YOUNG SOIL SCIENTISTS DAY
BRUSSELS – MARCH 26, 2025

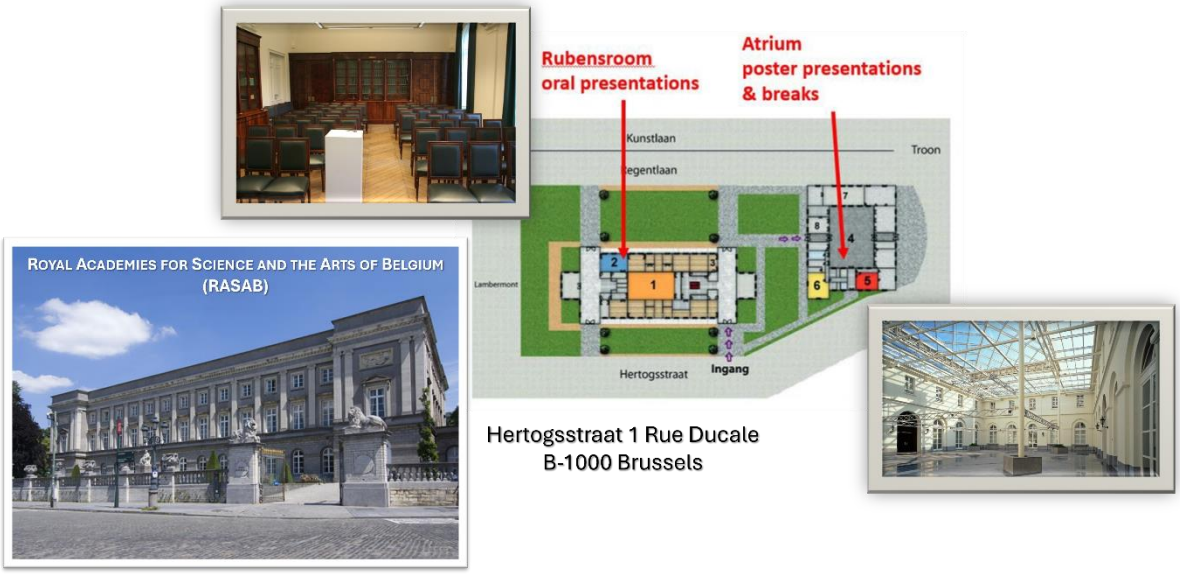
Abstract proceedings

Venue

Royal Academy of Sciences, Hertogsstraat 1 Rue Ducale, Brussels

Registration, poster presentations & breaks: Atrium – Throne Building

Welcome & oral presentations: Rubens Auditorium – Palace (ground floor)



Program

Program morning session

8.30 onwards	**Doors open**	
8.40-9.00	**Registration & poster set-up**	
9.00-9.10	**Welcome** President of SSSB – Stefaan Dondeye (VUB / ULiège)	
9.10-10.30	**Oral presentations**	
	9.10 - 9.30	Alain Kagisye (UCLouvain) – *Determinants of the physical and sensory quality of coffee in small-holder farms of Burundi*
	9.30 - 9.50	Alexander James (KU Leuven) – *Geomorphic control of peat age and extent in temperate floodplains*
	9.50 - 10.10	Rémy Willemet (ILVO / UGent) – *Mulch Type Matters: Quantifying the effects of mulch on potato crop development under wet conditions in Belgium*
	10.10 - 10.30	Abdellah Oumou (KU Leuven) – *Advancements in Spectral Technology for Assessing Soil Degradation in Morocco's Agricultural Lands*
10.30-11.30	**Coffee Break + Posters** (incl. poster tour start@10.40)	
11.30-12.30	**Workshop** Ramos Pamplona Marilou (ULiège) – *Effective science communication for early career researchers*	
12.30-13.30	**Lunch Break + Posters** (incl. poster tour start@12.40)	

Program afternoon session

13.30-14.50	**Oral presentations**	
	13.30 - 13.50	Sophia Findeisen (UAntwerpen) – *Silicate rock powder application: perspectives for the use as buffer restoration measure in acidified soils*
	13.50 - 14.10	Afework Ashagrie Simegn (KU Leuven) – *Estimation of suspended sediment concentration using satellite remote sensing data in the Lake Tana, Ethiopia*
	14.10 - 14.30	Joëlle Kilela Mwamba (ULiège) – *Characterization of trace metal contamination and performance of tree species on the Kipushi mine tailings in the Katangan Copperbelt, DR Congo*
	14.30 - 14.50	Melkamu Teshome Ayana (KU Leuven) – *Monitoring water and sediment delivery to Lake Abaya and Lake Chamo in the Southern Rift Valley Basin, Ethiopia*
14.50-15.50	**Coffee Break + Posters** (incl. poster tour start@15.10)	
15.50-17.10	**Oral presentations**	
	15.50 - 16.10	Jasper Roussard (UAntwerpen) – *Co-deployment of enhanced weathering and biochar for soil carbon sequestration*
	16.10 - 16.30	Sullivan Tsay Fofang (UGent) – *Landcover change amidst climate change and implications for soil erosion in the Lake Tana Basin (Ethiopia): Insights from 37 years of Earth Observation data*
	16.30 - 16.50	Fikirte Seyoum Demiss (KU Leuven) – *A combined field and remote sensing approach to assess spatiotemporal changes in vegetation cover for erosion modelling*
	16.50 - 17.10	Xin Li (ULiège) – *A Comparison of Sensitivity and Effectiveness of Soil Biological Indices for Soil Health Evaluation*
17.10-18.00	**Closing – announcing DYSS award winners 2025 – Drink**	

Poster Program – Morning break

10.40-11.15	**Poster presentations**	
	10.40 - 10.45	Glenn Desplentere (UGent) – *The effect of heavy rainfall on splash erosion*
	10.45 - 10.50	Tharaka Ravinda Premathilaka (UGent) – *Assessing Land Cover Dynamics and Soil Erosion Risks in the Tensift Watershed, Morocco: A 37-Year Earth Observation-Based Analysis*
	10:50 - 10.55	Pascal Sibomana (ULiège/INES-Ruhengeri) – *Effect of land use on soil moisture in a landslide prone tropical environment: field-based monitoring in Rwanda*
	10.55 - 11.00	Hannah De Cock (UGent) – *Geomorphological Mapping of the Virunga Volcanoes: A Comparison of Modern Remote Sensing and Aerial Photography*
	11.00 - 11.05	Ellen Timmermans (UGent) – *From Digital Elevation Models to 3D geomorphological maps for inclusive education of visually impaired students: exploring the Virunga volcanoes*
	11.05 - 11.10	Yibeltal Mekonnen (KU Leuven/Arba Minch University) – *Assessing crop desiccation effect due to gullies: Insights from farmers' perceptions and field monitoring in the southern main Ethiopian Rift*
	11.10 - 11.15	Antoine Anneessens (UGent) – *Mapping the geomorphology of the Lys River and its relevance to environmental management*

Poster Program – Lunch break

12.40-13.15	**Poster presentations**	
	12.40 - 12.45	Marie Tuerlinckx (UGent) – *The impact of soil organic matter on sorption of phosphate in acid sandy soils at different saturation degrees*
	12.45 - 12.50	Ludy Keino (KU Leuven/University of Eldoret) – *Layered Double Hydroxides as a Slow-Release Nitrogen Fertilizer*
	12.50 - 12.55	Lu Liu (ULiège/CAAS) – *The way and mechanisms of long-term multi-fertilization to improve soil acid buffering capacity*
	12.55 - 13.00	Xiaofang Ji (ULiège) – *High-C/N straw inputs lead to higher MAOM than low-C/N straws*
	13.00 - 13.05	Laxmi Moktan (KU Leuven/Czech University of Life Sciences) – *Forest management reduces soil carbon sequestration potential in European temperate forests*
	13.05 - 13.10	Keunbae Kim (KU Leuven) – *Mid-infrared spectroscopy as a tool to assess oxidative molecular damage to peatlands, and to infer restoration potential and vulnerability to future disturbances*
	13.10 - 13.15	Robin Tersago (KU Leuven) – *Greenhouse Gas Emissions from Grassland Mesocosms: Effects of Soil Texture, Biodiversity, and Cutting Frequency*

Poster Program – Afternoon break

15.10-15.40	**Poster presentations**	
	15.10 - 15.15	Joachim López (UCLouvain/KU Leuven) – *Tree stand communities are physically and chemically engineering their local environmental conditions*
	15.15 - 15.20	Lin Wang (UGent) – *Exploration of soil health change under treated wastewater irrigation*
	15.20 - 15.25	Kamarou-Dine Seydou (UCLouvain) – *Effect of 6-year of conservation agriculture practices on soil physical quality in cotton-based rotations in northern Bénin*
	15.25 - 15.30	Axel Cerón-González (VUB/KU Leuven) – *Historic Agricultural Terraces in the Mediterranean – A human-soil perspective through archaeological methods*
	15.30 - 15.35	Meihui Li (VUB) – *Interpreting the Urban Stratification Processes: An Integrated Soil Micromorphogical Study of Late Medieval Dark Earth at Broodstraat (Oudenaarde, Belgium)*
	15.35 - 15.40	Robin Beckx (UGent) – *Comparing Nematode Exclusion Methods in Soil Samples: Dry Heat vs Freezing-Thawing Cycles vs Gamma Irradiation vs Microwaving*

Abstracts of oral presentations

Determinants of the physical and sensory quality of coffee in small-holder farms of Burundi

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The quality of coffee in Burundi has been declining in recent years due to poor soil fertility, suboptimal agronomic practices, and adverse climatic conditions. This deterioration challenges the international competitiveness of Burundian coffee, reduces export revenues, and negatively impacts the livelihoods of thousands of small farmers. Therefore, urgent research and interventions are needed to optimize production and improve coffee quality for immediate sustainable growth. This study examines the impact of altitude, soil fertility, and plant health on both the physical and sensory quality of Burundian coffee.

A total of 147 coffee plots were selected, covering all coffee-growing regions of Burundi. Data on plot management were collected through a diagnostic survey, while soil and leaf samples were analyzed in the laboratory. Coffee cherries were also gathered for physical and sensory evaluations. Statistical methods including ANOVA, Spearman correlations, and linear and logistic regressions were used to assess the relationships between coffee quality, environmental parameters and cultural practices.

Results indicate that higher altitudes enhance coffee quality by lowering temperatures and extending berry ripening, which leads to denser beans with superior cup characteristics. Key soil fertility parameters, such as pH, nitrogen, phosphorus, and exchangeable bases, positively influence bean size and sensory quality. A balanced ratio of calcium, magnesium, and potassium is critical, as imbalances can degrade quality. Foliar phosphorus also improves sensory attributes, whereas excessive potassium or magnesium may lead to undesirable flavors. Additionally, diseases like coffee leaf rust and coffee berries diseases negatively affect bean composition by increasing bitterness, astringency, and metallic taste, while sweetness and citric acidity enhance sensory quality.

Effective nutrient management, disease control, and optimized growing conditions are essential to stabilize and enhance the quality of Burundian coffee, ensuring a more consistent and high-value product for the market.

Geomorphic control of peat age and extent in temperate floodplains

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The preservation and restoration of peatlands contributes to a range of ecological, hydrological and climate change mitigation goals. Peat stored in temperate floodplains are soil organic carbon (SOC) storage hotspots, but the factors controlling alluvial peat distribution, and its evolution remain poorly understood.

Here, we present recently derived field and laboratory analysis data from contrasting alluvial environments across Belgium. The environments vary in geomorphic setting, plant ecology and past trajectories of human disturbance. In terms of fluvial energy, these sites vary between high-energy systems in the upland Ardennes to low-energy systems in lowland Flanders.

The upland floodplain site's carbon storage totals 548.1 Mg C/ha, of which 43% is in peat soils. The lowland floodplain site SOC is 1425 Mg C/ha with peat providing 80% of the SOC stock.

There is also a striking variation in the age of the peat and carbon between both sites. The median carbon age in the upland site is limited to 491 years. This is due to recent re-wetting, rapid peat reformation and its relatively recent initiation (1400–3800 cal. BP). SOC was concentrated in the upper horizons and decreased with depth. In contrast, in the lowland site, the SOC median age is 7441 years and its concentration increases with depth due to recent drainage (last 100-200 years). Lateral channel activity is limited in these low energetic environments, preserving older peats, in contrast to higher-energy sites in which soils are re-worked.

Environmental changes in floodplains storing ancient carbon can release large stocks which cannot be replaced, unlike agricultural or forested areas that maintain a more dynamic equilibrium. In contrast, the recently re-wetted site demonstrates the rapid carbon-capturing capability of reviving an acrotelm layer.

Mulch Type Matters: Quantifying the effects of mulch on potato crop development under wet conditions in Belgium

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In Europe, future summers are expected to bring both droughts and periods of excessive rainfall, highlighting the need for adaptable agronomic strategies across varying climatic scenarios. While mulch is well-documented for its ability to reduce soil evaporation and enhance tolerance against drought, its effects under wet conditions remain unclear.

In this study, we investigated the efficacy of three types of organic mulch - hay, miscanthus, and woodchips - for potato cultivation (Solanum tuberosum L.) during the wet summer of 2024 in the Flemish region of Belgium. Mulch was applied as a 6-cm layer on a sandy loam field. To gain insights into the impact of mulching on soil processes and crop development, we measured soil water content, matric potential, temperature, microbial activity, nitrogen in both soil and plant, and crop growth through a combination of manual and UAV measurements.

At the final harvest, the average tuber yields under hay and miscanthus treatments were 33.2±3.0 t/ha and 29.2±4.5 t/ha, respectively, surpassing the control group yield of 28.1±3.3 t/ha. In contrast, the woodchip treatment resulted in a lower tuber yield of 24.4±4.4 t/ha. The best-performing mulch thus led to an 18% increase in tuber yield, while the worst-performing mulch induced a 13% decrease compared to the control treatment.

In addition to the soil temperature buffer effect of the mulch layer, we assume that rapidly decomposing mulches provided a nitrogen boost, thereby enhancing crop growth. In contrast, slowly decomposing materials may have caused nitrogen immobilization, reducing crop development and yield compared to the control group. To validate our hypothesis, we developed a structural equation model to quantify the direct and indirect effects of the mulch type.

Advancements in Spectral Technology for Assessing Soil Degradation in Morocco's Agricultural Lands

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The advancement of sensor technology, particularly in spectral imaging and soil spectroscopy, has provided innovative means for assessing soil characteristics across spatial and temporal scales. This study investigates soil degradation in two different climatic, arid and semi-arid, regions of Morocco, an area that has experienced a succession of years of drought since 2016. The combination of excessive agricultural practices and the aridity of the climate has significantly contributed to soil degradation, exacerbating the challenges faced by the region. Through a combination of field and spaceborne spectral measurements, the research integrates spectral signature analysis with machine learning models to assess soil degradation in this changing climate.

Fieldwork has been started, with soil samples collected from diverse landforms. The spectral signatures of these samples were recorded using the MS-720 Portable Spectroradiometer (350 - 1,050 nm) in the visible and near-infrared ranges. To analyze the impact of soil moisture on spectral properties, moisture content was measured, and spectral signatures were recorded both before and after drying the soil samples. In addition to field spectroscopy, PRISMA hyperspectral satellite imagery is being analyzed for large-scale soil assessment, with 234 spectral bands VNIR (1 - 66 bands) and SWIR (66 - 234 bands) in a continuum of spectral bands ranging from 400 to 2500 nm.

The collected spectral data will be processed to establish correlations between soil characteristics and spectral responses, aiming to develop predictive models using machine learning techniques.

By integrating spectral imaging and advanced modeling, this research aims to enhance soil-water productivity assessment and provide a scalable approach for monitoring soil health. The findings will contribute to sustainable land and water resource management, offering insights into agricultural adaptation strategies in response to climate change.

Silicate rock powder application: perspectives for the use as buffer restoration measure in acidified soils

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Soil acidification, driven by elevated atmospheric deposition of acidifying compounds, threatens plant and soil biodiversity in European heathlands. Slow-release silicate rock powders (SRPs) are being explored as a mitigation strategy by enhancing soil pH and base saturation. We compared the effects of SRP and liming on soil chemistry, the soil microbiome, and vegetation with an untreated control, 5 years after application. We established 40 plots, equally divided across a wet and a dry acidified heathland, where we setup four treatments in a randomized block design: the application of 4 metric ton/ha Dolokal (liming), 10 metric ton/ha Biolit (SRP, chlorite/muscovite concentrate), 10 metric ton/ha Soilfeed (SRP, K-feldspar/biotite concentrate), or no application. With the used doses, we applied an acid neutralizing capacity (ANC) of approximately 70 keq/ha (Dolokal), 35 keq/ha (Biolit), and 10 keq/ha (Soilfeed). Dolokal had the strongest effects on soil chemistry, increasing soil pH by about 1 unit and base saturation by 49 and 65%, with the largest effects in soils with low cation exchange capacity. Of the SRPs, only Biolit increased base saturation significantly by 10–20%. All treatments significantly reduced exchangeable Al^{3+} and thereby soil Al:Ca ratios, and subtly changed vegetation composition. Despite the effects on microbial communities being subtle, treatments favoured saprotrophic fungi, which increased by up to 20% in the wet site. The latter trend, however, did not result in lower quantities of soil organic matter, nor did it lead to changes in soil C:N ratios While our findings indicate that SRPs have the capacity to gradually enhance soil quality in acidified heathlands, the magnitude of these effects is found to be highly context dependent.

Estimation of suspended sediment concentration using satellite remote sensing data in the Lake Tana, Ethiopia

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Soil erosion by water results in on-site land degradation and off-site problems such as lake sedimentation impacting aquatic ecosystems. Up-to-date information on soil erosion and sediment delivery rates is indispensable to manage their adverse impact, yet such data is lacking for many river systems, in particular in developing countries. The advent of satellite remote sensing applications has provided the opportunity to monitor sediment fluxes at low cost and for less accessible regions and thus may provide a cost-effective alternative to ground-based sampling schemes. However, satellite-based approaches require calibration and validation as the relation between suspended sediment concentration (SSC) and optical properties of the water recorded by satellite sensors vary with changing sediment properties.

Here, we use empirical models to estimate SSC values from sentinel 2 data for Lake Tana in Ethiopia using in situ collected water samples and reflectance data, which were measured using an ASD Field Spec 4 spectroradiometer instrument. SSC and in situ reflectance measurements were conducted for 750 water samples collected from the lake, particularly from the river plumes of the two most important rivers draining to Lake Tana, i.e. Gumara and Gilgel Abay. Observed SSC values ranged between 0 and 4 g/L. The individual bands in the NIR spectrum exhibited a good correlation (R2 = 0.79, RMSE = 0.296 g/L) for all ranges of SSC-values over Lake Tana. Moreover, the multilinear regression (MLR) analysis using both the visible and NIR bands improved results compared to using individual bands (R2 = 0.87, RMSE = 0.149 g/L).

The established relations between optical properties and field-based SSC values will be applied to long-term timeseries of optical data to assess the temporal variations in sediment concentration in rivers draining to Lake Tana, and in Lake Tana itself.

Characterization of trace metal contamination and performance of tree species on the Kipushi mine tailings in the Katangan Copperbelt, DR Congo

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The southern DR Congo is caracterized by the presence of the Katangan Copperbelt, which is a copper and cobalt rich deposit exploited since the early 20th century. This area is considered as a metropolis of copper metallurgy due to the intensity of mining activities conducted. Unfortunately, these activities generate various types of mine waste that are not managed rationally, causing serious contamination of the environment with high impacts to human health. This study aimed to characterize the contamination soil at Kipushi tailing park and in the tree experiment assisted with amendments installed to evaluate the performance of species for the phytostabilisation of mine tailing soil. After laboratory analysis, it appears that vertically, the trace metal content was higher in the first and second layer (0-15 and 15-36 cm) than in deeper layer with average of total Cu content of 15154-2968 mg kg^{-1} and 1235-203 mg/kg^{-1} for Pb. Metal contamination from tailings increased in the amended rhizosphere 4 months after tree planting; the average of Cu and Zn content in the amendment was 1474 mg kg^{-1} and 2731 mg kg^{-1} before application, 4 months later the average content increased to 3074.5 mg kg^{-1} and 3813.4 mg kg^{-1} respectively. The amendments applied to improve tree performance on mine tailings were the urban waste soil and black soil. *Albizia lebbeck* and *Acacia polyacantha* had an average height of 188.3 cm and 151 cm with urban waste soil, whereas it was 108.5 and 97 cm with black soil respectively. This trend was repeated on the rest of tree species 13 months after planting. Our result shows that the use of urban waste soil as amendment can promote better tree growth and cost minimization as it is free of charge and can be a good strategy for easy reclamation of mine tailings in the Katangan Copperbelt.

Keywords: metal, amendment, pollution, mine tailings, tree performance

Monitoring water and sediment delivery to Lake Abaya and Lake Chamo in the Southern Rift Valley Basin, Ethiopia

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Human activities such as deforestation accelerate runoff and soil erosion, leading to land degradation and excessive lake sedimentation. Climate change further exacerbates erosion, threatening the sustainability of natural lakes. This is evident in the tropical lakes of Abaya and Chamo in the Ethiopian Rift Valley, where high rainfall, steep slopes, and population growth contribute to rapid sedimentation and coastal flooding.

To assess these impacts, seven monitoring stations were established across four rivers: Bilate (5480 km²), Elgo (298 km²), Kulfo (467.2 km²), and Shafe (191 km²) covering about 40% of the lakes' drainage area. Streamflow (Q) was recorded at 10-minute intervals using T-divers and Barometric divers to monitor water and barometric pressures respectively. We analyzed 3563 suspended sediment concentration (SSC) samples, with SSC ranging from 0.08 to 129.4 g/l and discharge between 0.01 and 429 m³/s. Sediment rating curves, relating SSC to Q, were established to estimate continuous sediment loads for the gauged rivers. Preliminary results show that Bilate contributes 67% of the sediment load, though the three smaller catchments draining the Gamo highlands experience higher net erosion rates when normalized by catchment area. Seasonal variations show peak sediment transport in May-June for the highland catchments when vegetation cover is low, while Bilate peaks in August-September, in line with the main rainy season in this catchment.

The integration of satellite-derived NDVI, rainfall erosivity data, and timeseries of SSC and discharge enables to identify periods and areas of enhanced erosion and sediment delivery to the lakes. Such spatiotemporal information can be used to calibrate and validate erosion models, which in turn can simulate the impact of management scenarios on lake water and sediment budgets.

Co-deployment of enhanced weathering and biochar for soil carbon sequestration

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To minimize climate change to 2 °C, as decided upon in the Paris Agreement, active atmospheric CO2 removal is needed via so-called carbon dioxide removal (CDR) technologies. Enhanced weathering (EW) of silicate minerals is a promising CDR technology based on the natural process of rock weathering. EW aims to accelerate the slow natural weathering rates by crushing silicate rocks to powder and applying it on soils. As silicates weather, they react with CO2 to form bicarbonates that can either leach out to the oceans or precipitate in the soil as carbonates. Because of potential co-benefits for soil health (e.g. nutrient release and improved water retention), EW is attractive to be applied on agricultural soils. Biochar is another promising CDR technology that can be obtained by pyrolyzing biomass. Biochar is rich in stable carbon and when applied on soils, a large fraction can persist for long periods of time without being decomposed back to CO2. Moreover, biochar can increase soil health for example by increasing nutrient and water retention.

Co-deployment of EW and biochar carries great potential to increase CDR efficiency in agriculture. Furthermore, potential synergies can be hypothesized. In example, biochar can attract EW reaction products, thereby potentially preventing weathering rates to slow down because of saturation in the soil porewater. Despite its potential, co-application of EW and biochar has been rarely studied.

To study potential interactions between EW and biochar, a leaching experiment was setup in which soil was mixed with silicates and biochar in a full factorial design. Rainwater was added daily on the soil columns. The water that percolated through the soil mixture was captured and sampled for chemical analysis. Our results revealed an effect of biochar on EW rates. Detailed results will be discussed during the presentation.

Landcover change amidst climate change and implications for soil erosion in the Lake Tana Basin (Ethiopia): Insights from 37 years of Earth Observation data

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Soil erosion in the Lake Tana Basin, Ethiopia, is influenced by land use/land cover (LULC) changes and climate variability, yet their long-term combined effects remain underexplored. This study assesses how shifts in LULC and rainfall patterns from 1985 to 2022 have impacted soil erosion. Using remote sensing data, we quantify LULC transformations, evaluate rainfall trends, and estimate potential soil loss, highlighting risks to soil erosion.

LULC dynamics were analyzed using the Global Land Cover Fine Classification System (GLC_FCS30D), while rainfall trends were assessed using CHIRPS-v2 data. Soil erosion estimates were derived from the Revised Universal Soil Loss Equation (RUSLE). GLC_FCS30D classifications had overall accuracies of 77.3% (2005), 80.2% (2014), and 80.3% (2022). Cropland expanded slightly from 32.9% to 33.3%, while tree cover declined from 31.2% to 27.8% before recovering to 29.9%. Rainfall increased by 2.92 mm yr^{-1}, with high spatial variability, and rainfall erosivity rose by 1.25 MJ mm ha^{-1} h^{-1} yr^{-1}.

Despite modest LULC and rainfall changes, their effects on soil erosion were substantial. Potential soil loss increased by 0.9% from 1985 to 1995, decreased slightly (0.12%) from 1995 to 2005, and dropped 2.3% between 2005 and 2015 before rising sharply by 8.2% from 2015 to 2022. The results highlight increasing erosion risks, driven by intensified rainfall erosivity and LULC changes. Integrated land management and climate adaptation strategies are essential to mitigating soil degradation. Targeted conservation efforts, such as reforestation and sustainable land use, can enhance ecosystem resilience and safeguard agricultural productivity. Our results underscore the importance of considering the combined effects of LULC change and climate change in studies assessing the impact of climate change on soil erosion.

A combined field and remote sensing approach to assess spatiotemporal changes in vegetation cover for erosion modelling

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Water erosion in African tropical mountain regions caused by intensive land use may lead to severe land degradation that not only reduces crop productivity, but also results in increased sediment delivery to rivers and lakes. In order to mitigate the erosion problem, a detailed understanding of the driving factors, and the spatio-temporal patterns in erosion rates is key. These data are required to run spatially distributed erosion models that can simulate the impact of various management scenarios, yet are often missing for tropical mountain environments like the southern Ethiopian highlands. Indeed, typical soil erosion models require an assessment of the vegetation cover, and most model applications use standard tabulated values that are not region-specific and are thus not representative for the spatio-temporal vegetation developments. New developments using remote sensing provide an opportunity to better parameterize the crop management factor in widely used erosion models such as RUSLE or WaTEM/SEDEM.

In this study, we use Sentinel 2 optical data to assess the changing erosion risk and cover management factor in Gamo Highlands (Charcharo, 145ha and Zaga, 87ha). We have digitalized all the crop parcels and collected 1538 field observations of vegetation cover for different fields and crop types throughout the year. The Charcharo catchment is dominated by grazing land, with barley and potato as primary crops, while Zaga catchment is mainly agricultural land with maize, sorghum and teff as dominant crops. Additionally, we measured NDVI values for 264 field parcel-crop combinations using a crop sensor. These field-based observations were used to correct the satellite-based time series. These time-series show that in particular during the first rainy season (April-May), crop cover is very low and the erosion risk high, whilst vegetation cover is higher in the second rainy season (October-November). These time-series will be used as input to the erosion model.

A Comparison of Sensitivity and Effectiveness of Soil Biological Indices for Soil Health Evaluation

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It is widely recognized that quantifying soil health is crucial, not only for assessment but also as a tool to guide management strategies. Given the significant impact of microbes and microbial processes on various aspects of soil health, microbial indicators have been widely applied to assess soil health. However, many of these pre-existing microbial measurements are not easy to interpret and may not necessarily provide credible inferences about soil health status.

In this study, we sampled soils from 11 long-term fertilization experiments in different climate zones in China, including different fertilization strategies. Carbon quality and activity indicators, microbial community, enzyme activities, and functional gene were integrated into four indices respectively and compared for the sensitivity and effectiveness. All the biological indicators showed high sensitivity to various management practices. Carbon related enzymes and saprophytic fungi were more sensitive among all the indicators. Enzyme activity index (EA-index) and microbial community index (MC-index) were more sensitive to management practices. Functional gene index (FG-index) showed a large coefficient of variation, indicating its instability during the determination. Besides, MC-index and EA-index were sensitive to soil health change, since the rate of change in these indices exceeded that of the changes in soil health. MC-index and C-index were two main explanatory factors and main contributors of carbon cycling, nutrient cycling, and crop productivity functions. These two indices were also highly correlated to soil functions. MC-index and C-index are deeply influenced by factors such as management practices, inherent soil properties and climatic conditions, which meant they were interpretable and informative to soil health.

Overall, the MC-index and C-index were sensitive to management practices and could provide a more detailed and mechanistic understanding of soil functions than conventional indicators. With these two indices, soil health and soil functions can be evaluated effectively by capturing the biochemical processes.

Abstracts of poster presentations

The effect of heavy rainfall on splash erosion

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Splash erosion represents the initial stage of soil erosion by water. Understanding the relationship between rainfall erosivity parameters (kinetic energy, intensity) and splash erosion is crucial for improving our knowledge of soil erosion processes, especially, in the context of climate change, which is expected to increase the frequency of intense rainfall events. However, rainfall erosivity parameters are rarely studied under natural rainfall conditions.

This study was conducted in Lemberge, Belgium, on an experimental field of the ILVO institute. The site is equipped with an optical laser disdrometer (OTT Parsivel2), enabling the calculation of rainfall erosivity parameters. On three 1 m² plots, holes were drilled in the soil, to insert bottles with funnels to capture splash erosion. The captured sediment was collected weekly or after a significant rain event. The data collection started in August 2024. A unique aspect of this research is the close spatial proximity (2 meters) of the disdrometer and the 12 funnels which measure the splash erosion.

During rainfall events, both rainfall parameters and splash erosion amounts were recorded. To identify the parameter that best explains splash erosion, regression analyses were performed between rainfall parameters and the measured splash erosion. Up until present, a total of 11 rainfall events were analyzed and the study is still ongoing. Preliminary results indicate that total and maximum kinetic energy showed a weak correlation with splash erosion rates. In contrast, stronger correlations were found when using average kinetic energy or kinetic energy normalized by rainfall amount.

Assessing Land Cover Dynamics and Soil Erosion Risks in the Tensift Watershed, Morocco: A 37-Year Earth Observation-Based Analysis

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Land use/land cover (LULC) changes and climate variability significantly impact soil erosion, yet their combined long-term effects are often underexplored. Using remote sensing data, this study investigates the changes in LULC and rainfall trends from 1981 to 2023 in the Tensift Basin, Morocco, and their implications for soil erosion. The Global Land Cover Fine Classification System (GLC_FCS30D) data is employed to analyze LULC dynamics, CHIRPS-v2 data is utilized to assess rainfall variability, and the Revised Universal Soil Loss Equation (RUSLE) is applied to estimate potential soil erosion. The accuracy assessment for LULC classification shows an overall accuracy of 88.1% in 2022, 83.4 % in 2015, and 79.5 % in 2005. The Cropland area increased by 15.9 %, while forest decreased from 2.7% to 1.6 %. Forest loss converted to shrubland (22.5 %), and bare lands expanded into cropland by 7.2 %.
Overall over the watershed, for the periods 1985-2000 to 2001-2022 the average annual rainfall increased with 72 mm/year, and rainfall erosivity rose by 121 MJ mm ha−1 h−1 yr−1. The cumulative impact on potential soil erosion was considerable, despite relatively minor variations in rainfall and land cover across different periods. The Tensift watershed exhibited significant spatial and temporal variability in soil loss. Between 1985 and 1995, potential soil loss increased by 4.4%, followed by a decrease of 11.8% between 1995 and 2005. However, soil loss escalated sharply by 54 % between 2005 and 2015 and continued to rise by 36% between 2015 and 2022, highlighting the influence of changing environmental conditions. This study enhances our understanding of landscape dynamics in the Tensift Basin by clarifying the relationships among soil erosion, rainfall variability, and land cover changes over nearly 37 years. Emphasizing the importance of temporal rainfall variability, it provides insights to guide targeted soil conservation, promote sustainable land management, and strengthen ecosystem resilience in tropical regions.

Keywords: CHIRPS, LULC changes, RUSLE, Global Landcover, rainfall erosivity

Effect of land use on soil moisture in a landslide prone tropical environment: field-based monitoring in Rwanda

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Rainfall-triggered shallow landslides often affect the mountainous regions of Rwanda, posing a significant hazard. Recent studies in the region indicate that landslides predominantly occur at the end of the wet season, when soil moisture (SM) levels are highest. Overall, elevated SM contents are widely recognized as a key factor leading to slope instabilities. However, apart from (antecedent) rainfall conditions, SM content depends on a wide range of factors, including soil and land cover/management characteristics. Due to the important demographic pressure, Rwanda experiences significant changes in land use/management, including deforestation and the construction of agricultural terraces. These changes are likely to have an effect on SM conditions and, by extension, landslide hazard. However, very few quantitative observations on SM exist, especially for regions influenced by a tropical climate. As a result, also the factors controlling SM remain poorly understood.
To help bridging this gap, this research analyzes the dynamics of soil moisture in relation to various environmental factors. For this, we conducted daily SM measurements for a period of 3 years along six hillslope transects on two different soil types (i.e., clayey or sandy loam) and three different land managements (i.e., forested, cultivated without agricultural terraces & cultivated with agricultural terraces).

Our results, based on 195,026 individual SM observations, indicate an important variation in SM values with respect to soil depth, soil texture, rainfall and land use types; clayey soils exhibit overall higher moisture content compared to the sandy loam soil. The impact of land use and management practices varies between clayey and sandy loam soils. For example, at depths of 100 cm, sandy loam soils under forests are typically much drier than cultivated ones. However, these effects are clearly less pronounced under clayey soils. Meanwhile, clayey soils show more important lag times between antecedent rainfall and soil moisture. Also, the effect of terracing seems to differ between both soil types; SM being increased in sandy loam soils. Overall, these findings show the complexity of SM dynamics in relation to different environmental factors, underscoring the significance of accounting for soil texture and land management practices in enhancing landslide early warning systems and other disaster risk reduction strategies.

Geomorphological Mapping of the Virunga Volcanoes: A Comparison of Modern Remote Sensing and Aerial Photography

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The Virunga volcanoes, spanning DR Congo, Rwanda, and Uganda, are home to mountain gorillas. In the 1960s, Monique Degroote studied their geomorphology using aerial photographs. While subsequent research examined geology, geomorphology, and soils, an updated synthesis is lacking. We compared insights from digital elevation models and satellite imagery with Degroote's study to create an updated geomorphological map.

First, we identified terrain units using a 12.5 m resolution digital elevation model (ALOS PALSAR). Recent lava flows were mapped via Harmonized Sentinel-2 MSI satellite images. Integrating these with geological data, we produced a comprehensive geomorphological map. Finally, we compared our findings with Degroote's aerial photo analysis.

Using the Iwahashi and Pike method, we identified 16 broad terrain classes, further subdivided based on landforms classified via the Topographic Position Index. Satellite imagery enabled mapping of recent lava flows. The resulting geomorphological map illustrates the Virunga volcanoes' structures and landforms.

Comparing remote sensing data with Degroote's aerial photographs revealed differences in resolution, accuracy, and temporal aspects. While aerial photos provided fine spatial details, modern remote sensing and GIS tools improved accuracy across the entire region. Multitemporal satellite imagery also allowed tracking of recent changes, such as lava flows. These insights enabled us to draft an updated geomorphological map of the Virunga volcanoes.

From Digital Elevation Models to 3D geomorphological maps for inclusive education of visually impaired students: exploring the Virunga volcanoes

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Understanding geomorphology, tectonics, and volcanism is essential for grasping Earth's processes. However, geography classes pose challenges for visually impaired students due to their reliance on visual aids like maps and graphs. Using a geomorphological map of the Virunga volcanoes, we explored how 3D models and tactile maps with 3D features can enhance inclusive education.

We created 3D models using a 12.5 m resolution digital elevation model (ALOS PALSAR) and developed a tactile version of the geomorphological map with braille codes and a legend. These tools were tested in secondary school lectures with both visually impaired and sighted students.

The integration of 3D models and tactile maps helped visually impaired students better understand complex geomorphological concepts. Tactile maps provided a hands-on way to explore volcanic features, including shield and stratovolcanoes, rift formations, and hilly terrains. Meanwhile, 3D models enhanced engagement and participation for all students, promoting inclusivity.

Despite their benefits, preparing and utilizing tactile materials required significant attention to detail and additional educator training. These findings highlight the potential of 3D models and tactile maps in breaking learning barriers and fostering inclusive education in earth sciences. Further research is needed to refine these tools and expand their use in secondary school curricula.

Assessing crop desiccation effect due to gullies: Insights from farmers' perceptions and field monitoring in the southern main Ethiopian Rift

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The Shafe catchment is, like many regions along the main Ethiopian Rift, severely affected by gully erosion. Previous studies elsewhere suggest that gullies can lead to reduced crop productivity in nearby farmlands, including through decreased soil moisture availability. Nonetheless, the extent of this effect remains overall poorly understood and quantified. This research aims to quantify the potential crop yields reductions due to the presence of gullies in Shafe catchment and understand the causing mechanisms.

We interviewed 171 randomly selected farmers, each owning at least one gully-affected plot, to assess their perceptions of crop yield reductions due to gullying. Furthermore, we measured crop yields for sorghum, wheat, and haricot beans over two cropping seasons on 1 x 1m plots, located at 1, 5, 10, 20, and 40 m from the gully edge. We also collected composite soil samples to assess potential soil fertility differences along the transects. In addition, we conducted daily soil moisture measurements along two farmed transect and at six depths, using access tubes and PR2/6 profile probe measurements.

Preliminary results show that 85.6% of farmers observed faster crop drying near gullies, particularly within 10 m from the gully edge. Measurements confirmed that soil moisture was indeed often higher at greater distances from the gully edge. Nonetheless, great differences between fields appear, with the largest gradient observed along more sandy soils. These soil moisture variations correspond with the observed crop yield trends, which generally increased with distance from the gully edge. Among the crops sampled, sorghum showed the greatest sensitivity to gully proximity, with its yield being significantly lower at 1 m from the gully edge (0.09 ± 0.06 kg/m²) compared to 20 m (0.35 ± 0.16 kg/m²) and 40 m (0.45 ± 0.17 kg/m²). These preliminary results underline the significant impacts of gully erosion on crop productivity.

Mapping the geomorphology of the Lys River and its relevance to environmental management

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Lowland river environments typically exhibit minimal landform demarcation, making their geomorphological mapping challenging. This study utilizes a high-resolution 1-meter Digital Elevation Model (DEM) to visualize topography relative to river height, supplemented by thematic maps and terrain observations, such as soil augerings, to create a large-scale (1:50.000) geomorphological map. The map explicitly addresses mapping uncertainties, allowing targeted improvements. Based on the valley morphology and small-scale landforms, such as point bars, oxbow lakes, river dunes, and natural levees, four geomorphic sections are identified. Beyond traditional reliance on soil data, this method provides a more comprehensive framework for river restoration and geo-archaeological research. Focusing on the Lys River in Belgium, where river restoration is a policy priority, this study underscores the value of large-scale geomorphological mapping, facilitated by high-resolution DEMs. To enhance usability, the map is available as an interactive online resource for stakeholders.

The impact of soil organic matter on sorption of phosphate in acid sandy soils at different saturation degrees

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Phosphorus (P) is a vital macronutrient for plant growth, yet its availability in soils is often constrained by adsorption and immobilization processes. In lighter textured acid soils, pedogenic Fe and Al oxyhydroxides are the principal sorbents for both soil organic carbon (SOC), as well as ortho-phosphates. Therefore, the presence of either one of these compounds may influence the ability for sorption of the other onto these mineral binding sites. Our research aimed to understand to what extent SOC content would influence phosphate sorption dynamics and further test the hypothesis that the SOC-phosphate competition increases with higher degree of phosphorus saturation (DPS).

To investigate this, 50 agricultural fields were selected from a large dataset of over 3,000 sandy-acid agricultural soils in Flanders, collected in 1995-1997. These fields were chosen for their consistent pH, clay content and phosphate sorption capacity (PSC), while varying in SOC content. The soils were categorized into two DPS ranges: a 'low' DPS-class (23-45% DPS) and a 'high' DPS-class (58-85% DPS).

Phosphate batch sorption experiments were conducted on these soils to determine the amount of phosphate sorbed by the soil. The results were then used to create Langmuir isotherms. A general trend was observed where an increase in carbon content corresponded to a decrease in the amount of phosphate sorbed by the soil, although this trend was not statistically significant. However, the content of OC sorbed onto poorly crystalline Fe and Al oxyhydroxides may instead prove a better predictor for phosphate sorption. Quantification of this mineral-bound C is challenging and requires an adapted extraction scheme over the standard NH4-oxalate extraction method. Therefore, we are now testing an alternative hydroxylamine extraction and TOC analysis, expecting a closer adverse relation between SOC associated with poorly crystalline Fe and Al oxyhydroxides and phosphate sorption parameters.

Layered Double Hydroxides as a Slow-Release Nitrogen Fertilizer

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Nitrogen (N) is a vital element for plant nutrition, hence nitrate fertilizers (e.g. calcium nitrate) are often applied to overcome deficiencies and low crop yields. However, while soluble nitrate fertilizers readily supply N, they often have a low N use efficiency (NUE) due to nitrate leaching. Therefore, our research examines Ca/Al and Mg/Al layered double hydroxide (LDH) minerals as potential slow-release nitrate fertilizers. LDHs with varying M^{2+}/M^{3+} ratios (2, 3, and 4) were synthesized using coprecipitation and hydrothermal methods. Conventional coprecipitation LDH synthesis uses expensive soluble metal salts, hence we hypothesize that hydrothermal conditions can convert soluble calcium nitrate fertilizer (in combination with low-cost gibbsite and quick lime) into nitrate-LDH fertilizer. Obtained samples were characterized by X-ray diffraction (XRD) and inductively coupled plasma optical emission spectrometry (ICP-OES). XRD confirmed the identity of nitrate-intercalated LDH, with the d_{003} basal spacing ranging from 7.71 to 8.73 Å, accommodating nitrate anions in a flat-lying to a tilted position. For the coprecipitation synthesis, Mg/Al LDHs exhibited broader d_{003} peaks compared to Ca/Al LDHs, possibly due to a more disordered interlayer anion population. The anions in the Ca/Al LDH may be arranged perpendicular to the hydroxide sheets, resulting in sharp, intense peaks. The N content was 3.8% for Mg_3Al, 3.6% for Mg_4Al, and 3.50% for Ca_4Al LDHs synthesized by the coprecipitation method. The percentage of nitrate-N captured by the LDHs during the hydrothermal synthesis ranged from 83.31% in Ca_4Al to 95.51% in Ca_3Al, indicating that most of the soluble nitrate supplied during synthesis was effectively converted into LDH-nitrate. Further research is ongoing to test the nitrate release from LDH in soil conditions and the NUE of this new N fertilizer in plant growth trials.

KEYWORDS: *Nitrogen, Layered Double Hydroxide (LDH), Nitrogen-use efficiency, slow-release fertilizer.*

The way and mechanisms of long-term multi-fertilization to improve soil acid buffering capacity

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Soil pH buffering capacity (pHBC) plays crucial role in determining soil resistance to acidification. Long term manure fertilization is known to improve soil pHBC by increasing soil organic matter (SOM), but the intrinsic mechanisms of this effect have not been well explored. Here, a long term fertilization experiments was carried out since 1981, including: i) CK; ii) F, chemical fertilizer; iii) FG, F plus green manure in early rice; iv) FG+S, FG plus straw in winter; v) FGM, FG plus pig manure in early rice; vi) FG+M, FG plus pig manure in late rice; vii) FG+M+S, FG plus pig manure and straw in late rice, respectively. The results indicated that the soil pHBC in FG+M and FGM treatment was increased by 30.55% and 27.82% compared with F treatment, while no significant difference between F and FGS treatment, resulting from the decreased SOM and exchangeable base ions. And FTIR result showed that compare with straw application, pig manure could increase the pHBC through improving the process of protonation of organic anions from the dissociation of weakly acidic functional groups on soil humic acid, thereby increasing the release of base ions. Besides, the organically complexed Al content in FG+M treatment was 5.21% higher than that in FG+S treatment, leading to a reduction in the release of exchangeable $Al^{3+}$and consequently mitigating soil acidification. The findings of this study are significant in understanding the effect of soil organic matter in mitigating soil acidification through long-term muti-fertilization.

High-C/N straw inputs lead to higher MAOM than low-C/N straws

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The formation of mineral-associated organic matter (MAOM) from plant litter decomposition is pivotal for climate change mitigation. However, the way in which plant litter of varying qualities influences MAOM formation and decomposition, particularly regarding the quantity of litter inputs, remains largely unclear. This study aimed to determine how the quality of straw (high-C/N (low-quality) wheat (Triticum aestivum L.) versus low-C/N (high-quality) milk vetch (Astragalus sinicus L.)) and its quantity (input level) affect MAOM formation and decomposition. We conducted a 420-day laboratory incubation experiment using low-quality wheat versus low-C/N milk vetch straws added to artificial soil (pure quartz vs. soil with reactive minerals (sandy soil: 5% clay, 10% silt, and 85%)) at input levels of 0, 3, 6, 18, 26, 31, and 35 g C kg-1 soil. Contrary to the Microbial Efficiency-Matrix Stabilization theory, our research indicates that adding high-C/N wheat straw addition led to a significantly greater MAOM content than milk vetch. Notably, the MAOM stabilization efficiency declined at high input levels (26, 31, and 35 g C kg-1 soil) for wheat than for milk vetch. This is further supported by the evidence that reactive minerals slowed the decomposition rate of high-C/N wheat straw more effectively than that of low-C/N milk vetch. Moreover, the lower C:N ratio of the MAOM fraction, the reduced C:N ratio of dissolved organic matter (DOM), and a higher fluorescence index of DOM after adding wheat straw than adding milk vetch straw suggest the significant role of plant-derived organic matter in MAOM formation. Our findings disclose that reactive minerals preferentially protect high-C/N litter over low-C/N litter through direct interaction with plant-derived organic matter, providing a critical pathway for MAOM formation distinct from microbial assimilation. This study highlights the key role of high-C/N straw in the efficient and long-term stabilization of soil C within agricultural practices.

Forest management reduces soil carbon sequestration potential in European temperate forests

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In recent years, the carbon (C) balance of temperate forests has been the focus of growing research interest, as even European temperate forests have shown potential to serve as effective CO2 sinks. However, almost all the attention has predominantly focused on the aboveground biomass of the trees, while C accumulated in forest soils has largely been neglected. This study provides a comparative quantitative assessment of total C stored in the forest soils subjected to varying degrees of human influence, highlighting their role in the overall carbon budget in the temperate forests of Central Europe. We found that soil C stocks in unmanaged forests, with likely low or no human influence in the past, generally exceed those in adjacent managed forests. However, some unmanaged forests, despite being protected for several past decades, did not achieve soil C stocks comparable to those of adjacent managed forests likely due to prior severe human exploitation. Soil C stocks (down to 40 cm of mineral topsoil) in managed forests ranged from 1117 g/m2 to 2058 g/m2, while in unmanaged forests, they ranged from 774 g/m2 to 3490 g/m2. Among different soil horizons, humus layer (FH), and 0-10cm, 10-20cm, and 20-40cm of mineral soil, the upper mineral soil layer (0-10 cm) contributed most to C stocks (32% to 47%). In conclusion, forests that have remained unmanaged with little to no historical human impact tend to store significantly more soil C than recently managed forests. Therefore, it is crucial to assess how forest management practices affect soil C sequestration to prevent forests from transitioning from carbon sinks to carbon sources.

Keywords: Soil organic carbon, forest soil, carbon sink, soil profiles, forest management practices.

Mid-infrared spectroscopy as a tool to assess oxidative molecular damage to peatlands, and to infer restoration potential and vulnerability to future disturbances

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Peatlands are crucial components of the global carbon (C) cycle, but have been significantly degraded by drainage. Rewetting is a common practice to restore drained peatlands, yet its effectiveness and impact on belowground soil organic carbon (SOC) dynamics remain uncertain. To effectively monitor the success of these management practices, affordable, time-efficient, and sufficiently informative tools are essential. Pyrolysis-gas chromatography and mass spectrometry (py-GC/MS) is a powerful technique for characterizing the complex SOC, but its high cost, time-intensive nature, and technical complexity limit its routine use. In contrast, mid infrared (MIR) spectroscopy, combined with chemometrics, can offer a promising alternative, despite mineral interference, providing high-resolution insights into SOC. This study evaluated the potential of MIR spectroscopy for: (1) reproducing the relative contribution of C functional groups as derived from py-GC/MS, (2) estimating SOC decomposability and degradability of C functional groups and (3) monitoring below-ground changes when undrained peatlands are drained or rewetted. Our results indicated that MIR spectroscopy can effectively estimate specific C functional groups, including benzene (R^2P = 0.89), carbohydrate (R^2P = 0.80), and N-containing compounds (R^2P = 0.81), with fair predictions for lignin (R^2P = 0.68) and phenol (R^2P = 0.64). In addition, MIR spectroscopy performed as a reasonable proxy for SOC decomposability (R^2CV = 0.76). MIR spectra from rewetted fens were marginally different from their undrained counterparts (P = 0.059), whereas spectra for both undrained and rewetted fens were significantly different from drained fens (Ps < 0.05). Furthermore, a PLS-discriminant analysis (PLS-DA) model effectively differentiated spectra across hydrological status, tracking which C functional groups were altered by hydrological changes. This study demonstrates the potential of MIR spectroscopy as a cost-effective, time-efficient, and sufficiently detailed tool for peat C stability research, offering a pathway for more informed and data-driven management and restoration strategies.

Greenhouse Gas Emissions from Grassland Mesocosms: Effects of Soil Texture, Biodiversity, and Cutting Frequency

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Grasslands play a crucial role in the global carbon cycle, and have the potential to contribute to climate goals. Yet, their greenhouse gas (GHG) emissions are influenced by various management and environmental factors and the effect of individual management factors and their combinations remains unclear. This study investigates the impact of soil texture, biodiversity, and cutting frequency on GHG emissions from grassland mesocosms. A full factorial experimental setup was established with 65 pots, consisting of five replicates across two soil texture classes (sandy and loamy), two biodiversity levels (low and high), and three cutting frequencies (low, high and rotational). Gas flux measurements were conducted weekly to quantify emissions of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) under controlled conditions. The results indicate significant effects of soil texture, biodiversity, and cutting frequency on different GHG emissions, highlighting the complexity of this ecosystem. Understanding these effects and their causes will continue to provide valuable insights for optimizing grassland management to mitigate climate change.

Tree stand communities are physically and chemically engineering their local environmental conditions

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Litter decomposition is a key ecosystem function in forests. Through its impact on the nutrient and water cycle, it regulates availability of essential elements and carbon budget in forests. Under similar conditions of macroclimate, topography and soil, litter decomposition under forests is expected to depend mainly on tree species composition, this through a chemical and physical engineering pathway. The tree canopy shapes the local decomposition environment by the accumulation of organic matter and the regulation of the local microclimate.

The scope of this project is to explore how tree communities engineer their local decomposition environment and topsoil condition. Therefore, an experimental setup was conducted in the geographical arboretum of Tervuren, Belgium. The arboretum is a unique collection of mature temperate and boreal forest communities mostly from the northern hemisphere. By selecting similar (initial) site condition and stands that are at least 40 years old, we assume that the trees had sufficient time to "shape" their environment. Twenty-four different monoculture forest stands were selected, in which local microclimate was monitored (Tomst4 loggers), yearly litterfall characterized, and local soil conditions (0-100cm) identified. While forest soil temperature and humidity were mostly determined by forest structural characteristics, we found strong tree identity effects on litter input and associated topsoil carbon storage with pH in the topsoil varying between 3.6 and 5.5.

Humus type systems are typically linked to specific soil parent material and natural vegetation but can shift with planted tree species or climate-driven alterations in species composition. Through highlighting these specific tree species effects on the local forest environment, we can increase our knowledge on tree species with different traits and origins, and their potential effects on forest soils and carbon storage.

Exploration of soil health change under treated wastewater irrigation

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The increasing freshwater scarcity has widen adoption of treated wastewater (TWW) for agricultural irrigation. Despite undergoing treatment, TWW may still contain residual salts, organic matter, and microorganisms, raising concerns regarding its impact on soil health. This study evaluates the effects of TWW irrigation on soil physical, chemical, and microbial properties. In 2019, a field experiment was established in Beitem, Belgium (50°55'N, 3°7'E) with five irrigation treatments: three TWW sources (vegetable industry, household, and potato industry), rainwater irrigation, and rainfed plots, each with four replicates.

In 2022, soil chemical properties, including electrical conductivity (EC) and sodium adsorption ratio (SAR), were analyzed to assess salinity and sodicity. TWW irrigation increased soil salinity (EC) and sodicity (SAR), though values remained within FAO-established thresholds. Physical parameters such as bulk density and field-saturated hydraulic conductivity were measured to evaluate soil structure and water movement. No significant effects on bulk density or field-saturated hydraulic conductivity were observed. Rhizosphere microbial diversity, focusing on bacterial and fungal communities, was also investigated. Microbial analysis revealed both beneficial (e.g., increased *Rhizobiaceae*, associated with nitrogen fixation) and potentially detrimental shifts (e.g., increased *Olpidiaceae*, linked to plant pathogens).

TWW irrigation did not significantly alter soil physical properties but increased salinity and sodicity risks within acceptable limits till 2022. The observed microbial shifts highlight the need for further investigation to determine their functional implications for soil health and crop productivity. Continued long-term research is essential to optimize TWW use in sustainable agriculture.

Effect of 6-year of conservation agriculture practices on soil physical quality in cotton-based rotations in northern Bénin

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Unsustainable agricultural practices and climate change favor soil degradation, low yields, and food insecurity in Sub-Saharan Africa. In this context, conservation agriculture with soil-improving plants appears as a promising agroecosystem management approach for enhancing the sustainability of food systems.

This study evaluated the effect of six years of CA-based cropping systems on soil physical quality at the Opkara experimental station in Northern Benin. The trial used a randomized block design with three replications and three treatments: (S1) a two-year cotton - maize rotation with conventional tillage, (S2) a two-year cotton - maize+cowpea rotation with strip tillage, and (S3) a three-year cotton – maize+*Stylosanthes*+*Crotalaria* - Sorghum+*Glycine* rotation with strip tillage. Composite soil samples (0–20 cm depth) were analyzed for total organic carbon (Ctot) and nitrogen (Ntot) content. Soil structural stability (0-5 cm) was measured on undisturbed 100 cm³ soil samples per plot using the QuantiSlake Test and was assessed based on the ratio of initial and final dry mass after 1000 sec. Soil penetration resistance was measured with a hand-held mini-penetrometer (0–10 cm depth).

After 6 years, values ranged from 0.62% to 0.99% for Ctot, 0.047% to 0.069% for Ntot, and 13.25 to 15.87 for C/N. However, there were no significant effects of the cropping system or crop type on Ctot, Ntot or C/N ratio ($p > 0.05$). Soil samples were more stable in Cotton S3 (80%) and Maize S3 (77%) compared to Cotton S1 (71%), though differences were not statistically significant ($p > 0.05$). Soil penetration resistance was also unaffected by cropping system and crop type ($p > 0.05$). Soil structural stability correlated positively with Ctot content ($r = 0.79$, $p < 0.001$) and soil penetration resistance ($r = 0.60$, $p < 0.001$).

In conclusion, CA with soil-improving plants had a limited effect on soil physical quality in Northern Benin after 6 years of rotation.

Keys words: Conservation agriculture, Cotton-Maize Rotation, Soil quality, West Africa.

Historic Agricultural Terraces in the Mediterranean – A human-soil perspective through archaeological methods

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Historic agricultural terraces in the Mediterranean go beyond ancient land management processes. They are symbols of transgenerational human agency, enhancing food production, managing water, and preventing soil erosion in challenging mountainous environments. Recent studies have increasingly recognized agricultural terraces as key sites for understanding human-soil interactions through structural and trend–based historical dynamics. The MedMory Project and the larger Terrace Project (at VUB-KU Leuven, funded by FWO) aim to investigate how ancient societies in the Mediterranean transformed their landscapes by building stone-walled terrace systems. The focus is on spatial and temporal differences across three distinct case studies: 1) the Cycladic Islands, where the studied terraces potentially date back to the Late Bronze Age and remain abandoned with uncertain dating, yet interconnected among the small islands; 2) Cyprus, a larger island with limited flatlands, where the studied terraces likely originated in the Late Bronze Age and have persisted, although in part affected by modern transformations by bulldozers; and 3) Italy, where Late Medieval terraces have been abandoned for several decades. The methodology employs interdisciplinary terrace soil storytelling, exploring the relationship between soil properties and stone stratigraphy. Techniques such as soil micromorphology, phytolith analysis, lipid extractions, sedaDNA characterization, and OSL dating are intended to extract the "memory" of terrace soils and the enduring legacy of Mediterranean terrace systems.

Interpreting the Urban Stratification Processes: An Integrated Soil Micromorphogical Study of Late Medieval Dark Earth at Broodstraat (Oudenaarde, Belgium)

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Anthropogenic soils in urban areas vary based on land use and city structure, which is essential for understanding different stages of urbanization. However, the seemingly unstratified Dark Earth found at many urban sites poses a significant challenge for archaeologists and soil scientists due to its macroscopic homogeneity. Without integrated micromorphological investigations, the internal complexity of Dark Earth remains hidden. Traditionally, Dark Earth—characterized by its thick, dark, and uniform appearance—has often been overlooked or attributed to a single natural or human event. In this study, a detailed micromorphological analysis of four thin sections from the Broodstraat site in Oudenaarde identified 19 distinct stratigraphical units, documenting a complex sequence of depositional and post-depositional processes involved in the formation of this Dark Earth.

This micromorphological study aims to examine how the soil micromorphology of Dark Earth can enhance our understanding of spatial organization and human-environment interactions in urban contexts, particularly in terms of waste management. The results indicate that both natural and human-induced processes have shaped the site. These processes include sedimentation (alluvium), reduction, bioturbation, and mineralization/degradation/decomposition/humification. Key human activities identified are the dumping and accumulation of waste, along with soil compaction caused by trampling and poaching. Additionally, this study can contribute to the "biography" of the site by investigating both 'stratigraphic/time' and 'processes/activities' dimensions.

Overall, the present study can enhance our understanding of Dark Earth formation in a late medieval urban context and highlight the effectiveness of soil micromorphology in interpreting the complex stratification processes of anthropogenic soils in urban settings.

Comparing Nematode Exclusion Methods in Soil Samples: Dry Heat vs Freezing-Thawing Cycles vs Gamma Irradiation vs Microwaving

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It is widely recognized that nematodes contribute to a variety of soil processes, such as carbon cycling, nitrogen mineralization, phosphorus mineralization, and influencing the activity and composition of soil microbial communities. Their direct and indirect effects on soil processes can be studied through various experimental approaches, including the addition or removal of specific soil biota or functional groups. This can be achieved through partial sterilization techniques, which aim to selectively remove the nematode population within a soil sample while minimally impacting other soil microorganisms and physicochemical properties. Recently, the use of low dosages of gamma irradiation has been proposed as the preferred technique for nematode exclusion. However, it is still associated with several concerns, including the reproducibility of the method and nutrient flushes that may misrepresent the impact of nematodes.

This study evaluated alternative nematode exclusion techniques, including oven-heating, freezing-thawing, and microwave irradiation. In the first stage, these methods were tested in sandy loam soil by assessing nematode abundance in bare and planted microcosms incubated for two and eight weeks, respectively. The most effective treatments included three freezing-thawing cycles (-80°C to 22°C for 72 h each) and microwaving for 135 or 270 seconds (800 W, 2450 MHz).

In the second phase, the most successful exclusion techniques were assessed for side effects on chemical and biological properties of soils with lighter (loamy sand) and heavier (silt loam) textures. Half of the soil cores were leached and inoculated with pulverized soil powder before incubation to mitigate the side effects caused by defaunation. Side effects were evaluated by measuring nitrogen mineralization, microbial carbon biomass, dehydrogenase and β-glucosidase activities. We hypothesize that effectiveness of these methods depends on soil type and that side effects caused by the exclusion techniques could be partly resolved through leaching and inoculation with soil powder.