



ECO GUIDE TO International Projects

Overview

Though i-Tree Eco was originally developed for the United States, growing interest among international urban foresters has spurred improved model functionality in other countries as time and limited resources have permitted.

Supported Countries

Eco v6.0 has been adapted for use throughout Canada, Australia, Mexico, several countries in the European Union, and the United Kingdom with the necessary species information, location information, and pollution and precipitation data preprocessed and available directly in the application.

Other International Eco Users

International users completing projects in locations outside Canada, Australia, Mexico, several countries in the European Union, and the UK will be required to submit additional data using the i-Tree Database web application. The new **i-Tree Database** system has been developed to support the increasing number of international projects. Users in unsupported locations will work with i-Tree Database to add the necessary tree species information, location information, and properly formatted pollution and precipitation data for their project study area. Once data has been submitted, it can be incorporated into a future version of Eco allowing for automated processing in these newly added locations.

Key points for international Eco users:

- **Manual processing for international projects is not available** – In the past, i-Tree Eco projects in unsupported areas were processed manually by the U.S. Forest Service as a courtesy. Due to increases in demand, this option is no longer possible.
- **Data should be submitted in i-Tree Database as soon as possible** – Working with i-Tree Database enables international users to enter the data necessary for running an

Eco project in an unsupported area. This data should be entered as soon as possible – it will take time for the data to be validated and incorporated into a future version of Eco.

- **Data will be validated before it is made available in the i-Tree Tools** – The U.S. Forest Service will validate all data submitted through i-Tree Database. Invalid data will be returned to sender for correction.
- **Validated data will be incorporated into a future version of Eco** – Once validated, data submitted through i-Tree Database will be added to i-Tree's databases. Periodic updates to the i-Tree software will make this new, validated data available in i-Tree Eco.
- **Eco updates containing new data allow for automatic processing** – When data for an unsupported area is made available in i-Tree Eco, projects for that study area can be run and processed automatically just as projects in the U.S., Australia, Canada, Mexico, several countries in the European Union, and the UK are!



Caution

Though i-Tree Database allows international users to make their unsupported areas available in Eco, there are still limitations and model components that will not be available.

In this guide we will describe the recommended steps for completing a new i-Tree Eco project outside of the U.S., Australia, Canada, Mexico, several countries in the European Union, and the UK; provide guidelines for data formatting; and outline the limitations of conducting a project in a country outside of the fully supported areas.

New International Projects

Recommended Steps for International Users

As you work on your new Eco project, we recommend that you move through the following steps in order:

- 1 Design Your Project
- 2 Prepare Additional Data
- 3 Submit Additional Data using i-Tree Database
- 4 Prepare for Field Data Collection
- 5 Collect Field Data
- 6 Enter Field Data
- 7 Run the Eco Model

Design Your Project

i-Tree Eco provides a broad picture of the urban forest or trees in your study area. It is designed to use field data from complete inventories of trees or randomly located plots throughout a community along with local hourly air pollution and meteorological data to quantify urban forest structure, environmental effects, and value to communities.

Designing a new i-Tree Eco project requires some early decision-making and planning. You must define the boundaries of your study area, determine what type of project is most suitable for your objectives, and decide what data you will be collecting in the field.

For detailed information on designing your Eco project, please see **Phase I: Planning For Your Project** and **Phase II: Setting Up Your Project** in the Eco **User's Manual**.

Prepare Additional Data

Datasets that are used in conjunction with the collected field data include:

- Species information
- Location information
- Precipitation data
- Pollution data

These data are already incorporated in Eco for study areas in the U.S., Australia, Canada, Mexico, several countries in the European Union, and the UK. Outside of these countries, you will need to provide your own additional data and submit it using i-Tree Database.



Tip

Weather data is also used in i-Tree Eco and is available globally from the National Climatic Data Center (NCDC). All datasets from the NCDC with sufficient weather data have been incorporated in i-Tree Eco v6.0. Currently, users will select from the available weather stations directly in the application and are not able to submit their own weather data.

i-Tree Database provides two functions. Users may choose to do one or both of the following while working with the tool:

- 1 View the Species or Location databases, or
- 2 Add Species, Location, Precipitation, or Pollution data to the databases.

The option to view the Species or Location databases allows users to search the data used by the i-Tree applications. Users can see what species and locations are currently available for modeling. For new projects, users should check if their location and species of interest are already in the data. Identifying missing data will help inform decisions to add data to the databases.

To get started, go to i-Tree Database at: <http://www.itreetools.org/database>. View the Species and Location databases in turn. Note if your project location and desired tree and shrub species are already in the database.



Tip

Refer to i-Tree Database's "How to Use" text by going to **Menu > Help** at the top of the webpage.

To view available species:

- 1 Click on **View Database** at the top of the i-Tree Database webpage.
- 2 Select **Species** from the drop-down list.
- 3 Choose one of the following from the **Search by** drop-down:
 - a Scientific Name
 - b Common Name
- 4 Enter the name of the species that you are trying to find based on your selection in the **Search by** drop-down (i.e., scientific or common name).

- 5 Click **Go**.
- 6 The species that match your search will be listed below the search box.
- 7 Click **Clear** to discard the name that you entered and start over.

If you are having difficulty finding a species, try searching by both scientific and common name or entering only part of the name in the search box.

To view available locations:

- 1 Click on **View Database** at the top of the i-Tree Database webpage.
- 2 Select **Location** from the drop-down list.
- 3 Define a search area by:
 - a Selecting a nation from the **Search by** drop-down.
 - b Selecting a more precise area from the list, if additional drop-down menus appear.
- 4 Click **Go**.
- 5 All of the available locations in your designated search area will be listed below the search box.
- 6 Click **Clear** to discard the search area that you defined in the search box and start over.



Tip

If you see incomplete or erroneous data in either the species or location information, let the i-Tree Team know! Go to the **Feedback** menu at the top of the i-Tree Database webpage and click on **Comments**.

Species Information

The Species database includes species information for more than 6,500 tree and shrub species. Though adding new species for i-Tree Eco is optional, it is necessary for your analysis if any species in your local area are not already included.

By viewing the database, as described above, you can identify any missing tree or shrub species. To make those species available in Eco, collect the necessary information for those species and submit it using i-Tree Database. The required and optional species information are described in the **Data Formatting** section of this guide.

Location Information



Tip

Location information is required to run Eco in any location not yet in the database.

The Location database includes location information for places in the U.S., Australia, Canada, Mexico, and the UK and is expanding internationally. When you designed your Eco project, you should have decided on the location and boundaries of your study area. By viewing the database, as described above, you can identify if your location is already available in Eco. If it is, you do not need to submit any location information. Your Eco project can be run directly in Eco.



Caution

If your location is already available in Eco, you will not need to submit any location information. However, be sure to read about the species information, precipitation data, pollution data, and valuation data in this guide as you may still want to submit those data.

To make the location for your project available in Eco, collect the necessary information for that location and submit it using i-Tree Database. The required and optional location information are described in the **Data Formatting** section of this guide.

Precipitation Data



Tip

Precipitation data is required for avoided runoff modeling and strongly recommended for pollution removal. Without precipitation data, the i-Tree Eco model cannot estimate avoided runoff. Pollution removal estimates for PM_{2.5} also use precipitation data and without the data the model will likely overestimate PM_{2.5} removal.

Internationally, precipitation data is often insufficient or absent from the weather data available in Eco. To supplement Eco's existing weather data with hourly precipitation data for your location, collect the necessary information for the precipitation data and submit it using i-Tree

Database. More information about providing and formatting precipitation data is available in the **Data Formatting** section of this guide.

Pollution Data



Tip

Air quality data is required to run the pollution model. Without this data, pollution removal estimates will not be included in your results.

Hourly air quality data can be submitted for particulate matter less than 2.5 microns (PM_{2.5}), carbon monoxide (CO), ozone (O₃), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), and particulate matter less than 10 microns (PM₁₀). Users may choose to provide hourly data for some or all of these pollutants. Pollutants for which no hourly data are submitted will be excluded from the analysis. To provide local pollution data for your location, collect the necessary information for the pollution data and submit it using i-Tree Database. More information about providing and formatting pollution data is available in the **Data Formatting** section of this guide.



Caution

The pollutant particulate matter less than 10 microns (PM₁₀) is not currently estimated in i-Tree Eco v6.0. Future development of the application will include incorporating PM₁₀ in Eco results. However, due to overlaps in estimates, users will be required to choose between estimating removal for particulate matter less than 10 microns (PM₁₀) or less than 2.5 microns (PM_{2.5}).

Valuation Data

International users are also encouraged to provide local valuation data. Providing your own benefit prices allows users to localize their results. i-Tree Eco uses values from the scientific literature to estimate the economic value associated with tree benefits. Default values currently estimated are:

- **Carbon** – based on the U.S. Social Cost of Carbon (SCC)
- **Avoided runoff** – U.S. national average costs of stormwater control

- **Pollution removal** – based on U.S. median externality values for carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter less than 2.5 microns, and ozone removal
- **Energy** – U.S. national average cost of electricity and fuels (e.g., heating oil, propane, natural gas)

You can provide your own valuation data if you would like to localize your benefit estimates. If you do not provide your own valuation data, the default values will be used and converted to the local currency with a user-defined exchange rate. Unlike species, location, precipitation, and pollution data which are submitted in i-Tree Database, valuation data are entered directly in the i-Tree Eco application. By entering the data directly in Eco, it will be used for your project, but it will not be added to the databases. Read about adding valuation data in Eco under **Enter Field Data > Valuation Data**.

Submit Additional Data using i-Tree Database

When you have gathered all of the i-Tree Eco required data and as much of the optional data that you wish to provide, it is time to submit your data using i-Tree Database. To work with i-Tree Database, go to i-Tree Database at: <http://www.itreetools.org/database>.



Caution

Please keep in mind, submitted data will be validated by the U.S. Forest Service before they are incorporated into i-Tree Eco. Only complete, high quality data will be accepted.



Tip

Location information and precipitation and pollution data are important components of working with i-Tree Eco. If you are submitting a new location and would like to include precipitation and pollution data for that location, data must be entered in sequential order. Read the directions that follow carefully to correctly submit this data in i-Tree Database.

Species Information



Tip

New tree species are entered and submitted individually, but you may choose to submit as many new tree species as you like!

To add a new tree species to the **Species** database:

- 1 Click on **Add to Database** at the top of the page.
- 2 Select **Species**.
- 3 Fill in all of the required fields for your new tree species.
 - a If the genus name of your new species is not available in the **Genus Name** drop-down list, add it to the database by doing the following:
 - b Click the **Add New Genus** button.
 - c Enter the name of the new genus in the space provided.
 - d Click **Save** to add the entry to the database.
 - e Click **Cancel** to discontinue the action of adding a new genus.
- 4 Fill in any of the optional fields that you are able to – the more information you provide, the better!
- 5 As you fill in the fields, if you are not satisfied with the data you've entered click **Reset** to clear the form.
- 6 Click **Submit** when you are satisfied with the information you've provided. The data entered in the **Species** form will be sent to the i-Tree Team to be validated and incorporated into the i-Tree databases.

Location Information



Tip

New locations are entered and submitted individually, but you may choose to submit as many new locations as you like!

To add a new location to the **Location** database:

- 1 Click on **Add to Database** at the top of the page.
- 2 Select **Location**.
- 3 Choose the **Continent** where your location is found from the drop-down.
- 4 Choose the **Nation** where your location is found from the drop-down.
- 5 To define your location:

- a Include up to 3 additional levels of location types.
For example, the location you are entering may be a city that is located within a greater administrative division (e.g., state) of the nation. In this case you may want to add 2 levels of location types, one for the city and one for the state it is located in.
 - b Include additional levels by clicking on **Add Location Detail**.
 - c Indicate the **Location Type** and **Location Name** for each level of detail.
- 6 Fill in the required fields for your new location.
For the **Latitude** and **Longitude** fields, use the map feature to indicate your location and retrieve map coordinates by doing the following:
- a Click the **Select on Map** button.
 - b Navigate to your location by:
 - i Using the zoom tools in the bottom right corner of the map;
 - ii Left- clicking and holding your computer mouse to drag or pan around the map; or
 - iii Using the mouse scroll wheel to zoom in and out.
 - c Click on the map at the point of your new location's center. The latitude and longitude of the point that you clicked on will be entered into the **Location** form.

For help choosing a **Climate Region**:

- a Climate region is used to estimate the energy effects of trees. For locations outside of the United States, i-Tree assumes that emission factors, typical construction practices and building characteristics, and energy composition (i.e., type of and amount used) are comparable to those of the U.S. climate region selected.
- b Compare the local climate of your location to the climate variations found in the U.S.
- c Find a U.S. city whose climate is most similar to the climate of your location. A systematic process for selecting the best match is outlined here:
<http://www.itreetools.org/streets/resources/Selecting%20Ref%20Cities%20for%20iTree%20Streets%20McPherson%20AUF.pdf>
- d Based on the U.S. city you select, choose the corresponding climate region from this map: https://www.itreetools.org/streets/images/climate_zones.jpg

Land surface albedo data is used in Eco to model pollution removal by the urban forest.

Answer the following questions to **Generate Albedo Data** for your location:

- a Warm Temperatures – select “Yes” if average summer maximum temperatures are greater than 25°C
- b Abundant Rain – select “Yes” if amount of rainfall is greater than 1,000 millimeters a year
- c Abundant Vegetation – select “Yes” if vegetation covers 50% or more of the land area
- d Snow – select “Yes” if average snowfall is 10 centimeters or more a year

For help choosing an **Ozone State**, try one of the following:

- a If you have measured ozone depth data for your location, compare the estimates to those available by U.S. state
(<http://www.itreetools.org/resources/content/OzoneStateTable.pdf>). Select the state whose ozone depth is most similar to the ozone depth at your location.
- b Select a state in the U.S. that is either located at the same latitude as your location or located at a close latitude. For locations in the southern hemisphere, do the same assuming that your latitude is positive.
- c Select a state based on the **Climate Region** that you entered for your location.

Please note that ozone levels are slightly variable across the U.S. In the event that limited data is available, approximate **Ozone State** entries are acceptable.

- 7 Fill in the optional fields that you are able to – the more information you provide, the better!
- 8 As you fill in the fields, if you are not satisfied with the data you've entered click **Reset** to clear the form.
- 9 When you are satisfied with the information you've provided, do one of the following:
 - a Click **Submit** and the data entered in the **Location** form will be sent to the i-Tree Team to be validated and incorporated into the i-Tree databases; or
 - b Click **Add Precipitation Data** to add the hourly data for this location.

IMPORTANT: Additional data, including hourly precipitation and pollution, will be necessary to run analyses, such as avoided runoff and pollution removal, for new locations in the i-Tree Eco application. If you choose to add precipitation and pollution data for this location, which is optional, it must be done in sequential order. Following this process means you will:

- i Add your location data in the **Location** form and click **Add Precipitation Data**.
- ii Add your precipitation data in the **Precipitation** form and click **Add Pollution Data**.
- iii Add your pollution data in the **Pollution** form and click **Submit**.

Precipitation Data



Tip

Providing precipitation data is optional. Without this data, your analysis will not include avoided runoff estimates and pollution removal may be over-estimated. However, forest structure and some additional forest benefits will still be provided.

To add precipitation data:

- 1 To add precipitation data to an existing location, click on **Add to Database** at the top of the page and select **Precipitation**.

To add precipitation data to a new location, data must be added in sequential order.

Following this process means you will:

- a Add your location data in the **Location** form then click **Add Precipitation Data**.
- b Add your precipitation data in the **Precipitation** form then click **Add Pollution Data**.
- c Add your pollution data in the **Pollution** form and click **Submit**.

By following this process, you will automatically be brought to the **Precipitation** form and do not need to select it from the **Add to Database** menu.

- 2 Choose the **Continent** and **Nation** of the location that your precipitation data is associated with. For new locations, this information will automatically be filled in from the **Location** form.
- 3 Choose the **Year** that the precipitation data was collected. Note: All datasets used by Eco, including precipitation, pollution, and weather, must be from the same year for an Eco project.
- 4 Choose the **Weather Station** that your precipitation data will be appended to.

To choose a weather station:

- a Click on **Select Weather Station**.
- b Navigate the map by:
 - i Using the zoom tools in the bottom right corner of the map;
 - ii Left- clicking and holding your computer mouse to drag or pan around the map; or
 - iii Using the mouse scroll wheel to zoom in and out.
- c Click on the pin of the desired weather station.

i-Tree features weather data from numerous weather stations around the globe. These weather stations have been evaluated so only those with the data necessary for i-Tree are available to choose on the map. Additionally, weather station availability varies from year to year. If you have a weather station in mind that you'd like to work with, these factors may mean that it is not available or you may want to see if it is available for an alternative year.

- 5 Click **Choose File**.
- 6 Navigate to your formatted precipitation data and select the file.
- 7 Click **Open**.
- 8 Click **Upload**.
- 9 When you are satisfied with the information you've provided, do one of the following:
 - a If adding data for a) an existing location or b) a new location that you are not adding pollution data for, click **Submit** and the data entered in the **Precipitation** form will be sent to the i-Tree Team to be validated and incorporated into the i-Tree databases; or
 - b If adding data for a new location where you would also like to add pollution data, click **Add Pollution Data**.

Pollution Data



Tip

Providing pollution data is optional. Without this data, your analysis will not include pollution removal estimates. However, forest structure and some additional forest benefits will still be provided.

To add pollution data:

- 1 To add pollution data to an existing location, click on **Add to Database** at the top of the page and select **Pollution**.

To add pollution data to a new location, data must be added in sequential order.

Following this process means you will:

- a Add your location data in the **Location** form and click **Add Precipitation Data**.
- b Add your precipitation data in the **Precipitation** form and click **Add Pollution Data**.
- c Add your pollution data in the **Pollution** form and click **Submit**.

By following this process, you will automatically be brought to the **Pollution** form and do not need to select it from the **Add to Database** menu.

- 2 Choose the location that your pollution data is associated with. For new locations, this information will automatically be filled in from the **Location** form.
- 3 Choose the **Year** that the pollution data was collected. Note: All datasets used by Eco, including precipitation, pollution, and weather, must be from the same year for an Eco project.
- 4 Click **Choose File**.
- 5 Navigate to your formatted pollution data and select the file.
- 6 Click **Open**.
- 7 Click **Upload**.
- 8 When you are satisfied with the information you've provided, do one of the following:
 - a If adding data for an existing location, click **Submit** and the data entered in the **Pollution** form will be sent to the i-Tree Team to be validated and incorporated into the i-Tree databases; or
 - b If adding data for a new location, click **Submit** and the data entered in the **Location**, **Precipitation**, and **Pollution** forms will be sent to the i-Tree Team to be incorporated into the i-Tree databases.

Next Steps

Once your data have been submitted in i-Tree Database, it will be vetted by the U.S. Forest Service and incorporated into i-Tree Eco. You will receive an email notifying you when your submitted data have been received and again when the data have been added to Eco. Any issues with the submitted data will be brought to your attention.



Tip

While you are waiting for your data to be incorporated into Eco, you can still work with the application. Try using temporary, place holder variables where necessary! For example, enter a temporary location that you can change when your location becomes available.

After receiving notification that your submitted data have been added to the application, you should update i-Tree Eco using the **Update Software** tool under the **Support** tab.



Tip

If you are working with the mobile data collector, it is best to complete all data entry and retrieval before updating the software to the latest version. This will help avoid possible conflicts between versions.

Be sure to update any temporary, place holder variables that you used. For example, if a temporary location was entered and you do not change it before submitting your project for processing, the model will not be using the local data you provided in i-Tree Database.

Prepare for Field Data Collection

Once you have appropriately designed your project, decided which data to collect during your inventory, and gathered and submitted your additional data, it is time to get started with the i-Tree Eco software. Users can create a new i-Tree Eco project directly in the Eco application and prepare their data collection materials.



Tip

****REMINDER**** If you have not already submitted your additional data using i-Tree Database, consider doing that before you collect your field data. Data submitted in i-Tree Database will need to be vetted by the U.S. Forest Service before it can be made available in Eco. This will take some time.



Tip

To begin working in Eco before your additional data have been added to the application, try using temporary, place holder variables where necessary. For example, enter a temporary location that you can change when your location becomes available.

For detailed directions on creating your Eco project, please see **Phase III: Collecting Your Field Data > Preparing for the Field** in the **User's Manual**.

Collect Field Data

Field data collection can take place once you have designed your project and are prepared for data collection. At this point you should have identified what field data you will be collecting and how you will collect your data. Use the Eco **Field Guide** to guide you as you collect and record your data out in the field.

Enter Field Data

Field data can be entered into the i-Tree Eco software using the methods described below.



Tip

To begin working in Eco before your additional data have been added to the application, try using temporary, dummy variables where necessary. For example, enter a temporary location that you can change when your location becomes available.



Tip

The **Data** tab of the Eco application is where you add your new data manually or edit data that have already been entered.

From Paper Forms

If you recorded your data using Eco's paper form, you will have to enter your data manually into the i-Tree Eco Software:

- 1 Click on the **Data** tab.
- 2 Use the functions in the **Inventory Data** group of the ribbon.

The data entry forms are in table format and allow you to enter or edit data for plots, trees, and shrubs, depending on how you customized your project. The tools in the **Action** group allow you to add new records, delete existing records, and undo or redo the last actions that you took.

From the Mobile Data Collector

If you recorded your data using Eco's mobile data collector, you can import your data directly into Eco:

- 1 Click on the **Data** tab.
- 2 Click on the **Retrieve from Mobile** function.
- 3 Enter your password in the space provided and click **Show List**. (**Note:** This password is the one you entered in the **Submit to Mobile** function when you submitted your project settings.)
- 4 After you have entered your password and clicked **Show List**, a description of your data will appear.
- 5 Check the box next to the record(s) that you would like to retrieve. Each record includes a description and date to help you determine which records should be imported.
- 6 Click **Retrieve Data**.

Valuation Data

The **Data** tab of the Eco application is also where you enter your local valuation data.

- 1 Click on the **Data** tab.
- 2 Click on the **Benefit Prices** function.
- 3 Enter the currency exchange rate in the space provided. You also have the option of entering the current exchange rate by clicking on the **Get today's rate** button. These exchange rates are provided courtesy of openexchangerates.org.
- 4 Enter local benefit prices in the spaces provided. Next to each of the benefit prices, the units (e.g., \$/kWh) are listed in parentheses. Take note of these units and be sure that the benefit prices you define match the units listed.
- 5 When you are satisfied with the benefit prices you have set, click **OK** in the top right-hand corner of the action panel. This will save the edits that you have made to the prices.
- 6 Click **Cancel** if you decide to revert to all of the previous values, whether default values or those that you had previously entered manually.



Tip

If you would like to use the benefit price provided for the U.S., simply click on the **Default** button next to the benefit price. U.S. default prices will be converted to your local currency using the exchange rate provided.

Run the Eco Model

Running the Eco model is a two-step process that is necessary in order to view your reports. This should only be done after you have submitted your additional data using i-Tree Database, received notification that the data have been incorporated into Eco, updated your software to the latest version, and corrected any temporary, place holder variables you may have used.

The first step to running the Eco model is to send your data to the i-Tree server where the Eco model will be run. The second step is to retrieve your results from the server.

First, send your data to the i-Tree server:

- 1 Click on the **Reports** tab.
- 2 Click on the **Submit Data for Processing** function.
- 3 Read the i-Tree End User's License Agreement and click **OK** if you consent.
- 4 In the **Contact Information** window, enter your personal information in the spaces provided.
- 5 To confirm your email address, enter the same email address in the spaces labeled "Email" and "Confirm." This information is critical.
- 6 Click **OK**.

Please be patient – model processing time depends on the number of projects that have recently been submitted to the server as well as the size of your project. You can click on the **Track & Retrieve Results** function to track your status in the queue.

When your data have been processed, an auto-generated email notifying you that the results are ready to download will be sent to the email address that you provide in the **Contact Information** window. This email will be from info@itreetools.org; please check your spam folders if you do not receive the email. Likewise, you will be notified of processing errors that require data to be submitted again. If you do not receive your results within 24 hours, please contact info@itreetools.org.

Second, retrieve your results from the i-Tree server:

- 1 Click on the **Reports** tab.
- 2 Click on the **Track & Retrieve Results** function.
- 3 In the **Retrieve Processed Results** window, click **OK**.
- 4 Please be patient while results are downloaded.



Caution

If you make changes to your project settings or add or edit your field data, you will need to send your data to the server and retrieve your results again to ensure that your changes are reflected in your reports.

Data Formatting

Species Information

i-Tree Eco includes data for more than 6,500 tree and shrub species. This data is used to estimate the structure and environmental benefits of your urban forest. For example, leaf characteristics, such as leaf type, are used to determine the amount of leaf area that a tree contributes to the urban forest. Leaf area is an important part of estimating many environmental benefits, including air pollution removal.

In i-Tree Database, please provide the following fields for each tree or shrub species you add:

Table 1—Species fields for i-Tree Database

Field	Required	Description
Genus Name	x	Genus name of species. Used to establish taxonomic rank.
Species Name	x	Species name of species. Used to establish taxonomic rank.
Family	x	Family name of species. Used to establish taxonomic rank.
Order	x	Order name of species. Used to establish taxonomic rank.
Class	x	Class name of species. Used to establish taxonomic rank.
Common Name	x	Common name of species.
Growth Form	x	Expected life-form of species if located in a natural setting.
Percent Leaf Type	x	Leaf characteristic of species. Used to inform leaf density.
Leaf Type	x	Leaf characteristic of species. Used to inform if and when leaves are dropped.
Growth Rate		Expected diameter growth rate, in inches per year, of species. <i>OPTIONAL: If no value entered, a "Moderate" growth rate will be assumed.</i>
Longevity		Expected lifespan, in years, of species. <i>OPTIONAL: If no value entered, a "Moderate" longevity will be assumed.</i>
Height at Maturity		Expected height at maturity, in feet, of species. <i>OPTIONAL: If no value entered, a height of 50 feet will be assumed.</i>
Native Continent		Continent(s) where species is naturally found. <i>OPTIONAL: If no value entered, native range will be considered unknown.</i>

All required species fields (see Table 1 above) must be populated for new tree or shrub species. Fill in any of the optional fields that you are able to – the more information you provide, the better!

**Tip**

While working in i-Tree Database, you can move your cursor over the blue question marks (?) to see descriptions and more information.

Location Information

i-Tree Eco includes data for locations in the U.S., Australia, Canada, Mexico, and the UK and is expanding internationally. Location data helps provide localized tree benefit estimates for your urban forest.

In i-Tree Database, please provide the following fields for each location you add:

Table 2—Location fields for i-Tree Database

Field	Required	Description
Continent	x	Continent name of location.
Nation	x	Nation name of location.
Location Type	x	Type of location (i.e., administrative division) of location.
Location Name	x	Name of location.
Currency	x	Primary currency, or monetary unit, used in location.
Latitude	x	Latitude, in decimal degrees, of location's center point.
Longitude	x	Longitude, in decimal degrees, of location's center point.
Elevation	x	Elevation, in meters, of location's center point.
Climate Region	x	U.S. region whose climate is most similar to climate of location. Used to estimate local energy effects.
Electricity Emissions		Amount of carbon dioxide (CO ₂), in kilograms, emitted per kWh of electricity used in location. <i>OPTIONAL: If no value entered, the U.S. national average will be used.</i>
Mean Minimum Temperature		Long-term average daily minimum temperature, in degrees Fahrenheit, observed locally. <i>OPTIONAL: If no value entered, a value will be estimated based on latitude and longitude.</i>
Leaf On Day of Year		Day of the year (1-365) in spring when frost ends locally. <i>OPTIONAL: If no value entered, a value will be estimated based on latitude and longitude.</i>
Leaf Off Day of Year		Day of the year (1-365) in autumn when frost begins locally. <i>OPTIONAL: If no value entered, a value will be estimated based on latitude and longitude.</i>

GMT Offset		Difference, in hours, between local time and Greenwich Mean Time (GMT). (Daylight savings time not included.) <i>OPTIONAL: If no value entered, a value will be estimated based on latitude and longitude.</i>
Warm Temperatures	x	Select Yes if average summer maximum temperatures are greater than 25°C.
Abundant Rain	x	Select Yes if amount of rainfall is greater than 1,000 millimeters a year.
Abundant Vegetation	x	Select Yes if vegetation covers 50% or more of the land area.
Snow	x	Select Yes if average snowfall is 10 centimeters or more a year.
Ozone State	x	U.S. state whose ozone depth is most similar to ozone depth of new location.

All required location fields (see Table 2 above) must be populated for new locations. Fill in any of the optional fields that you are able to – the more information you provide, the better!



Tip

While working in i-Tree Database, you can move your cursor over the blue question marks (?) to see descriptions and more information.

Precipitation Data

Precipitation data must be hourly data in meters submitted in Excel format for a complete calendar year. A template is provided in i-Tree Database to ensure proper data formatting.

To provide properly formatted precipitation data:

- 1 Go to i-Tree Database at: <http://www.itreetools.org/database>.
- 2 Click on **Add to Database** at the top of the page.
- 3 Select **Precipitation**.
- 4 Click on the **Template** link to download the precipitation template.
- 5 From the compressed file, choose the spreadsheet for the year that corresponds to the year your precipitation data was collected.
- 6 Populate the sheet with your hourly data. Be sure your data is in meters per hour.
- 7 Save a copy of your formatted precipitation data.

Your spreadsheet should be uploaded in i-Tree Database for submission as described in **Submit Additional Data using i-Tree Database**. Please also provide the following fields for each dataset you add:

Table 3—Precipitation fields for i-Tree Database

Field	Required	Description
Continent	x	Continent name of location for which precipitation data is being added
Nation	x	Nation name of location for which precipitation data is being added
State	x	Primary partition (e.g., state, province, or territory) name of location for which precipitation data is being added
Year	x	Calendar year in which new precipitation data was collected
Weather Station	x	Weather station that precipitation data will be added to
Precipitation Data	x	File containing new precipitation data to be uploaded

Pollution Data

Pollution data can be submitted for particulate matter less than 2.5 microns (PM_{2.5}), carbon monoxide (CO), ozone (O₃), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), and particulate matter less than 10 microns (PM₁₀). Data must be hourly submitted in Excel format for a complete calendar year. A template is provided in i-Tree Database to ensure proper data formatting.

To provide properly formatted air quality data:

- 1 Go to i-Tree Database at: <http://www.itreetools.org/database>.
- 2 Click on **Add to Database** at the top of the page.
- 3 Select **Pollution**.
- 4 Click on the **Template** link to download the pollution template.
- 5 From the compressed file, choose the spreadsheet (leap year or non-leap year) that is appropriate for the year your pollution data was collected.
- 6 Follow the formatting requirements listed below to populate the sheet with your hourly data.
- 7 Save a copy of your formatted pollution data.

Table 4—Formatting requirements for pollution template

Column	Column name	Format	Description	Requirements
A	YEAR	Number	Year the data were recorded	Must be 2005-2013 and match year of weather data to be used
B	MONTH	Number	Month of the year the data were recorded	CANNOT BE EDITED. Must be 1-12
C	SPNAME	Text	Name of the pollutant	CANNOT BE EDITED. Must be: <ul style="list-style-type: none"> • CO for carbon monoxide, • NO₂ for nitrogen dioxide, • O₃ for ozone, • PM_{2.5} for particulate matter less than 2.5 microns, • SO₂ for sulfur dioxide, or PM₁₀ for particulate matter less than 10 microns

D	CITYNAME	Text	Name of the city where the pollution monitor is located	Do not leave blank; if city name is unknown, fill in with a letter (e.g., X)
E	ADDR	Text	Address of the pollution monitor	Do not leave blank; if address is unknown, fill in with a letter (e.g., X)
F	UNITS	Number	Units of the pollutant	Must be: <ul style="list-style-type: none"> • 1 for micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) or • 7 for parts per million (ppm)
G	QUANTITY	Number	Value of the measurement in units given in Column F	Missing values must be entered as -999
H	DAY	Number	Day of the month the data were recorded	CANNOT BE EDITED. Must be 1-31
I	HOUR	Number	Hour of the day the data were recorded	CANNOT BE EDITED. Must be 0-23

Your spreadsheet should be uploaded in i-Tree Database for submission as described in **Submit Additional Data using i-Tree Database**. Please also provide the following fields for each dataset you add:

Field	Required	Description
Continent	x	Continent name of location for which pollution data is being added
Nation	x	Nation name of location for which pollution data is being added
State	x	Primary partition (e.g., state, province, or territory) name of location for which pollution data is being added
Year	x	Calendar year in which new pollution data was collected
Pollution Data	x	File containing new pollution data to be uploaded

Avoiding Common Air Quality Data Problems

Providing properly formatted pollution data consistently causes the most problems for international users. Submitting incorrect or incomplete pollution datasets may require corrections or resubmission and influences the amount of time before it can be made available in Eco. Here are a couple items to keep in mind to avoid common issues while you gather your pollution data and ensure timely incorporation into Eco:

- **Complete calendar year** – Eco requires hourly pollution data for a complete calendar year (Jan 1 – Dec 31). The year does not have to be recent, but it needs to be complete and within the same calendar year for all pollutants. For example, although data available for June 1, 2014 to May 31, 2015 spans 365 days, the Eco model cannot process this data because it is taken from two separate calendar years. It is not possible

for the i-Tree team to piece together parts of pollution data from different years if data is incomplete from one station.

- **Pollution data gaps** - The pollution model can handle some time gaps without pollutant values for several hours (e.g., 2-3 hour gaps in data) as this is typical with most external pollution data sets. In these cases, the model will interpolate to fill data gaps over short time frames.



Caution

Gaps in pollution data should be avoided as much as possible. Frequent data gaps and gaps over long time frames diminish the accuracy of ecosystem service estimates and may not work with the pollution model.

- **Missing pollutants** - If you are missing data for a pollutant, such as PM_{2.5}, the model will exclude that pollutant from the analysis.

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, and the UK.

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, several countries in the European Union, and the UK. 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 cover estimates of the contiguous U.S. The default economic value associated with avoided

runoff is also based on the U.S. national average cost of stormwater control unless users provide local values.

Carbon – While Eco’s methods for calculating carbon storage and sequestration are not specific to the U.S., the model does use U.S. data to estimate monetary values associated with those benefits. The default carbon value used by the model is based on the U.S. Social Cost of Carbon (SCC) unless users provide local values.

Pollution – Methods for estimating pollution removal use local pollution and weather data. Additional local variables, including latitude, longitude, leaf on and leaf off dates, GMT offset, and elevation, are also required to estimate pollution removal and are provided by the international user. 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 (PM_{2.5}), 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.



Tip

Hourly pollution data is not inherent in i-Tree Eco for areas outside of the U.S., Australia, Canada, Mexico, several countries in the European Union, and the UK. Providing pollution data is optional for new locations. Without this data, your analysis will not include pollution removal estimates.



Tip

Hourly precipitation data is not inherent in i-Tree Eco for areas outside of the U.S., Australia, Canada, Mexico, several countries in the European Union, and the UK. Providing precipitation data is optional for new locations. Without this data, pollution removal may be over-estimated.

Volatile Organic Compounds – Methods for estimating VOCs require local weather data. The i-Tree Eco model also requires maximum ozone incremental reactivity (MOIR) values which are available only for the U.S., but needed to convert VOC emissions to ozone formation in the model. In these instances, international studies use the values of U.S. cities that are comparable in location or climate.

Energy – Because this model component is designed specifically for the U.S., its utility is limited in international applications. International users will receive energy results that are based on the characteristics of the user-defined U.S. climate region, including emission factors, typical construction practices and building characteristics, and energy composition (i.e., type of and amount used). Therefore, 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.

Structural Value – The Eco model uses the Council of Tree and Landscape Appraisers (CTLA) formula methodology to determine the structural value of trees within the U.S. Because the model currently does not have the data needed to generate amenity values using other accepted international methods for determining tree values, structural values are not estimated for international Eco projects.

Avian Habitat – The avian habitat suitability component of Eco uses habitat models for nine common bird species in the U.S. As such, users outside of the U.S. will not receive wildlife suitability estimates.