducted in dug pits (0.30 m wide × 0.30 m long × 0.40 m depth) spaced by 50 m at each site, to 0.30 m depth. Soil bulk density and SOC were obtained by samples obtained with volumetric rings. Soil organic C was analyzed by dry combustion. Soil C stocks were calculated per layer and cumulatively (0.00-0.20 and 0.00-0.30 m). Soil C content was higher under grasslands in soils from sites with finer, clayey texture (ACE, JAG), and lower in soils at sites with sandier topsoil. Land-use conversion to silviculture and cropland minimally affected SOC stocks. The same pattern was observed with soil N, because of the tight connection between C and N cycles. Soil bulk density was similar across sites and layers, but higher values were measured in sites with coarser texture. Mean SOC stock of the grassland sites was 62 ± 24.6 Mg ha^{-1}, similar to 66 Mg ha^{-1} reported for grasslands soils of Rio Grande do Sul State, and higher than that reported by IPCC for this region (55 ± 4.4 Mg ha^{-1}). Adopting these default values would lead to underestimation of baseline SOC stocks in the region. Land-use conversion to cropland did not affect SOC stocks significantly, probably because of the adoption of no-tillage system with winter cover crops. Soil C stocks were lower in Eucalyptus stands in the 0.00-0.30 m soil layer, which could be attributed to intensive soil management at planting and lower soil fertility in some sites. This lack of effect of conversion on soil C was attributed to the short time since conversion and adoption of soil conservation practices (no-tillage) in cropland. The study contributed to reduce existing soil data gaps in the region and supports Brazilian public initiatives like the ABC Program and National Greenhouse Gas Inventories.

Keywords: soil organic C, *Eucalyptus*, silviculture, grasslands, no-tillage.

INTRODUCTION

Brazilian Pampa is the northeastern reach of the much larger Río de la Plata grasslands ecoregion (Pallarés et al., 2005; Andrade et al., 2019), including large parts of Uruguay and Argentina (Figure 1). In Brazil, this region constitutes a major portion (~60 %) of Rio Grande do Sul State land surface, originally comprising 17 Mha of grassy ecossystems (Verdum et al., 2019). In this realm, locally called “campos”, grass and legumes predominate, with shrubs and forbs coexisting within a complex vegetation matrix. Indeed, these grasslands have been considered among the most species-rich grasslands in the world (Overbeck et al., 2007).

These ecosystems have been neglected in terms of biodiversity conservation and valuation of their ecosystem services (Overbeck et al., 2007). Pampa grasslands have been degraded by overgrazing and conversion to other land-uses (Andrade et al., 2015; Foucher et al., 2023), most notably for agriculture and forestry (Oliveira et al., 2017). Recent estimates of land-use change have shown a dramatic reduction of the original area under grasslands: the MapBiomas Project (Azevedo et al., 2023) reported 32 % of the land in non-forest physiognomies (including grasslands), a reduction of 9.7 Mha to 6.3 Mha from 1985 to 2021. The most noticeable land-use change in the last 25 years have been the expansion of cropland (mostly soybean in the summer/pastures and cover crops in winter) and silviculture (mostly *Eucalyptus* sp), both of which already occupy more than 45 % of the Brazilian Pampa biome.

Studies indicate that perennial ecosystems, in particular grasslands, store large quantities of C that, in the context of climate change, provide stable C storage in soils (Crews and Rumsey, 2017; Dass et al., 2018; Maia et al., 2022; Bai and Cotrufo, 2023). Grassland soils are a crucial component of the global C cycle, storing 343 Pg C in the topsoil (0.00-1.00 m), approximately 50 % more than in forest soils (Conant et al., 2017). However, different management practices modify C fluxes in these ecosystems, shifting from C source to sink. In general, grasslands have been regarded as atmospheric CO_2 sinks in Europe (Rees et al., 2005; Soussana et al., 2007), North America (Conant et al., 2001; Schuman et al., 2002) and South American (Viglizzo et al., 2020), but grassland conversion to other more intensive land-uses usually releases CO_2 and decreases SOC: Guo and Gifford (2002) estimated a 10 % loss of SOC by conversion to forestry and 59 % to agriculture. Conversely, afforestation (with commercial plantations) could also impact SOC by tillage practices at the establishment, but long-term changes in vegetation structure, which alter the microclimate and the biological community, are also likely (Jorge et al., 2023). In addition, detailed, site-specific information on how grassland conversion influences soil organic C (SOC) is still scarce, especially for neotropical regions (Conant and Paustian, 2004).

Brazilian National Policy on Climate Change (Federal Law No. 12,187/2009), in line with the guiding principles established by the United Nations Framework Convention on Climate Change (UNFCCC, 2018), committed to voluntarily reduce 37 % of the greenhouse gases (GHG) emissions by 2025 (relative to a 2005 baseline) and established a climate action plan to achieve this goal. The plan contemplates a National Inventory of Anthropogenic Greenhouse Gas Emissions, which requires up-to-date SOC and GHG information across Brazilian ecosystems. In fact, small-scale SOC inventories have been produced in Brazil (e.g., Bernoux et al., 2003; Tornquist et al., 2009). However, C dynamics in grassy ecosystems such as the Pampa in Southern Brazil have not been treated extensively, and updated SOC stock data under land-use change are scarce.

This research aimed to fill part of the SOC data gaps that Pillar et al. (2012) acknowledged, reflecting the most common land-uses in Pampa region and comparing these data with published inventories. Our objective was to evaluate SOC stocks due to land-use and other environmental drivers, and we hypothesized grassland conversion to cropland and forestry decreases SOC storage.

MATERIALS AND METHODS

Study region

The study region encompasses approximately 176.000 km^2 (2.3 % of the Brazilian territory). Climate is subtropical, mostly classified as Köppen type *Cfa* (Alvares et al., 2014). The Pampa landscape in Rio Grande do Sul is generally described as flat or gently sloping terrain with rolling hills, with altitudes varying from >500 m in the north to sea level in the southeast, overlaid by a mosaic of drylands, wetlands and rocky outcrops (Figure 1). These grasslands consist of a matrix of grasses, legumes, and a wide variety of forbs (Hasenack et al., 2023). The major soils orders are Entisols, Inceptisols, Ultisols and Oxisols (*Neossolos*, *Cambissolos*, *Argissolos and Latossolos*), with smaller occurrence Mollisols (*Chernossolos*) on lands near the Uruguay border (Almeida, 2023).

Location, soil sampling design and lab analysis

Multiple soil sampling campaigns took place from late 2019 through mid-2021. The sampling sites (Figure 2) had been established previously in field campaigns to characterize vegetation and ecosystem functioning within the scope of the Nexus II project "Cenários de Conversão da Vegetação Nativa e Sustentabilidade de Agroecossistemas no Pampa" (EcoQua, 2023). Site selection prioritized grassland physiognomies (Andrade et al., 2019) and predominant soil classes in the Pampa. This study design consists of paired treatments, the "reference" grassland physiognomies under cattle grazing (G) paired to: a) cropland - consisting of annual grain crops and winter cover crops (black oats – *Avena sativa* and annual ryegrass - *Lolium multiflorum*), usually grazed by livestock (*Bos taurus* and *Ovis aries*); b) *Eucalyptus* plantations of commercial varieties used for pulp and paper production.

Figure 1. Location of the Southern Brazilian Pampa in Rio Grande do Sul State within the *Río de la Plata* grasslands ecoregion.

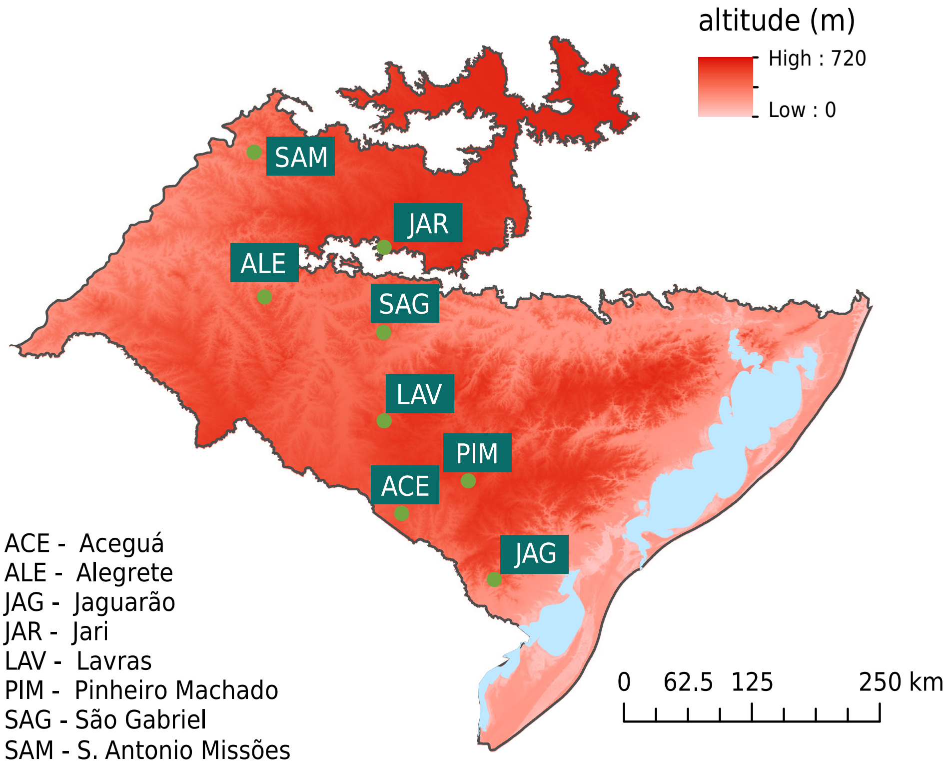

Figure 2. Location of sampling sites in the study region overlaid on the SRTM90 digital elevation model.

In detail, the predominant soil classes (according to Soil Taxonomy and SiBCS-Brazilian Soil Classification System) are Udults (*Argissolo Vermelho Amarelo*), Udorthents (*Neossolo Litólico*), with some Udox (*Latossolo Vermelho* and *Nitossolo Vermelho*) and Udolls (*Chernossolo Ebânico*) encompassing a range of soil textures from clay to sandy loam (Tables 1 and 2). Large-scale soil surveys and soil maps were unavailable in this region, so these soils were classified tentatively based on the 1:250,000 soil map of RS state (IBGE, 2017) and spot-checks in the field before soil sampling.

Sampling design followed the RAPELD approach (Magnusson et al., 2005): sampling points were located along 250-m transect following approximately the contour lines at each site, thus minimizing variability due to topography. Soil sampling encompassed eight pairs (grassland × cropland and graslands × forestry), with three transects for each land-use, totaling 64 transects. The paired transects of grassland × cropland were, on average, 347 m apart, and the transects of grasslands × forestry were, on average, 1800 m apart - the latter distance due to the large size of the commercial plantation stands (thousands of hectares). Each site was established by matching soil class, slope and altitude, and the reference land-use status (grassland) before conversion was verified with historical satellite imagery. Transects were at least 100 m away from field boundaries to avoid edge effects, especially farm or forestry machinery traffic.

Soil sampling protocol was adapted from FAO (2019) and IPCC (2019): Soil samples were obtained in five dug pits (0.30 m wide × 0.30 m long × 0.40 m depth) and composited. Pits were spaced by 50 m along each transect (Figure 3). This number of subsampling pits per transect was determined by a sample sufficiency test conducted at the SGA site. Parameters for soil C stock calculation ‒ soil bulk density (SBD) and SOC ‒ were obtained by sampling the pit wall with volumetric rings (Ø = 8 cm, height = 5 cm), comprising six rings per pit to 0.30 m depth (Figure 3). Soil samples were oven-dried at 50 °C for five days, ground, homogenized and sieved (2 mm mesh).

Table 1. Site description: Time of land use change, management and cropping systems, soil classification

Site[1]	**Conversion year**	**Crop/Forestry**	**Soil management[2]**	**Soil**
Cropland				
ACE	2010	Summer: soybeans (Glycine max) Winter: Avena sativa and *Lolium minutiflorum* cover crops - grazed for several weeks in the Spring	Conversion: sod killing (w/glyphosate), followed by disk plow (~ 0.30 m), at least one harrow pass before direct seeding; then no-till planter used for crops.	*Nitossolo Vermelho* (Kandiudox)
ALE	2015			*Latossolo Vermelho* (Hapludox)
JAR	2005			*Argissolo Vermelho Amarelo* (Hapludult)
SAG	2015			*Argissolo Vermelho Amarelo* (Hapludult)
SAM	2006			*Chernossolo Ebânico* (Argiudoll)
Forestry				
JAG	2008	Commercial hybrids (pulp-mill grade) of *Eucalyptus urograndis, urophylla* and *dunnii*	Conversion: sod killing (w/glyphosate), followed by subsoiling (~ 0.40 m depth) and ridge tillage.	*Argissolo Vermelho Amarelo* (Hapludult)
LAV	2008			*Neossolo Litólico/Regolítico* (Udorthent)
PIM	2008			*Argissolo Vermelho Amarelo* (Hapludult)
SAG	2010			*Neossolo Litólico/Regolítico* (Udorthent)

[1] ACE: Aceguá; ALE: Alegrete; JAG: Jaguarão; JAR: Jari; LAV: Lavras; PIM: Pinheiro Machado; SAG: São Gabriel; SAM: Santo Antônio das Missões.
[2] Grassland management is described in the text.

Coarse materials (>2 mm), including gravel and belowground plant material, such as roots, rhizomes and tubers were separated, dried, and weighed. Subsequently, the residual moisture of the samples was determined (105 °C for 24 h) to assess dry soil mass and calculate SBD. Soil organic C was determined in a CN Thermo Flash elemental analyzer. Soil organic C stocks per sampled layer (0.05 m) were calculated with equation 1.

$$SOC\ stock = SOC\ (kg\ Mg^{-1}) \times layer\ thickness\ (m) \times SBD\ (Mg\ m^{-3}) \times (1 - corse\ material\ fraction) \times 10 \qquad \text{Eq. 1}$$

The SOC stocks to the layers of interest were obtained by summing the corresponding layers. Using the same soil sample to obtain SBD and SOC estimates has been explicitly recommended by FAO (2019), and adopted in regional studies (Phachomphon et al., 2010; Schöning et al., 2013; Dávila et al., 2019). We reported SBD of the fine soil fraction (<2 mm) following Poeplau et al. (2017) and FAO (2019). Following SOC stock calculation, we did not apply equivalent soil mass corrections as suggested by Ellert and Bettany (1995) and IPCC (2019) because it would be impossible to ascertain soil mass conservation

Table 2. Site characterization: Particle-size analysis (means of sites and land-uses at 0.00-0.30 m layer)

Site[1]	**Clay**	**Silt**	**Sand**	**Clay**	**Silt**	**Sand**
	g kg^{-1}					
		Cropland			Grassland	
ACE	553±10	327±55	121±71	508±82	395±61	97±32
ALE	216±67	59±26	724±84	171±54	51±30	778±80
JAR	565±10	266±87	169±58	432±40	231±31	338±45
SAG	174±34	80±23	746±16	75±4	49±14	876±18
SAM	561±92	230±37	208±71	534±89	286±35	180±59
		Forestry			Grassland	
JAG	313±77	151±39	536±53	275±77	227±39	497±86
LAV	179±48	128±40	693±74	279±66	197±65	524±77
PIM	272±10	167±44	560±56	228±89	184±43	589±10
SAG	96±31	15±15	837±24	68±24	51±17	881±14

[1] ACE: Aceguá; ALE: Alegrete; JAG: Jaguarão; JAR: Jari; LAV: Lavras; PIM: Pinheiro Machado; SAG: São Gabriel; SAM: Santo Antônio das Missões.

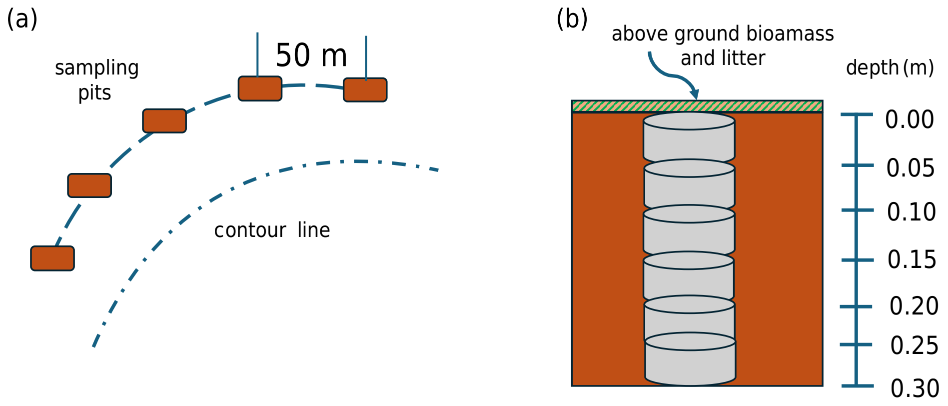

Figure 3. Schematics of the sampling strategy: (a) points on a transect following contour lines;(b) sampled depths in dug pits (0.00-0.30 m).

irrefutably in the sampled sites – especially water erosion and tillage erosion in cropland and silviculture would have a confounding effect reporting SOC stock using the equivalent mass approach. Additionally, we found large amounts of coarse soil material fractions (>2 mm) in several sites, which further complicates the application of equivalent soil mass approach (Rovira et al., 2015).

Statistical analysis

Linear mixed models (LMM) were applied to compare C, N, and SBD and SOC stocks across land-uses, implemented in SAS Studio with PROC GLIMMIX (SAS Institute, 2023), with land-use as the fixed factor and the sampling sites the random effect. Data normality and equality of variance were checked as a preliminary step in SAS. Variables not normally distributed were log transformed. Tukey *post-hoc* tests were performed for the multiple comparisons, and differences were reported as significant at $p<0.05$. Principal Component Analysis was performed with packages *factoextra* and *ggplotgui* in R version 2022 (R Core Team, 2024) to explore interrelationships among response variables (C and N) and SBD and soil texture.

RESULTS AND DISCUSSION

Soil organic C, N and bulk density

The basic parameters for soil C stocks calculation are discussed briefly, as we emphasized soil C stocks in the following pages. Our data revealed a large soil C variability in the Pampa region across sites (Table 3). Regional forcing drivers such as climate, soil class and vegetation (e.g., grasslands physiognomies) affect two key compartments of C cycle: uptake via photosynthesis and C release due to soil and plant respiration. Soil C content was higher under grasslands in soils from sites with finer, clayey texture (ACE, JAG), and lower in soils with sandier texture (ALE and SAG) (Table 3). Clay contributes to soil aggregation, leading to physical protection and SOC stabilization (Bayer et al., 2006). Carbon stored in clayey soils such as those in this study where kaolinite and iron oxides predominate (except ACE site, with 2:1 clay minerals) is inherently stabler because C is mostly associated with minerals that comprise the <2 µm fraction. On the other hand, the soils with coarser texture have lower aggregation and, therefore, reduced physical protection and chemical stabilization of SOC (Santos et al., 2011). This observation in soils under grasslands was minimally affected by conversion to silviculture and cropland. The same pattern was observed with soil N, because of the tight connection between C and N cycles (Aerts and Chapin, 1999). Mean C/N ratio was 11.3, within the range of mineral

Table 3. Soil properties (0.00-0.30 m): means of C, N and SBD, coarse material fragments >2 mm (FRAC2)

Site / land-use		SBD	FRAC2	C	N	C/N
		g cm^{-3}	g kg^{-1}			
ACE						
	grassland	1.19±0.23	0	25.9±14.3	2.3±1.4	11.3
	cropland	1.26±0.20	19±21	19.5±5.9	1.8±0.5	10.9
ALE						
	grassland	1.53±0.13	0	7.4±3.9	0.7±0.3	10.5
	cropland	1.48±0.13	0	8.1±3.9	0.8±0.3	10.8
JAR						
	grassland	1.27±0.16	0	21.1±7.6	1.6±0.6	13.3
	cropland	1.29±0.14	0	20.1±6.4	1.8±0.8	10.9
SAG						
	grassland	1.71±0.19	0	7.3±5.8	0.7±0.5	9.8
	cropland	1.28±0.11	0	8.9±5.2	0.9±0.4	10.1
SAM						
	grassland	1.28±0.18	0	18.7±4.9	1.8±0.7	10.3
	cropland	1.27±0.11	0	15.2±3.4	1.3±0.3	11.9
JAG						
	grassland	1.09±0.24	223±225	25.1±13.2	2.1±1.2	11.9
	forestry	0.89±0.38	388±303	25±11.4	2.1±0.9	12.2
LAV						
	grassland	1.15±0.19	173±123	22.6±9.4	1.8±0.8	12.3
	forestry	1.33±0.14	94±65	14.2±5	1.2±0.4	11.7
PIM						
	grassland	1.17±0.5	272±300	17.5±6.5	1.6±0.6	11.3
	forestry	1.11±0.33	199±250	19±4.8	1.7±0.3	11.2
SAG						
	grassland	1.47±0.14	2±2	6±3.6	0.6±0.3	10.0
	forestry	1.57±0.06	2±3	4.3±1.6	0.4±0.1	10.0

There were no statistically significant differences (Tukey $p<0.05$) between grasslands and cropland or forestry at each site.

soils in the Subtropics. Soil C content decreased with depth, which is common in most soils worldwide (Jobággy and Jackson, 2000). Although not statistically significant, higher C content in grasslands (Table 3) could be explained by the lower shoot-to-root ratio, i.e., more C allocated to the belowground biomass (Franzluebbers, 2012). Grasslands can accumulate larger labile fractions of soil organic matter, namely particulate SOC (53 µm to 2 mm) (Franzluebbers and Stuedemann, 2002). Soil bulk density was similar across sites and depths, but higher values were measured in coarser-textured sites (Table 3). Soil bulk density is mostly determined by soil texture and management and is usually higher in sandy soils under cultivation (Reinert et al., 2008).

SOC stocks

We emphasize the discussion of SOC stocks as the most relevant information of this study in the context of the National Greenhouse Gas Inventories highlighted above.

Overall assessment

Mean SOC stocks of grassland sites pooled were 62 ± 25 Mg ha^{-1}, which is similar to a recent synthesis study that reported a mean SOC stock of 66 Mg ha^{-1} in grasslands soils in the Pampas of RS (Tornquist et al., 2024). An earlier statewide assessment of SOC stocks in Rio Grande do Sul under native vegetation reported a mean 74 ± 19 Mg ha^{-1} (Tornquist et al., 2009), but that estimate included non-grassy ecosystems (e.g., woodlands). More recently, the MapBiomas Project reported an overall mean SOC stock of 49 Mg C ha^{-1} for the whole biome in 2021, but this comparison is compromised because this study included land converted to other uses (MapBiomas 2023). In comparison, the reported IPCC default for the general soil class of this region (warm temperate moist soils with low activity clays) was 55 ± 4.4 Mg ha^{-1}. Soil organic C stocks in the only high activity clay site in this study (ACE - *Chernossolo Ebânico*/Argiudoll) under grasslands were 80.8 Mg ha^{-1}, 20 % more than the IPCC suggested default for these soils (64 ± 3.2 Mg ha^{-1}). Therefore, adopting the IPCC Tier 1 (IPCC, 2019) default values for this region would lead to major underestimation of baseline SOC stocks.

Sites and land-uses

Our analysis identified marked differences in SOC stocks across the sampled sites (Figure 4). A major contributing factor could be the distinct primary productivity of grassy vegetation physiognomies in South Brazil (Andrade et al., 2019). An additional driver of SOC could be ascribed to soils with contrasting textures (Table 2), where clay (and silt) favor aggregation and SOC accumulation through reduced mineralization and increased microbial biomass (Zinn et al., 2005; Rakhsh et al., 2020). These observations must be considered with caution because of confounding factors such as large amounts

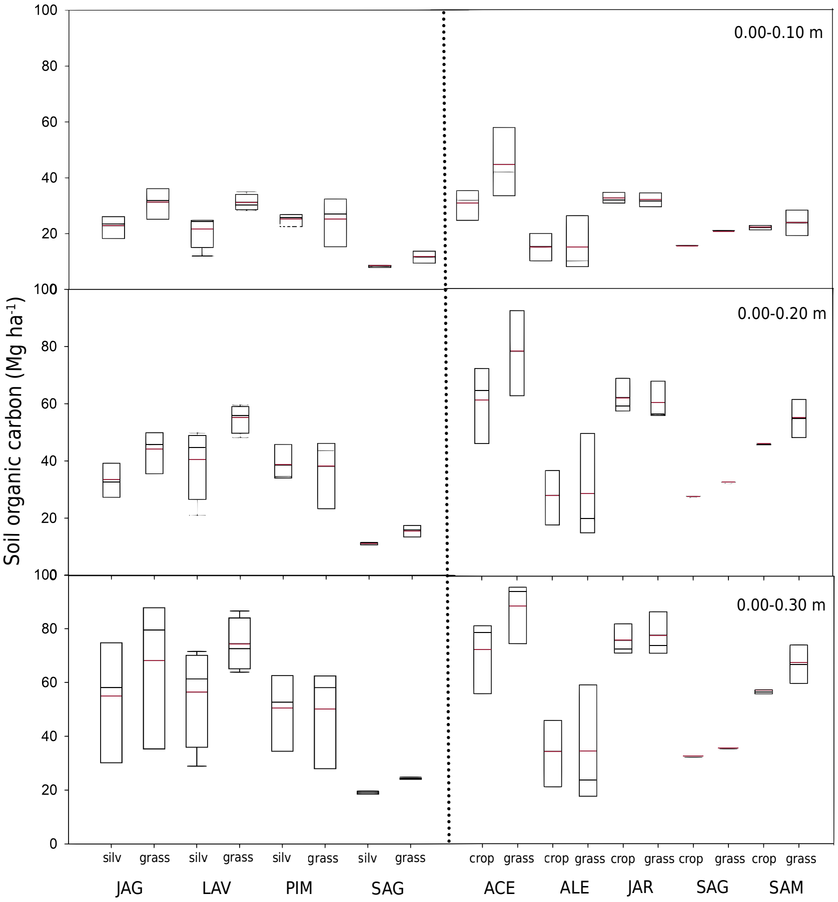

Figure 4. Box-plots of soil C stocks (0.00-0.10, 0.00-0.20 and 0.00-0.30 m layer) across sites and land-uses. In boxplots (–) are means and (–) are medians. There were no statistically significant differences (Tukey, p<0.05) between grasslands and cropland or forestry at each site. The sites are ACE: Aceguá; ALE: Alegrete; JAG: Jaguarão; JAR: Jari; LAV: Lavras; PIM: Pinheiro Machado; SAG: São Gabriel; SAM: Santo Antônio das Missões.

coarse fractions (>2 mm) at some sites (e.g., PIM, LAV and JAG - Table 2), which diminish potential SOC storage. Also included in this coarse fraction were roots and other vegetative structures (bulbs, rhizomes, etc.) that may comprise a major component of ecosystem C, but are not considered part of soil C. However, upon senescence and decomposition, these belowground biomass pools constitute a major contribution to the SOC stock in a grassy ecosystem, more than the aboveground biomass additions (Kätterer et al., 2011; Pausch and Kuzyakov, 2018).

A general comparison of grassland (this study's reference) to cropland and silviculture (Figure 5) revealed that these land-use conversions did not affect SOC stocks significantly ($p<0.05$) at the layers of 0.00-0.10, 0.00-0.20 or 0.00-0.30 m. The SOC stocks at 0.00-0.30 m soil layer were lower in *Eucalyptus* stands (approximately 10 years-old) in comparison to the paired grasslands. Similarly, Santos et al. (2020) observed SOC losses 5 ½ years after the conversion of grasslands to *Eucalyptus* and concluded that soil management at planting time was determinant for the observed C dynamics. Indeed, it could take approximately 20 years to assess the loss or accumulation of soil C under *Eucalyptus* plantations, as noted by Turner and Lambert (2000). Soares et al. (2019) observed SOC stock loss in plantations initially (10-13 years) and small increases after 22 years in the Eastern part of the Pampa.

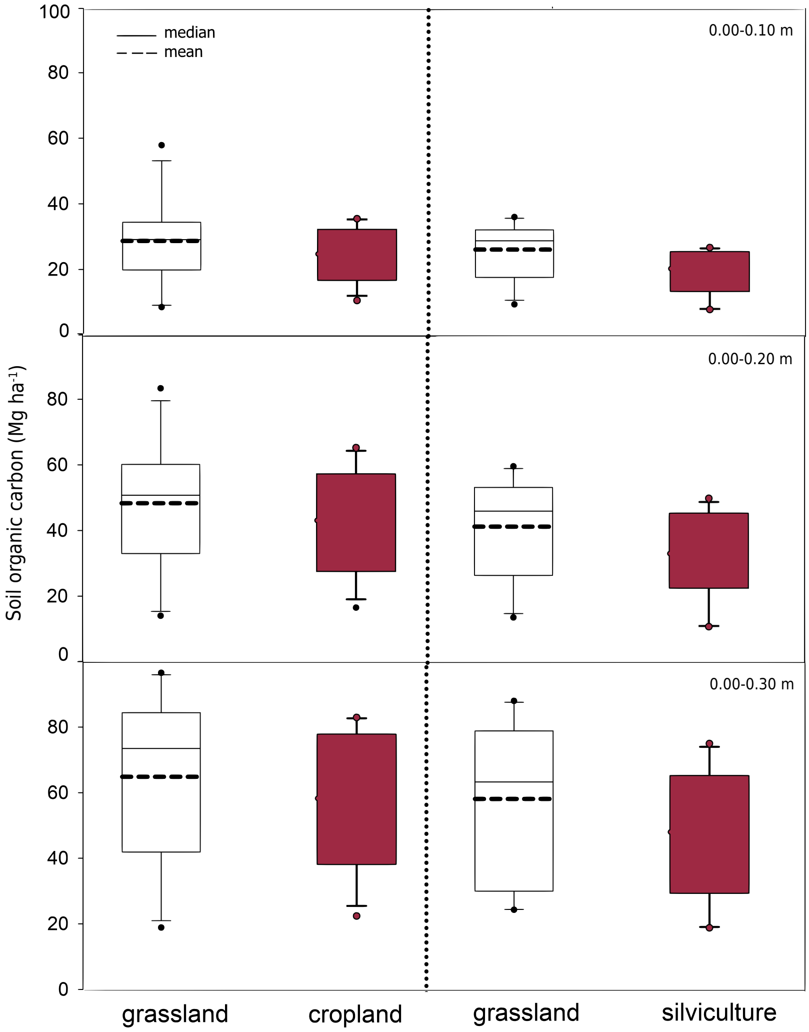

Figure 5. Soil C stocks (0.00-0.20 and 0.00-0.30 m soil layers) across sites and land-us. There were no statistically significant differences (Tukey, $p<0.05$) between grasslands and cropland or silviculture.

Soil management affects SOC stocks, especially the degree of disturbance at planting: deep plowing and subsoiling potentially enhance organic matter decomposition. Poor silvicultural practices and management in the field that lead to soil loss could additionally decrease SOC stocks.

The SOC stocks in cropland were not different from those in grasslands ($p<0.05$). All the sampled sites in cropland were conducted in a no-tillage system, with black oats and annual ryegrass as winter cover crops grazed for periods, and soybean as the main crop (summer). This cropping system is considered a conservation management, contributing to C storage in soils (Turetta et al., 2020). In fact, conservation management could enhance soil function as atmospheric C sink or at least markedly decrease soil organic matter decomposition (Pillar et al., 2012; Rodrigues et al., 2023). In general, the most likely factor determining the observed stability in SOC stocks was the short time since conversion (approximately ten years) from grasslands to these other uses.

Multivariate analysis

Principal Component Analysis explained 96.3 % of the variability of the data in its first two components (Figure 6). The first component shows a trend associating clay, silt, and more strongly influenced C and N content, but in opposition to sand content and SBD, which is consistent with the explanations presented above: Clayey soils from sites like JAR, SAM and ACE are closely grouped, which is related to the respective soil C and N, whereas the sites with coarse-textured soils (e.g., ALE and SAG) accumulated less C and N. Within each site, the paired points (grasslands × cropland or silviculture) are usually very close, pointing to the limited effect of land-use conversion on soil C and N already noted.

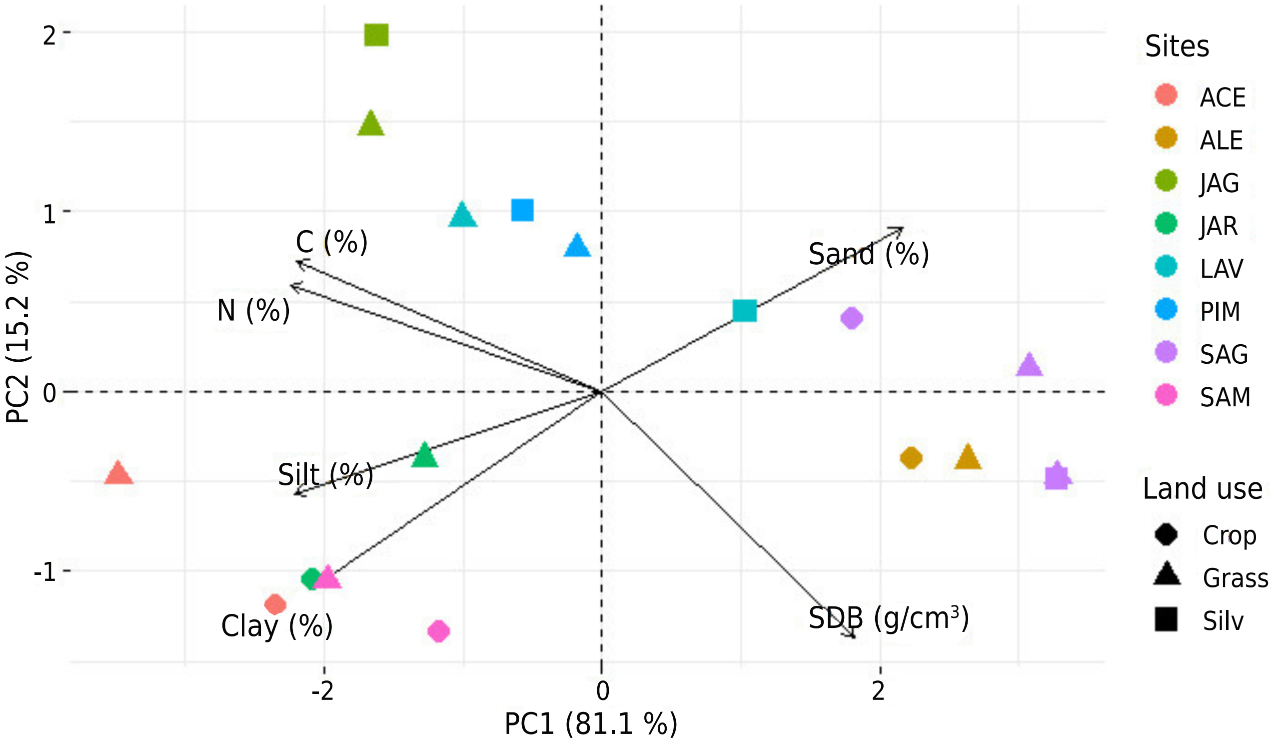

Figure 6. Biplot of Principal Component Analysis (PCA).

CONCLUSIONS

The sites investigated in the Brazilian Pampa stored more soil organic C than reported in previous studies. Conversion of the Pampas grasslands in Rio Grande do Sul State to intensive agriculture, i.e., with cropping system soybeans–summer/cover crops–winter or silviculture with *Eucalyptus,* did not significantly decrease soil C stocks. This lack of effect on soil C could be attributed to the short time since conversion (approximately 10 years) and, in particular, the adoption of conservation management (no-tillage) in cropland. We provided a comprehensive assessment of soil organic C estimate for this unique biome in Southern Brazil, contributing to reduce existing soil data gaps in the region. Additionally, our research is aligned with public policy like the ABC Program and National Inventories of Greenhouse Gases.

DATA AVAILABILITY

Data used in this study is available at the SoilData repository (https://doi.org/10.60502/SoilData/H0L2TG).

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