i-Tree™

Strengthening Natural Resources Stewardship

A Cooperative Initiative Among:

i-Tree: Version 2018

i-Tree is a suite of software that has been developed through a consortium of partners. All programs are available freely at www.itreetools.org, including technical support, user's manuals and resources, and a moderated peer-to-peer on-line forum. The following applications are included:

i-Tree Eco uses sample or inventory data to **assess forest structure, ecosystem services and values for any tree population** (including number of trees, diameter distribution, species diversity, potential pest risk, invasive species, and tree effects related to air pollution removal and health effects, carbon storage and sequestration, runoff reduction, UV radiation reduction, VOC emissions, wildlife habitat and building energy effects). It runs on local field data and hourly meteorological and pollution data. The program is designed to readily work in the **United States, Canada, Australia and the United Kingdom**, with 2018 updates to include **Mexico, Europe and Colombia**. For other countries, i-Tree Database can be used to enable i-Tree Eco for their area. i-Tree Eco includes plot selection programs, data entry programs or mobile application data entry, table and graphic reporting and exporting, automatic report generation and the ability to forecast future tree population totals, canopy cover, and ecosystem services and values by species.

i-Tree Species Selector is a web-based utility designed to help users **select the most appropriate tree species** based on desired environmental functions and geographic area.

i-Tree Storm helps assess widespread street tree damage in a simple and efficient manner immediately after a severe storm. It is adaptable to various community types and sizes and provides **information on the time and funds needed to mitigate storm damage**.

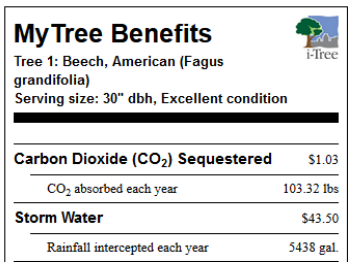
i-Tree Hydro is designed to **simulate the effects of changes in tree and impervious cover within a watershed on hourly stream flow and water quality**. It contains auto-calibration routines to help match model estimates with measured hourly stream flow and produces tables and graphs of changes in flow and water quality due to changes in tree and impervious cover within the watershed.

The **Pest Detection Protocol** provides a systematic protocol for long-term pest detection and monitoring. It allows users to input health signs and symptoms of their trees to produce **indications of potential pests, diseases and threats to their forest**. The protocol is incorporated within i-Tree Streets and i-Tree Eco.

i-Tree Canopy is a tool that allows users to **easily photo-interpret Google aerial images** of their area to produce statistical estimates of tree and other cover types along with calculations of the uncertainty of their estimates. This tool provides a simple, quick and inexpensive means for cities and forest managers to accurately estimate their tree and other cover types. i-Tree Canopy can be used anywhere in the world where high-resolution, cloud-free Google images exist (most areas). Use of historical imagery can also be used to aid in change analyses.

i-Tree Design links to Google maps and **allow users to sketch their home and see how the trees around their home affect energy use and other environmental services and values**. This tool can assess which locations and tree species will provide the highest level of benefits. It is a simple tool geared toward homeowners, school children or anyone interested in tree benefits. This program allows users to add multiple trees and illustrates current, future and past benefits of these trees.

MyTree is a phone app that allows users to easily quantify the benefits and values of individual trees.

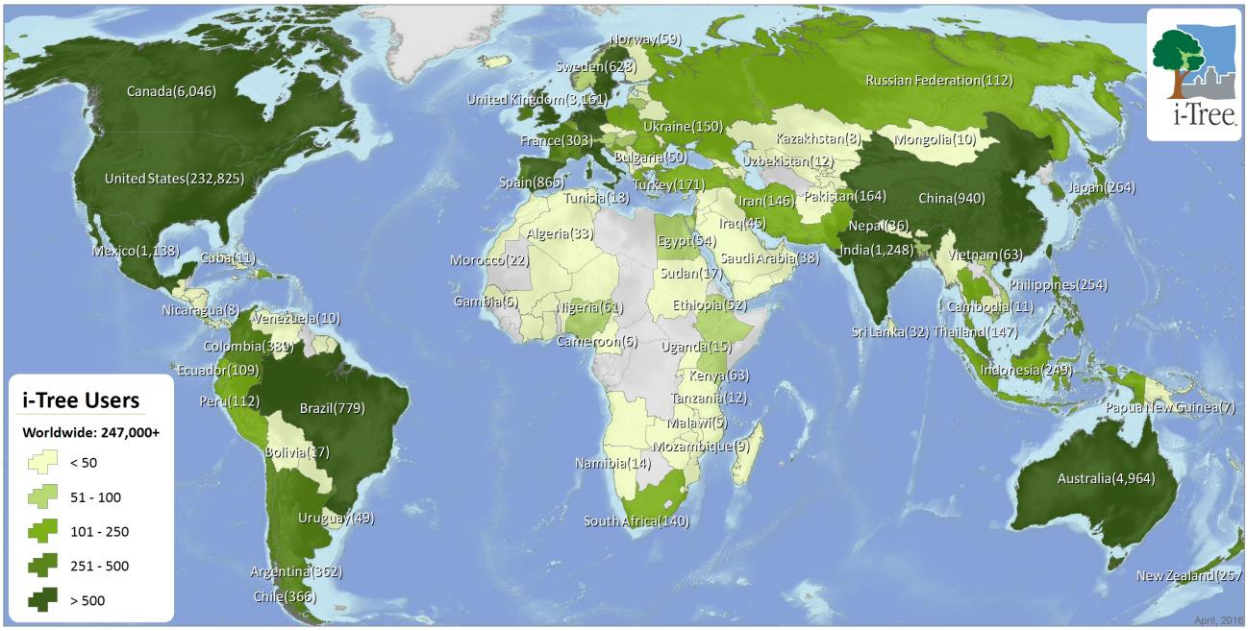


i-Tree Landscape allows users to **explore tree canopy, land cover, forest cover and basic demographic information** anywhere in the conterminous US. With the information provided by i-Tree Landscape, users learn about the **benefits and values of trees** (carbon storage, air pollution removal, reduced runoff) in their area, understand **local risks to people and forests** (insects and diseases, wildfire potential, ultraviolet radiation exposure, land surface temperatures, urban-wildland interfaces, air pollution exposure, climate change) and can map areas in which to prioritize tree planting or protection efforts to improve forest and human health and sustainability.

i-Tree Database is a web-based tool that allows international users to submit local city, pollution and precipitation data to be imported into i-Tree. Once data are processed, users can run i-Tree Eco for that international city or area. Users can also view and submit new tree species information to help build a global tree database.

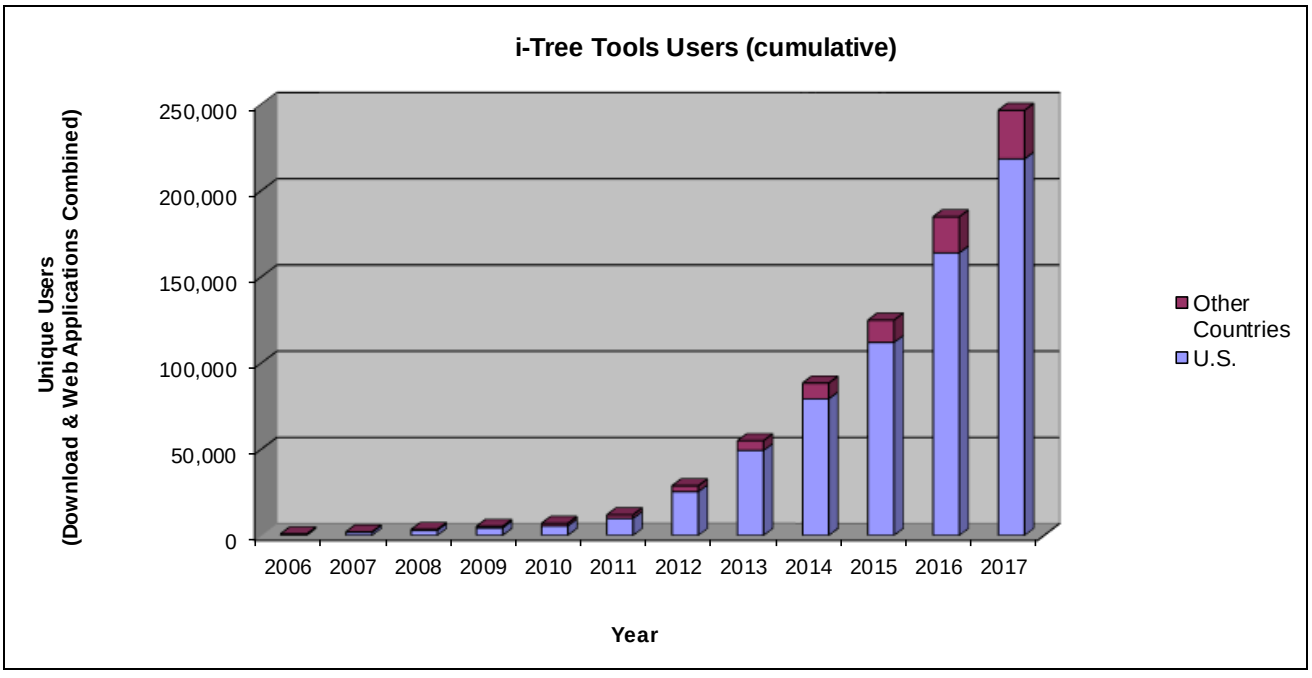
i-Tree Planting is a web-based tool that estimates the long-term environmental benefits from a tree planting project.

i-Tree Usage and Distribution



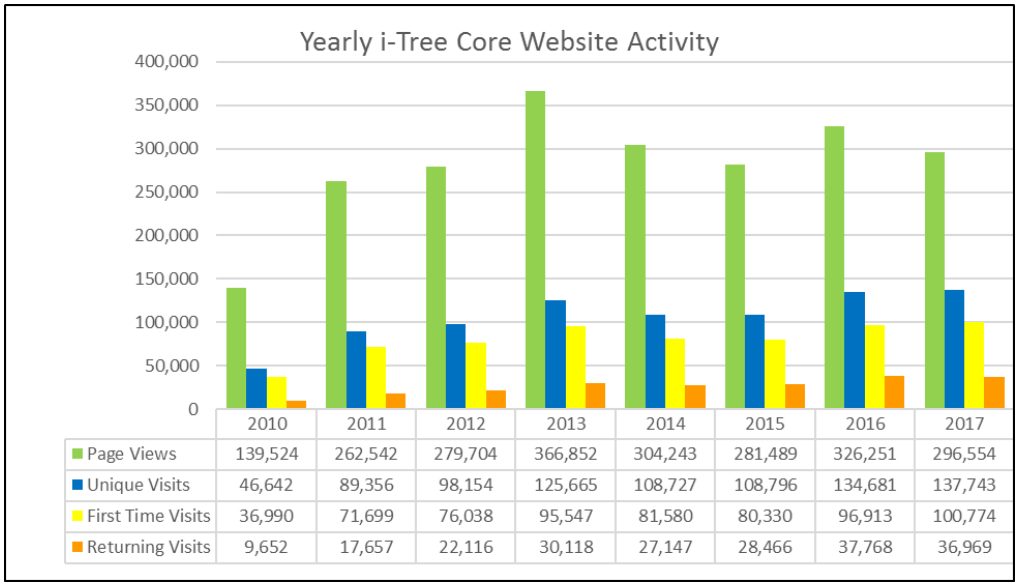
Since its release in 2006, there have been over 247,000 users of i-Tree products in 131 countries.

Cumulative i-Tree Usership



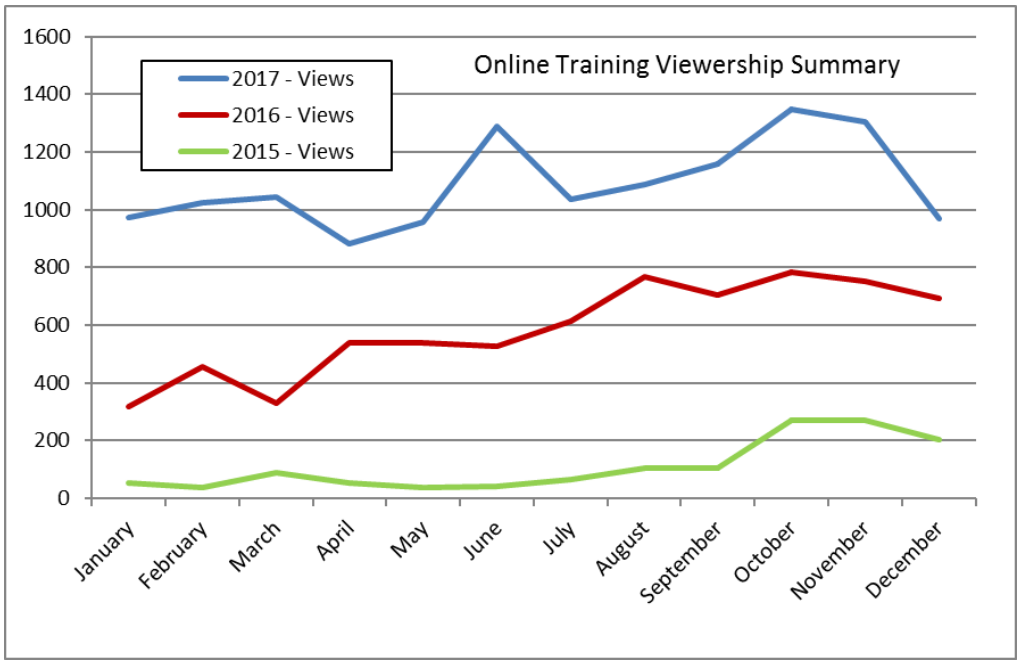
i-Tree added 63,000 new users in 2017 (+34%)

i-Tree Website Activity Summary from Jan 2010 through December 2017



	2010	2011	2012	2013	2014	2015	2016	2017
Page Views	139,524	262,542	279,704	366,852	304,243	281,489	326,251	296,554
Unique Visits	46,642	89,356	98,154	125,665	108,727	108,796	134,681	137,743
First Time Visits	36,990	71,699	76,038	95,547	81,580	80,330	96,913	100,774
Returning Visits	9,652	17,657	22,116	30,118	27,147	28,466	37,768	36,969

In 2017, the website attracted approximately 11,500 unique visitors a month with nearly 40,000 returning visitors utilizing the website multiple times over the course of the year.



In 2017, i-Tree doubled the number of on-line training videos to over 50 videos (3-8 minutes each).

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i-Tree Hydro in 2018

State-of-the-Art, Peer-Reviewed, Public-Domain

Process-Based Hydrological Model

Assessing How Changes in **Tree and Impervious Cover** Affect **Water Quantity & Quality**

Based on *Cutting-Edge U.S. Forest Service Science*

What Hydro Can Inform Us About

- How management practices & urbanization affect water resources.
- How land cover changes impact water quality & quantity in watersheds, municipalities, and user-defined places nation-wide.
- Hourly & total results available in tabular & graphical form, including an automatically-generated Executive Summary report.

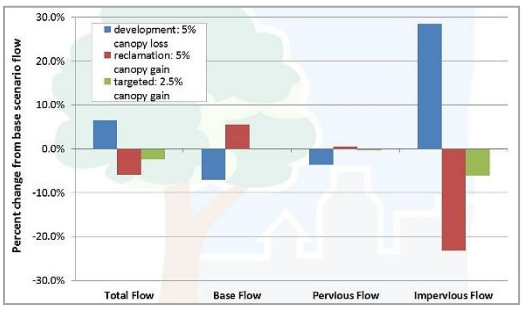

Figure 1: i-Tree Hydro simulation of alternative management scenarios as compared to initial conditions

How It Works

- **Data needs:** location; topography; weather; optional stream flow for calibration; land cover for initial case & optional alternatives.
- **Users inputs:** location, simulation period, and land cover information derived from i-Tree Canopy, NLCD data, and/or local knowledge.
- **Pre-loaded & increasing automated data inputs** with vast coverage in the U.S. for topography, weather data, and hydrological parameters.

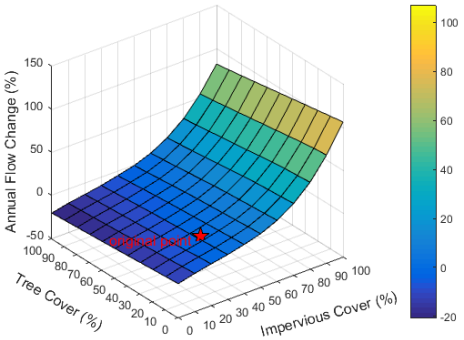

Figure 2: i-Tree Hydro simulated effects of incremental changes to Tree Cover and Impervious Cover in 161km² Rock Creek watershed near Washington, DC.

What's New in 2018: i-Tree Hydro version 6.0

- **Increased functionality** & **accessibility**, e.g. 4 scenarios can be paired with different parameter sets & canopy properties in a single project.
- **Easier-to-edit weather & streamflow file formats** enable users to customize their weather and streamflow inputs.
- **Detailed output graphs** for specific hydrologic processes including interception, infiltration, evapotranspiration, and more.
- **Customizable pollutant coefficient** (Event Mean Concentration) values can be set, instead of using the national U.S. average.

How Can Hydro Help

- **By supporting decision-making** to **reduce stormwater damage** and improve urban forests, environmental quality, and human health.

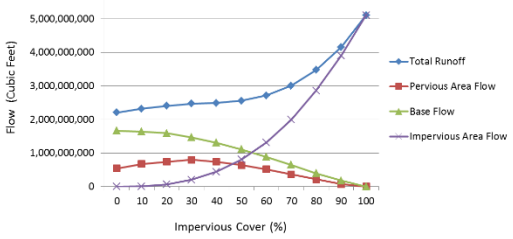

Figure 3: i-Tree Hydro simulation scaling Impervious Cover, with constant Tree Cover, in Rock Creek watershed near Washington, DC.

What's Planned for the Future – Projects, Partnerships, & Research

- **Green infrastructure**: tree pits; rain barrels; green roofs; rain gardens; and pervious pavement – each uniquely parameterized.
- **Design Rain tool** for simulating storms using regional NOAA data and Intensity-Duration-Frequency (IDF) curves for the U.S.
- **Improved water quality modeling**, including tool to identify pollution build-up & buffering hotspots, and database of pollutant coefficients specific to project location and effects of current land cover.
- **Localized soil & hydrology parameters** informed by the NRCS SSURGO database for users all over the U.S.
- **Spatially-distribution of model**, providing advanced users with localized land use decision-making support.