TropSOC Database

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Authors Contributions

SD functioned as the project leader. SD and PF were lead coordinators for compiling the data base, responsible for data analysis and designed the metadata. BB, MC, LK, DM, MR, LS and FW were collecting and creating datasets and also analysed these data before inclusion into the database. All technical contributors participated via data collection. All conceptual contributors participated in the design of the study and gave advice and feedback during the campaign. SD and PF wrote the paper. All authors supported data analysis and gave feedback during the writing process.

When using these data, please cite the database and the key publication in ESSD:

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0. Introduction of test region and project & data base structure

This database is the result of scientific activities from 2017-2020 within project TropSOC, funded via the Emmy-Noether-Program of the German Research Foundation (project ID 387472333). The main objective of project TropSOC was to develop a mechanistic understanding of soil organic carbon dynamics including plant and microbial response to soil properties in the African tropics. In addition, the project aimed at understanding landscapes as a whole and assessing how humans re-shape and affect tropical ecosystems. A more detailed description of the project objectives can be found in Doetterl et al. (2021). Here we focus on a short description of the study sites, which puts the data presented in this database in a broader context.

Study sites of project TropSOC are situated within the border region between the Congo and the Nile basin and are spread across South and North Kivu (Democratic Republic of the Congo), Western Rwanda and Southwestern Uganda (see Figure 1). Human disturbance (e.g. deforestation) in the Congo Basin is still comparably low, with deforestation currently spreading along river systems into largely pristine forests of local mountain ranges. Growing population in the lowlands and the reliance on subsistence farming for food as well as charcoal production for energy threaten these remaining forests and drive an acceleration of deforestation, which leads to erosion and land use change in steep terrains. Overall, the study area provides a unique combination of (i) different geologically parent material for soil formation (Figure 2), (ii) varying land use representing different levels of disturbance by human activities and (iii) steep terrain with slopes up to 60% prone to soil redistribution, making it an ideal study area to identify the relative strength of various environmental controls on tropical soil C dynamics.

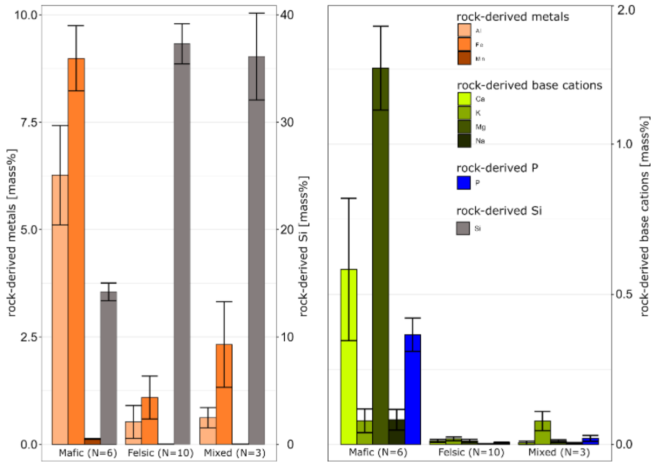

Figure 2. Chemical composition of unweathered rock samples of soil parent material in the three studied geochemical regions studied. Total elemental concentration of main elements with relevance for plant nutrition and SOC stabilization. Error bars represent the standard error of the mean.

Our intention was to study pristine forest sites vs. cropland sites. Hence, the database is structured into two main parts, one representing forest and the other representing cropland data. Another part of the database presents the basic information, structure and connections between datasets. A further part contains meteorological data that represents forest and cropland study sites. Forest and cropland soils developed from three geochemical distinct parent material (mafic, felsic, mixed sedimentary rocks) were sampled following a stratified random plot design were plots where are at different topographic position (3 to 6 plots per topographic positions “plateau”, “sloping” and “valley”) to study the potential effect of soil geochemistry, land use and soil redistribution on soil C dynamics. Details of the plot and sampling design is given with the individual data-sets and in Doetterl et al. (2021), while a first overview regarding the characteristics of these plots are given in Table 1 and 2.

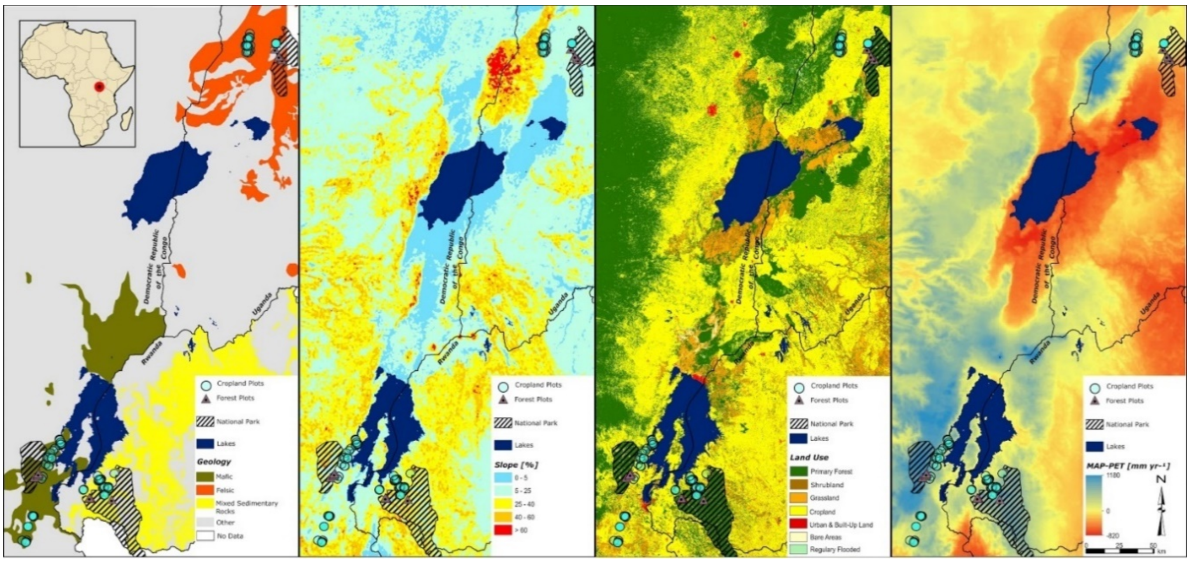

Figure 1. Overview of the study area with respect to major investigated factors (from left to right): soil parent material geology, slope steepness, land use, climate (expressed as mean annual precipitation – potential evapotranspiration) (Doetterl et al. 2021).

Table 1. Topographic information of pristine forest and cropland plots in the studied geochemical regions. Slope and altitude are displayed as minimum and maximum values.

	felsic sub-region in Uganda					
	forest plots			cropland plots		
topographic position	*plateau*	*sloping*	*valley*	*plateau*	*sloping*	*valley*
slope [%]	3 - 5	9 - 55	3	1 - 5	7 - 50	1 - 5
altitude [m] a.s.l	1304 - 1306	1271 - 1420	1272-1277	1507 - 1797	1466 - 1830	1587 - 1768
	mixed sedimentary rocks sub-region in Rwanda					
	forest plots			**cropland plots**		
topographic position	*plateau*	*sloping*	*valley*	*plateau*	*sloping*	*valley*
slope [%]	3	9 - 60	1	3 - 5	8 - 50	2 - 5
altitude [m] a.s.l	1908 - 1939	1891 - 2395	1882 - 1889	1719 - 1837	1565 - 1952	1556 - 1758
	mafic sub-region in DR Congo					
	forest plots			**cropland plots**		
topographic position	*plateau*	*sloping*	*valley*	*plateau*	*sloping*	*valley*
slope [%]	3	11 - 60	1 - 2	0 - 5	8 - 43	0 - 3
altitude [m] a.s.l	2208 - 2227	2188 - 2248	2181 - 2310	1477 - 1731	1486 - 1774	1505 - 1708

Table 2. Mean chemical and physical soil characteristics following wet chemistry analyses for forest and cropland plots of the different geochemical regions. Mean values (± standard errors) were calculated averaging results from 36 forest plots and 87 cropland plots for three soil depths (0 - 10cm, 30 - 40cm, 60 - 70cm).

geochemical region	**mafic sub-region in DR Congo**		**felsic sub-region in Uganda**		**mixed sedimentary rocks sub-region in Rwanda**	
land use	*forest*	*cropland*	*forest*	*cropland*	*forest*	*cropland*
soil chemistry						
pH (KCl)	3.78±0.10	4.28±0.04	4.87±0.13	5.02±0.07	3.43±0.07	3.97±0.02
CEC [me/100 g]	38.71±1.44	20.71±1.04	14.17±0.94	29.08±1.13	14.86±1.49	20.80±1.74
share of bases in CEC [%]	13.70±2.91	18.21±1.87	66.44±4.65	48.01±2.36	4.29±1.20	12.03±1.44
ECEC [me/100g]	10.06±1.04	6.20±0.36	11.25±1.09	14.67±0.74	5.33±0.41	6.60±0.56
share of bases in ECEC [%]	43.07±5.87	56.55±3.92	84.99±2.68	92.52±0.61	7.12±0.72	34.22±3.54
Si [%]	11.59±0.20	12.97±0.39	18.47+0.79	17.20±0.52	18.69±1.52	15.65±0.57
Al [%]	10.55±0.34	12.19±0.27	9.07±0.56	8.50±0.53	7.16±0.77	11.18±0.35
Fe [%]	11.00±0.25	12.01±0.67	4.46±0.32	7.07±0.40	5.32±1.07	7.461±0.71
Mn [%]	0.19±0.02	0.22±0.06	0.18±0.02	0.23±0.03	0.01±0.00	0.07±0.02
SOC [%]	3.89±0.45	2.16±0.18	1.63±0.24	2.26±0.18	3.31±0.38	2.57±0.19
SON [%]	0.38±0.04	0.18±0.01	0.16±0.02	0.20±0.01	0.19±0.03	0.21±0.01
SOC/SON [-]	10.23±0.18	11.72±0.31	10.28±0.22	10.47±0.24	18.96±1.13	12.14±0.25
P [%]	0.23±0.02	0.14±0.02	0.08±0.01	0.47±0.06	0.09±0.01	0.12±0.01
bioavailable P [mg/kg soil]	22.34±2.72	4.77±0.70	17.39±4.00	172.96±10.27	12.27±4.27	5.08±1.06
Total reserve base cat. [%]	0.62±0.10	0.28±0.04	1.56±0.10	2.88±0.27	1.07±0.24	1.05±0.17
soil physics						
BD [g/cm^3]	1.05±0.03	1.24±0.03	1.66±0.04	1.29±0.03	1.27±0.05	1.22±0.04
clay [%]	54.20±2.91	64.63±2.34	38.62±1.77	36.02±1.28	37.74±2.90	44.49±1.86
silt [%]	14.24±0.74	13.88±1.05	9.48±0.53	17.77±0.64	22.63±2.25	21.46±1.39
sand [%]	31.56±2.81	21.49±1.50	51.90±1.48	46.21±0.89	39.63±3.63	34.05±1.49

Description of database

An overview of all datasets presented in this database is given in Table 3. Datasets are given as tab-delimited .csv files. For each .csv file the metadata describing data structure and assessment methods are given in a .pdf file of the same name. Moreover, additional .pdf files for each main section of the database (basic information, forest, cropland, and meteorology) are given, providing an overview of the structure within each section. Note that the '**basic information**' section of the database provides the linkages between individual data, e.g. from soil analysis and the location and/or soil depths where these samples were acquired (for linkages see also Figure 3).

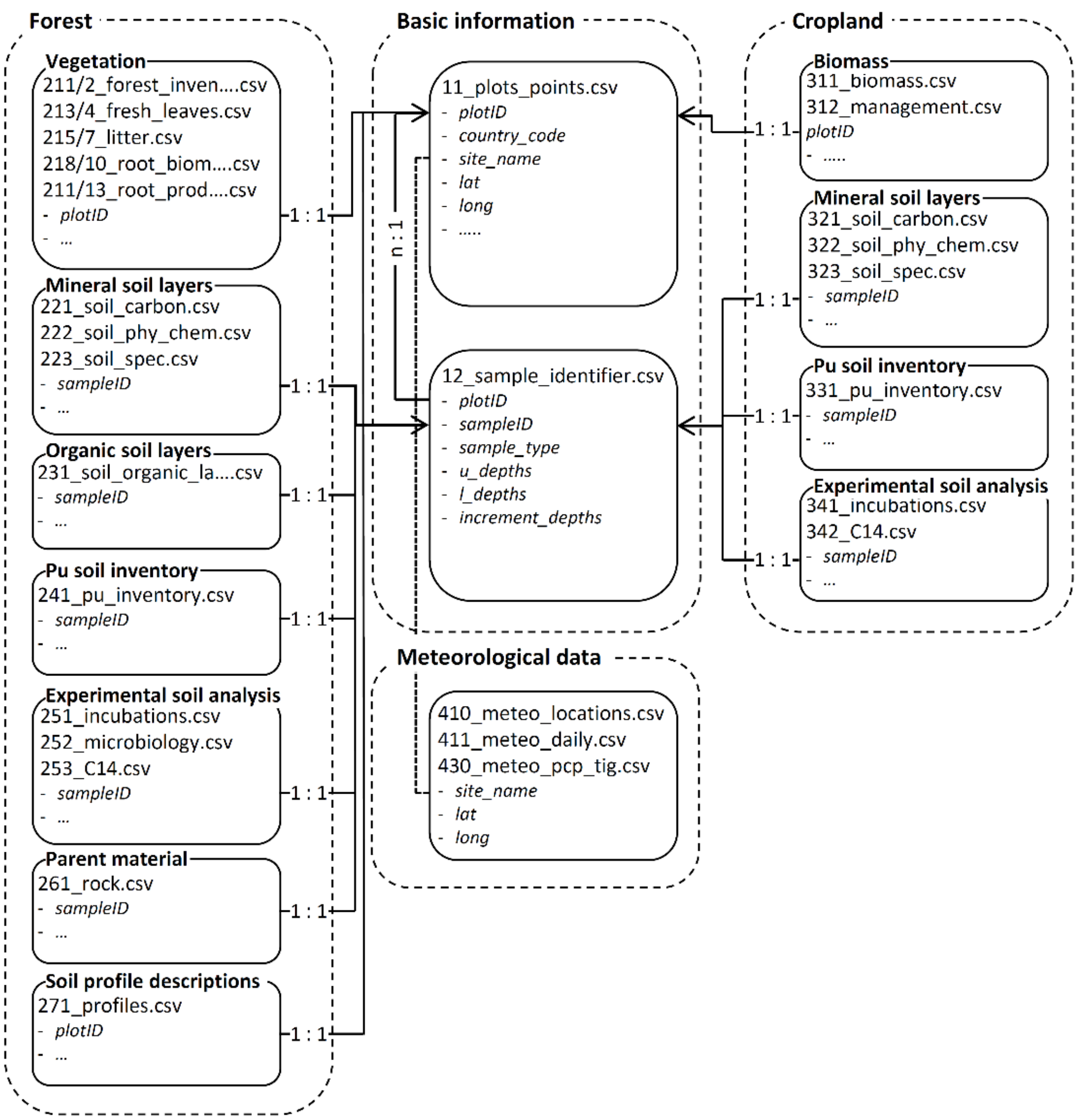

Figure 3. Overview of linkages between datasets in the TropSOC database v1.0.

Table 3. Structure of the TropSOC database. For each topic a .pdf file is given that entails an overview for the available data sets. Each dataset comprises a data-containing .csv file and an additional metadata-containing .pdf file of the same name.

Introduction & structure of the data base		0_intro_structure.pdf
1.	**Basic information**	**1_basic_information.pdf**
1.1.	Location and basic background information for all plots and points where data were collected	11_plots_points.csv/pdf
1.2.	Data base internal connection between location of plots and points and soil data from different soil depths	12_sample_identifier.csv/pdf
2.	**Forest**	2_forest.pdf
2.1.	Vegetation	
2.1.1.	Forest inventory	211_forest_invent.csv/pdf
2.1.2.	Forest inventory aggregated	212_forest_invent_agg.csv/pdf
2.1.3.	Fresh leaves chemistry	213_fresh_leaves.csv/pdf
2.1.4.	Fresh leaves chemistry aggregated at species level	214_fresh_leaves_agg.csv/pdf
2.1.5.	Litter fall	215_litter.csv/pdf
2.1.6.	Litter fall aggregated to seasonal values	216_litter_seasonal.csv/pdf
2.1.7.	Litter fall aggregated to annual values	217_litter_annual.csv/pdf
2.1.8.	Root biomass	218_root_biomass.csv/pdf
2.1.9.	Root biomass aggregated to seasonal values	219_root_biomass_seasonal.csv/pdf
2.1.10.	Root biomass aggregated to annual values	2110_root_biomass_annual.csv/pdf
2.1.11.	Root productivity	2111_root_prod.csv/pdf
2.1.12.	Root productivity aggregated to seasonal values	2112_root_prod_seasonal.csv/pdf
2.1.13.	Root productivity aggregated to annual values	2113_root_prod_annual.csv/pdf
2.2.	Mineral soil layers	
2.2.1.	Soil carbon and nitrogen including organic matter fractions	221_soil_carbon.csv/pdf
2.2.2.	Physicochemical soil properties from laboratory analyses	222_soil_phy_chem.csv/pdf
2.2.3.	Physicochemical soil properties from NIR-MIR spectroscopy	223_soil_spec.csv/pdf
2.3.	Organic soil layers	231_soil_organic_layer.csv/pdf
2.4.	Pu soil inventory	241_pu_inventory.csv/pdf
2.5.	Soil experiments	
2.5.1.	Incubation experiments	251_incubation.csv/pdf
2.5.2.	Microbial biomass and enzyme experiments	252_microbiology.csv/pdf
2.5.3.	^{14}C data from bulk soil and CO_2 measurements	253_c14.csv/pdf
2.6.	Parent material	261_rocks.csv/pdf
2.7.	Soil profile descriptions	271_profiles.csv/pdf
3.	**Cropland**	3_cropland.pdf
3.1.	Biomass & management	
3.1.1.	Biomass yield based on plot data	311_biomass.csv/pdf
3.1.2.	Land management data	312_management.csv/pdf
3.2.	Mineral soil layers	
3.2.1.	Soil carbon and nitrogen including organic matter fractions	321_soil_carbon.csv/pdf
3.2.2.	Physicochemical soil properties from laboratory methods	322_soil_phy_chem.csv/pdf
3.2.3.	Physicochemical soil properties from NIR-MIR spectroscopy	323_soil_spec.csv/pdf
3.3.	$^{239+240}Pu$ soil inventory	331_pu_inventory.csv/pdf
3.4.	Soil experiments	
3.4.1.	Incubation experiments	341_incubation.csv/pdf
3.4.2.	^{14}C data from bulk soil and CO_2 measurements	342_c14.csv/pdf
4.	**Meteorological data**	4_meteo.pdf
4.1.	Locations of meteorological stations	410_meteo_locations.csv/pdf
4.2.	Daily meteorological data from six meteorological stations	420_meteo_daily.csv/pdf
4.3.	High resolution 5 min triggered precipitation data	430_meteo_pcp_tig.csv/pdf