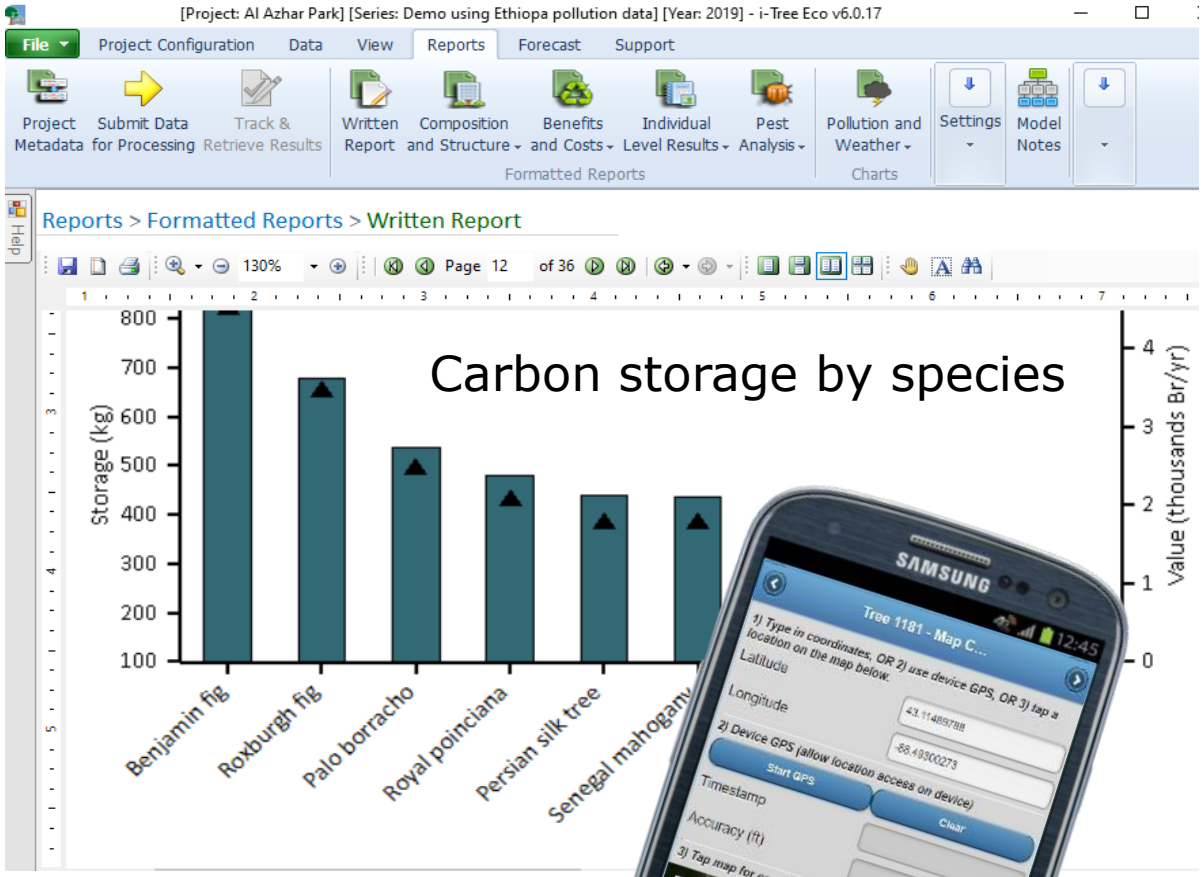
i-Tree International Academy
Session 5
i-Tree Eco Data Entry & Database

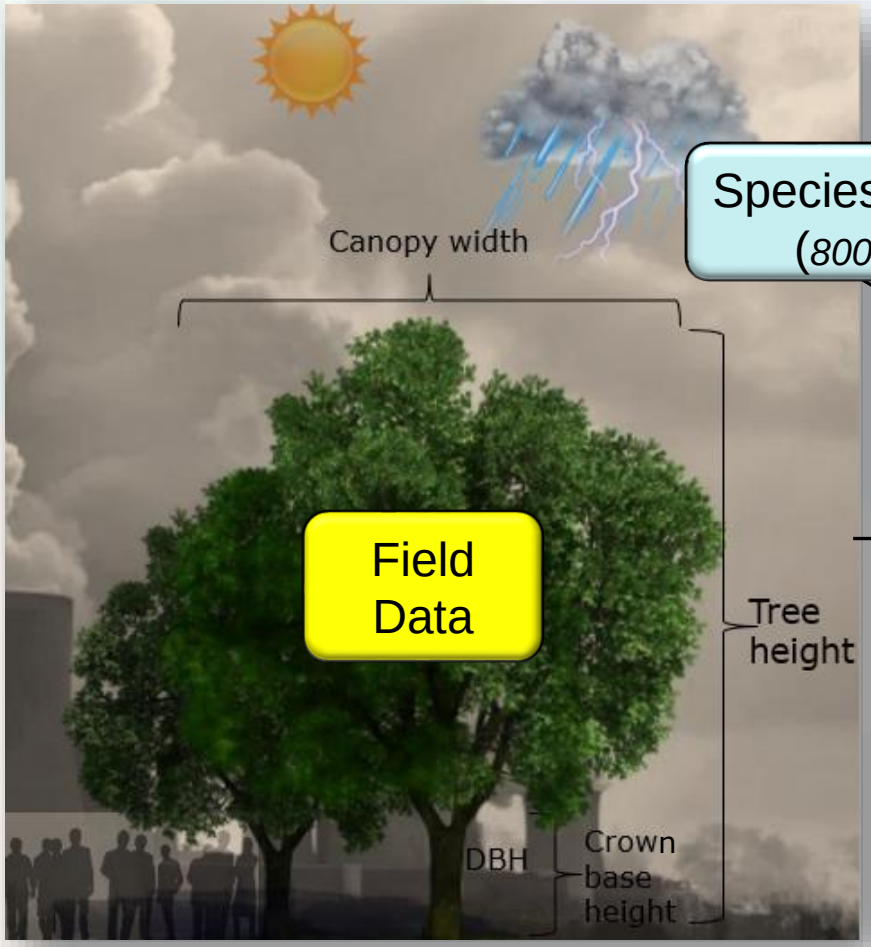
i-Tree Eco for international field-based projects

- **Tree & Forest Structure** - *leaf area & biomass, condition, species composition, size distribution, importance value, etc.*
- **Tree & Forest Function**
  - Carbon storage & annual sequestration
  - Air pollution reduction
  - Hydrology effects – avoided stormwater runoff
  - Energy effects *
  - Oxygen production
  - Shade ultraviolet effects *
  - Foodscape characteristics *(limited species)*
- **Value ($)**
- **Management information**
  - Tree health
  - Relative performance index
  - (3) customizable fields
- **Forecasting scenarios**
- **Cost benefit analysis**



*Some Eco analyses reports are limited to sample plot projects, or are limited because they are based off US characteristics and research

i-Tree Eco model components and relationships



i-Tree Database for New User Data

City Data

Pollution Data

Precipitation Data

Species Data (*8000+*)

Location Data

Field Data

i-Tree Eco

Carbon

Air Quality

Hydrology

Energy

Volatile Organic Compounds

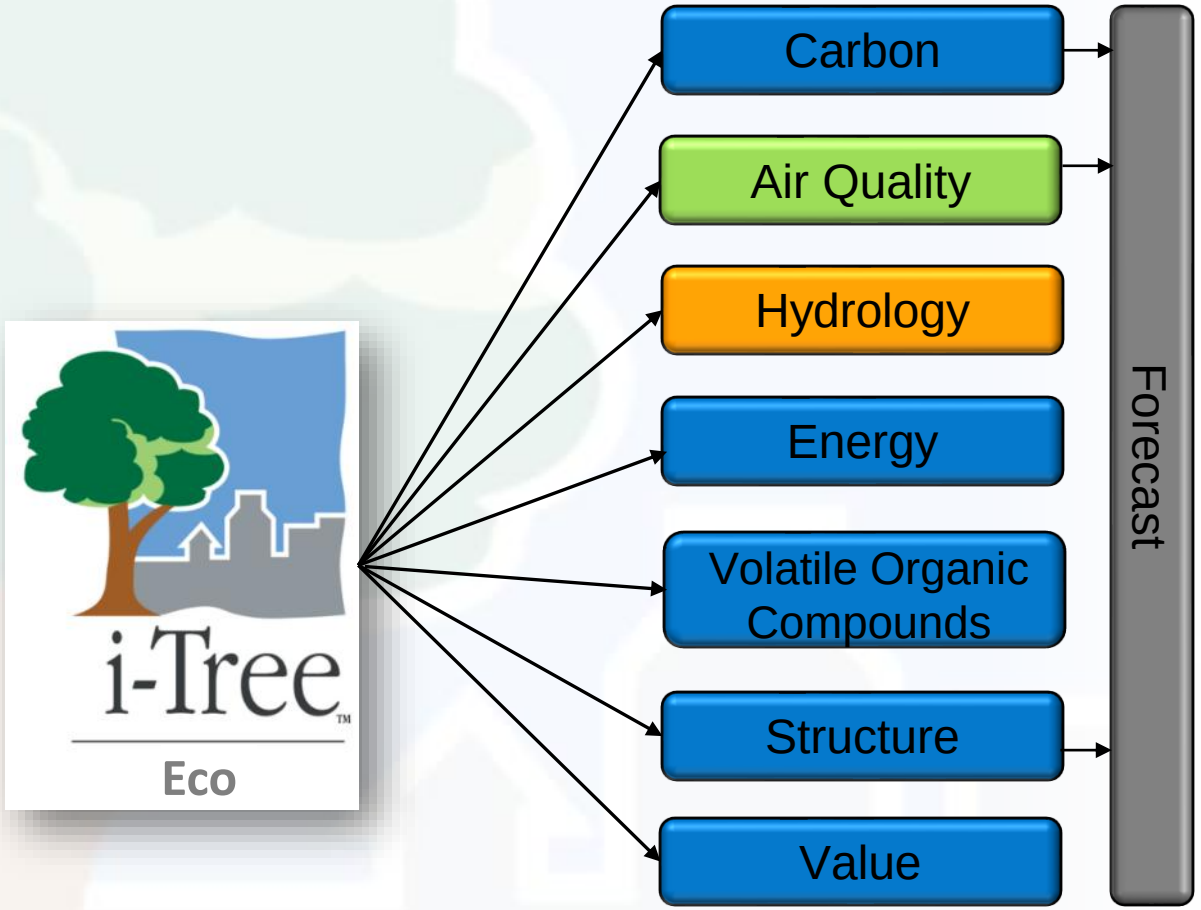
Structure

Value

Forecast

https://www.itreetools.org/support/resources-overview/i-tree-methods-and-files

Understanding i-Tree Eco international adaptations



Limitations

The following information is provided to summarize international limitations for users considering using i-Tree Eco outside of the supported countries. Eco users with international projects have access to most of the same model functions and reports as U.S., Australian, Canadian, and UK users. However, there are some important limitations to be aware of.

Turnaround Time

Working with i-Tree Eco requires users to submit their additional data using the i-Tree Database application. Data must be validated and added to the i-Tree databases before it can be incorporated into Eco and released in a software update. This turnaround can take time. Users working with i-Tree Database will receive an email notifying them when their submitted data have been received and again when the data have been added to Eco. Once the validated data for a new study area have been incorporated into Eco, any user can do a project for that location with the same automatic processing as the U.S., Australia, Canada, Mexico, South Korea, Colombia, and most countries in Europe.

Benefits and Values

Because i-Tree Eco was originally developed for the United States, several methodologies have been developed around U.S. parameters. Please read the following descriptions for information on specific ecosystem services and how they are estimated for international projects.

Tip

Hourly precipitation data is not inherent in i-Tree Eco for areas outside of the U.S., Australia, Canada, Mexico, South Korea, Colombia, and most countries in Europe. Providing precipitation data is optional for new locations. Without this data, your analysis will not include avoided runoff estimates.

Avoided Runoff – Methods for calculating avoided runoff assume that precipitation falls uniformly over the study area and falls either on vegetation or ground area. Interception processes dictate whether that precipitation will be intercepted by leaves or reach the ground and infiltrate or become runoff. This methodology uses the assumption that 25.5 percent of the ground area is impervious cover and 74.5 percent is pervious cover, which is based on national

http://www.itreetools.org/resources/manuals/Ecov6_ManualsGuides/Ecov6Guide_InternationalProjects.pdf

International Projects and Limitations

Eco Guide To International Projects – Key document for conducting i-Tree Eco projects in locations outside the US

Limitations (page 26)

Energy – Results should be used with caution as they assume that the building types, energy use, and emission factors of the U.S. are the same as those internationally.

Pollution - To estimate pollution removal value, the monetary value of carbon monoxide (CO), nitrogen dioxide (NO2), sulfur dioxide (SO2), particulate matter less than 2.5 microns (PM2.5), and ozone (O3) removal are estimated using U.S. median externality values. Users may provide local pollution removal values to be used in place of the U.S. values.

Understanding how the models work: communicating results

Understanding i-Tree: Summary of program and methods – Summary of all the models and underlying methods with links to additional details

Table 3.—continued

Species	Eq. form	x	A	B	C
Quercus phellos	$y = A * (x^B)$	d.b.h.^{2} x height	0.05652	0.94267	0.00000
Quercus prinus	$y = e^{(A + B * Ln(D) + (C/2))}$	d.b.h.	-2.37532	2.57796	0.08714
Quercus rubra	$y = e^{(A + B * Ln(D) + (C/2))}$	d.b.h.	-2.07550	2.42949	0.07839
Quercus velutina	$y = e^{(A + B * Ln(D) + (C/2))}$	d.b.h.	-2.24967	2.55053	0.05745
Quercus wislizeni	$y = e^{(A + B * Ln(D) + (C/2))}$	d.b.h.	-2.17185	2.50939	0.07789
Thuja occidentalis	$y = e^{(A + B * Ln(D) + (C/2))}$	d.b.h.	-1.78066	1.99440	0.09031
Thuja plicata	$y = e^{(A + B * Ln(D) + (C/2))}$	d.b.h.^{2} x height	-4.88072	1.00448	0.00076
Tilia americana	$y = e^{(A + B * Ln(D) + (C/2))}$	d.b.h.	-2.42943	2.35806	0.25912
Tsuga canadensis	$y = e^{(A + B * Ln(D) + (C/2))}$	d.b.h.	-2.25566	2.32302	0.04002
Tsuga heterophylla	$y = e^{(A + B * Ln(D) + (C/2))}$	d.b.h.^{2} x height	-4.19825	1.00526	0.00198
Ulmus americana	$y = e^{(A + B * Ln(D) + (C/2))}$	d.b.h.	-2.22755	2.39866	0.06020

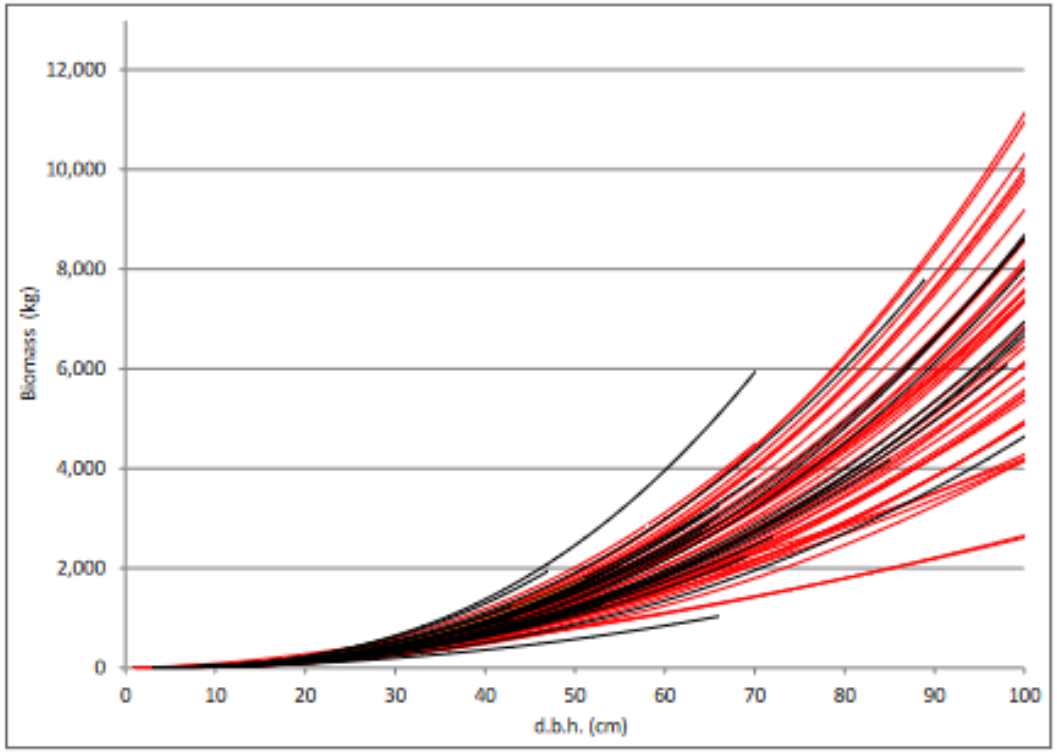
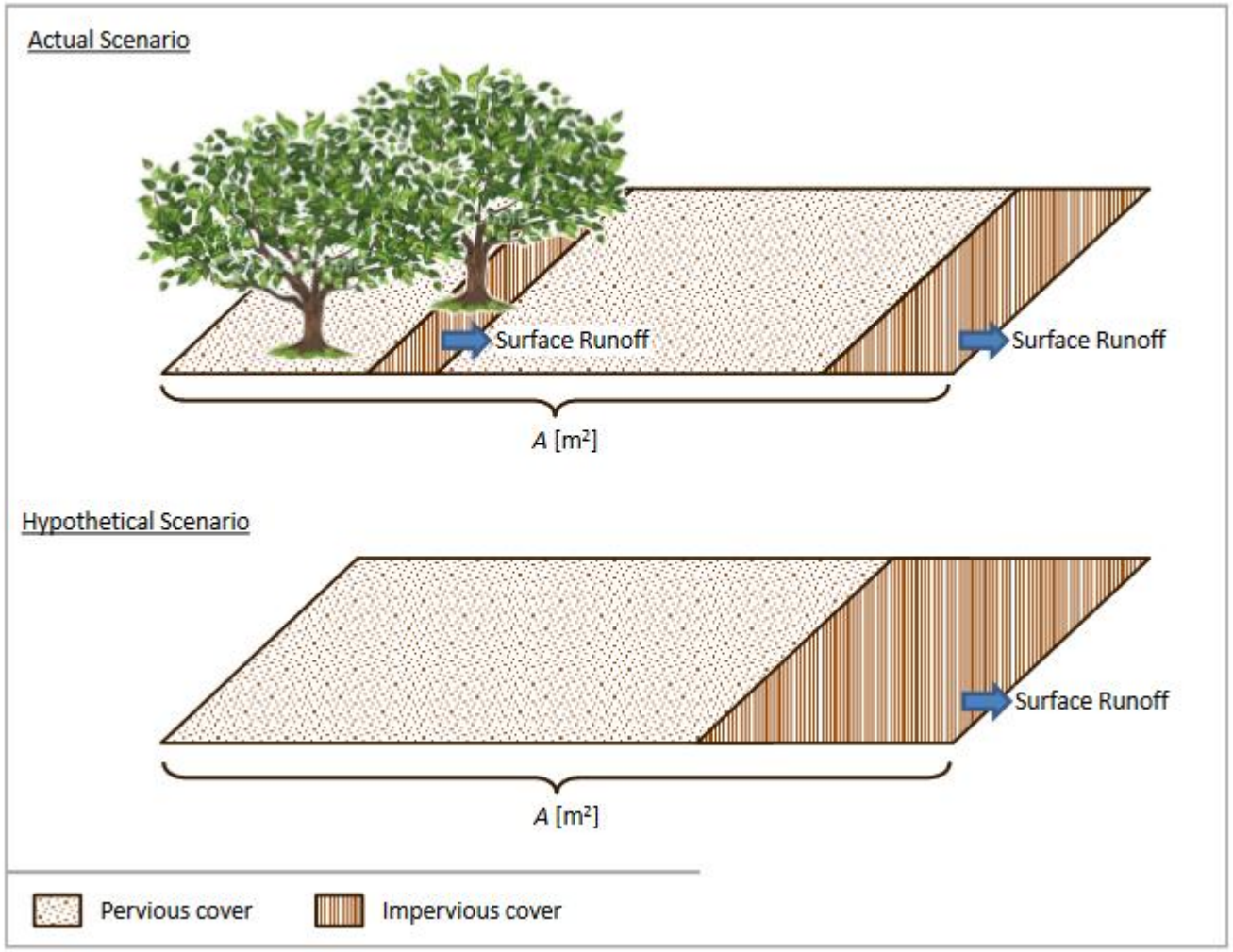


Figure 12.—Estimates of dry weight biomass for numerous species using various equations across a large diameter range. Red lines are i-Tree equation estimates (Table 3); black lines are estimates from equations from Jenkins et al. (2003).

Understanding how the models work: communicating results

i-Tree Eco Precipitation Interception Model Descriptions – Example of detailed ecosystem service model documentation



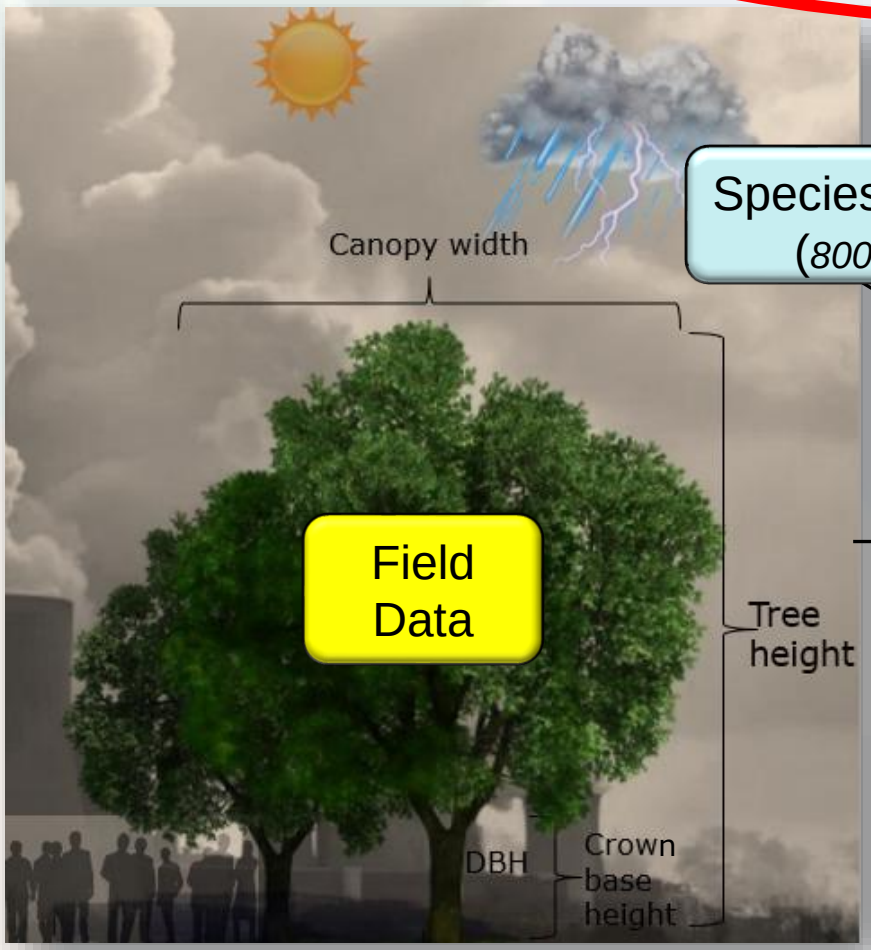
Understanding how the models work: designing your project

Understanding i-Tree: Summary of program and methods – Relationships between field data collected and i-Tree Eco results

Table 2.—Summary of which directly field-measured characteristics are used to estimate derived variables and ecosystem services. D= directly used; I= indirectly used; C= conditionally used.

	DERIVED VARIABLES		ECOSYSTEM SERVICES										
DIRECT MEASURES	Leaf Area	Leaf Biomass	Carbon Storage	Gross Carbon Sequestration	Net Carbon Sequestration	Energy Effects	Air Pollution Removal	Avoided Runoff	Transpiration	VOC Emissions	Compensatory Value	Wildlife Suitability	UV Effects
Species	D	D	D	D	D	D	I	I	I	D	D		
Diameter at breast height (d.b.h.)			D	D	D						D	D	
Total height	D	D	C	C	C	D	I	I	I	I		D	
Crown base height	D	D	C				I	I	I	I			
Crown width	D	D	C				I	I	I	I			
Crown light exposure			C	D	D								
Percent crown missing	D	D	C	C	C	D	I	I	I	I			
Crown health (condition/ dieback)				D	D						D	D	
Field land use				D							D	D	
Distance to building						D							
Direction to building						D							
Percent tree cover						D	D	D				D	D
Percent shrub cover							D					D	
Percent building cover						D							
Ground cover composition							I					D	

i-Tree Eco model components and relationships



i-Tree Database for New User Data

City Data

Pollution Data

Precipitation Data

Species Data (*8000+*)

Location Data

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i-Tree Eco

Carbon

Air Quality

Hydrology

Energy

Volatile Organic Compounds

Structure

Value

Forecast

https://www.itreetools.org/support/resources-overview/i-tree-methods-and-files

City Data

Population:

Population of the location.

Area in square meters:

Area of the location

Climate Region:

-- Select Climate Region --

U.S. region whose climate is most similar to the climate of the location. Use to estimate local energy effects. See Help for more info.

Electricity Emissions (kg CO_2/kWh):

Amount of CO_2, in kilograms, emitted per kWh of electricity used in the location.

Mean Minimum Temperature (Fahrenheit):

Long-term average daily minimum temperature, in degrees Fahrenheit, observed locally.

Leaf On Day of Year:

Day of the year (1 - 365) in spring when frost ends locally.

Leaf Off Day of Year:

Day of the year (1 - 365) in autumn when frost begins locally.

City Data

Details about your location so that the models can be localized

Energy model

Climate Region

Electricity emissions (kg CO_2/kWh)

Carbon uptake model

Average minimum temperature

Leaf on/off day of year

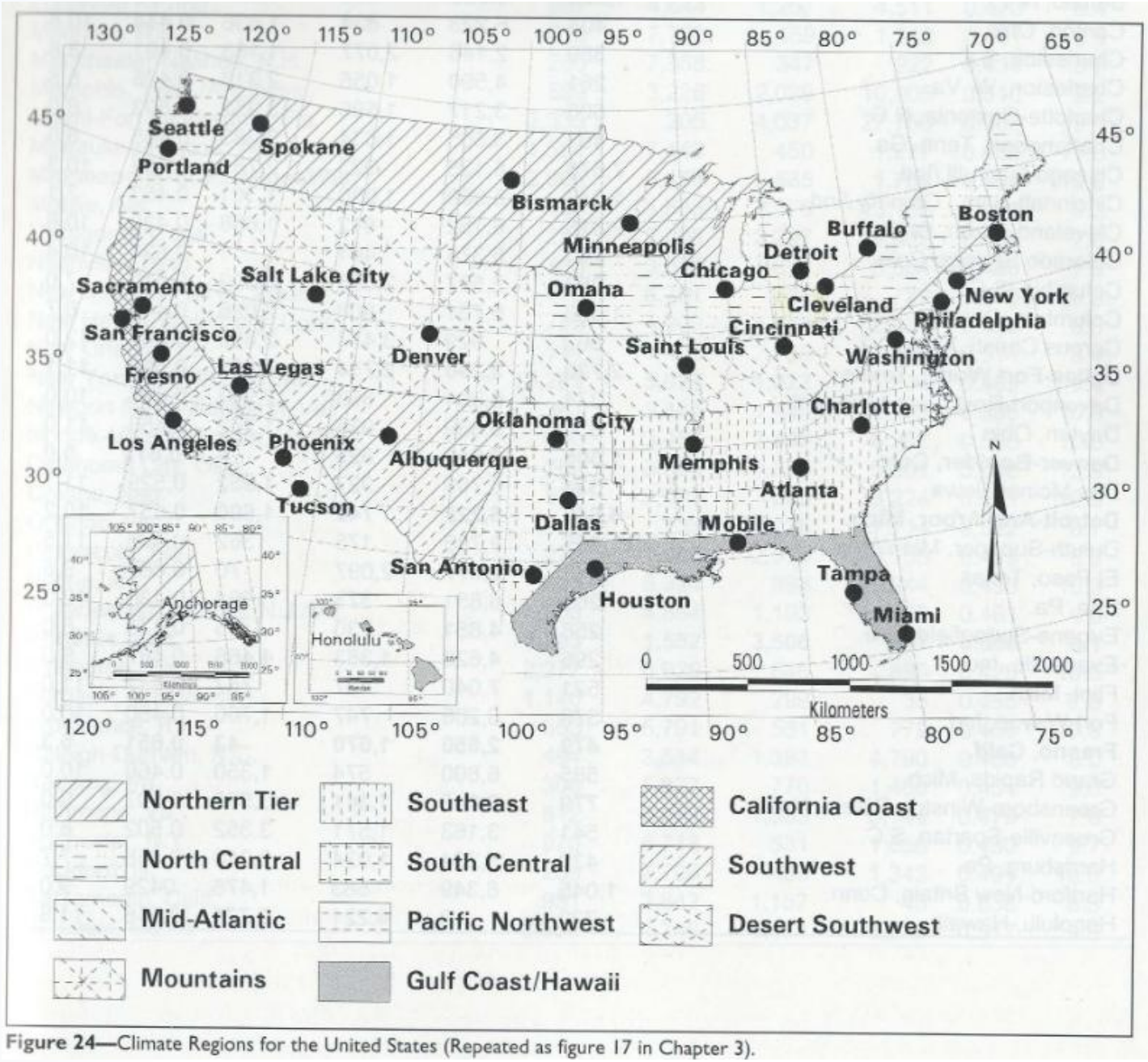
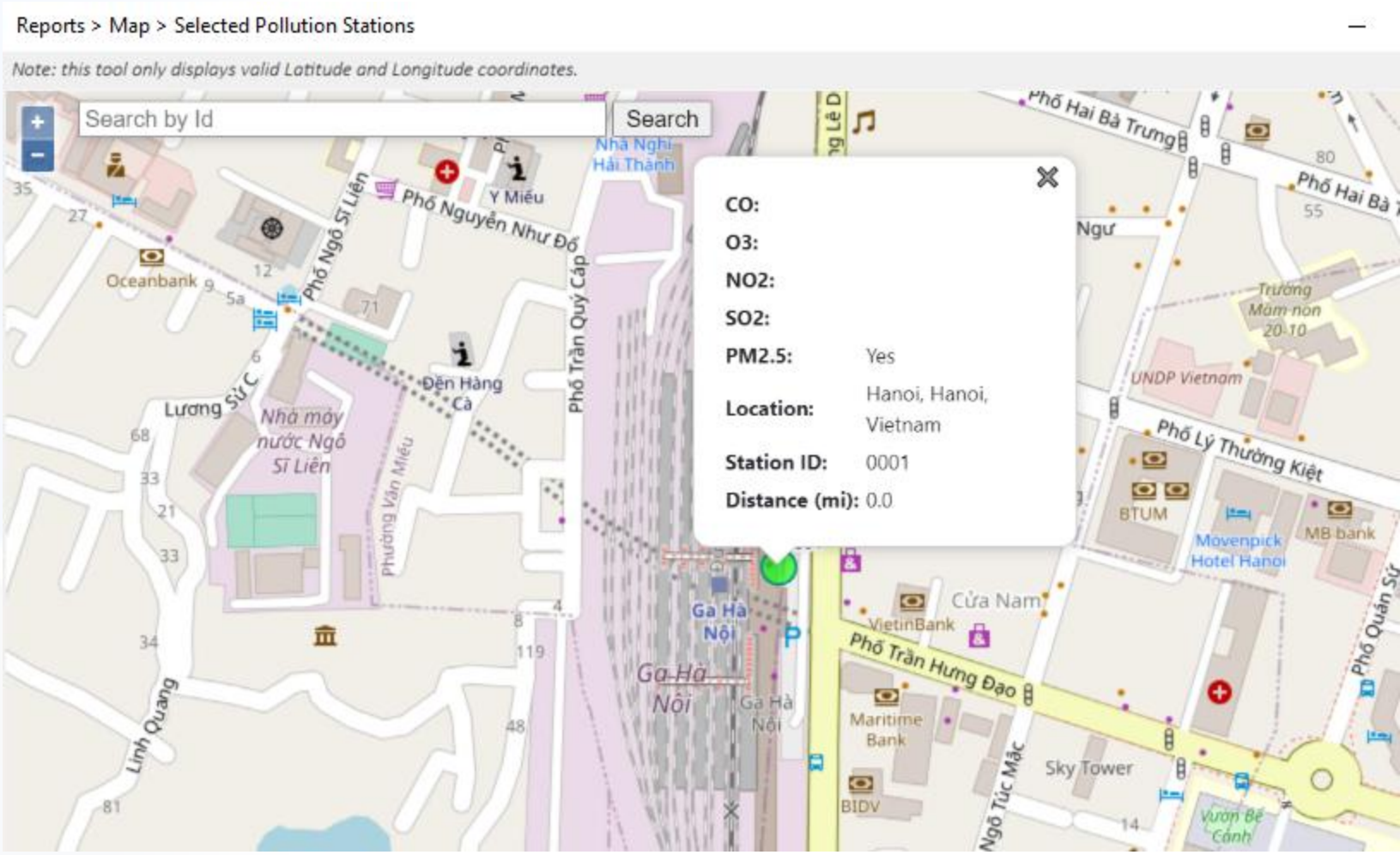


Figure 24—Climate Regions for the United States (Repeated as figure 17 in Chapter 3).

Pollution Data

Must provide <u>hourly</u> air pollution concentrations if you want air pollution related results

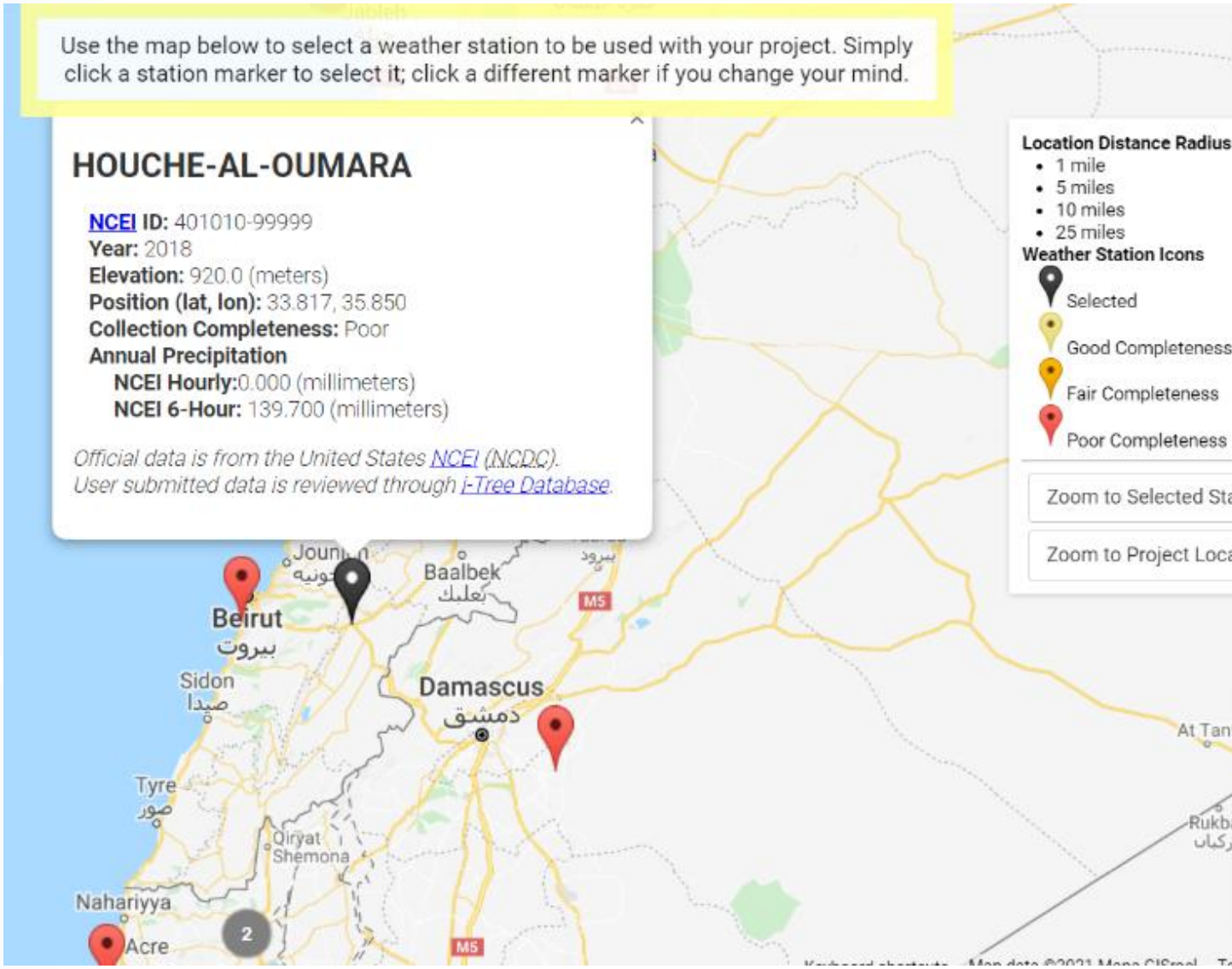
- CO, O_3, NO_2, SO_2, PM 2.5, PM 10*
- Do not need to provide all pollutants
- 2005-2023 data



Precipitation data

Provide to increase the accuracy and localization of hydrology and pollution models

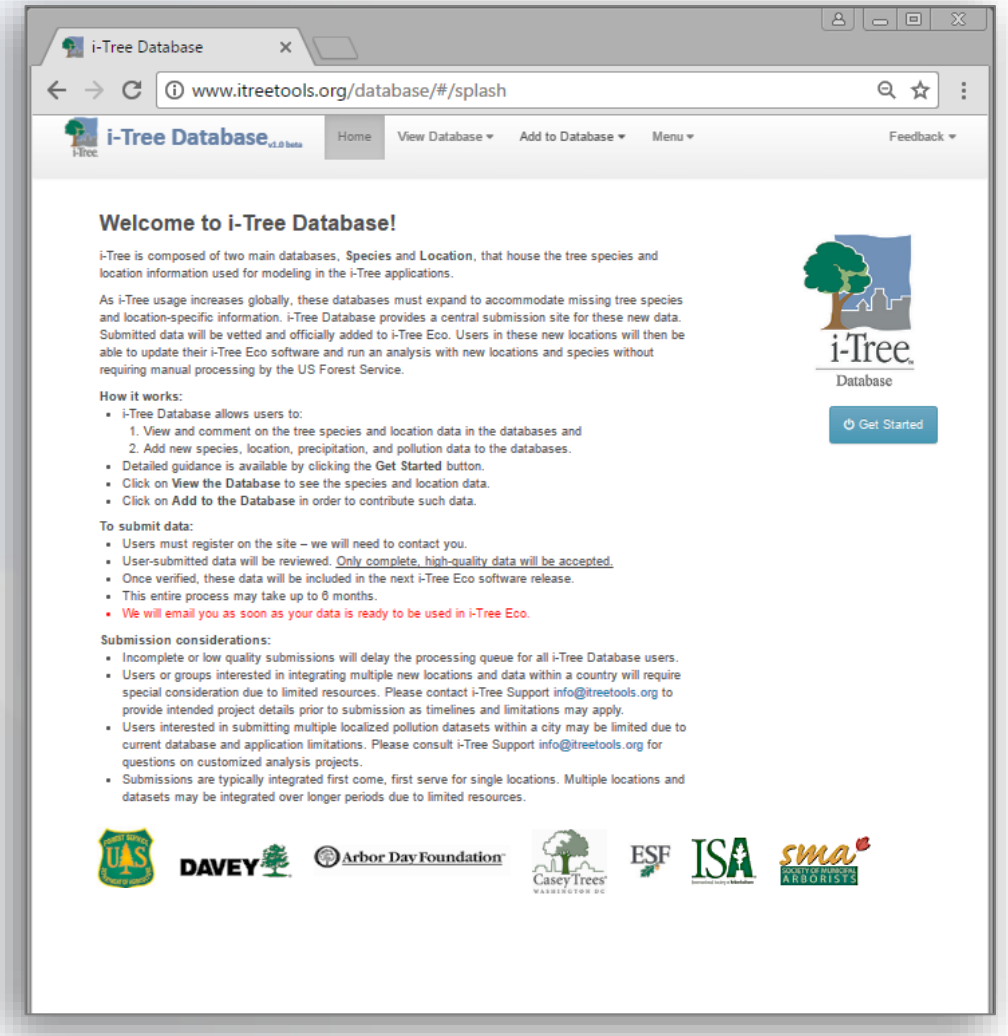
- Hourly rainfall for a complete calendar year
- Accepting 2005-2023 data
- Associate with an existing weather station
- Replaces default values



How do locations outside the US get into Eco?

i-Tree Database

- Web-based submission of data for a single city
- Partial pollutant data is acceptable
- City permanently integrated into i-Tree Eco for all users
- New species submission



database.itreetools.org

Location Data

City Data

Pollution Data

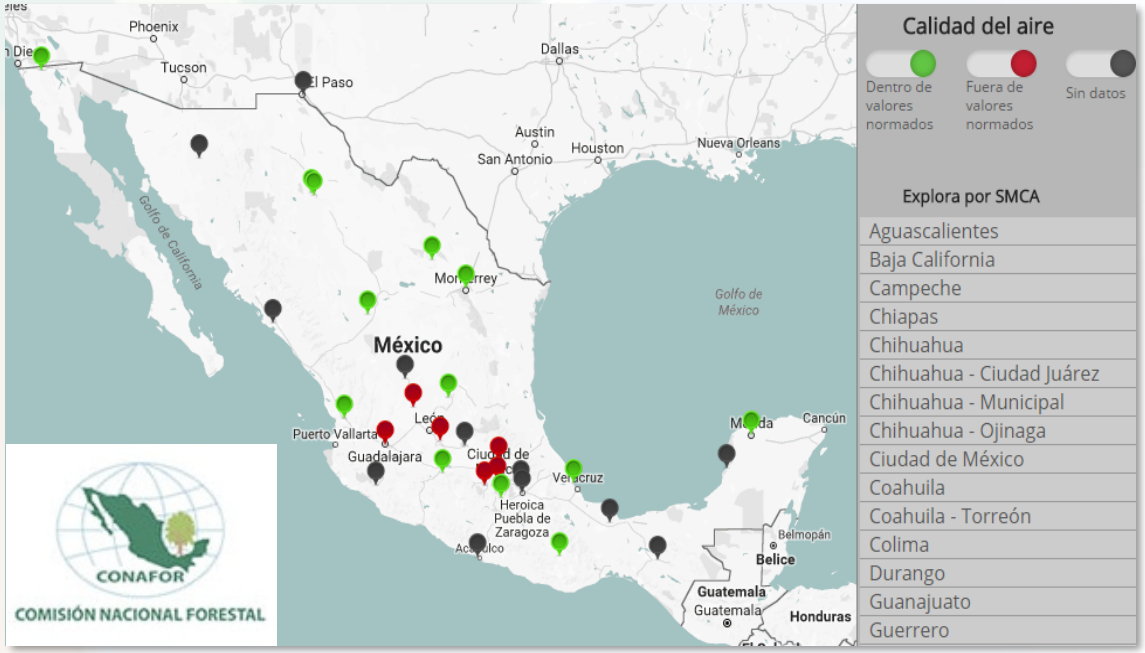
Weather Data

Species Data

How do *countries* get into Eco?

Full integration of entire country

- Local partners provide data and funding to support integration
- i-Tree Eco functions the same as it does in the US



Canada
Australia
United Kingdom
Mexico
European Union
Colombia
South Korea
Japan
New Zealand
Ukraine

Location Data

City Data

Pollution Data

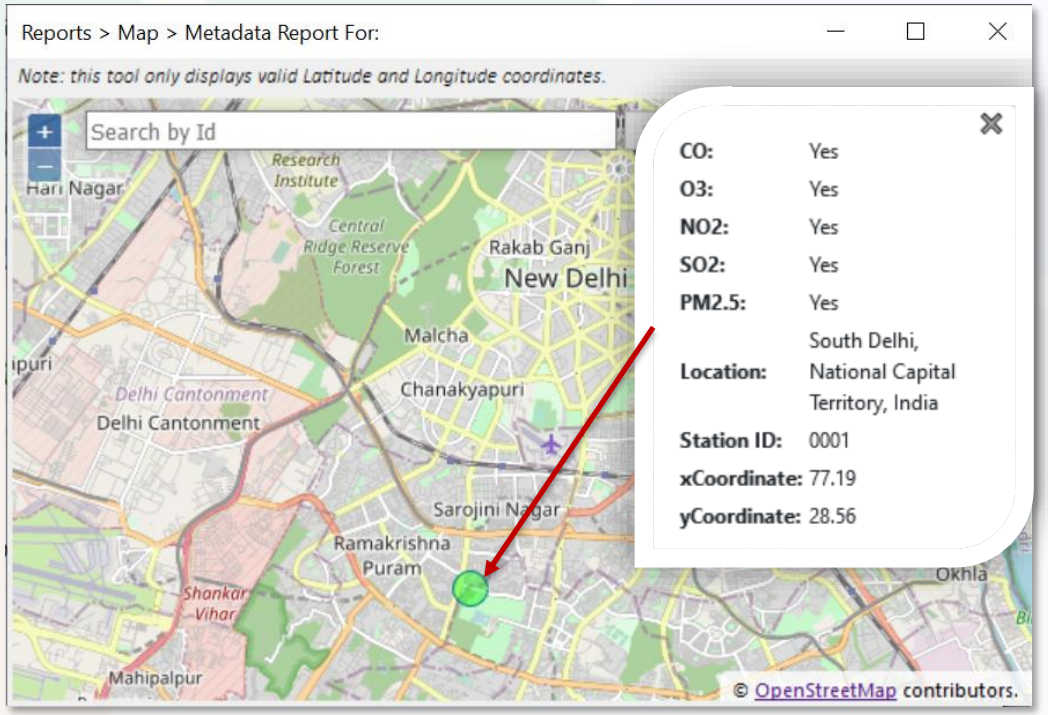
Weather Data

Species Data

How do *individual global cities* get into Eco?

Global city integration

- Global users provide data for their city.
- i-Tree Eco functions the same as it does in the US for that individual city
- No cost & partial data options



Many individual global cities available with pollution & precipitation

Delhi, India
Montevideo, Uruguay
Concepcion, Chile
Sao Paulo, Brazil
Bangkok, Thailand
Kowloon, Hong Kong
Beijing, China
Da Nang, Vietnam
Lahore, Pakistan
Kaohsiung City, Taiwan
Dhaka, Bangladesh…

Location Data

City Data

Pollution Data

Precipitation Data

Species Data

i-Tree Database integration options & considerations

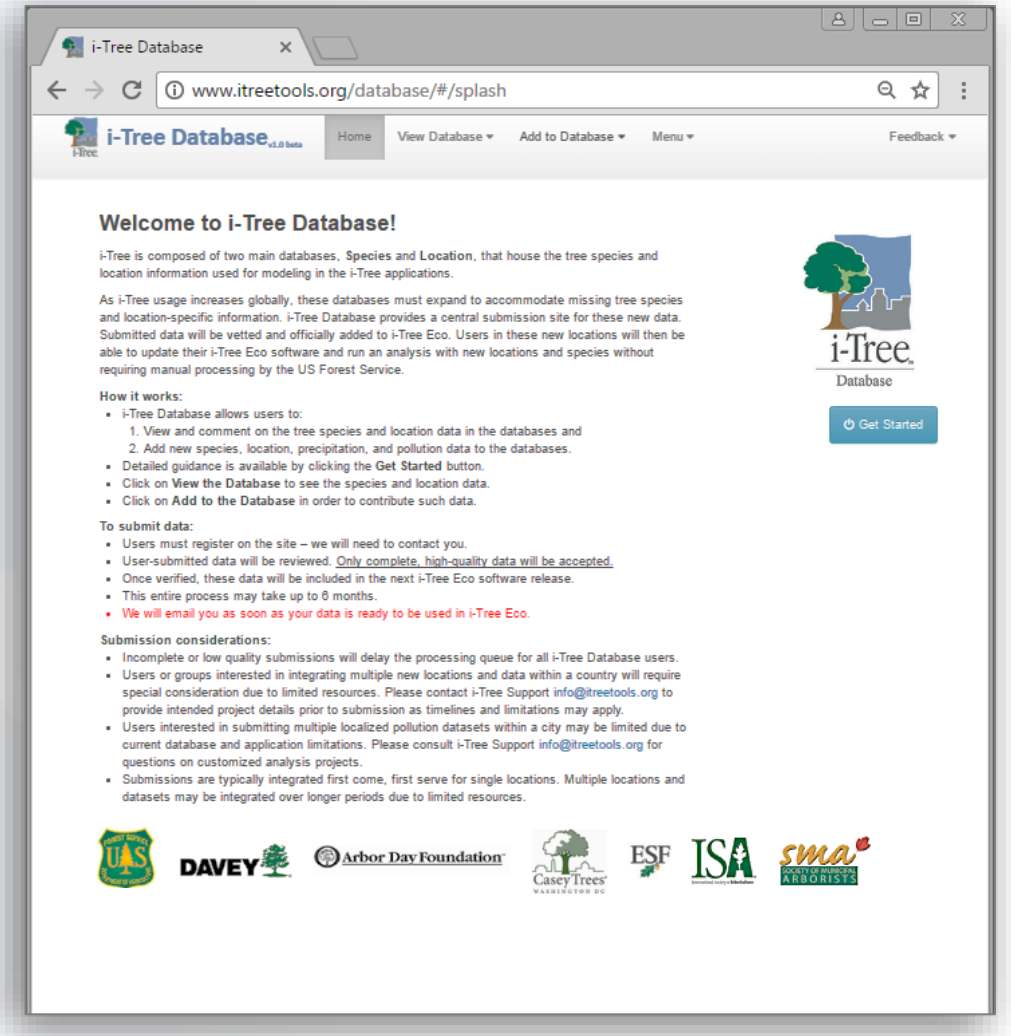
Full Integration Countrywide

- Extensive data required for all desired national cities
- $$$ funding required for integration work
- Collaborating partners work directly with i-Tree Development Team
- Longer development & integration timeline
- Key Benefit: Countrywide access to i-Tree Eco
- Future countrywide updating not typically considered
- Options available for updating individual city data

Individual Global City with Pollution & Precipitation

- City info, hourly pollution and precipitation for (1) city
- No fee for integration
- Individual submits all info & data using i-Tree DB form using templates
- New city & data typically available in Eco within 3-6 months
- Key Benefit: Eco use for individual city or nearby location
- Key Use: Student projects or pilot or demo projects
- Multiple individual cities can be submitted
- Future updating using i-Tree Database

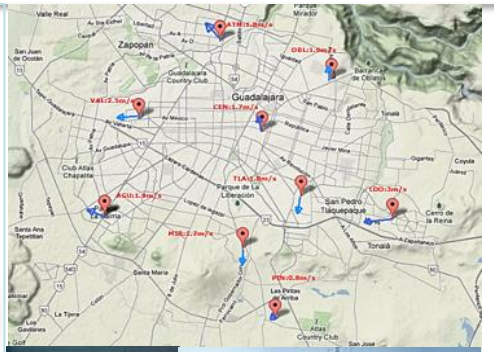
Exploring i-Tree Database

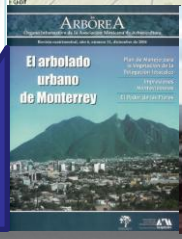


database.itreetools.org

I-TREE ECO MEXICO INTEGRATION

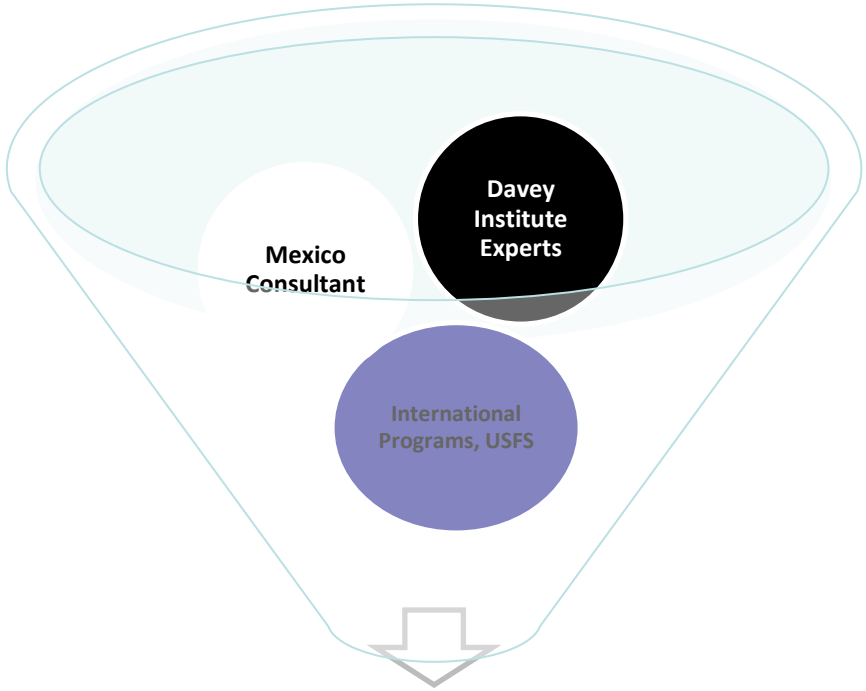
S. Fabiola Lopez L.
Urban Forestry & i-Tree Consultant for Mexico and Latin America
International Programs, US Forest Service





Why i-Tree Eco in Mexico?

- Development of i-Tree Eco Mexico was an initiative from the first meeting of the Urban Forest Working Group under NAFC in 2017
- Adding Mexico allows for greater collaboration and engagement on urban issues across the continent
- Provide a tool to diverse communities and user groups in Mexico to improve urban forest planning, advocacy, and engagement.



i-Tree Eco for Mexico

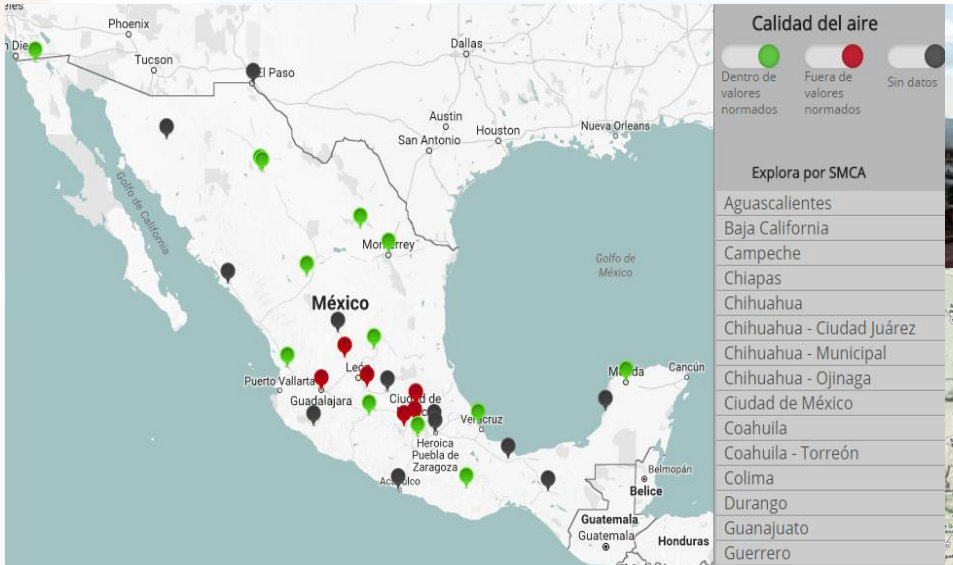
SELECTION OF CITIES

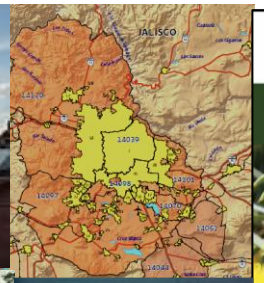
Based on availability of:

- Demographic information
- Pollution data
- Climate data

IN-COUNTRY RESOURCES FOR I-TREE ECO

- Location (INEGI)
- Population density (INEGI)
- Climate (SMN-CONAGUA)
- Pollution data (SINAICA-INECC)
- Matching with US climate regions
- Urban tree species





Data integration by Davey Institute experts

REVIEW AND DATA INTEGRATION BY DAVEY INSTITUTE EXPERTS

i-Tree Eco User Input Form Database

- **Location**
- **Climate**
- **New species (+120 added) and more.**

Information ordered by primary (states), secondary (municipalities) and tertiary partitions (urban localities).

Hourly pollution data by year

Hourly precipitation data by year

Partition Maps

Translation of i-Tree web page and i-Tree Eco manuals and main guides

Mexico integration includes 33 cities, where **82.7%** of the urban population lives.

i-Tree Eco for Mexico

Delhi i-Tree Project

Give Me Trees Trust
(New Delhi, India)

Akshat Tyagi

Program Brief

- Name : Assessing the benefits provided by trees in Delhi to the citizens
- Funded by : USFS IP
- Implemented by : Give Me Trees Trust
- Number of team members involved : 3
- Project duration : 1.5 years
- Locations covered across Delhi: 400

Program Goals

- To assess the benefits of trees in Delhi
- To assess how do trees affect: human health, wealth distribution, communities and youth

About Delhi

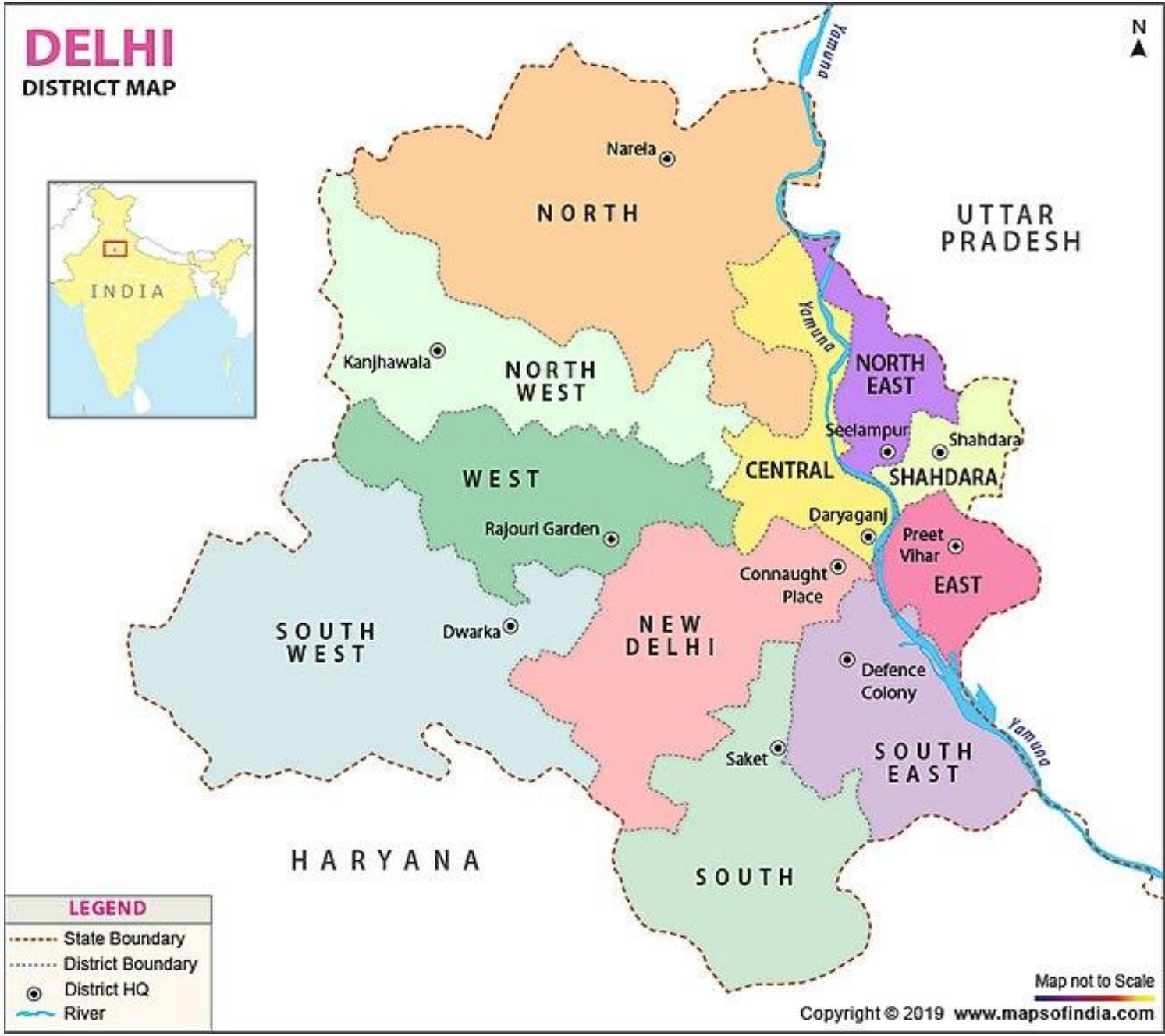
- Delhi – Capital of India
- Jointly administered by the Union Government of India and the Local Government of Delhi

	Delhi (NCT)	New York State
Area	1,484 sq km (573 sq mi)	141,300 sq km (54,556 sq. mi)
Total Population	20.6 million (2021)	20.2 million (2021)
Density (per sq. km)	13,862 people/sq km	159 people /sq km
Forest cover *	13.15%*	61%*
Green cover	23.06 % (2021)	

95 times smaller

87 times denser

11 Districts in Delhi



Major Environmental Issues in Delhi

Air pollution

Water scarcity & pollution

Yamuna River

Loss of biodiversity

Climate change

Headlines

...

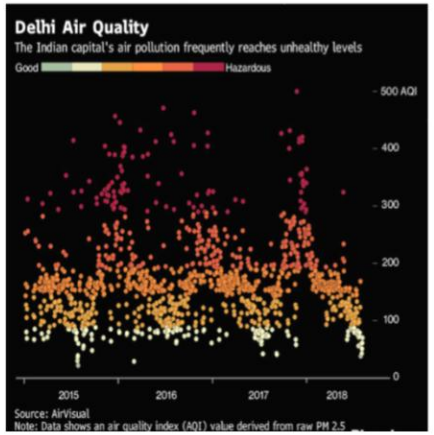
The Washington Post
Democracy Dies in Darkness

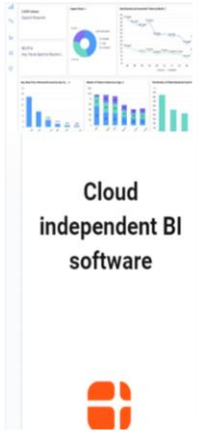
Energy • Analysis

Why Delhi Is the World's Smog Capital Year After Year

By Debjit Chakraborty and Rajesh Kumar Singh | Bloomberg

November 18, 2021 at 9:24 p.m. EST

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FEDERAL BUDGET | Follow our live blog as the federal government prepares to unveil its election-

Doctors say breathing toxic air in Delhi is like smoking 10 cigarettes a day and urgent solutions are needed

By Charmaine Manuel

Posted Mon 3 Jan 2022 at 12:27am, updated Mon 3 Jan 2022 at 2:11am

The Guardian
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Delhi schools to close for a week due to smog

Levels of PM 2.5 particulates hit 20 times safe levels as agricultural fires add to city's air pollution crisis

Advertisement

The Washington Post
Democracy Dies in Darkness

Delhi considers new lockdown — this time for pollution, not covid

By Gerry Shih

November 15, 2021 at 8:41 a.m. EST

Morning haze and smog envelop the skyline in New Delhi on Nov. 5. (Altaf Qadri/AP)

HT Hindustan Times

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DELHI NEWS

Delhi world's most polluted capital for fourth year in row

Among the most polluted cities, Rajasthan's Bhiwadi fared the worst followed by Uttar Pradesh's Ghaziabad, on the outskirts of Delhi.

Annual average PM2.5 levels in Delhi increased by almost 15% in 2021 compared to the previous year.(HT Photo)

Updated on Mar 23, 2022 12:32 PM IST

The Washington Post
Democracy Dies in Darkness

Asia

Diwali may bring 'severe' air pollution to Delhi, despite fireworks ban

By Amy Cheng

November 3, 2021 at 5:59 a.m. EDT

Air Quality Index Scale

- Scale for measuring air pollution
- The city's AQI (air quality index) is usually in the range of **250-300**
- It can even cross **999** in months from October- December

Numerical Value	Color	Air Quality Index Levels of Health Concern	Meaning
0 - 50	Green	Good	Air quality is considered satisfactory, and air pollution poses little or no risk.
51 - 100	Yellow	Moderate	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
101 - 150	Orange	Unhealty for sensitive groups	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
151 - 200	Red	Unhealthy	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
201 -300	Purple	Very unhealthy	Health alert: everyone may experience more serious health effects.
301 - 500	Maroon	Hazardous	Health warnings of emergency conditions. The entire population is more likely to be affected.

Air Quality Index : 50

Air Quality Index : 350

The important questions to ask..

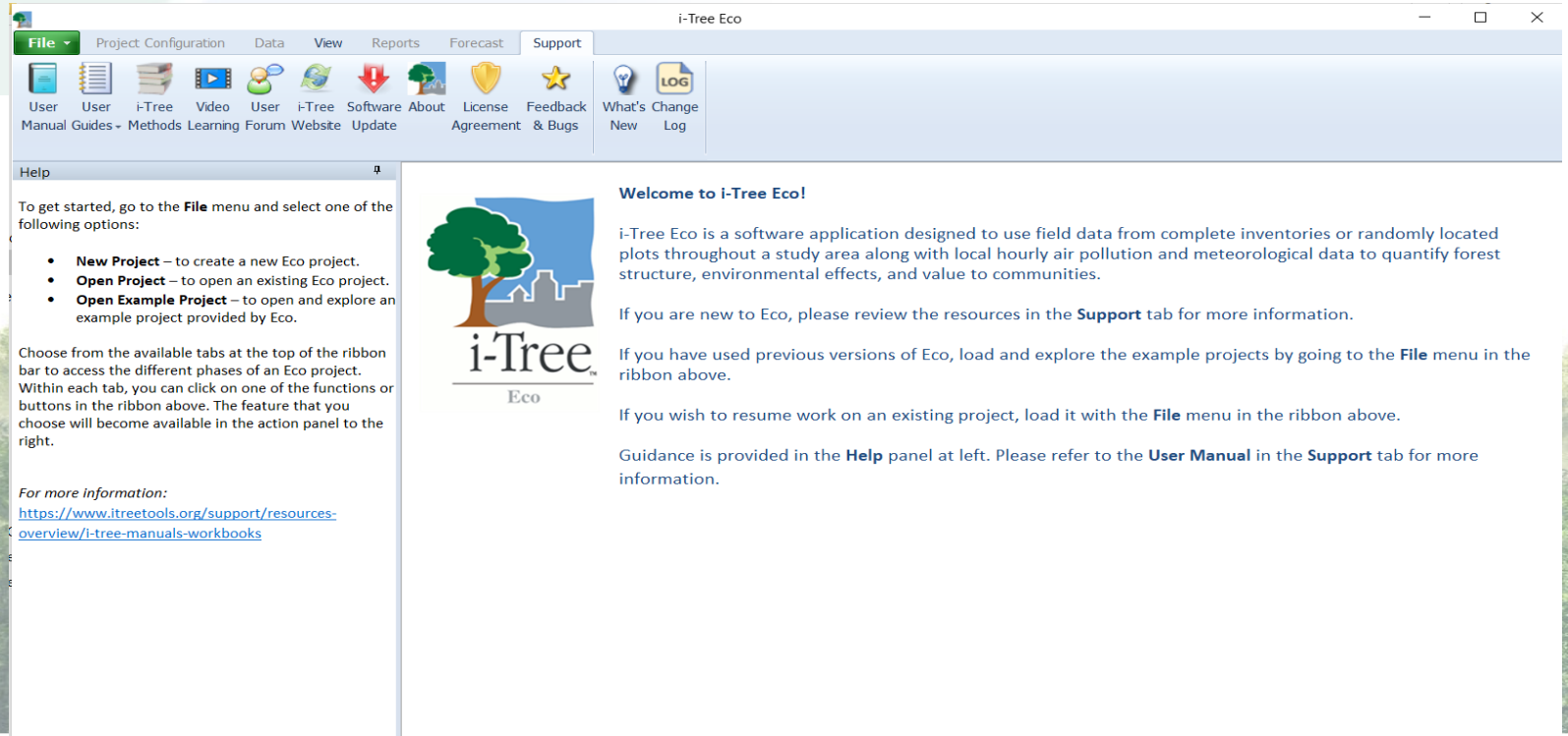
Even though the government figures say that there is 23% green cover in Delhi, the area still suffers from **extreme** air pollution.

It is important to understand:

(i) WHAT does the green cover in Delhi consist of?

(ii) How effective are the trees in removing air pollution?

For this, we have used i-Tree



What have we done?

Adaption of i-Tree Eco in Delhi

- **Using i-Tree Eco (Eco stands for Ecosystem services) to calculate benefits of trees in Delhi**
- For this, we are:
  - Collecting data of trees from all across Delhi
  - 400 locations across Delhi

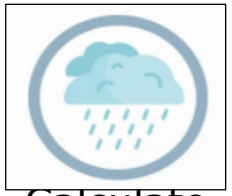
What else, apart from Air Pollution?

Proper decision making and policy advocation

Determine the Ecosystem services (benefits) of trees

Calculate the amount of air pollution removal by trees

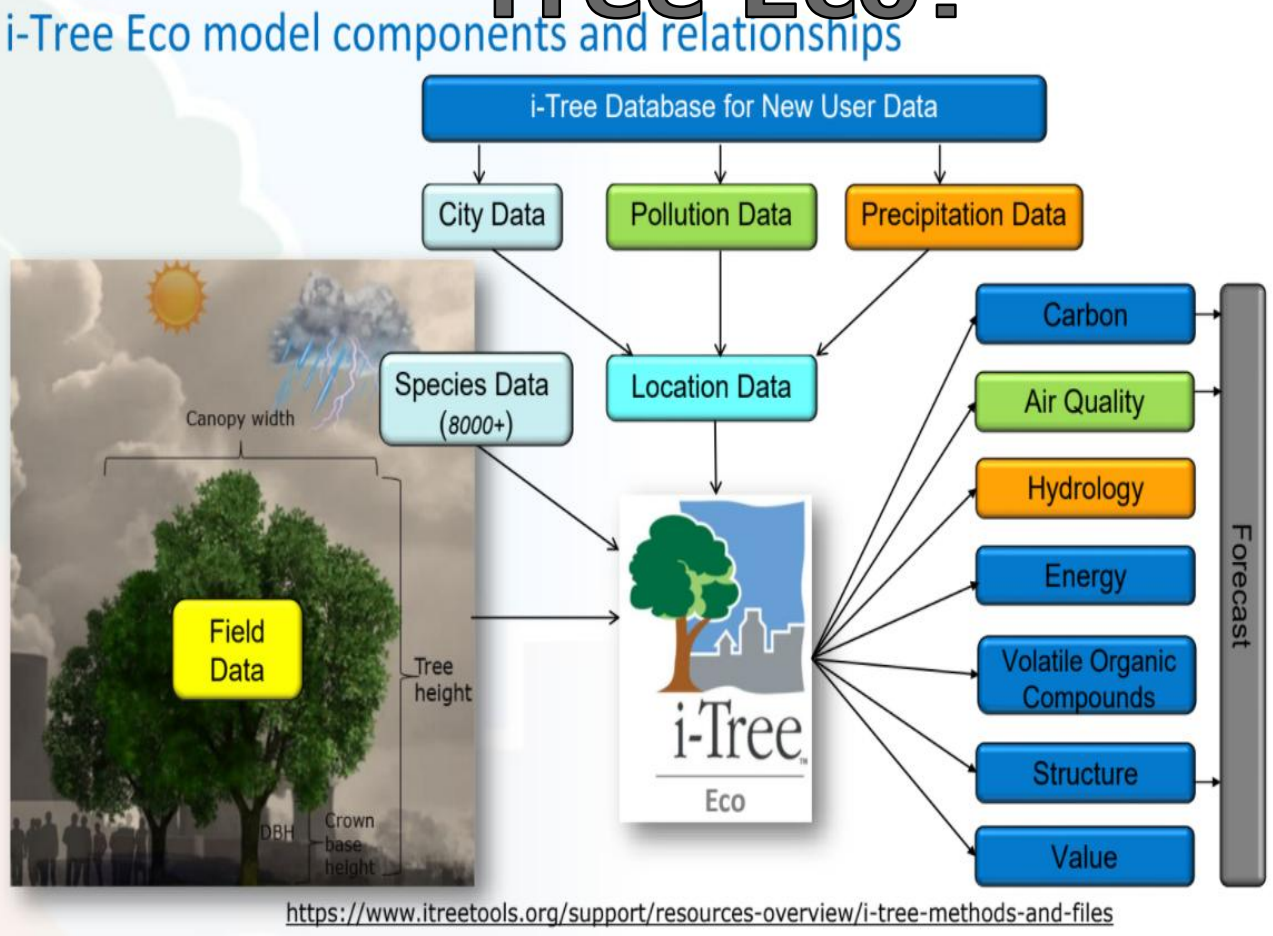
Create awareness



Calculate potential rainfall due to trees

Amount of carbon absorbed by trees annually

How to set-up a Project on i-Tree Eco?



- **Configuration for local use/ local modeling:**
- International users need to submit:
  - Pollution data
  - Rainfall data
  - City data

- Project set-up and tree variable selection (height, health etc)

- **Field data collection of trees**

i-Tree Implementation in New Delhi:
PHASE 1:

Rainfall Data
Pollution Data
Location Data

i-Tree Eco Adaption Phase 1 (A): Collecting rainfall data

How many rainfall monitoring stations in Delhi?

- 4 rainfall monitoring stations

Is the data available publicly?

- No. We had to purchase it from government agencies.

Hourly intervals of data available:

- 3 hourly basis (for 2 monitoring sta
- 24 hourly (for other 2 monitoring s

Frequency of data to be used in i-

- 1 hourly rainfall data

Solution?

- Convert 3 hourly data into 1 hourly data by dividing into 3 equal parts.

i-Tree Eco Adaption Phase 1 (B): Collecting Pollution data

How many pollution monitoring statio

- Around 32 pollution monitoring stations

Is the data available publicly?

- Yes. It is available online

Hourly intervals of data available:

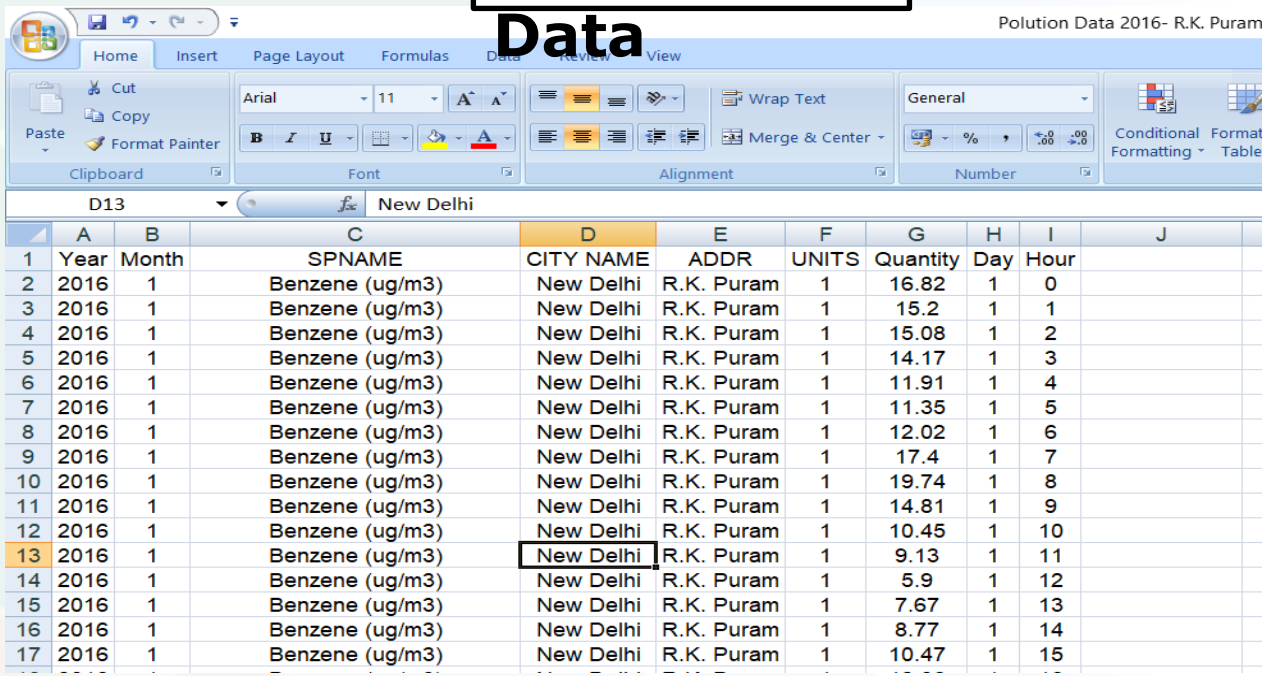
- 1 hourly basis

Frequency of data to be used in i-Tree:

- 1 hourly data

Submit Pollution and Rainfall Data on i-Tree server

Pollution Data

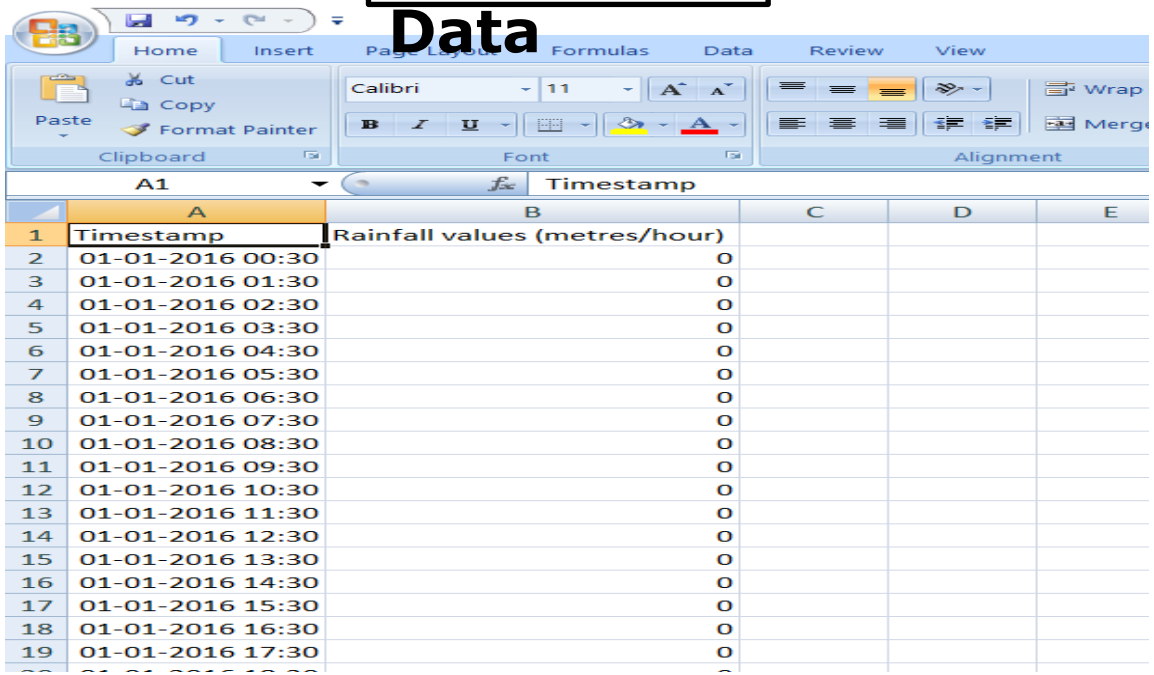


Polution Data 2016- R.K. Puram

D13 | New Delhi

	A	B	C	D	E	F	G	H	I	J
1	Year	Month	SPNAME	CITY NAME	ADDR	UNITS	Quantity	Day	Hour	
2	2016	1	Benzene (ug/m3)	New Delhi	R.K. Puram	1	16.82	1	0	
3	2016	1	Benzene (ug/m3)	New Delhi	R.K. Puram	1	15.2	1	1	
4	2016	1	Benzene (ug/m3)	New Delhi	R.K. Puram	1	15.08	1	2	
5	2016	1	Benzene (ug/m3)	New Delhi	R.K. Puram	1	14.17	1	3	
6	2016	1	Benzene (ug/m3)	New Delhi	R.K. Puram	1	11.91	1	4	
7	2016	1	Benzene (ug/m3)	New Delhi	R.K. Puram	1	11.35	1	5	
8	2016	1	Benzene (ug/m3)	New Delhi	R.K. Puram	1	12.02	1	6	
9	2016	1	Benzene (ug/m3)	New Delhi	R.K. Puram	1	17.4	1	7	
10	2016	1	Benzene (ug/m3)	New Delhi	R.K. Puram	1	19.74	1	8	
11	2016	1	Benzene (ug/m3)	New Delhi	R.K. Puram	1	14.81	1	9	
12	2016	1	Benzene (ug/m3)	New Delhi	R.K. Puram	1	10.45	1	10	
13	2016	1	Benzene (ug/m3)	New Delhi	R.K. Puram	1	9.13	1	11	
14	2016	1	Benzene (ug/m3)	New Delhi	R.K. Puram	1	5.9	1	12	
15	2016	1	Benzene (ug/m3)	New Delhi	R.K. Puram	1	7.67	1	13	
16	2016	1	Benzene (ug/m3)	New Delhi	R.K. Puram	1	8.77	1	14	
17	2016	1	Benzene (ug/m3)	New Delhi	R.K. Puram	1	10.47	1	15	

Rainfall Data

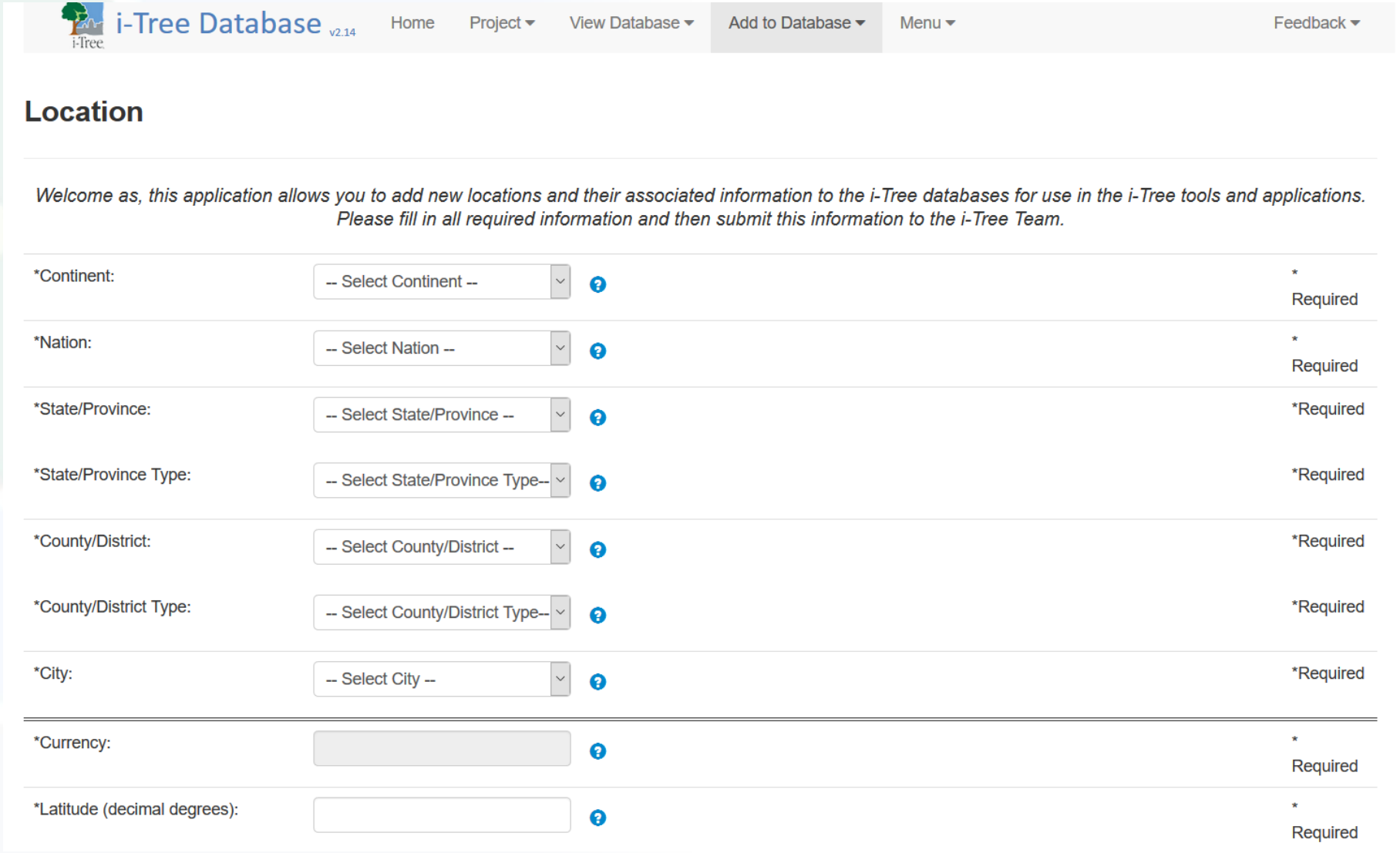


A1 | Timestamp

	A	B	C	D	E
1	Timestamp	Rainfall values (metres/hour)			
2	01-01-2016 00:30	0			
3	01-01-2016 01:30	0			
4	01-01-2016 02:30	0			
5	01-01-2016 03:30	0			
6	01-01-2016 04:30	0			
7	01-01-2016 05:30	0			
8	01-01-2016 06:30	0			
9	01-01-2016 07:30	0			
10	01-01-2016 08:30	0			
11	01-01-2016 09:30	0			
12	01-01-2016 10:30	0			
13	01-01-2016 11:30	0			
14	01-01-2016 12:30	0			
15	01-01-2016 13:30	0			
16	01-01-2016 14:30	0			
17	01-01-2016 15:30	0			
18	01-01-2016 16:30	0			
19	01-01-2016 17:30	0			

- It is recommended to use that pollution monitoring station which is at the **same location** or **close to** the rainfall monitoring station we have selected.

i-Tree Eco Adaption Phase 1 (C): Entering Location Data



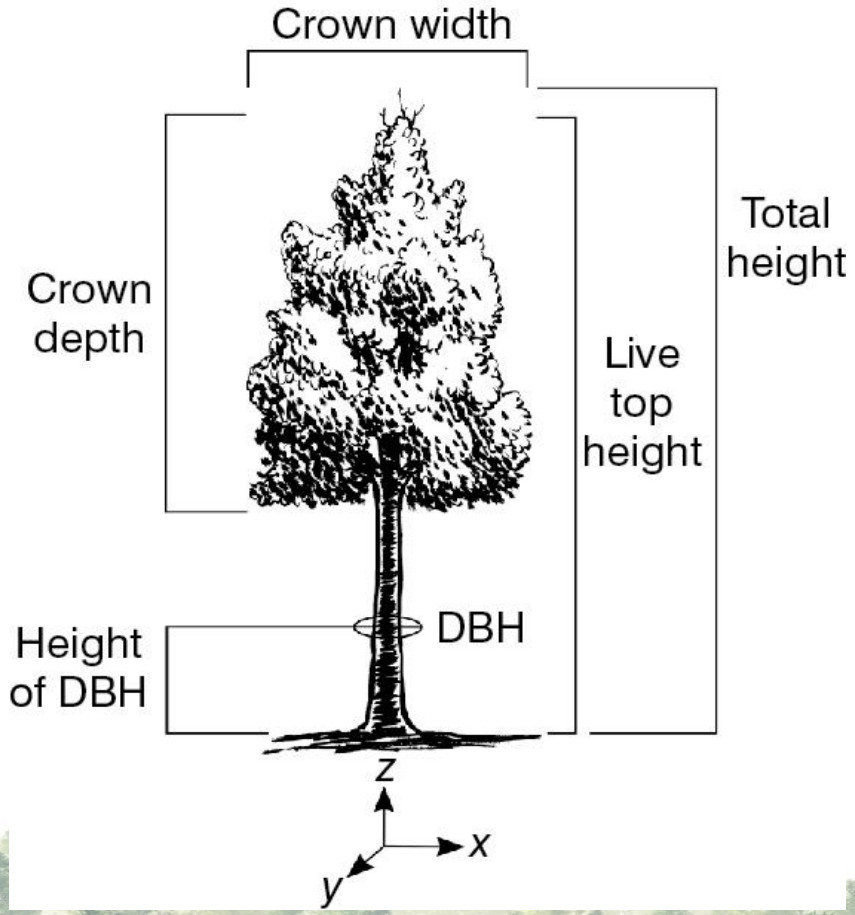
i-Tree Implementation in New Delhi:
PHASE 2:

Selecting tree variables and generating plots

Tree Variables in our study

- **Mandatory variables****
  1. Tree species
  2. Diameter at breast height (DBH)

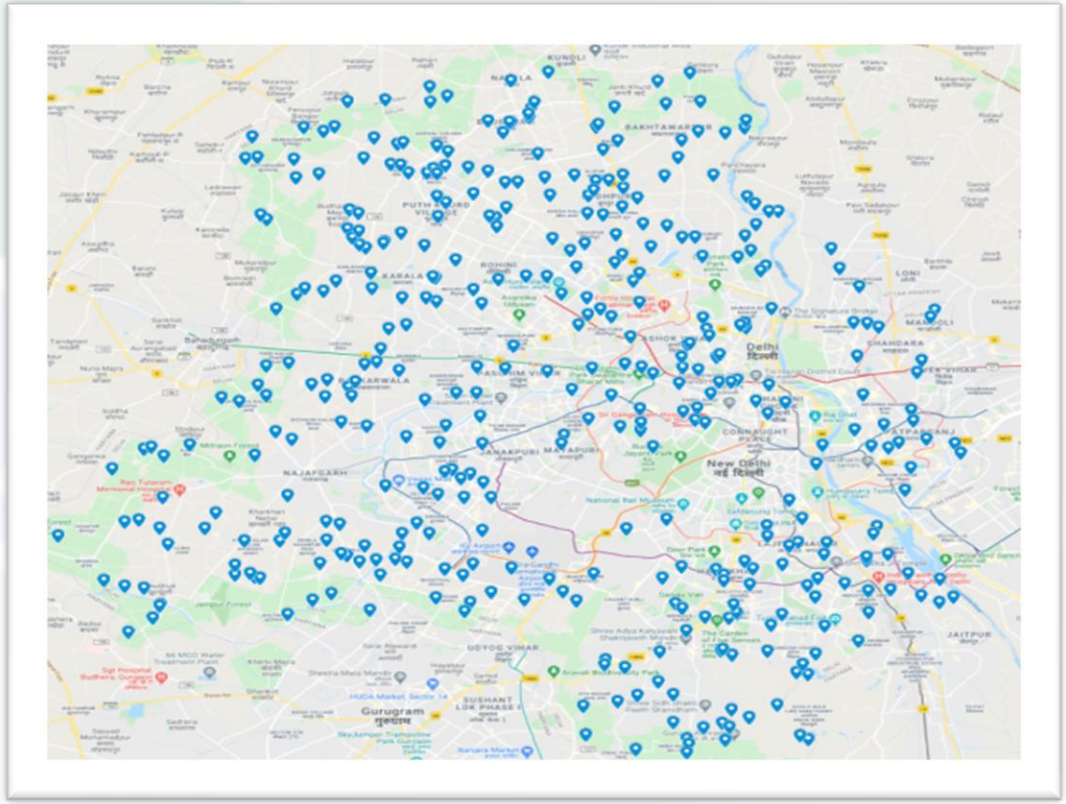
- **Recommended variables**
  3. Total height
  4. Crown live top height
  5. Crown base height
  6. Crown width (both sides)
  7. Sunlight Exposure of crown
  8. Gaps in crown (crown missing)
  9. Crown Health
  10. GPS Coordinates



HOW ARE WE DOING THIS?

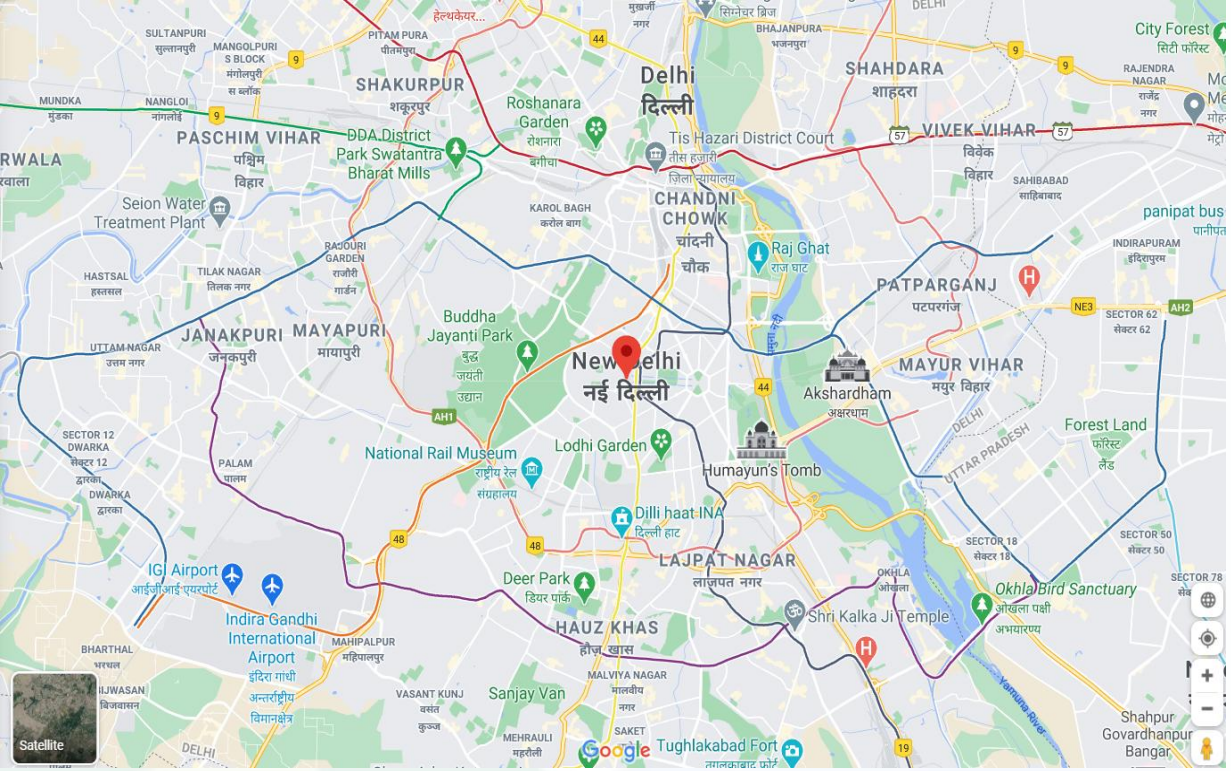
- Randomized 400 points (plots) in Delhi to collect trees data

- A Plot is basically a a circular area with 20 meters radius. We measure all the trees in the circular area



HOW ARE WE DOING THIS?

- ❑ Collecting trees & shrubs data
- ❑ Collecting photos & videos as proof



PROCESS THAT WE FOLLOWED

To use i-Tree locally in New Delhi, we collected and submitted:

- ❑ Rainfall data
- ❑ Air pollution data
- ❑ Location data

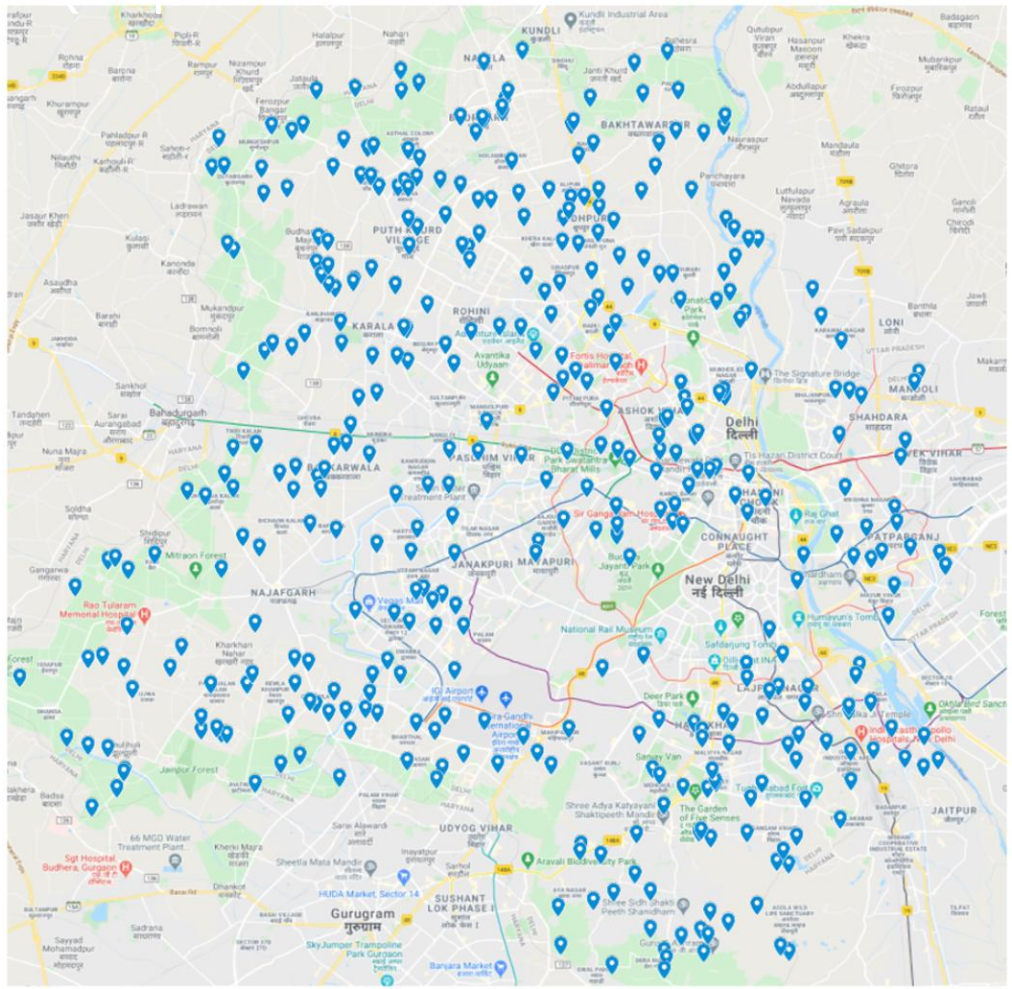
Category	Recommended	Our Project
Number of Plots	220	400
Plot Radius	11 meters	20 meters

Why did we chose more plots with greater area?

- ❑ To reduce the error in our study
- ❑ To have better results

400 Plots Completed

Plots when we started



- Complete data collection and inventory of all 400 plots across Delhi
- Total time taken for data collection : 1.5 years
- Number of people collected data : 3 (team)
- More than 500+ field visits
- Detailed report on results completed

TYPES OF PLOTS

A Special Thanks to:

THANK YOU