Urban Greenspace Carbon Calculator: Description and Case Study

Measuring the Environmental Benefits of City Green Spaces

Introduction

Many carbon footprint calculators focus on trimming down emissions from our daily lives, but have you ever wondered what role your favorite city park or leafy avenue plays in the fight against climate change? Urban greenspaces—think parks, gardens, tree-lined streets, and nature reserves—are often overlooked as powerful carbon sinks. By including these green gems in calculations, communities are inspired to connect with and protect their local environments.

This innovative calculator brings urban nature into the spotlight by estimating the carbon captured and stored in greenspaces, using data gathered through smartphone apps, images, and simple measurements. Perfect for citizen science projects, it empowers volunteers and students to map green spots in their neighborhoods. The rich database that results can boost satellite observations and provide valuable insights for city planning and sustainability. Dive into the sections below to explore the calculator's unique features, methodology, real-world applications, and a compelling case study showing it in action!

Urban Greenspace Carbon Calculator: Features and Methodology

Carbon stored refers to the long-term carbon held in greenspaces, while carbon sequestered is the carbon captured over shorter periods, typically measured annually. The urban greenspace carbon calculator measures carbon stored in trees and soil, and estimates annual tree sequestration. It does not calculate soil sequestration, as estimating this for undisturbed urban soil remains challenging and is planned for future work.

Required Data Inputs for the Urban Greenspace Carbon Calculator

Area Measurement

To begin, the calculator requires the physical area of the urban greenspace under study. This information can be obtained from official online sources, measured directly on site, or estimated using digital tools such as the measurement feature in Google Maps.

Tree Species Identification and Sampling

Accurate identification of tree species is crucial. Users are encouraged to utilize mobile applications like Seek by iNaturalist or Google Image Search to determine species present in the greenspace. For each species, the following details should be recorded:

- Count of trees per species
- Measurement of tree circumference, sampled representatively

The circumference should be measured at approximately 1.3 meters (4.3 feet) above ground, following the standard "diameter at breast height" methodology.

Soil Properties

Three key soil properties should be captured:

- Texture: Classify the soil using resources such as the LandPKS app or AI-powered tools, identifying one of the twelve USDA soil texture classes (sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay).
- Color: Estimate the soil color using the Munsell soil color system, quantifying hue, value, and chroma. The LandPKS app or AI-powered tools can be used for this step as well.
- Moisture: Assess soil moisture directly by handling a small sample, categorizing it as wet or dry.

Calculation Methodology

The calculator is structured to provide estimates for tree-based carbon storage and sequestration, soil-based carbon storage, and a final summary of overall results.

Tree Carbon Storage and Sequestration

Tree carbon storage and annual sequestration are estimated using the i-Tree MyTree tool. For each identified tree species, the tool calculates carbon stored and sequestered (in pounds) based on species and diameter at breast height. The method relies on allometric equations for storage and uses annual growth rates to determine sequestration. For more information on i-Tree methodology refer to Understanding i-Tree. Users must manually acquire these values from i-Tree for each species present. Future improvements may allow the calculator to directly extract data from i-Tree, streamlining the process.

Soil Carbon Storage

Soil carbon storage is calculated using information on soil texture, moisture, and color. The percentage of soil organic matter (OM%) for a particular soil texture, moisture and color is based on guidelines from Table 46 of Jahn, R., et al. Guidelines for soil description. Fao, 2006 Table 46 of Jahn et al. (FAO, 2006). Bulk density is calculated using average bulk density for a particular type of soil and organic matter percentage from Rawls (1983).

Soil organic matter (SOM) is calculated using the following equation from Guides for Educators (May 2014) Soil organic matter (SOM), NRCS USDA :

$$SOM = (OM\% * 10{,}000) * bulk\ desnisty * \left(\frac{sample\ depth\ [cm]}{10}\right) * 0.893$$

Soil organic carbon (SOC) is then estimated using:

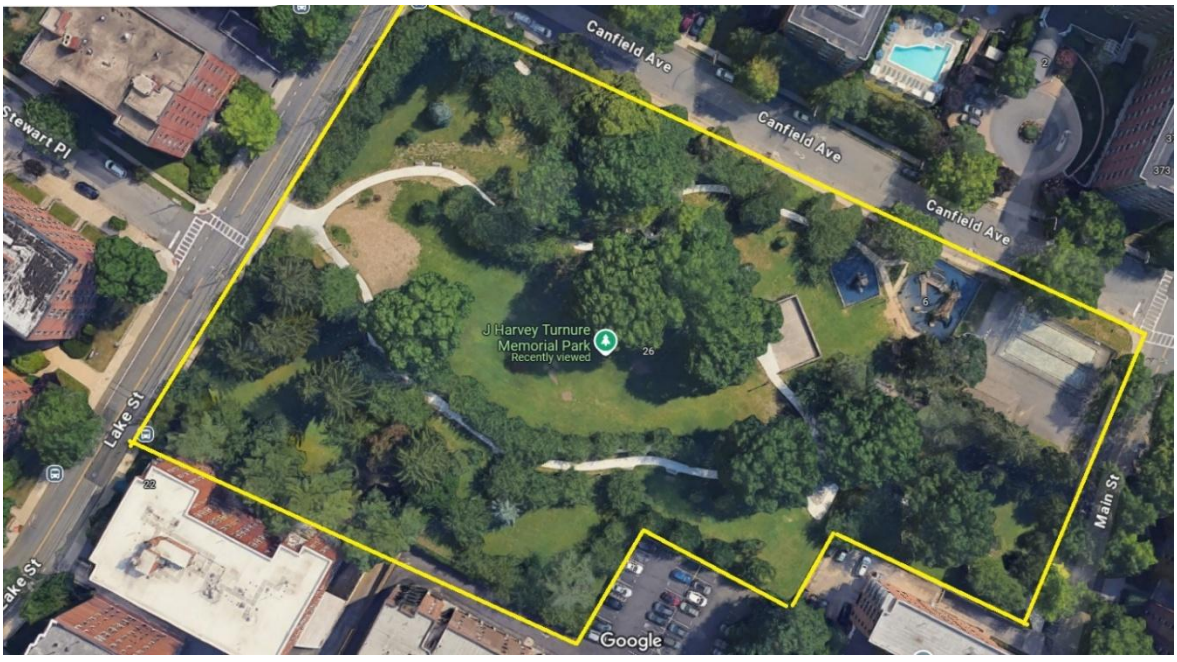
$$SOC = 0.58 * SOM$$

Result Summarization

The final step of the calculator combines total carbon stored in trees and soil, as well as the annual carbon sequestered by trees, to provide a comprehensive assessment of the greenspace's carbon impact.

Case Study: Park in neighborhood

Space: J Harvey Turnure Memorial Park, White Plains, NY, Size: 4.05 acres



Tree Measurements Summary

- **Cherry blossom** — Count: 94, Circumference: 35 in, C Sequestered: 2470.85 kg/yr (2.471 t/yr), C Stored: 24435.64 kg (24.436 t)
- **Norway spruce** — Count: 13, Circumference: 100 in, C Sequestered: 459.94 kg/yr (0.460 t/yr), C Stored: 22553.27 kg (22.553 t)
- **Weeping cherry blossom** — Count: 7, Circumference: 35 in, C Sequestered: 185.49 kg/yr (0.185 t/yr), C Stored: 1845.27 kg (1.845 t)
- **Red oak** — Count: 13, Circumference: 112 in, C Sequestered: 1215.49 kg/yr (1.215 t/yr), C Stored: 39808.42 kg (39.808 t)
- **Pine** — Count: 6, Circumference: 100 in, C Sequestered: 228.09 kg/yr (0.228 t/yr), C Stored: 7352.35 kg (7.352 t)
- **Tulip** — Count: 1, Circumference: 100 in, C Sequestered: 83.32 kg/yr (0.083 t/yr), C Stored: 1853.94 kg (1.854 t)
- **Blue spruce** — Count: 1, Circumference: 100 in, C Sequestered: 31.51 kg/yr (0.032 t/yr), C Stored: 1494.59 kg (1.495 t)
- **Horse chestnut** — Count: 2, Circumference: 70 in, C Sequestered: 110.95 kg/yr (0.111 t/yr), C Stored: 2210.89 kg (2.211 t)
- **Magnolia** — Count: 2, Circumference: 70 in, C Sequestered: 106.98 kg/yr (0.107 t/yr), C Stored: 2163.14 kg (2.163 t)
- **Red maple** — Count: 2, Circumference: 70 in, C Sequestered: 134.32 kg/yr (0.134 t/yr), C Stored: 2081.56 kg (2.082 t)
- **Ash** — Count: 2, Circumference: 70 in, C Sequestered: 73.29 kg/yr (0.073 t/yr), C Stored: 1572.88 kg (1.573 t)

Total Carbon Sequestered by Trees: 5,100.23 kg/year (5.1 t/year)
Total Carbon Stored in all Trees: 107,371.96 kg (107.372 t)

Soil Measurements Summary

Soil Texture Type: Loam
Green Space Area: 4 acres
Soil Moisture: Moist
Munsell Soil Color: Hue **10YR**, Value **4**, Chroma **3**
Soil Carbon Stored: 7.83 t/acre
Total Soil Carbon Stored: 31.32 t

Site: Turnure park **Location: Total Area:** 4 acres

Combined Carbon Summary

	Carbon (t)	CO_2 Equivalent (t)
Total Stored (Trees + Soil)	138.692	508.537
Total Sequestered (by trees) / yr	5.1	18.701

> **Note:** 1 tonne carbon (t C) = 3.67 tonnes CO_2 equivalent (t CO_2e)

Future Directions

The project's future plans include developing a citizen science initiative where volunteers and schools can use the calculator and contribute to a database. User feedback will be incorporated to enhance the tool, and the resulting database will be made accessible to the public.

Further development will focus on refining the methodology by integrating satellite-based and ground-based measurements. The potential use of CO2 sensors for ground-based observations will be assessed to better understand carbon flux.

Conclusion

This urban greenspace calculator was created as part of a ClimateBase fellowship capstone project. If you'd like to get involved, contact Sandhya Koteshwara at sandyk2088 [at] gmail [dot] com.