i-Tree

urban forestry lab

ir. Bregt Roobroeck

webinar 27 – 2 - 2021

www.urbanforestrylab.be

URBAN FORESTRY LAB

Bomen Beter Beheren

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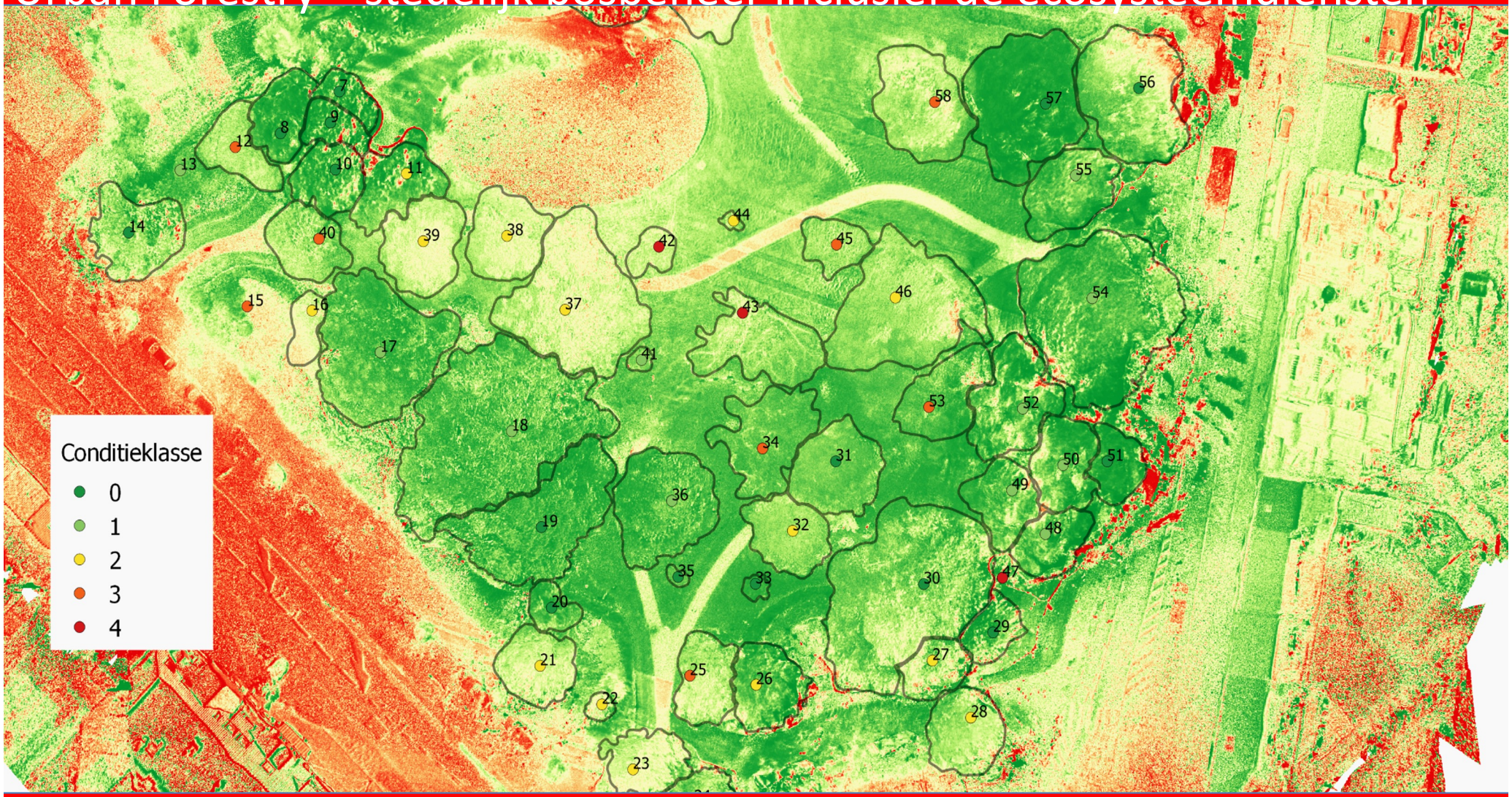
intro

Urban Forestry = stedelijk bosbeheer inclusief de ecosysteemdiensten



Ir. Bregt Roobroeck

Urban Forestry Lab

onderzoek – dienstverlening - onderwijs

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missie

beheer van stedelijk bos

beleid van stedelijk bos

belang van stedelijk bos

samenvatting

I-tree is....

- Een verzameling van software tools voor ecosysteemdiensten
- ontwikkeld in VSA in 1990 door de nationale bosbouwdienst
- voor het urban forest
- De referentie voor ecosysteemdienstenvalorisatie (I-tree eco)

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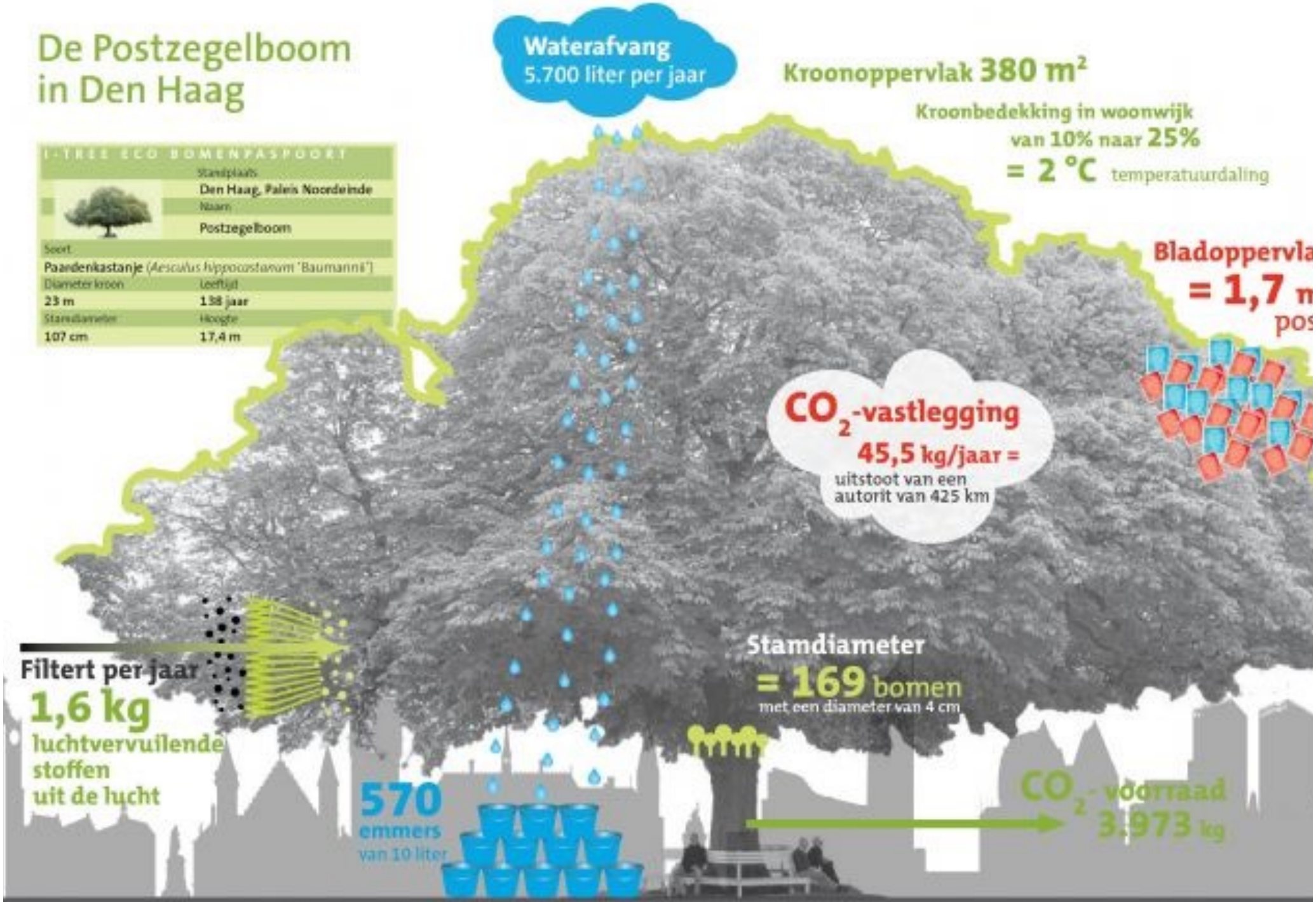
terminologie


Het stedelijke
bos = ecosysteem

De Postzegelboom in Den Haag



I-TREE ECO BOMENPASPOORT

Standplaats	Den Haag, Paleis Noordeinde
Naam	Postzegelboom
Soort	Paardenkastanje (*Aesculus hippocastanum* 'Baumannii')
Diameter kroon	23 m
Leeftijd	138 jaar
Stamdiameter	107 cm
Hoogte	17,4 m

De Postzegelboom staat in Den Haag, voor Paleis Noordeinde. Hij dankt zijn naam aan het feit dat er onder en om de boom jarenlang postzegels werden verkocht en geruild.

Groene baten van de postzegelboom:

- waterafvang € 6,50 per j
- afvang luchtvervuiling
- CO_2-vastlegging € 16 per
- CO_2-voorraad € 1.407

Lower East Side

Neighborhood Statistics

Trees on the Map	Activities Reported	Trees Favorited
2,005	1,618	128

Number of Species	Most Common Species
80	Thornless Honey locust 391 trees, 20% of Lower East Side trees on the map

Recent Tree Care Activities

- The Pin Oak near 234 East 3 Street was Managed Soil on 04/25/2019
- The Pin Oak near 226 East 3 Street was Managed Soil on 04/25/2019
- The Japanese Pagoda Tree near 226 East 3 Street was Managed Soil on 04/25/2019

Ecological Benefits

Benefits are calculated using formulas from the U.S. Forest Service. Learn more about the benefits of trees to NYC →

Stormwater intercepted each year
1,952,033 gallons — Value: $19,325.12

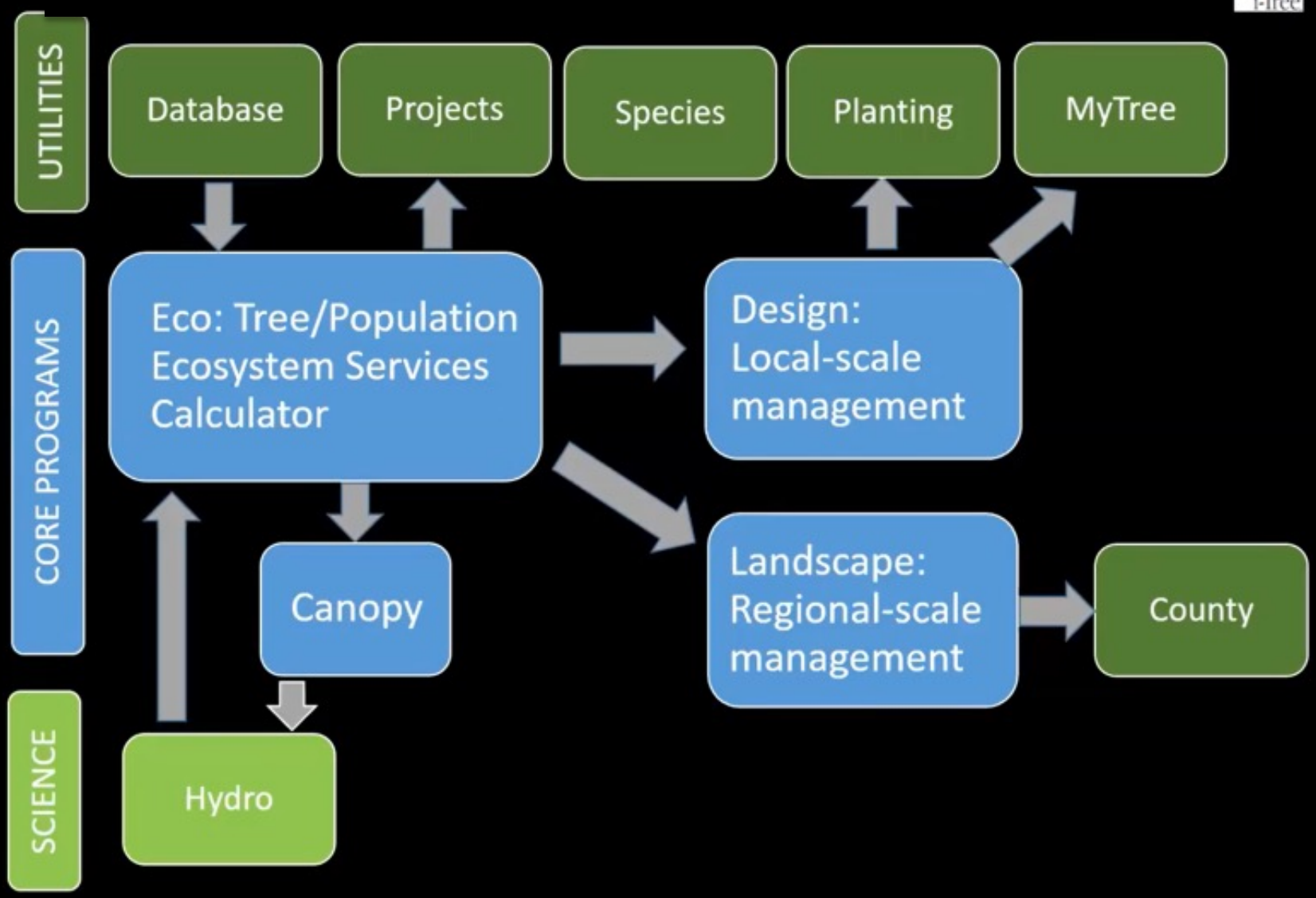
Energy conserved each year
1,343,695 kWh — Value: $169,634.66

Air pollutants removed each year
2,472 pounds — Value: $12,925.54

Carbon dioxide reduced each year
700 tons — Value: $4,674.34

Total Value of Annual Benefits
$211,234.03

i-tree tools



Check https://www.fs.fed.us/nrs/pubs/gtr/gtr_nrs200.pdf


timeline

1988-1994	Ontwikkeling methodiek (Chicago)
1996	UFORE model Urban forest effects model
2004	STRATUM model Street Tree Resource Assessment Tool for Urban Forest Managers
2005	Samenwerking USDA en Davey
2006	Launch i-Tree 1.0
2010	10 000 users + i-Tree canopy
2015	Launch i-Tree eco v6 + i-Tree landscape
2016	Mytree app in US en Canada (browser)
2018	Launch grote delen Europa (incl. Londen)
2019	Launch Nederland > 400 000 users in 130 landen

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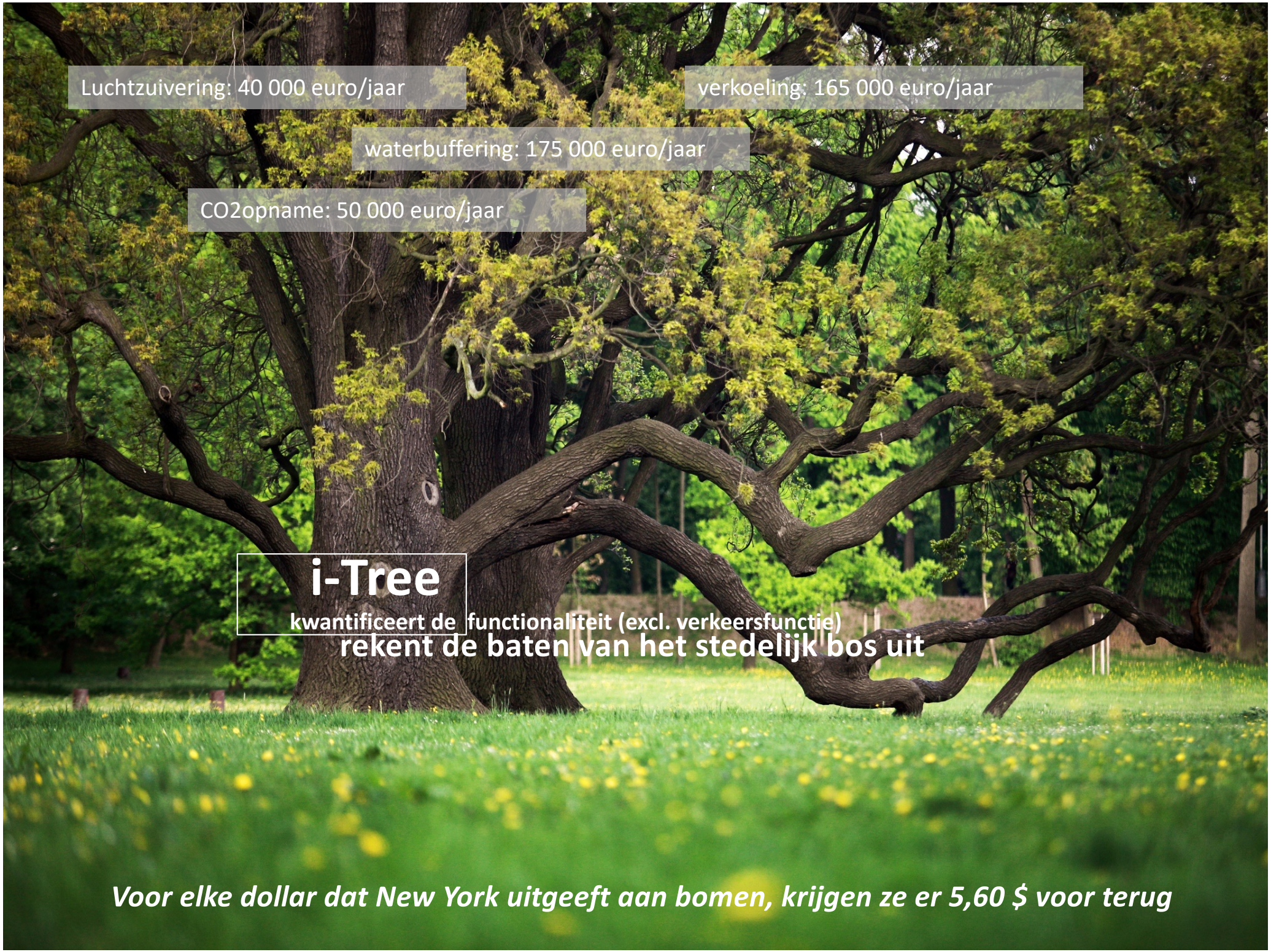
essentie

Functie van bomen

- verkoelend effect
- waterbuffering
- luchtzuivering
- sociale cohesie
- (psychologische) gezondheid
- …


Luchtzuivering: 40 000 euro/jaar
verkoeling: 165 000 euro/jaar
waterbuffering: 175 000 euro/jaar
CO2opname: 50 000 euro/jaar
i-Tree
kwantificeert de functionaliteit (excl. verkeersfunctie)
rekent de baten van het stedelijk bos uit
Voor elke dollar dat New York uitgeeft aan bomen, krijgen ze er 5,60 $ voor terug


Wat moeten we dan doen?
beheer
beleid
duurzaam en functioneel met bomen omgaan


duurzaamheid
functionaliteit
duurzaamheid
functionaliteit
Toegevoegde waarde creëren

Uniforme methode voor waardebepaling (VVOG)

De methode berekent enkel de waarde van de gehele boom, niet de waarde per ecosysteemdienst. Dit betekent dat het hoofddoel ervan is om de kost te schatten van de vervanging van een gelijkwaardige boom. Dit is heel wat anders dan het uitrekenen van de ecosysteemdienst.

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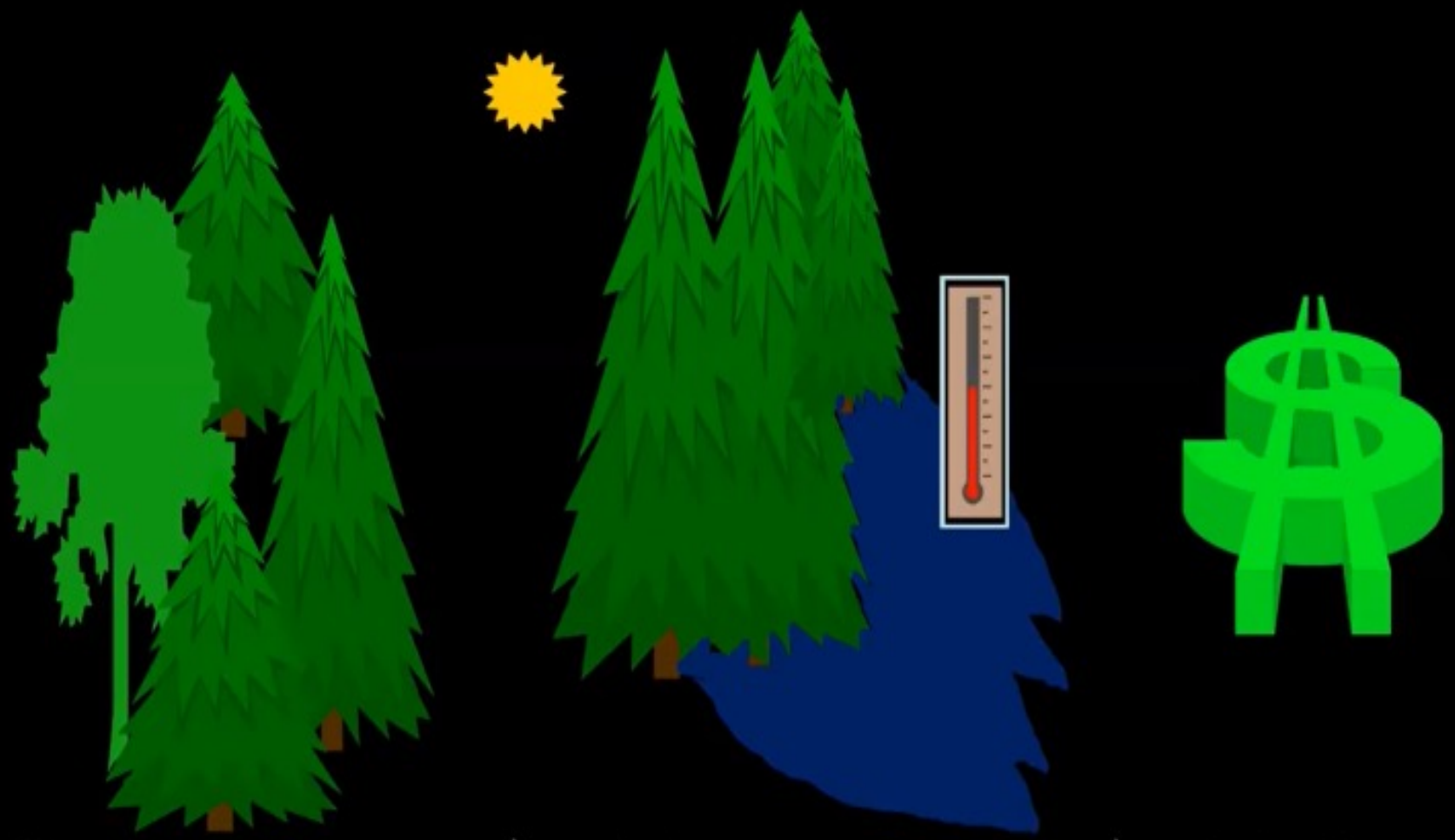
inspiratie

	New York City	Londen	Glasgow
Aantal bomen	6 970 000	8 421 000	2 000 000
Verwijdering van luchtvervuiling I-Tree eco schat de waarde van droge depositie (NO2 , O3 CO2 etc.) per uur (het hele jaar door)	1 100 ton/per jaar 6 590 503 euro per jaar	2 241 ton/per jaar 145 761 512euro per jaar	283 ton/ per jaar 1 618 491 euro per jaar
Koolstofopslag (per jaar) Bruto koolstof vastlegging hangt af van de bestaande biomassa en de boomgroei . Deze kan varieren van 0 cm d.b.h./yr (dood) tot 2,45 cm voor gezonde snelgroeiende bomen	51 000 ton/per jaar 5 608 939 euro per jaar	77 200 ton/ per jaar 5 536 856 euro per jaar	9 000 ton/ per jaar 2 774 556 euro per jaar
Koolstofopslag Deze waarde wordt geschat door de staande biomassa van een boom x 0.5 te vermenigvuldigen	1 200 000 ton 126 201 132 euro	2 367 000 ton 145 645 920 euro	183 000 ton 46 242 600 euro
Vermeden run-off Deze berekeningen zijn procesmatig dwz. Dat elk proces afzonderlijk wordt gestimuleerd en vervolgens gekoppeld is aan andere processen bv, onderschepping wordt gesimuleerd met behulp van een verbeterde Rutter-methodologie	1 953 862 m^3 per jaar 3 794 282 europer jaar	3 414 000m^3/per jaar 3 352 168 euro per jaar	812 000 m^3 1 271 671 euro per jaar

	New York City	Londen	Glasgow
Waarde van verminderd energieverbruik in gebouwen energieschattingen zijn gebaseerd op McPherson en Simpson (1999) maar de bomen moeten wel 6m of meer zijn en binnen de 18 meter van het gebouw staan	14 104 832 euro per jaar	300 539 euro per jaar	N/A
Waarde van verminderde CO2-uitstoot Het i-Tree proces voor het schatten van boomeffecten op het energieverbruik van gebouwen is ontwikkeld voor klimaat, gebouwen en brandstofverbruik in de VS. Deze kunnen wel gebruikt worden in andere landen maar wel met een waarschuwing	1 319 750 euro per jaar	63 113 euro per jaar	N/A


The black box

Model Framework



Structure ⇨ Function ⇨ Value

Table 3.—Equation forms and variables used to estimate tree biomass, by species. Inputs are either d.b.h. (cm) or d.b.h.^{2} (cm^2) x total tree height (m).

Species	Eq. form	x	A	B	C
Abies balsamea	$y = A * (x^B)$	d.b.h.	0.27965	2.04308	0.00000
Acer macrophyllum	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-1.53689	2.24355	0.03150
Acer rubrum	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-1.84135	2.36499	0.00913
Acer saccharinum	$y = A * (x^B)$	d.b.h.^{2} x height	0.17789	0.84670	0.00000
Acer saccharum	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-1.46455	2.30420	0.01354
Betula lenta	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-2.14313	2.49160	0.03467
Betula alleghaniensis	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-1.66653	2.30037	0.02373
Betula papyrifera	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-2.41197	2.56847	0.03474
Carya species	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-2.39652	2.53012	0.04591
Castanopsis chrysophylla	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-1.94995	2.31214	0.04259
Cornus spp.	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-1.98379	2.38367	0.03810
Fagus grandifolia	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-1.36313	2.27798	0.01060
Fraxinus americana	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-1.84460	2.37620	0.05731
Fraxinus nigra	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-1.90500	2.29776	0.08518
Fraxinus pennsylvanica	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.^{2} x height	-2.19052	0.84030	0.13692
Liquidambar styraciflua	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.^{2} x height	-2.61705	0.87383	0.20451
Liriodendron tulipifera	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-2.22561	2.39547	0.04837
Nyssa sylvatica	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-2.07379	2.37412	0.06518
Ostrya virginiana	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-2.28196	2.42731	0.08647
Picea species	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-1.87821	2.25867	0.04823
Picea glauca	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-1.73798	2.22809	0.05189
Picea abies	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-1.77212	2.25022	0.06069
Pinus banksiana	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.^{2} x height	-2.00907	0.79140	0.29405
Pinus contorta	$y = A * (x^B)$	d.b.h.	0.11886	2.23330	0.00000
Pinus echinata	$y = A * (x^B)$	d.b.h.^{2} x height	0.01512	0.99415	0.00000
Pinus elliottii	$y = A * (x^B)$	d.b.h.^{2} x height	0.01865	0.97777	0.00000
Pinus palustris	$y = A * (x^B)$	d.b.h.^{2} x height	0.02455	0.95612	0.00000
Picea rubens	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-1.75175	2.23587	0.05094
Pinus resinosa	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-1.93630	2.28250	0.05730
Pinus strobus	$y = e^{(A + B * Ln(X) + (C/2))}$	d.b.h.	-2.82175	2.42377	0.02545

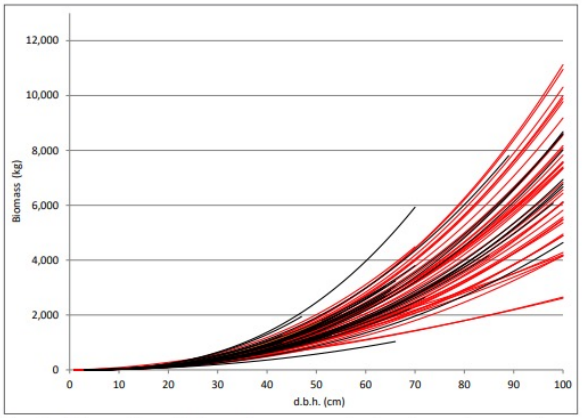


Figure 12.—Estimates of dry weight biomass for numerous species using various equations across a large diameter range. Red lines are i-Tree equation estimates (Table 3); black lines are estimates from equations from Jenkins et al. (2003).

Methods Overview

The following indices are calculated for the living tree population in plot sample projects:

Shannon-Wiener Diversity Index is a widely used measure of diversity, based on information theory. This index assumes that the individual trees are randomly sampled from an infinite population. It also assumes that all species within a land use type or city have been sampled. This index is an indicator of species richness and has a moderate sensitivity to sample size (Magurran 1988) and, therefore, land uses and/or cities may not be comparable. The index is calculated as:

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$

Where

p_i is the proportion of trees in species i estimated as n_i / N . n_i , and

N is the total number of trees measured.

Menhinick's Diversity Index (D_{Mn}) is an indicator of species richness and has high sensitivity to sample size (Magurran 1988) and, therefore, may not be appropriate for comparison between strata with widely different numbers of plots. The index is calculated as:

$$D_{Mn} = S / \sqrt{N}$$

Where

S = number of species recorded, and

N = total number of trees measured.

Simpson's Diversity Index is an indicator of species dominance and has a low sensitivity to sample size (Magurran 1988) and, therefore, may be more appropriate for comparison among strata. The index is calculated as:

$$SI = 1 / D$$

Where

$$D = \sum_{i=1}^{S} \left(\frac{n_i (n_i - 1)}{N (N - 1)} \right)$$

https://www.fs.fed.us/nrs/pubs/gtr/gtr_nrs200.pdf (understanding I-Tree)

i-Tree eco v6

i-Tree

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A New Version of i-Tree Has Been Released!

Click here for details and tips on what to do before updating.

i-Tree Eco

Aug. 3, 2020

i-Tree Eco v6 overview

i-Tree Eco version 6 is a flexible software application designed to use data collected in the field from single trees, complete inventories, c located plots throughout a study area along with local hourly air pollution and meteorological data to quantify forest structure, environı effects, and value to communities. Learn more

What does Eco provide?

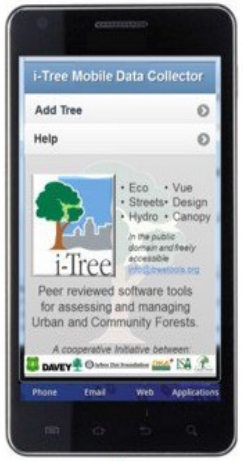
i-Tree Eco provides extensive forest and individual tree analyses including the following:

Functional Analyses:

- Pollution removal and human health impacts
- Carbon sequestration and storage
- Hydrology effects (avoided run-off, interception, transpiration)
- Building energy effects
- Tree bio-emissions
- Avian habitat suitability (plot-based projects; limited to 9 bird species) Avian Habitat Suitability Report Example
- Ultraviolet radiation (UV) tree effects UV Report Example

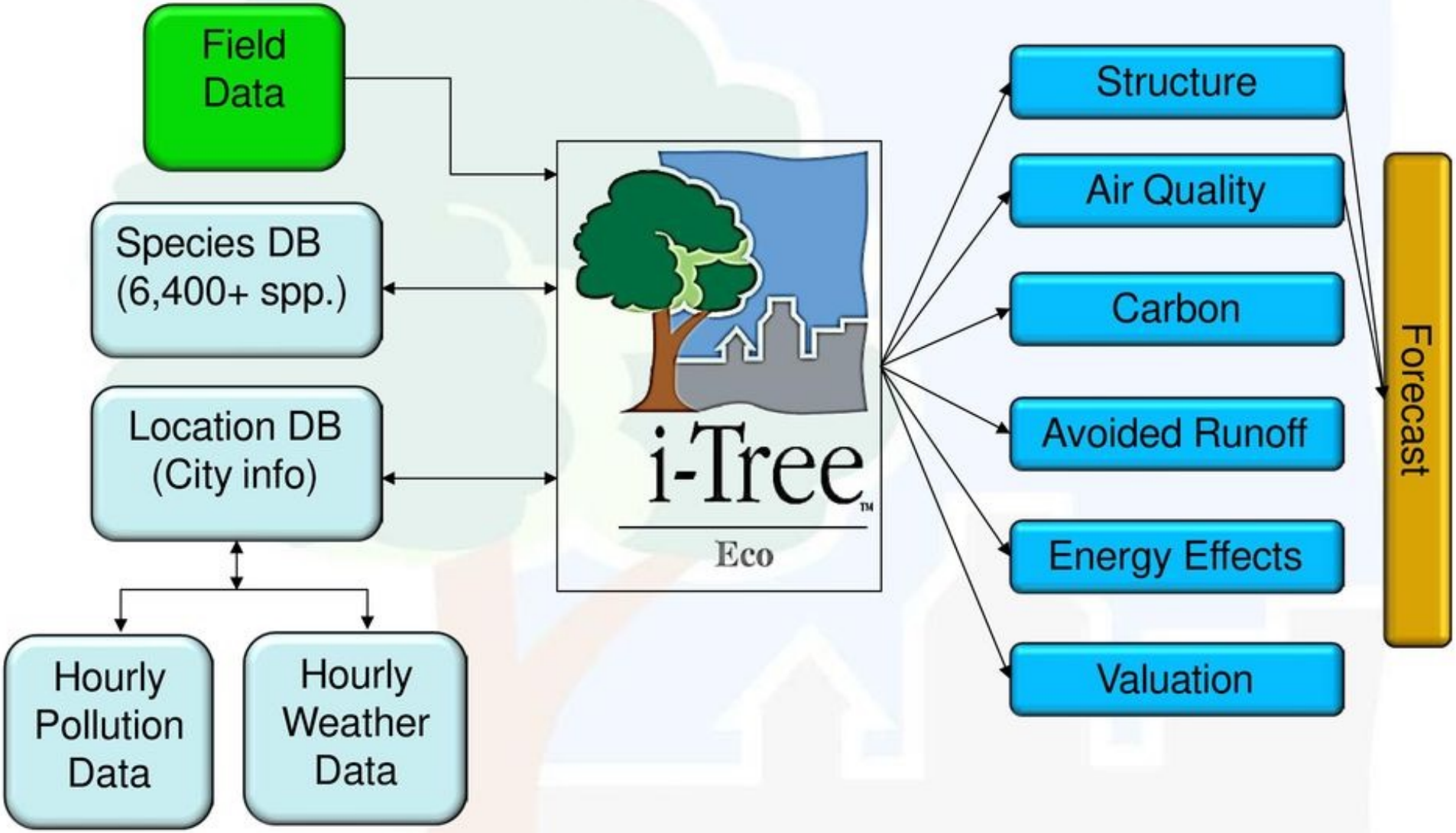
Structure and composition analyses:

- Species condition and distribution
- Leaf area and biomass

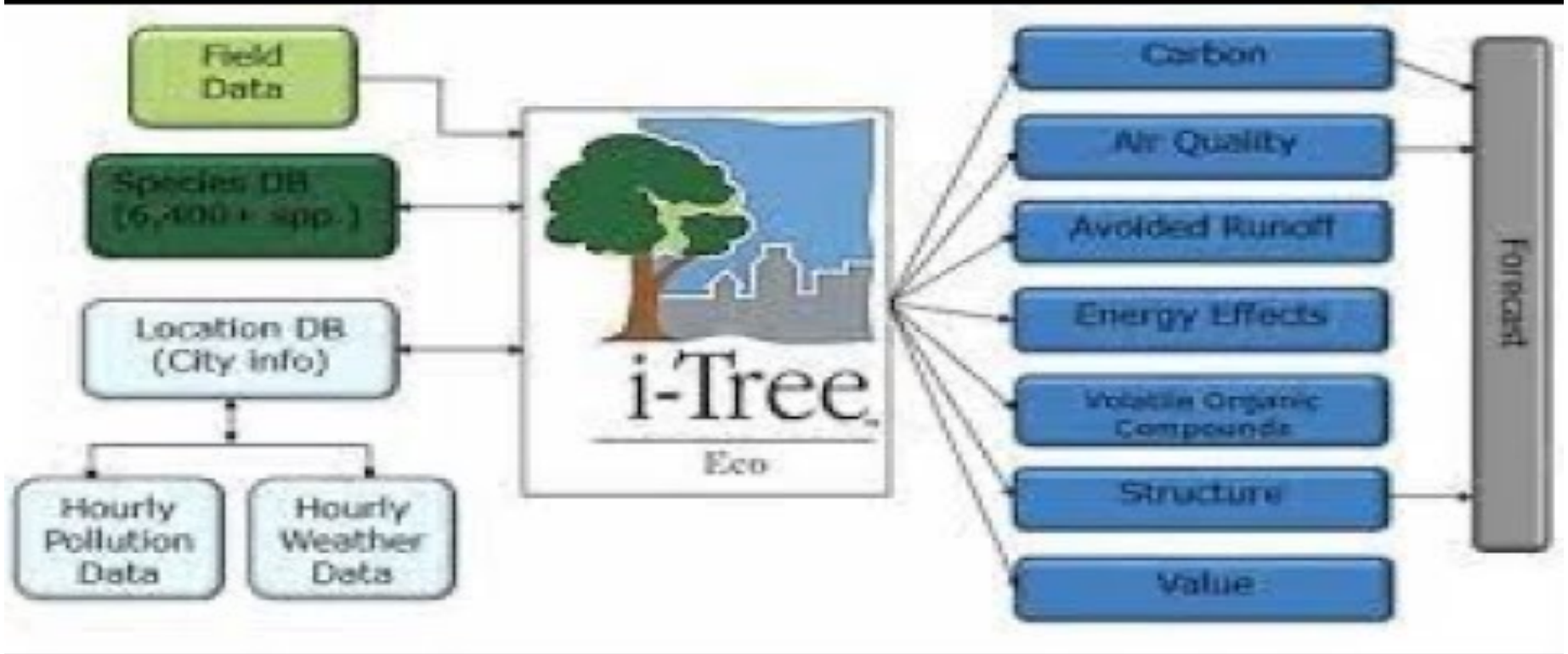


https://www.itreetools.org/tools/i-tree-eco

i-Tree Eco Model Schematic



www.itreetools.org/resources/archives.php

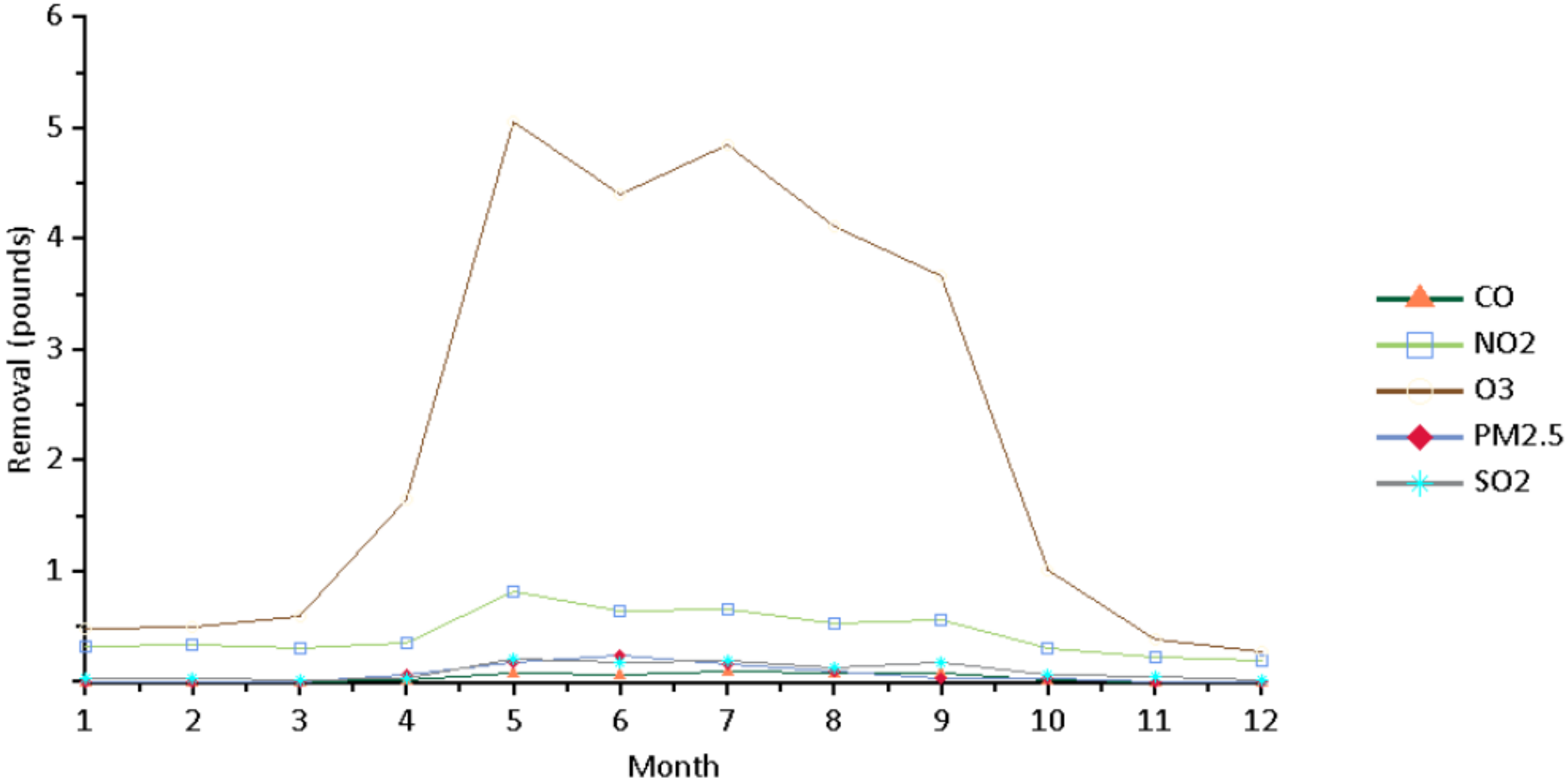


tutorial: zie www.urbanforestrylab.be

Pollution Removal by Trees and Shrubs - Monthly Removal

Location: Springfield, Hampden, Massachusetts, United States of America
Project: Springfield Squares, Series: Parks, Year: 2018
Generated: 4/8/2019

Voorbeeld op (slechts 44 bomen):
https://www.itreetools.org/tools/i-tree-eco



Brief Explanation of and Uses for i-Tree Eco Reports

Annual Carbon Sequestration by land use – This report contains one bar graph and one table. A bar graph depicts the calculated gross and net amount of elemental carbon that is sequestered in trees for each land use category within the project on an annual basis. A table numerically shows the numerical value of elemental carbon that is sequestered in trees by land use category annually. Growth and mortality rates of different land-uses are accounted for.

Uses – Through the process of photosynthesis, trees sequester carbon dioxide from the atmosphere and store the carbon in their wood and leaves. Sequestration is based on tree size, growth rate, and tree condition. This report quantifies the elemental carbon that is being sequestered by trees by land use type. Caution: if one or more of the land use categories is much larger than the others, then they will naturally have more trees in them and, depending on the size of those trees, may have a greater amount of carbon sequestration. It may be better to look at Carbon Sequestration Density by Land Use to see the amount of carbon being sequestered by trees on an area basis (acre or hectare). Carbon offset markets use CO_2 rather than C. To quantify the amount of carbon being sequestered as units of CO_2 rather than units of elemental carbon; take the value in the table for each land use area and multiply it by 3.67 (the molecular weight of CO_2).

Carbon Sequestration Density by Land Use - This report contains one bar graph and one table. A bar graph depicts the calculated amount of elemental carbon sequestered by trees on a per unit of area basis (acre or hectare) as well as the density of carbon sequestration for the entire project area (city, county, region). A table numerically shows the calculated amount of elemental carbon sequestered by trees by land use category and for the entire project area.

Uses – This information allows you to compare the calculated amounts of carbon sequestered by trees in each land use category. One example of how to use this report is if your community is interested in reducing its carbon footprint, this report can help you to plan for future development strategies. If you have a land use category that is sequestering a large amount of carbon, you may want to consider preserving existing trees in that land use area so as to not disrupt the carbon sequestering ability.

Monthly Pollutant removal by Trees and Shrubs - This report contains one graph and one table. A graph depicts the calculated amount of carbon monoxide (CO), nitrogen dioxide (NO2), ozone (O3), particulate matter less than 10 microns; such as soot (PM10), and sulfur dioxide (SO2) removed by tree and shrub leaf area by month. The amount of leaf area,

Meer info omtrent de resultaten:
https://www.itreetools.org/documents/33/Eco_reports_explanation.pdf

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boodschap

Bomen zijn **werkkrachten** voor de stad die zorgen voor een **gezonde leefomgeving**. Ze leveren ecosysteemdiensten die we kunnen **kwatificeren** in euro's.

We moeten hun functie **maximaal** laten **renderen**.

Het is dus cruciaal dat we **duurzaam** én **functioneel** omgaan met het stedelijke bos.

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I-Tree is een op weg om de referentie te zijn rond valoriseren van **ecosysteemdienstenen** voor de stad omwille van...

het is user friendly

wereldwijde opmars

science driven

updates

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Meer weten?

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