Soil Organic Carbon of Paved Urban Soils

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Introduction, Hypothesis, and Aims

Cities emit large amounts of carbon, but how much **soil organic carbon (SOC)** is stored in the **joint material** of paved urban soils?

Hypothesis:

Using **pedotransfer functions** based on the **Munsell color chart** to model carbon concentrations in the joint material of pavements **isn't applicable** due to their high **black carbon (BC)** levels.

Aims:

- Does the estimation model need adjustments?
- Can paved urban soils function as carbon sinks?

Material

Analysis of **37 joint material samples** from Berlin, Warsaw, Pisa, Nanjing, Moscow, Rom, Boston, Paris, Seoul, Shanghai & Vienna

Methods

Model C_{org} (Corg Mod) [g kg^{-1}]**:**

Munsell color chart → Soil color
Pedotransfer functions (KA5) → Humus concentration
Factor 0.5 (Pribyl 2010) → Carbon concentration

Analysis of Corg Lab and BC Lab [g kg^{-1}]**:**

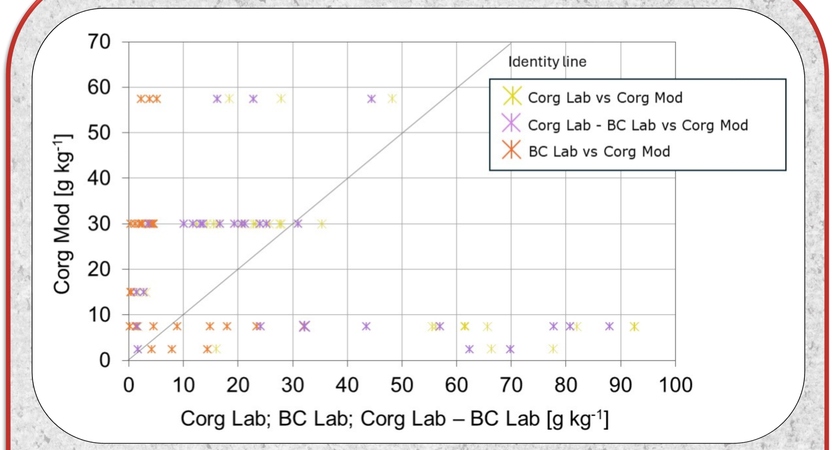
- Corg Lab → Elemental analyser
- BC Lab → Glaser et al. 1998

Calculation SOC stocks [kg m^{-2}] :

$$SOC = \left(\frac{C_{org}}{100} \times BD \times M \times \frac{JP}{100}\right) \times 10$$

C_{org} = Carbon Content [g kg^{-1}] ; BD = Dry Bulk Density[g cm^{-3}]; *M* = M = thickness of the layer [cm]; JP = Joint Percentage [%]

Modelled Values in Dependence on Laboratory Values (N = 37)

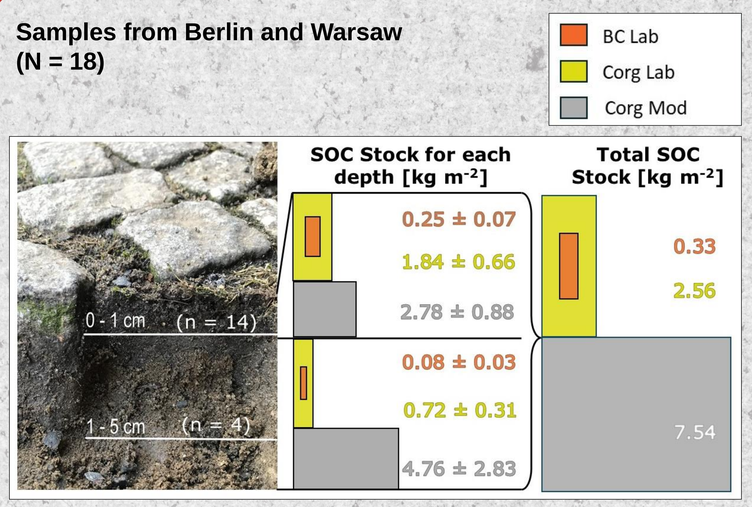


Ten lab values were higher than 112.5 g kg^{-1}

→ This exceeds the capabilities of the model, so they were excluded from visualization

SOC Stocks of the Joint Material of Paved Urban Soils

Samples from Berlin and Warsaw (N = 18)



Results

- Joint material shows **high Lab C concentrations**
- C Mod deviates by **up to 314** g kg^{-1} for Corg Lab
- → Lab values **from 50 g kg^{-1} C** onwards are consistently **underestimated** by the model
- Modelled values only have **7 levels**; values higher than 112.5 g kg C **cannot be modelled**
- **SOC stocks are overestimated** with modelled values for Berlin and Warsaw

SOC stocks of Soils

Natural SOC stock

Grassland Soils: 11.8 kg m^{-2} — Wiesmeyer et al. 2012

Urban SOC stocks

Open Street Soils: 3.2 kg m^{-2} — Klingenfuß et al. 2019

Paved Soils: 24.6 kg m^{-2} — Richter et al. 2019

Desealed Soils: 5.3 kg m^{-2} — Thrum et al. 2023

Joint Material of Paved Soils

- Results of this study show a **lower SOC stock** than values from publication for other soil types

→ **2.56** kg m^{-2}

Conclusion

- Contrary to expectations, **higher BC values do not result in darker colors**, which would then lead to higher modeled C concentration values
- → C concentrations of the joint material of paved soils **cannot be modeled with pedotransfer functions** for natural soils
- SOC stocks are **lower** compared to findings from other soils

BUT: The SOC stocks of the joint material of paved soils should be considered as **valuable carbon storage**

→ **Paved urban soils can function as carbon sinks**

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Acknowledgements: We used data from soil samples that were provided from numerous international colleagues and data from samples that were partly analysed by late Sonja Brodowski, Institute of Crop Science and Resource Conservation, Soil Science and Soil Ecology, University of Bonn