

i-Tree Tools and i-Tree Hydro

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Outline



🌳 Intro to the i-Tree Suite

🌳 i-Tree and hydrology

🌳 i-Tree Hydro

- Overview of methods, inputs, and outputs
- Project setup: step-by-step demo
- A look at outputs and a couple of use-cases
- Optional: preview of what's new in Hydro v6.0 beta

🌳 Where to find more info: support, videos, reports

🌳 Wrap-up discussion, Q&A, and *how can i-Tree help DEP?*



What is i-Tree?



A series of FREE tools to quantify ecosystem services and values from trees (free support also)



i-Tree is a Cooperative Initiative among these partners



How do the tools differ?

General categories:

-  Top-down
-  Bottom-up
-  Specialized utilities



Install on
Desktop PC



Use in a
Web Browser

i-Tree...



“Putting USFS Urban Forest science into the hands of users”

-  Public Domain Software
-  Based on peer-reviewed research
-  Technical support
-  Continuously improved

www.itreetools.org

The screenshot shows the i-Tree website homepage. At the top left is the i-Tree logo with the tagline "Tools for Assessing and Managing Community Forests". To the right is a "Google Custom Search" box and a "Get the Tools." button with a CD icon. Further right are fields for "Username" and "Password" with "Login" and "Register" buttons. Below the navigation bar is a large photograph of a city street with trees and a yellow bus. A horizontal menu contains buttons for "Home", "About", "Applications", "Utilities", "Resources", "Support", and "News". The main content area is divided into three columns. The left column features a "Community Trees: A Living Investment" section with a video thumbnail, a "Featured i-Tree Project: Corvallis, Oregon" section with a photo of autumn trees, and a "Who's Using i-Tree?" section with a world map. The middle column has a "What is i-Tree?" section with a detailed paragraph about the software's purpose and a "Follow i-Tree on Twitter" link. The right column has a "What's New?" section with three news items: "i-Tree Eco project featured with other Kansas City green initiatives", "USDA Forest Service video promoting the value of urban forests", and "i-Tree version 4.0 summary".

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i-Tree Landscape



- 🌳 National data sets
- 🌳 Explore & compare states, counties, watersheds, block groups
- 🌳 Estimate tree services and prioritize management areas

Current Prioritization Scenario Legend
Index is from 0 to 100, where 0 is a low priority and 100 is a high priority, based on the criteria assigned.

Type	ID	Highlight	Priority Index
Block Group	391535089003	<input type="checkbox"/>	100
Block Group	391535019001	<input type="checkbox"/>	72
Block Group	391535022003	<input type="checkbox"/>	68
Block Group	391535031001	<input type="checkbox"/>	67
Block Group	391535017001	<input type="checkbox"/>	66
Block Group	391535089002	<input type="checkbox"/>	66
Block Group	391535083011	<input type="checkbox"/>	65
Block Group	391535017002	<input type="checkbox"/>	65
Block Group	391535090002	<input type="checkbox"/>	64
Block Group	391535090001	<input type="checkbox"/>	64
Block Group	391535022001	<input type="checkbox"/>	62
Block Group	391535022004	<input type="checkbox"/>	60

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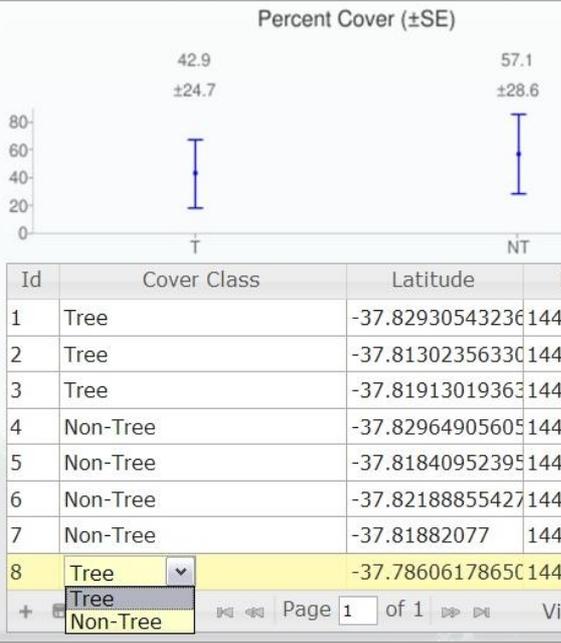
i-Tree Canopy



Get started in three easy steps!

- One** Browse to your project area boundary GIS file. The file must be in ESRI Shapefile format and in lat/long coordinates.

Or
 - Two** Configure the cover classes for your survey.
 - Three**
- Been here before?**
- Already started an i-Tree Canopy survey?
Load it here and resume your work.
-



**Determines
% tree cover**

**Easy & Fast
World-wide
Web-based**

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i-Tree Species



Selector - i-Tree Species

https://species.itreetools.org/selector/

i-Tree Species Home Project Menu i-Tree

Report

Report Type

Top 10% All

Save Report

Top 10% of Species for Selected Functions

Location: Indianapolis city (balance), Marion, Indiana, United States of America

Constraints:

- Minimum Height: None
- Maximum Height: 50

Air Pollutant Removal (0-10 Importance):

- Overall: 0

Other Functions (0-10 Importance):

- Low VOC: 8
- Carbon Storage: 4
- Wind Reduction: 0
- Air Temperature Reduction: 5
- UV Radiation Reduction: 4
- Building Energy Reduction: 0
- Streamflow Reduction: 0
- Low Allergenicity: 0

Generated: 11/11/2016

S = Sensitive I = Intermediate SI = Indeterminate

Species		Hardiness		Sensitivity			Pest Risk
Scientific Name	Common Name	Zone	Invasive	Ozone (O3)	Nitrogen Dioxide (NO2)	Sulfur Dioxide (SO2)	Possible Pests
SEQUOIA SEMPERVIRENS	COAST REDWOOD	7-10					
LIRIODENDRON TULIPIFERA	TULIP TREE	5-9		S			
ULMUS AMERICANA	AMERICAN ELM	3-9			I/S		Asian Longhorned Beetle, Dutch Elm Disease, Winter Moth
ULMUS GLABRA	WYCH ELM	4-7					Asian Longhorned Beetle, Dutch Elm Disease
MAGNOLIA GRANDIFLORA	SOUTHERN MAGNOLIA	7-10					
TILIA AMERICANA	AMERICAN BASSWOOD	4-9		I	I		Gypsy Moth, Winter Moth
TSUGA HETEROPHYLLA	WESTERN HEMLOCK	6-7			I		Southern Pine Beetle, Western Spruce Budworm
TSUGA MERTENSIANA	MOUNTAIN HEMLOCK	5-7					Fir Engraver, Southern Pine Beetle, Western Spruce Budworm

Air Pollutant Removal (0-10 importance)

Rank each of the following environmental services from 0 to 10 on how important these tree services are to you. 0 = not important; 10 = highly important.

Pollutant Removal

Overall Specific

Overall Rate ?



- Select Overall to consider the overall air pollutant removal impact of any tree (weights five pollutants based on the estimated effect of each pollutant).
- If you wish to rank the pollutants individually, select Specific to see a list of five pollutants.
- Ranking sliders: 10 is most important while choosing 0 means the pollutant will not be considered during species selection.

Other Functions (0-10 importance)

Loc VOC Emissions ?



Carbon Storage ?



Wind Reduction ?



Air Temperature Reduction ?



UV Radiation Reduction ?



Building Energy Reduction ?



Streamflow Reduction ?



Low Allergenicity ?



- Select species criteria
- Structure
- Services
- Lists top species that meet your criteria

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i-Tree Design v6.0

1614 North Newcastle Avenue, Chicago, IL 60707, USA

Start Over
Save Progress
About



Get started with these easy steps:

1. Draw Structures

2. Place Trees

Describe your tree:

- Tree species:
- Tree diameter: Inches
or circumference:
- Tree condition:
- Tree exposure to sunlight:

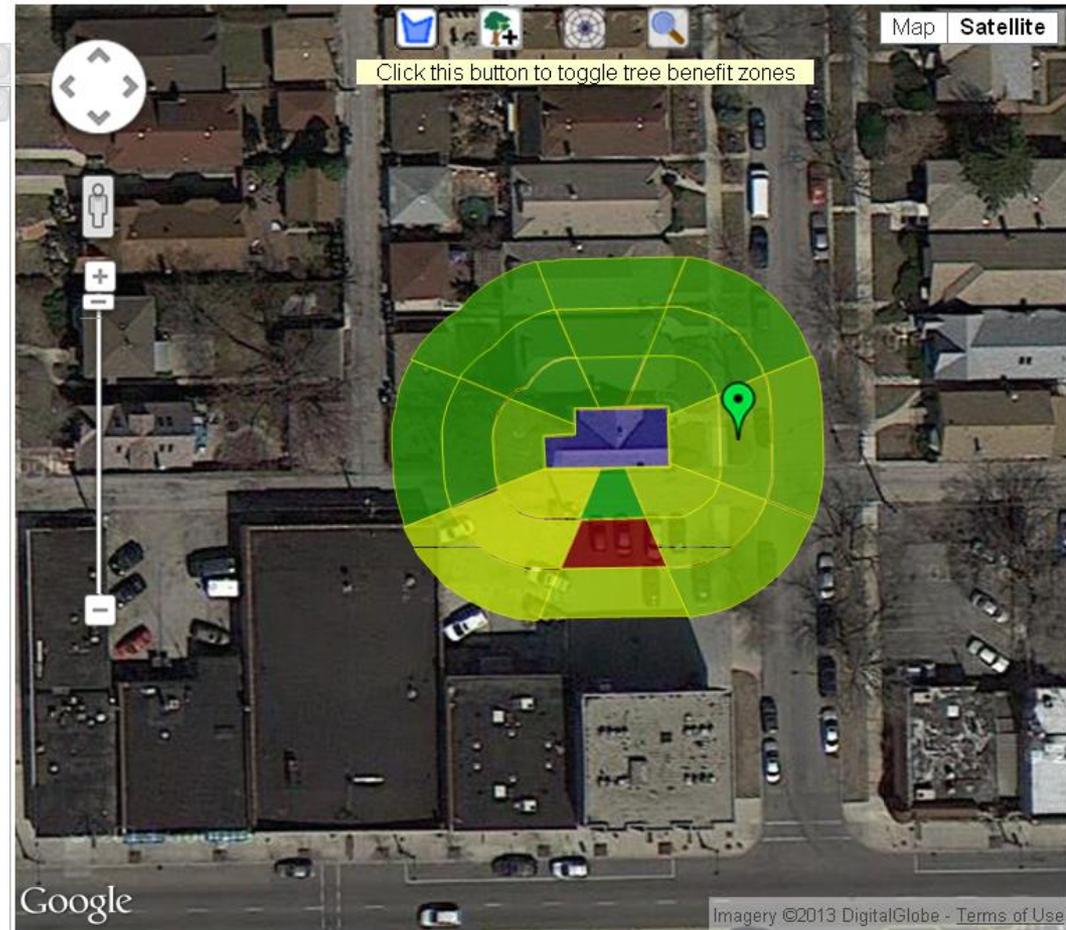
Tree benefit zones:

- The colored zones surrounding the structure, which appear as you describe your tree, illustrate the relative monetary value of energy savings that the tree would provide in each zone.
- Hover over each zone to see that energy benefit information displayed below the map.

To place a tree:

- Drag this icon  to the location on the map where you would like to place your tree.
- Repeat to place additional trees.
- Hover over any tree you have placed on the map to display its benefits.

Model the tree(s) future crown growth



Lat: 41.90995
Lng: -87.79631

i-Tree Design

-  Place trees on Google Maps imagery
-  Outline structures

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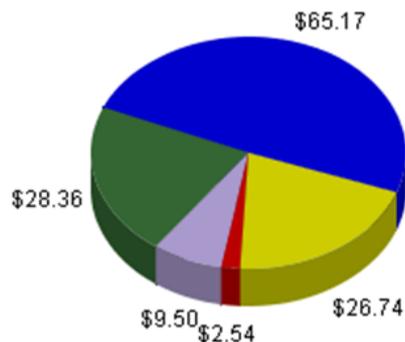
Display results for: **All Trees**

Overall Benefits

#1 Elm, American (DBH:30 inches, Condition:Excellent)
#2 Maple, Silver (DBH:24 inches, Condition:Good)

to Date Total (2013-2023) Future Year (2023) Current Year (2013)

- Stormwater
- Air Quality
- CO2
- Winter Savings
- Summer Savings



Breakdown of tree benefits

Click on one of the tabs above for more detail

Your selected trees provide overall benefits of \$131 in the current year.

While some functional benefits of trees are well documented, others are difficult to quantify (e.g., human social and communal health). Trees' specific geography, climate, and interactions with humans and infrastructure are highly variable and make precise calculations that much more difficult. Given these complexities, the results presented here should be considered initial approximations to better understand the environmental and economic value associated with trees and their placement.

Benefits of trees do not account for the costs associated with trees' long-term care and maintenance.

If these trees are cared for and grow, they will provide \$156 worth of annual benefit in 10 years. See 'Future Year (2023)' tab at left for details.

- Rapid estimate & forecast of tree benefits
- Stormwater, CO2, energy (heating/cooling), air quality

i-Tree Design

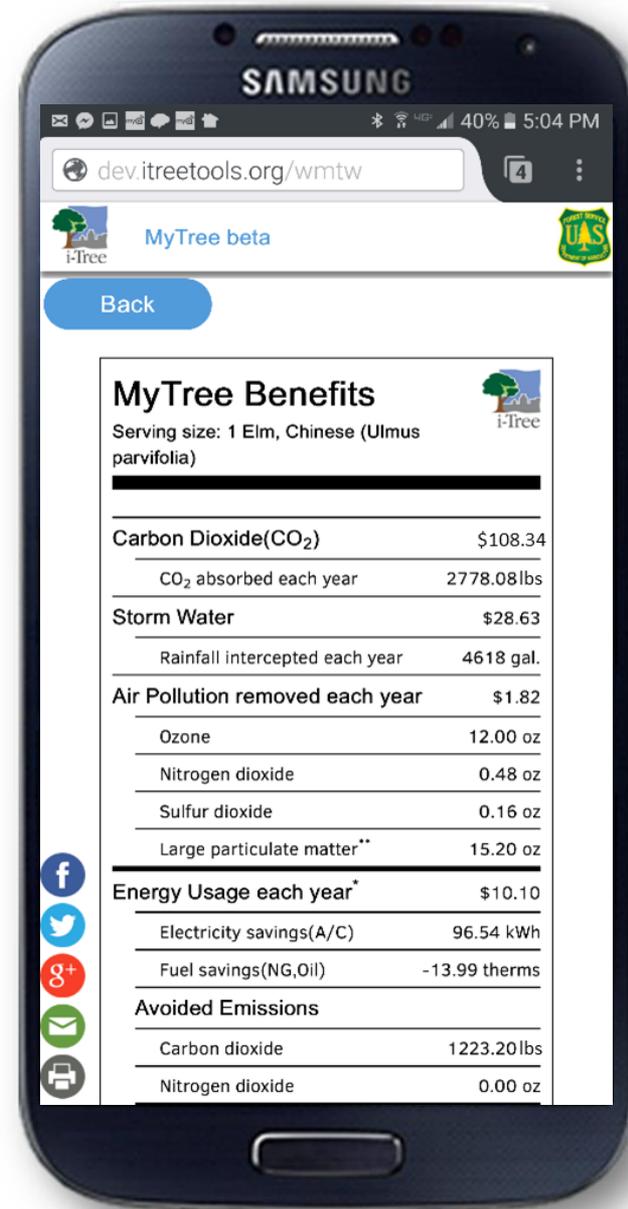
i-Tree is a Cooperative Initiative among these partners



i-Tree on the go!

- Running on the i-Tree Design engine

www.itreetools.org/MyTree



i-Tree Eco: Quantifies Tree and Forest Resources



www.itreetools.org



Structure

- Number of trees, species distribution, canopy cover, species diversity, etc.

Functions / Ecosystem Services

- Energy use
- Air pollution (w/ health impacts)
- UV
- Carbon
- Biogenic VOC emissions
- Avoided runoff & hydrology
- Wildlife

Management needs

- Pest risk
- Tree health
- Exotic/invasive spp.

\$ Value



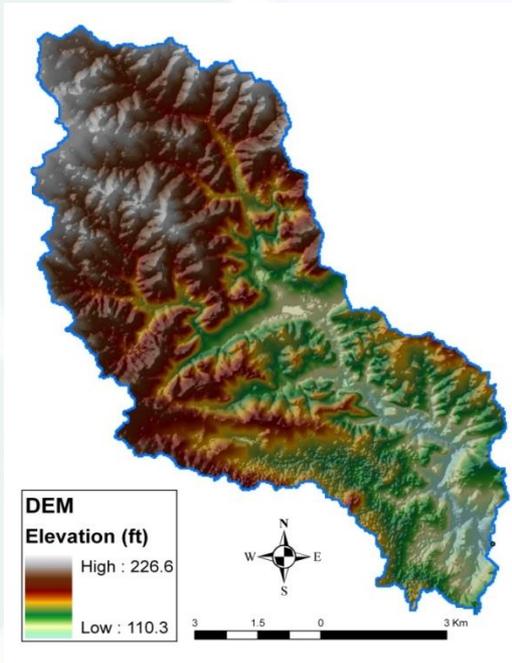
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i-Tree Hydro



Gwynns Falls Watershed, Baltimore



www.itreetools.org

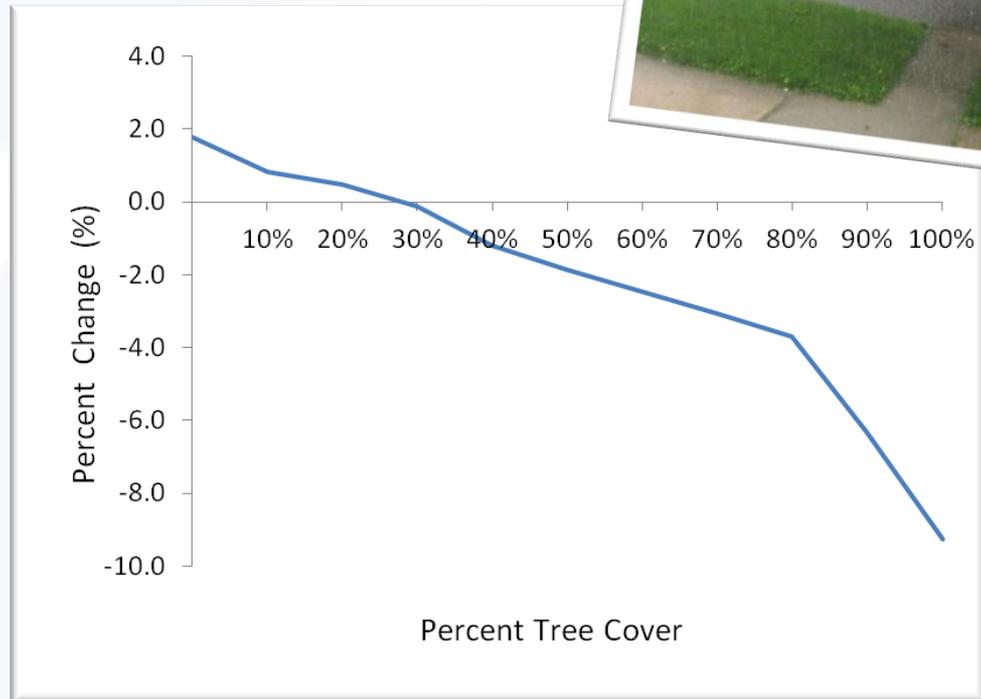


Quantifies effects of:

- Tree cover
- Impervious cover

on:

- Hourly stream flow
- Water quality



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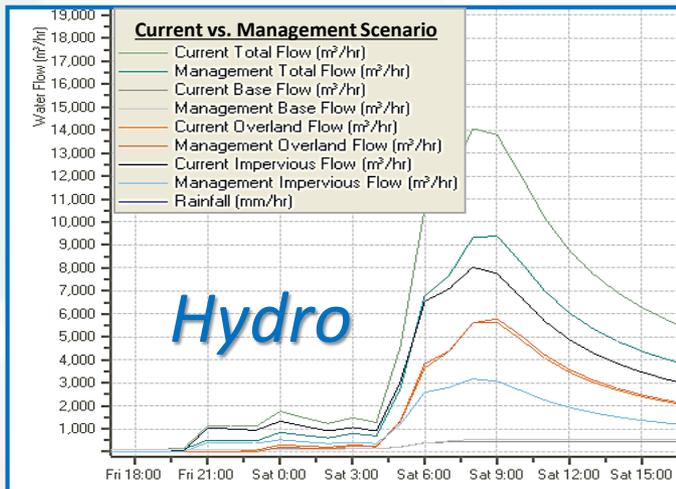


i-Tree Tools for Stormwater



Hydro

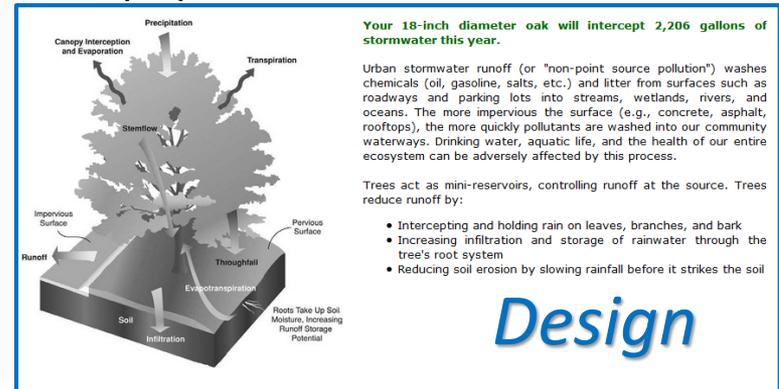
- Input % land cover
- Estimates hourly changes in streamflow and water quality
- Engine for Eco's hydrology estimates



Hydro

Landscape

- Examine & compare watersheds
- Forest-to-Faucet dataset shows area's importance to drinking water reservoirs
- Combine tree data with US Census population data



Design

Eco

- Input big or small plots or inventory
- Estimates runoff avoided, interception, transpiration
- Runs on simplified Hydro engine

Design & MyTree

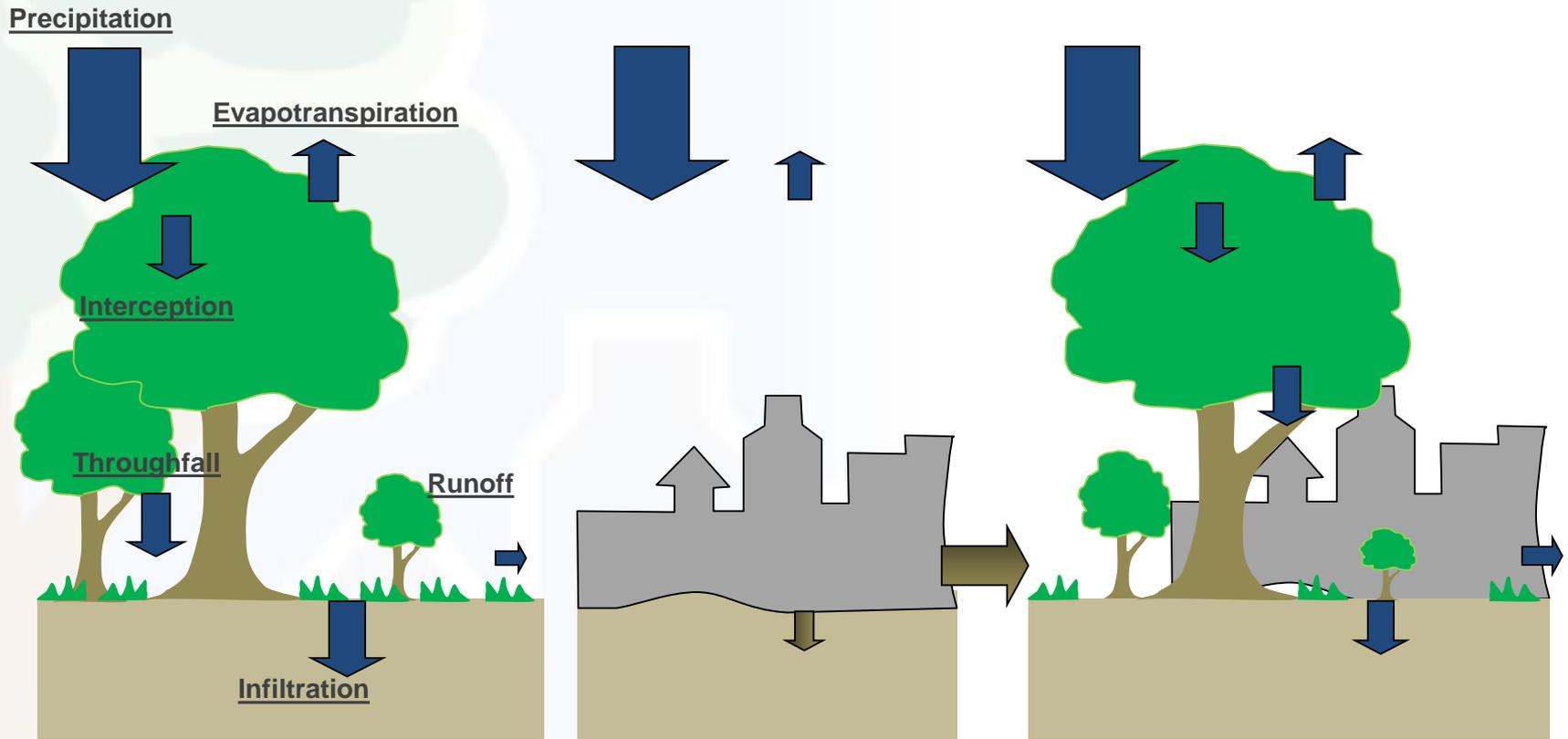
- User-friendly, quick & easy
- Estimates tree interception, soon to be updated to include Eco's estimates of Avoided Runoff



Zooming in on i-Tree Hydro



Simulating How Land Cover Changes Affect Water Quantity & Quality



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i-Tree Hydro



Model Background

- Origins from discussions between Dr. Ted Endreny (SUNY-ESF) and Dr. David Nowak (USFS - NRS)
- Wanted to replace curve number based runoff models with a processed based hydrological model



*St. Elizabeth Hosp. D.C. 2006-2011
Casey Trees*

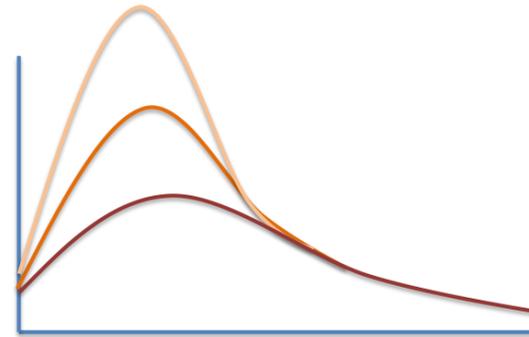
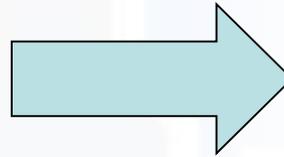
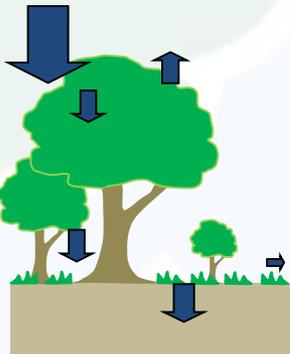


Rainfall-runoff Model



Rainfall – runoff model

- Transformation of rainfall into runoff
 - Effective precip -> Infiltration -> runoff generation
 - Runoff partitioning
 - baseflow, overland flow, shallow subsurface flow, etc.

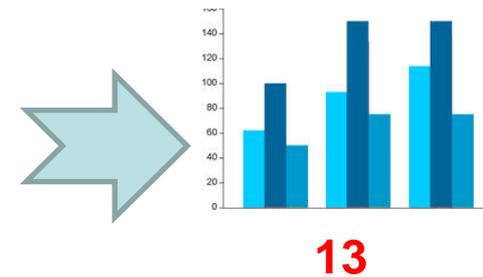
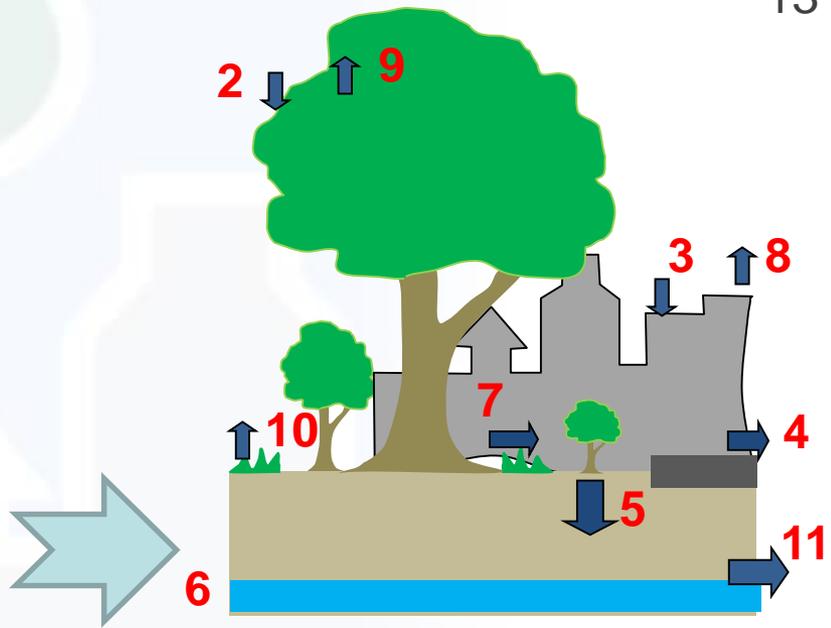
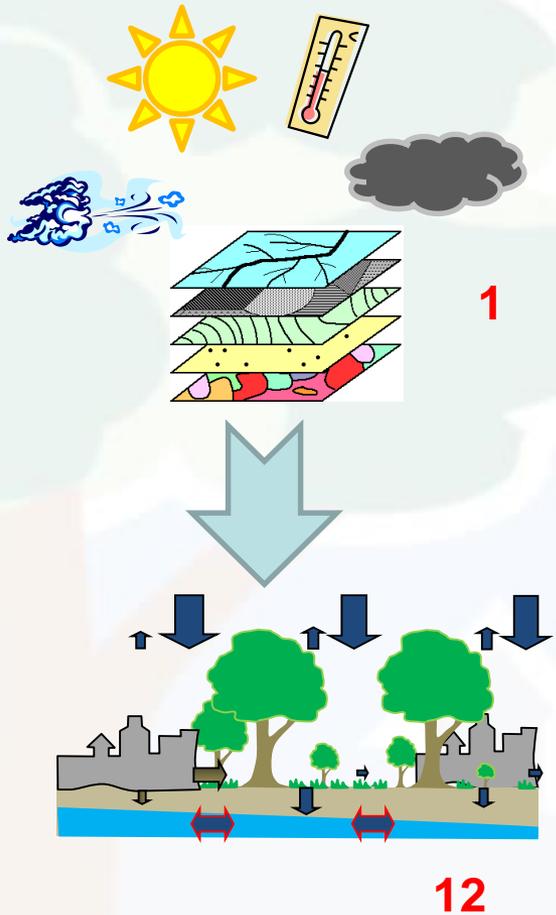


- Routing of runoff through watershed / to the outlet
 - Building of the hydrograph, timing of flow arrival

Modeled Hydrologic Processes



- 1 Inputs
- 2 Canopy Interception
- 3 Depression Storage
- 4 Impervious Runoff
- 5 Infiltration
- 6 Soil Moisture
- 7 Pervious Runoff
- 8 Surface Evaporation
- 9 Veg Evaporation
- 10 Evapotranspiration
- 11 Subsurface Runoff
- 12 Spatial Distribution
- 13 Outputs



Snapshot of All Inputs



- 🌳 Location (State, County, Place)
- 🌳 Topography (DEM or preloaded topographic index), typically of 30 or 10 m resolution
- 🌳 Precipitation data
- 🌳 Other weather and climate data (windspeed, solar radiation, etc.)
- 🌳 **Land cover data**, from iTree Canopy, Ground Surveys, etc.
- 🌳 Hydrology parameters



Snapshot of All Outputs



 For each time step (1 hour for these simulations):

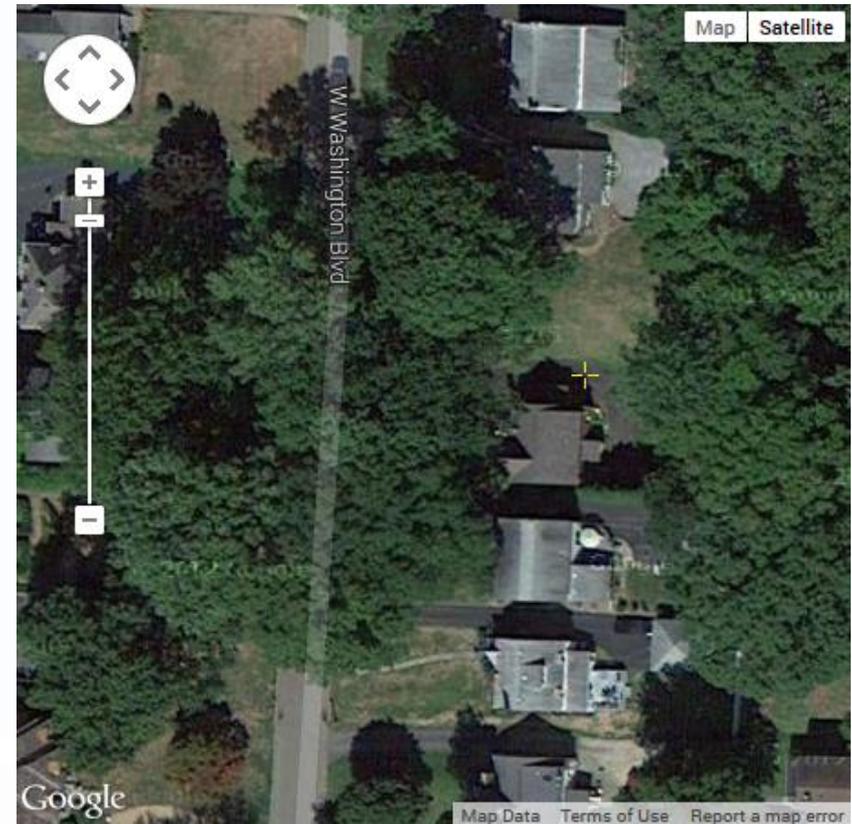
- Canopy interception
- Depression storage
- Infiltration
- Evapotranspiration
- Surface (pervious, impervious) and subsurface (base flow) flow
- Channel discharge (total flow)
- Water quality (EMC)



Model Inputs

Landcover

- 5 main cover classes
 - Bare Soil
 - Shrub/Grass/Herbaceous (SV)
 - Impervious Surface
 - Tree Cover over Impervious Area
 - Tree Cover over Pervious Area
- In the future: green infrastructure
 - Tree Pits
 - Rain Gardens
 - Green Roofs
 - Porous Pavement
 - Rain Barrels
 - ?



Model Inputs



Canopy Properties

- Leaf Area Index (LAI) – One sided leaf area per square meter of canopy
 - Tree LAI + Tree bark BAI
 - Shrub/ Herbaceous LAI + Bark BAI
 - Deciduous vs. Coniferous makeup
- Leaf On/Off days



Source: Aguilar, M.A. et al., 2010

Hydrological Parameters

- Defaults provide baseline for comparative analysis
- Autocalibration offers localized parameterization

Model Processes

Interception

- $f(\text{Tree}\%, \text{Shrub}\%, \text{Herb.}\%, \text{LAI}, \text{etc.})$
 - Open space vs. canopy cover, LAI, leaf on/off days, etc.



Depression storage

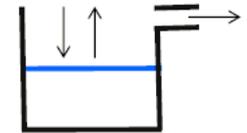
- $f(\text{Landcover type}, \text{Depression depth})$
 - Pervious vs. impervious – different depression storage maxes



Model Processes

🌳 Surface runoff – pervious and impervious

- f (Depression storage, Infiltration process, Soil moisture status)
 - Depression storage filled? Saturated soil? Rainfall intensity greater than infiltration rate?
 - Model user sets ratio of infiltration to saturation excess soils

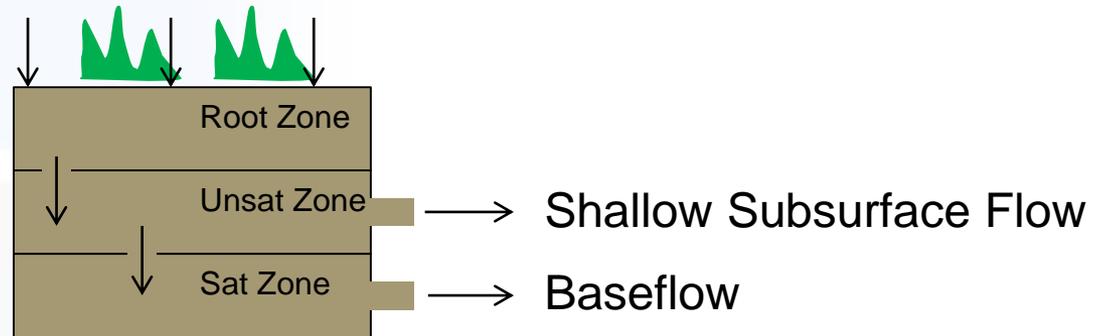


Model Processes



Infiltration

- $f(K_{sat}, \text{ Rainfall intensity, Infiltration process})$
- Infiltration excess – Modified Green-Ampt routine
- Saturation excess – unconstrained flow into rootzone



Soil Moisture

- Upper Soil zone \Rightarrow Unsaturated zone \Rightarrow Saturated zone
- $f(\text{Infiltrated water, ET, Intra-zone flow rates, Baseflow generation, etc.})$

Model Processes



Evaporation and ET

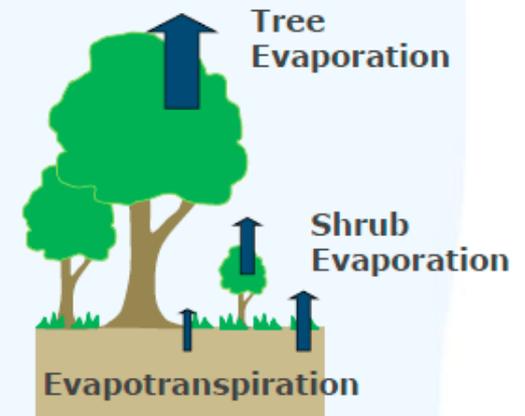
➤ Tree > Shrub > ET

➤ Potential Rates

- Penman-Montieth
- Evap - $f(\text{temp, net radiation, wind speed, etc.})$
- ET - $f(\text{temp, ..., soil + canopy resistances})$

➤ Actual Rates

- $f(\text{water availability, Storage/Rootzone depth, LAI, etc.})$



Model Processes

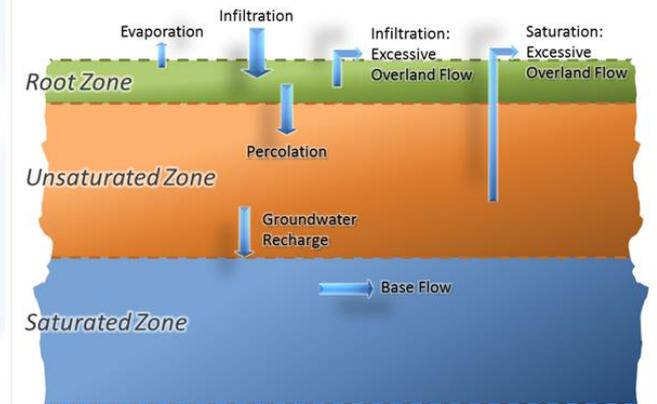


Subsurface flow

- $f(K_{sat}, \text{Average soil moisture deficit, Recession rate})$

Streamflow Prediction

- Baseflow – $f(\text{Subsurface flow})$
 - Specific discharge
- Overland runoff – $f(\text{Pervious and Impervious flow})$
 - Per landcover percentage/area



Model Calibration



Calibration

➤ Method:

- Determining optimal model parameter set
 - Optimization algorithm - PEST
- Repeated model runs
 - Comparing predicted and observed values
- Maximize goodness of fit metrics

➤ Problems:

- Equifinality – Different parameter sets, same optimum
- Disagreement between field data and model parameters



Model Calibration



Parameter Calibration Results

Daily Model Calibration Results

Enabled	Name	Volumetric Efficiency	CRF1 - Peak Flow Fit	CRF2 - Baseflow Fit	CRF3 - Overall Fit	Color
<input checked="" type="checkbox"/>	Observed Discharge	N/A	N/A	N/A	N/A	Black
<input checked="" type="checkbox"/>	Rainfall	N/A	N/A	N/A	N/A	Blue
<input type="checkbox"/>	Suggested Default Values	0.368219	0.113362	0.182292	0.00354765	Brown
<input checked="" type="checkbox"/>	AutoCalibrated Parameters	0.504397	0.683245	0.358546	0.571221	Green

The CRF1, CRF2, and CRF3 values are a measure of how well the estimated flow matches the flow observed at the gaging station. With a very good fit, these CRF values will approach 1.0. The full range for all values is anywhere from negative infinity to 1.0, so negative values are not necessarily "bad." Typically, "good" values range from 0.3 to 0.7, but higher values are better. A value of 0.0 means the model is no better than just using the observed average value to represent the observed data. In short, the calibration process is to maximize the NSE (CRF1) value.

Show Graph

Export JPG

Calibration Comparison

OK

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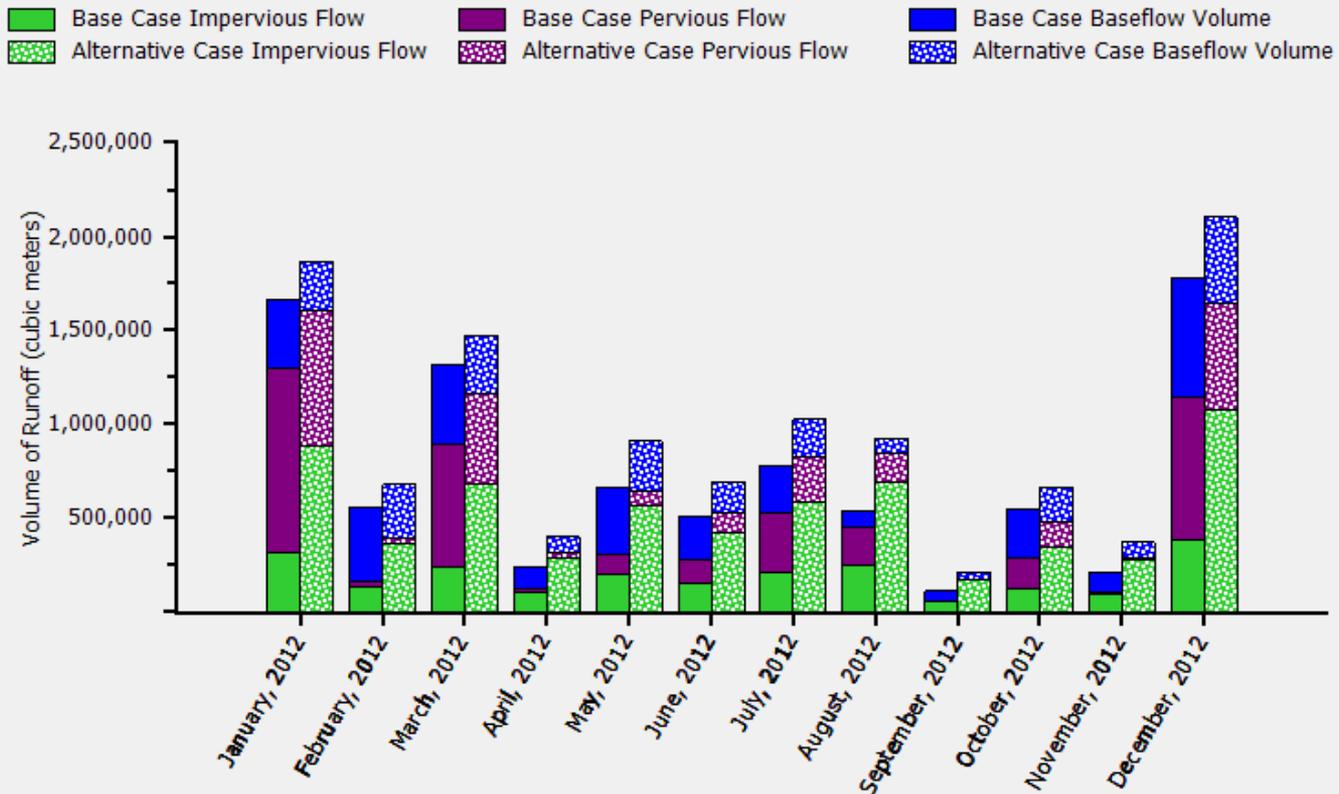
Outputs



Water Quantity Outputs

- Predicted streamflow vs. observed (if available)

Water Volume: Base Case vs. Alternative Case Predicted Streamflow Components



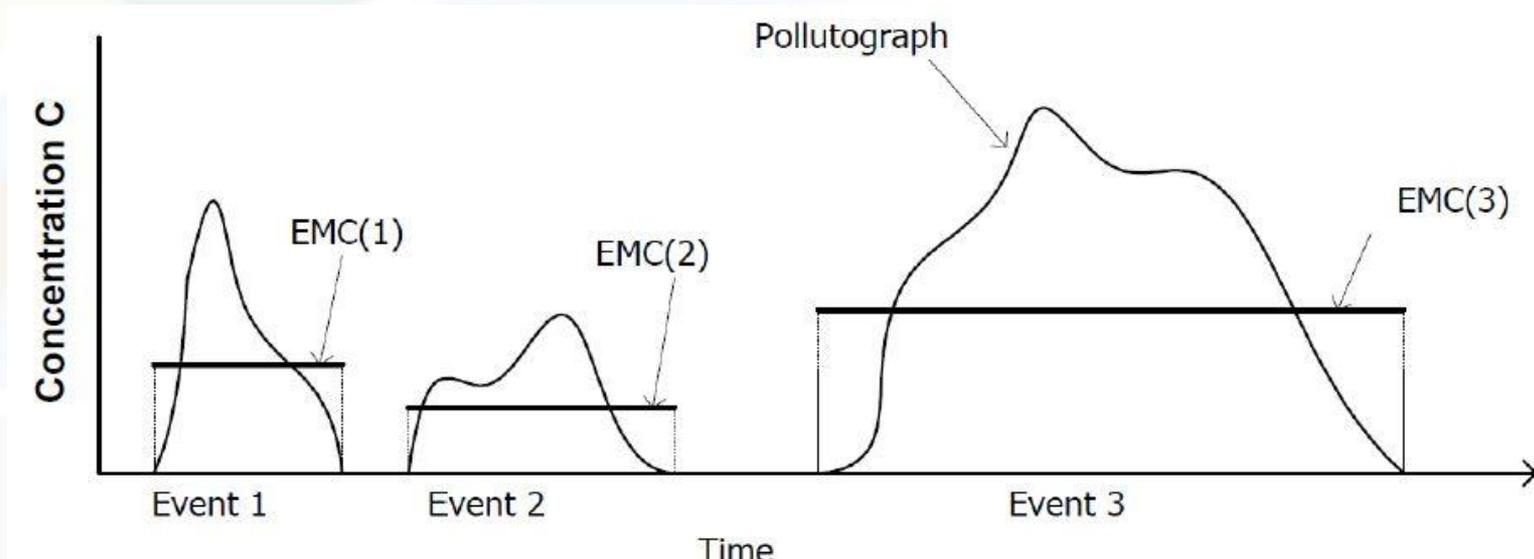
Outputs



🌳 Water Quality Outputs

➤ Pollution – Loading estimates

- Total pollutant mass
- Based on EMC values – from EPA’s NURP data
 - Currently using national avg, changing to localized HUC-8 and land cover specific EMC values to distinguish changes in concentration based on location and cover type





i-Tree Hydro

Introduction to Project Setup



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Initiative



i-Tree Hydro: An Introduction



 Model interfaces

 Model inputs

 Model outputs

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i-Tree Hydro: Model interface



Welcome to i-Tree Hydro!

[What is Hydro?](#)
[How to Run i-Tree Hydro](#)
[About the Sample Project](#)
[New Project Steps](#)

General References:

[i-Tree Hydro webpage](#)
[Hydrologic Cycle](#)
[Soil Profile](#)
[User's Manual](#)

What is Hydro?

i-Tree Hydro is a simulation tool that analyzes how land cover influences the volume and quality of runoff. It can analyze historical or future hydrological events and allow the user to contrast runoff volume and quality from existing land cover (referred to as the Base Case) with runoff from the Alternative Case land cover. The i-Tree Hydro model differs from other i-Tree products in the following ways:

- The model simulation area is loaded into the program either as a digital elevation model (DEM) file or as a topographic index (TI) file. It is not hand-delineated in the program by the user. If the user is interested in a watershed, they can load a DEM or TI file. If the user is interested in a city or parcel that is not defined by a single watershed they load a TI file.
- The model simulation can be run in calibration mode or non-calibration mode. For calibration runs the user loads observed streamflow data from a gauging station and the model will identify the optimal hydrological parameters to fit the observed streamflow data. Observed streamflow data are provided for thousands of watershed areas. For non-calibration runs the user can use previously calibrated parameters or independently set the land cover and hydrological parameter values by adjusting the default values that the model provides.

Current Project:

No project loaded.



Digital Elevation Model / Topographic Index

- Browse for my own DEM file *DEM File: C:\Program Files (x86)\i-Tree\Hydro\Sample Data\dem.dat*
- Use a Topographic Index

Project Location

Nation

State

County

City

Basic Watershed Characteristics

Watershed Land Area (km²) Metric

Percent Tree Cover

Tree Leaf Area Index

Percent Evergreen Tree Cover

Percent Evergreen Shrub Cover

Start Date / Time (Local)

End Date / Time (Local)

Observed Streamflow Data

- I need to pick a USGS gage from a map. *Stream Gage ID: 04240100*
- Browse for my own raw stream gage file
- Browse for my own processed stream gage file
- I wish to predict streamflow for a non-gaged stream.

Weather Station Data

- I need to pick a weather station it from a map *Weather Station ID: 725190-14771*
- Browse for my own raw weather file
- Browse for my own processed weather files

Next: Step 2) i-Tree Hydro Land Cover Parameters

OK

Cancel

Help for items on this page:

Digital Elevation Model (DEM)

Once you have identified your watershed of interest and noted the stream gage station number and stream name, your next step is to create a digital elevation model (DEM) of the watershed. The end product should be a DEM clipped to the boundaries of your watershed, projected in the proper UTM zone in meters, and converted to ASCII format. In general, you download free USGS DEM data, import it to your GIS, and use its appropriate watershed delineation tools to clip out only the watershed area. This creates the watershed's DEM for Hydro to work with. This process is explained in more detail in Appendix 1 of the manual.

coordinate system: UTM meters, with zone dependent on your project area



 **Step 1**

 **Topographic**

 **Project Location**

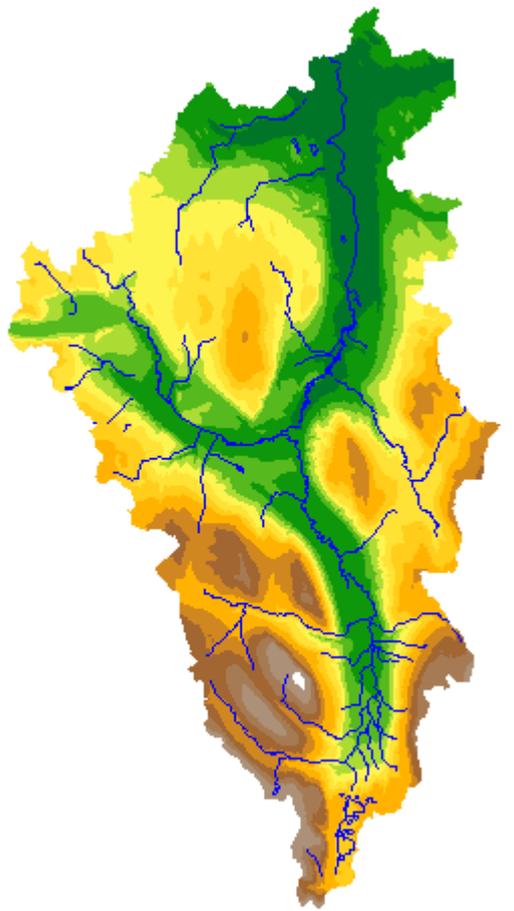
 **Basic WS Info**

 **Streamflow**

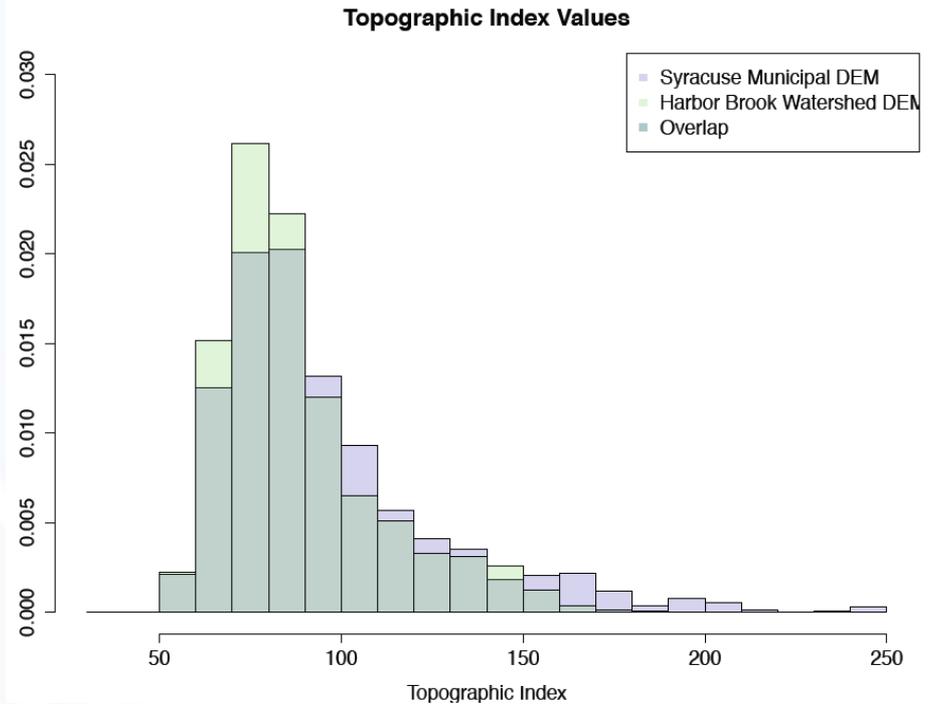
 **Weather**



i-Tree Hydro: DEM vs Topographic Index Option



Digital Elevation Model (DEM)



Topographic Index from DEM

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Digital Elevation Model / Topographic Index

- Browse for my own DEM file *DEM File: C:\Program Files (x86)\i-Tree\Hydro\Sample Data\dem.dat*
- Use a Topographic Index

Project Location

Nation

State

County

City

Basic Watershed Characteristics

Watershed Land Area (km²) Metric

Percent Tree Cover

Tree Leaf Area Index

Percent Evergreen Tree Cover

Percent Evergreen Shrub Cover

Start Date / Time (Local)

End Date / Time (Local)

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Digital Elevation Model (DEM)

Once you have identified your watershed of interest and noted the stream gage station number and stream name, your next step is to create a digital elevation model (DEM) of the watershed. The end product should be a DEM clipped to the boundaries of your watershed, projected in the proper UTM zone in meters, and converted to ASCII format. In general, you download free USGS DEM data, import it to your GIS, and use its appropriate watershed delineation tools to clip out only the watershed area. This creates the watershed's DEM for Hydro to work with. This process is explained in more detail in Appendix 1 of the manual.

coordinate system: UTM meters, with zone dependent on your project area



 Step 1

 Topographic

 Project Location

 Basic WS Info

 Streamflow

 Weather



Digital Elevation Model / Topographic Index

- Browse for my own DEM file DEM File: C:\Program Files (x86)\i-Tree\Hydro\Sample Data\dem.dat
- Use a Topographic Index

Project Location

Nation

State

County

City

Basic Watershed Characteristics

Watershed Land Area (km ²)	<input type="text" value="26.2375"/>	<input checked="" type="checkbox"/> Metric
Percent Tree Cover	<input type="text" value="39.2"/>	
Tree Leaf Area Index	<input type="text" value="5"/>	
Percent Evergreen Tree Cover	<input type="text" value="4.2"/>	
Percent Evergreen Shrub Cover	<input type="text" value="21.0"/>	
Start Date / Time (Local)	<input type="text" value="01/01/2012 00:00:00"/>	
End Date / Time (Local)	<input type="text" value="12/30/2012 00:00:00"/>	

Observed Streamflow Data

- I need to pick a USGS gage from a map. Stream Gage ID: 04240100
- Browse for my own raw stream gage file
- Browse for my own processed stream gage file
- I wish to predict streamflow for a non-gaged stream.

Weather Station Data

- I need to pick a weather station it from a map. Weather Station ID: 725190-14771
- Browse for my own raw weather file
- Browse for my own processed weather files

Help for items on this page:

Digital Elevation Model (DEM)

Once you have identified your watershed of interest and noted the stream gage station number and stream name, your next step is to create a digital elevation model (DEM) of the watershed. The end product should be a DEM clipped to the boundaries of your watershed, projected in the proper UTM zone in meters, and converted to ASCII format. In general, you download free USGS DEM data, import it to your GIS, and use its appropriate watershed delineation tools to clip out only the watershed area. This creates the watershed's DEM for Hydro to work with. This process is explained in more detail in Appendix 1 of the manual.

coordinate system: UTM meters, with zone dependent on your project area

Next: Step 2) i-Tree Hydro Land Cover Parameters

OK

Cancel



Step 1

Project Location

Basic WS Info

Streamflow

Weather

Topographic



i-Tree Hydro: Land Cover Data (via i-Tree Canopy)



How It Works Report Export Start Over Exit



i-Tree Canopy v6.1



Id	Cover Class	Latitude	Longitude
491	Grass/Herbaceous	41.79033	-72.68715
492	Impervious Road	41.74460	-72.68292
493	Impervious Buildings	41.75931	-72.69842
494	Tree/Shrub	41.77135	-72.70451
495	Grass/Herbaceous	41.77403	-72.70396
496	Soil/Bare Ground	41.77663	-72.69132
497	Impervious Buildings	41.73789	-72.67604
498	Tree/Shrub	41.80099	-72.68062
499	Grass/Herbaceous	41.73083	-72.67079
500	Impervious Road	41.76210	-72.66642

Page 50 of 50 View 491 - 500 of

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Step 1

Step 1) i-Tree Hydro Project Area Information

Geographic Reference Location

Nation: United States of America
 State: New York
 County: Onondaga
 City: Syracuse

Project Time Period

Start Date / Time (Local): 01/01/2012 00:00:00
 End Date / Time (Local): 12/30/2012 00:00:00

Topographic Data

Browse for my own topography data
 Select preprocessed topographic data

Weather Station Data

Select a weather station from map
 Select raw NCDC weather file
 Select processed weather files

Calibration Data

Select USGS gage from map
 Select raw USGS data file
 Select processed data file
 Not calibrating

Next: Step 2) i-Tree Hydro Land Cover Parameters

i-Tree Hydro Weather Station Selector

Map Type: Normal
 Go To Location:
 Go

Zoom Level: 7

ID: 725190-14771
 Details: SYRACUSE/HANCOCK 725190-14771

Select: Left Click Marker
 Zoom: Mouse Wheel
 Pan: Right Click & Drag

OK Cancel

station closest to (or most appropriate for) your watershed on the map.

Browse for my own raw weather file. If you wish to run the model for a different year, you will need to gather and format the hourly data for your year of choice.

Example:
<http://www.itreetools.org/hy>

Streamflow

Weather

i-Tree Hydro: Weather Data



WeatherData.dat - Notepad

File Edit Format View Help

yyyymmdd	Hr:Min:Sec	Tair(F)	Tdew(F)	NetRad(w/m^2)	wndSpd(m/s)	Precip(m/hr)	Snow(m/hr)
20110101	00:00:00	42.70000000	34.90000000	0.00000000	3.44210997	0.00000000	0.00000000
20110101	01:00:00	40.00000000	34.00000000	0.00000000	2.23513634	0.00000000	0.00000000
20110101	02:00:00	42.10000000	34.10000000	0.00000000	3.48681270	0.00000000	0.00000000
20110101	03:00:00	42.90000000	35.00000000	0.00000000	2.68216361	0.00000000	0.00000000
20110101	04:00:00	42.00000000	35.00000000	0.00000000	2.68216361	0.00000000	0.00000000
20110101	05:00:00	36.85000000	36.00000000	0.00000000	0.00000000	0.00025400	0.00000000
20110101	06:00:00	36.76000000	36.00000000	0.00000000	1.01922217	0.00000000	0.00000000
20110101	07:00:00	36.00000000	36.00000000	0.00000000	1.34108181	0.00000000	0.00000000
20110101	08:00:00	35.31578947	35.31578947	12.50021015	0.00000000	0.00000000	0.00000000
20110101	09:00:00	36.00000000	36.00000000	53.31007742	0.44702727	0.00000000	0.00000000
20110101	10:00:00	37.00000000	37.00000000	88.96392811	0.00000000	0.00000000	0.00000000
20110101	11:00:00	47.00000000	41.00000000	180.3095209	2.77156907	0.00000000	0.00000000
20110101	12:00:00	47.20000000	41.10000000	382.4534808	3.48681270	0.00000000	0.00000000
20110101	13:00:00	49.00000000	42.00000000	174.0454807	2.68216361	0.00000000	0.02540000
20110101	14:00:00	49.90000000	42.90000000	131.4296478	3.17389361	0.00000000	0.00000000
20110101	15:00:00	49.00000000	42.00000000	159.7079611	3.71032633	0.00000000	0.00000000
20110101	16:00:00	49.00000000	42.00000000	27.88483690	4.91729996	0.00000000	0.00000000
20110101	17:00:00	46.00000000	41.90000000	0.00000000	3.57621815	0.00000000	0.00000000
20110101	18:00:00	46.30000000	41.10000000	0.00000000	3.63582179	0.00000000	0.00000000
20110101	19:00:00	49.00000000	42.00000000	0.00000000	3.12919088	0.00000000	0.02540000
20110101	20:00:00	49.10000000	40.90000000	0.00000000	3.71032633	0.00000000	0.00000000
20110101	21:00:00	50.00000000	40.00000000	0.00000000	5.05140814	0.00000000	0.00000000
20110101	22:00:00	50.00000000	40.00000000	0.00000000	6.25838176	0.00000000	0.00000000
20110101	23:00:00	49.00000000	39.00000000	0.00000000	6.79481448	0.00000000	0.00000000
20110102	00:00:00	48.90000000	39.10000000	0.00000000	7.42065266	0.00000000	0.02540000
20110102	01:00:00	48.00000000	40.00000000	0.00000000	5.81135449	0.00000000	0.02540000

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i-Tree Hydro: Land Cover Parameters



Step 2) i-Tree Hydro Land Cover Parameters

These parameter values describe the study area land cover conditions. Project Location: Atlanta, Georgia

Help for items on this page:

Surface Cover Types

as set on Project Area Information form

Tree Cover (%)	<input type="text" value="36.8"/>
Shrub Cover (%)	<input type="text" value="14.2"/>
Herbaceous Cover (%)	<input type="text" value="14.2"/>
Water Cover (%)	<input type="text" value="0.2"/>
Impervious Cover (%)	<input type="text" value="33.6"/>
Soil Cover (%)	<input type="text" value="1.0"/>
<i>Total Cover (%) (Should = 100)</i>	100.0

▶ Tree Leaf Area Index	<input type="text" value="5"/>
▶ Shrub Leaf Area Index	<input type="text" value="2.2"/>
▶ Herbaceous Leaf Area Index	<input type="text" value="1.6"/>
▶ Directly Connected Impervious Cover (%)	<input type="text" value="20.9"/>

Shrub Leaf Area Index

Leaf Area Index (LAI) is defined as the one sided green leaf area per unit ground area in broadleaf canopies, or as the projected needleleaf area per unit ground area in needle canopies. I-Tree Eco users: Leaf area indexes can be calculated from Eco results for leaf area. These results are presented in units of m²/ha. To get LAI, divide by 10,000. way to think about LAI is to imagine drawing a square on the ground under a tree canopy, with sides 1 meter in length. Standing in this 1-meter square area, looking up into the tree canopy, the LAI represents the surface area (1-sided) of the leaves present directly above this 1 meter square area. Typical LAI values range from 1-7, representing 1-7 square

And it is important to know what typically is going on beneath areas of tree canopy.

Cover Types beneath Tree Cover

Pervious Cover (%)	<input type="text" value="86.4"/>
Impervious Cover (%)	<input type="text" value="13.6"/>
<i>Total Cover (%) (Should = 100)</i>	100.0

Next: Step 3) i-Tree Hydro Hydrological Parameters

OK Cancel



i-Tree Hydro: Land Cover Parameters



Step 2) i-Tree Hydro Land Cover Parameters

These parameter values describe the study area land cover conditions. Project Location: Atlanta, Georgia

Surface Cover Types

Tree Cover (%) <small>as set on Project Area Information form</small>	<input type="text" value="36.8"/>	➔ Tree Leaf Area Index	<input type="text" value="5"/>
Shrub Cover (%)	<input type="text" value="14.2"/>	➔ Shrub Leaf Area Index	<input type="text" value="2.2"/>
Herbaceous Cover (%)	<input type="text" value="14.2"/>	➔ Herbaceous Leaf Area Index	<input type="text" value="1.6"/>
Water Cover (%)	<input type="text" value="0.2"/>		
Impervious Cover (%)	<input type="text" value="33.6"/>	➔ Directly Connected Impervious Cover (%)	<input type="text" value="20.9"/>
Soil Cover (%)	<input type="text" value="1.0"/>		
<i>Total Cover (%) (Should = 100)</i>	100.0		

Cover Types beneath Tree Cover

Pervious Cover (%)	<input type="text" value="86.4"/>
Impervious Cover (%)	<input type="text" value="13.6"/>
<i>Total Cover (%) (Should = 100)</i>	100.0

Shrub Leaf Area Index

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Help for items on this page:

Next: Step 3) i-Tree Hydro Hydrological Parameters

OK Cancel



i-Tree Hydro: Land Cover Parameters



Step 2) i-Tree Hydro Land Cover Parameters

These parameter values describe the study area land cover conditions. Project Location: Atlanta, Georgia

Help for items on this page:

Surface Cover Types

as set on Project Area Information form

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Shrub Cover (%)	<input type="text" value="14.2"/>
Herbaceous Cover (%)	<input type="text" value="14.2"/>
Water Cover (%)	<input type="text" value="0.2"/>
Impervious Cover (%)	<input type="text" value="33.6"/>
Soil Cover (%)	<input type="text" value="1.0"/>
<i>Total Cover (%) (Should = 100)</i>	100.0

▶ Tree Leaf Area Index	<input type="text" value="5"/>
▶ Shrub Leaf Area Index	<input type="text" value="2.2"/>
▶ Herbaceous Leaf Area Index	<input type="text" value="1.6"/>
▶ Directly Connected Impervious Cover (%)	<input type="text" value="20.9"/>

Cover Types beneath Tree Cover

And it is important to know what typically is going on beneath areas of tree canopy.

Pervious Cover (%)	<input type="text" value="86.4"/>
Impervious Cover (%)	<input type="text" value="13.6"/>
<i>Total Cover (%) (Should = 100)</i>	100.0

Shrub Leaf Area Index

Leaf Area Index (LAI) is defined as the one sided green leaf area per unit ground area in broadleaf canopies, or as the projected needleleaf area per unit ground area in needle canopies. I-Tree Eco users: Leaf area indexes can be calculated from Eco results for leaf area. These results are presented in units of m²/ha. To get LAI, divide by 10,000. way to think about LAI is to imagine drawing a square on the ground under a tree canopy, with sides 1 meter in length. Standing in this 1-meter square area, looking up into the tree canopy, the LAI represents the surface area (1-sided) of the leaves present directly above this 1 meter square area. Typical LAI values range from 1-7, representing 1-7 square

Next: Step 3) i-Tree Hydro Hydrological Parameters

OK Cancel



i-Tree Hydro: Hydrological Parameters



Step 3) i-Tree Hydro Hydrological Parameters

These parameters define study area soil, vegetation, and water conditions. The goal is to adjust them until modeled streamflow resembles observed streamflow.

You may create and compare multiple parameter sets. Start by Auto-Calibrating with the Suggested Default Values, and then Compare the Parameter Set Calibration Results. You modify these parameter sets by FIRST Retaining and Editing a NEW Parameter Set. At any time, run the Auto-Calibration routine with any Current Parameter set to create new Auto-Calibrated Parameters which may then be further adjusted.

Note: Auto-calibration is available only when modeling a watershed.

Project Location: Atlanta, Georgia

Help for items on this page:

Current Parameter Set

These are the Hydrological Parameters that i-Tree Hydro will use as it attempts to create a best-fit scenario between all your model inputs and the observed streamflow at the stream gage. The parameters that are currently displayed will be used in either the Auto-Calibration routine or compared against other parameter sets so that you may choose the best-fit scenario.

Upon exiting this screen, the hydrological parameters last displayed will be used within the model.

Refer to the manual for more information.

Current parameter set: AutoCalibrated Parameters

Retain and Edit as NEW parameter set | Delete this parameter set | Auto-Calibrate this Parameter Set | Compare Parameter Set Calibration Results

Parameters:

We start with a preliminary value for the amount of water coming through the gauge.

Annual Average Flow at Gauging Station (cms) 0.1535422500

Then we select a soil type to account for the way water moves into and through the ground.

Soil Type Blended Texture

Wetting Front Suction (m) 0.1200000

Wetted Moisture Content (m) 0.4800000

Surface Hydraulic Conductivity (cm/h) 0.2970000

Condition of the soil in terms of root penetration and water content is set next.

Depth of Root Zone (m) 0.014869

Initial Soil Saturation Condition (%) 35.75160

Advanced Settings

Leaf Transition Period (days) 28

Leaf On Day (Day of year 1-365) 75

Leaf Off Day (Day of year 1-365) 311

Tree Bark Area Index 1.7

Shrub Bark Area Index 0.5

Leaf Storage (mm) 0.2

Pervious Depression Storage (mm) 0.8012

Impervious Depression Storage (mm) 1.7239615

Scale Parameter of Power Function 2

Scale Parameter of Soil Transmissivity 0.027938

Transmissivity at Saturation (m²/h) 0.057036

Unsaturated Zone Time Delay (h) 10.0000

Time Constant for Surface Flow: Alpha (h) 1.175744289

Time Constant for Surface Flow: Beta (h) 47.0259259

Watershed area where rainfall rate can exceed infiltration rate (%) 100

Next: Step 4) i-Tree Hydro Alternative Case

OK Cancel



i-Tree Hydro: Hydrological Parameters



Step 3) i-Tree Hydro Hydrological Parameters

These parameters define study area soil, vegetation, and water conditions. *Project Location: Atlanta, Georgia*
The goal is to adjust them until modeled streamflow resembles observed streamflow.

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Note: Auto-calibration is available only when modeling a watershed.

Current parameter set: **AutoCalibrated Parameters**

Retain and Edit as NEW parameter set | **Delete this parameter set** | **Auto-Calibrate this Parameter Set** | **Compare Parameter Set Calibration Results**

Parameters: Advanced Settings

We start with a preliminary value for the amount of water coming through the gauge.

Annual Average Flow at Gauging Station (cms)

Then we select a soil type to account for the way water moves into and through the ground.

Soil Type

Wetting Front Suction (m)

Wetted Moisture Content (m)

Surface Hydraulic Conductivity (cm/h)

Condition of the soil in terms of root penetration and water content is set next.

Depth of Root Zone (m)

Initial Soil Saturation Condition (%)

Leaf Transition Period (days)	<input type="text" value="28"/>
Leaf On Day (Day of year 1-365)	<input type="text" value="75"/>
Leaf Off Day (Day of year 1-365)	<input type="text" value="311"/>
Tree Bark Area Index	<input type="text" value="1.7"/>
Shrub Bark Area Index	<input type="text" value="0.5"/>
Leaf Storage (mm)	<input type="text" value="0.2"/>
Pervious Depression Storage (mm)	<input type="text" value="0.8012"/>
Impervious Depression Storage (mm)	<input type="text" value="1.7239615"/>
Scale Parameter of Power Function	<input type="text" value="2"/>
Scale Parameter of Soil Transmissivity	<input type="text" value="0.027938"/>
Transmissivity at Saturation (m ² /h)	<input type="text" value="0.057036"/>
Unsaturated Zone Time Delay (h)	<input type="text" value="10.0000"/>
Time Constant for Surface Flow: Alpha (h)	<input type="text" value="1.175744289"/>
Time Constant for Surface Flow: Beta (h)	<input type="text" value="47.0259259"/>
Watershed area where rainfall rate can exceed infiltration rate (%)	<input type="text" value="100"/>

Help for items on this page:

Current Parameter Set

These are the Hydrological Parameters that i-Tree Hydro will use as it attempts to create a best-fit scenario between all your model inputs and the observed streamflow at the stream gage. The parameters that are currently displayed will be used in either the Auto-Calibration routine or compared against other parameter sets so that you may choose the best-fit scenario.

Upon exiting this screen, the hydrological parameters last displayed will be used within the model.

Refer to the manual for more information.

Next: Step 4) i-Tree Hydro Alternative Case

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i-Tree Hydro: Hydrological Parameters



Step 3) i-Tree Hydro Hydrological Parameters

These parameters define study area soil, vegetation, and water conditions. The goal is to adjust them until modeled streamflow resembles observed streamflow.

Project Location: Atlanta, Georgia

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Current parameter set: AutoCalibrated Parameters

Retain and Edit as NEW parameter set | Delete this parameter set | Auto-Calibrate this Parameter Set | Compare Parameter Set Calibration Results

Parameters: *We start with a preliminary value for the amount of water coming through the gauge.*

Annual Average Flow at Gauging Station (cms) 0.1535422500

Then we select a soil type to account for the way water moves into and through the ground.

Soil Type Blended Texture

Wetting Front Suction (m) 0.1200000

Wetted Moisture Content (m) 0.4800000

Surface Hydraulic Conductivity (cm/h) 0.2970000

Condition of the soil in terms of root penetration and water content is set next.

Depth of Root Zone (m) 0.014869

Initial Soil Saturation Condition (%) 35.75160

Advanced Settings

Leaf Transition Period (days)	28
Leaf On Day (Day of year 1-365)	75
Leaf Off Day (Day of year 1-365)	311
Tree Bark Area Index	1.7
Shrub Bark Area Index	0.5
Leaf Storage (mm)	0.2
Pervious Depression Storage (mm)	0.8012
Impervious Depression Storage (mm)	1.7239615
Scale Parameter of Power Function	2
Scale Parameter of Soil Transmissivity	0.027938
Transmissivity at Saturation (m ² /h)	0.057036
Unsaturated Zone Time Delay (h)	10.0000
Time Constant for Surface Flow: Alpha (h)	1.175744289
Time Constant for Surface Flow: Beta (h)	47.0259259
Watershed area where rainfall rate can exceed infiltration rate (%)	100

Help for items on this page:

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Upon exiting this screen, the hydrological parameters last displayed will be used within the model.

Refer to the manual for more information.

Next: Step 4) i-Tree Hydro Alternative Case

OK Cancel



i-Tree Hydro: Hydrological Parameters



Step 3) i-Tree Hydro Hydrological Parameters

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Project Location: Atlanta, Georgia

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Current parameter set: AutoCalibrated Parameters

Retain and Edit as NEW parameter set | Delete this parameter set | Auto-Calibrate this Parameter Set | Compare Parameter Set Calibration Results

Parameters:

We start with a preliminary value for the amount of water coming through the gauge.

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Advanced Settings

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Leaf Off Day (Day of year 1-365) 311

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Leaf Storage (mm) 0.2

Pervious Depression Storage (mm) 0.8012

Impervious Depression Storage (mm) 1.7239615

Scale Parameter of Power Function 2

Scale Parameter of Soil Transmissivity 0.027938

Transmissivity at Saturation (m²/h) 0.057036

Unsaturated Zone Time Delay (h) 10.0000

Time Constant for Surface Flow: Alpha (h) 1.175744289

Time Constant for Surface Flow: Beta (h) 47.0259259

Watershed area where rainfall rate can exceed infiltration rate (%) 100

Next: Step 4) i-Tree Hydro Alternative Case

OK | Cancel



i-Tree Hydro: Hydrological Parameters



Step 3) i-Tree Hydro Hydrological Parameters

These parameters define study area soil, vegetation, and water conditions. The goal is to adjust them until modeled streamflow resembles observed streamflow.

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Note: Auto-calibration is available only when modeling a watershed.

Project Location: Atlanta, Georgia

Help for items on this page:

Current Parameter Set

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Refer to the manual for more information.

Current parameter set: AutoCalibrated Parameters

Retain and Edit as NEW parameter set | Delete this parameter set | Auto-Calibrate this Parameter Set | Compare Parameter Set Calibration Results

Parameters:

We start with a preliminary value for the amount of water coming through the gauge.

Annual Average Flow at Gauging Station (cms) 0.1535422500

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Soil Type Blended Texture

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Surface Hydraulic Conductivity (cm/h) 0.2970000

Condition of the soil in terms of root penetration and water content is set next.

Depth of Root Zone (m) 0.014869

Initial Soil Saturation Condition (%) 35.75160

Advanced Settings

Leaf Transition Period (days)	28
Leaf On Day (Day of year 1-365)	75
Leaf Off Day (Day of year 1-365)	311
Tree Bark Area Index	1.7
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Scale Parameter of Power Function	2
Scale Parameter of Soil Transmissivity	0.027938
Transmissivity at Saturation (m ² /h)	0.057036
Unsaturated Zone Time Delay (h)	10.0000
Time Constant for Surface Flow: Alpha (h)	1.175744289
Time Constant for Surface Flow: Beta (h)	47.0259259
Watershed area where rainfall rate can exceed infiltration rate (%)	100

Next: Step 4) i-Tree Hydro Alternative Case

OK Cancel



i-Tree Hydro: Alternative Case



Step 4) Define an i-Tree Hydro Alternative Case

Input the Cover Type values below to reflect the Alternative Land Use Scenario you wish to model. Example: increase your tree canopy and decrease your impervious cover. Remember: all the cover types must add to 100%

Surface Cover Types

	Base Case	Alternative Case		Base Case	Alternative Case
Tree Cover (%)	36.8	20.0	➔	Tree Leaf Area Index	5
Shrub Cover (%)	14.2	14.2	➔	Shrub Leaf Area Index	2.2
Herbaceous Cover (%)	14.2	14.2	➔	Herbaceous Leaf Area Index	1.6
Water Cover (%)	0.2	0.2			
Impervious Cover (%)	33.6	50.4	➔	Directly Connected Impervious Cover (%)	20.9
Soil Cover (%)	1.0	1.0			
<i>Total Cover (%) (Should = 100)</i>	100.0	100.0			

Cover Types beneath Tree Cover

	Base Case	Alternative Case
Soil Cover (%)	86.4	70.0
Impervious Cover (%)	13.6	30.0
<i>Total Cover (%) (Should = 100)</i>	100.0	100.0

Next: Step 4) Run the i-Tree Model!

Reset OK Cancel

Help for items on this page:

Percent Tree Cover

How much of your watershed area is covered by tree canopy? Here you would enter this percentage. This percentage represents tree canopy found over both pervious and impervious cover. For example, trees planted in a parking lot, where the majority of the canopy might be over impervious asphalt, and trees planted in parks, where the canopy is over pervious soil/grass, are both included in this percentage. This percentage could come from data sources you have already compiled or you could make use of other i-Tree tools, such as i-Tree Canopy (www.itreetools.org/canopy), to create a statistical



i-Tree Hydro: Alternative Case



Step 4) Define an i-Tree Hydro Alternative Case

Input the Cover Type values below to reflect the Alternative Land Use Scenario you wish to model. Example: increase your tree canopy and decrease your impervious cover. Remember: all the cover types must add to 100%

Surface Cover Types

	Base Case	Alternative Case		Base Case	Alternative Case	
Tree Cover (%)	36.8	20.0	➔	Tree Leaf Area Index	5	5
Shrub Cover (%)	14.2	14.2	➔	Shrub Leaf Area Index	2.2	2.2
Herbaceous Cover (%)	14.2	14.2	➔	Herbaceous Leaf Area Index	1.6	1.6
Water Cover (%)	0.2	0.2		Directly Connected Impervious Cover (%)	20.9	40.0
Impervious Cover (%)	33.6	50.4				
Soil Cover (%)	1.0	1.0				
<i>Total Cover (%) (Should = 100)</i>	100.0	100.0				

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Next: Step 4) Run the i-Tree Model!

Reset OK Cancel



i-Tree Hydro: Alternative Case



Step 4) Define an i-Tree Hydro Alternative Case

Input the Cover Type values below to reflect the Alternative Land Use Scenario you wish to model. Example: increase your tree canopy and decrease your impervious cover. Remember: all the cover types must add to 100%

Surface Cover Types

	Base Case	Alternative Case		Base Case	Alternative Case
Tree Cover (%)	36.8	20.0	➔	Tree Leaf Area Index	5
Shrub Cover (%)	14.2	14.2	➔	Shrub Leaf Area Index	2.2
Herbaceous Cover (%)	14.2	14.2	➔	Herbaceous Leaf Area Index	1.6
Water Cover (%)	0.2	0.2			
Impervious Cover (%)	33.6	50.4	➔	Directly Connected Impervious Cover (%)	20.9
Soil Cover (%)	1.0	1.0			
<i>Total Cover (%) (Should = 100)</i>	100.0	100.0			

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Outputs: In the User Interface

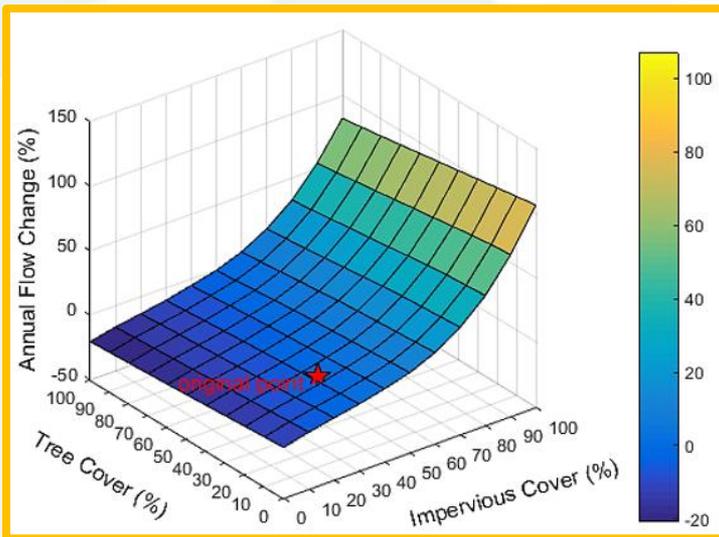
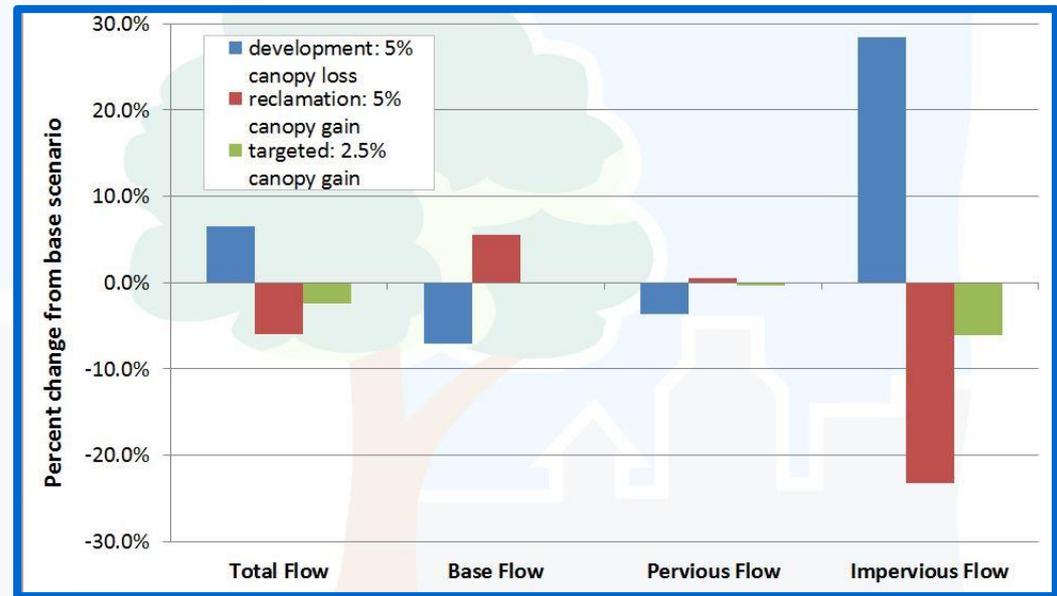
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Exported Outputs & Examples of Additional Processing



Site condition	Total flow (m ³)	Base flow (m ³)	Pervious flow (m ³)	Impervious flow (m ³)
Current	12,322	5,063	4,700	2,559
Post-development	37,277	6,488	14,327	16,462
Increased Gallons	6.6 million	376 K	2.5 million	3.7 million
Percent Increase	303%	28%	305%	643%



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Preview of i-Tree Hydro Version 6



Step 1) i-Tree Hydro Project Area Information

Geographic Reference Location

Nation: United States of America
State: New York
County: Onondaga
City: Syracuse

Project Time Period

Start Date / Time (Local): 01/01/2012 00:00:00
End Date / Time (Local): 12/30/2012 00:00:00

Topographic Data

Browse for my own DEM file
DEM File: G:\i-Tree_Hydro\SVN\Hydro\weftec_branch_step_2wc\Hydro\bin\x86\Debug\SampleData\dem.dat

Select preprocessed topographic data

Weather Station Data

Select a weather station from map
 Select raw NCDC weather file
Weather Station ID: 725190-14771
 Select processed weather files

Calibration Data

Select USGS gage from map
 Select raw USGS data file
Stream Gage ID: 04240100
 Select processed data file
 Not calibrating

Help for items on this page:

Next: Step 2) i-Tree Hydro Land Cover Parameters

Cancel OK Next

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Preview of i-Tree Hydro Version 6

Step 2) Land Cover Inputs

Project Area
 Area: 26237500 Units: m²

Evergreen Cover
 Evergreen Canopy: 0.042 (%)
 Evergreen Shrub Canopy: 0.21 (%)

Land Cover Area

	Base Case		Alternate Case 1	Alternate Case 2	Alternate Case 3
	%	Area	(%)	(%)	(%)
Tree Canopy (TC)	39.20	10285100.1	34.20	44.20	41.70
Pervious under TC	38.49	10098813.1	33.49	38.49	38.49
Impervious under TC	1.80	472275.00	1.80	6.80	4.30
Shrub Canopy	33.50	8789562.50	33.50	33.50	33.50
Herbaceous	15.00	3935625.00	15.00	15.00	15.00
Water	2.00	524750.00	2.00	2.00	2.00
Impervious	10.30	2702462.50	15.30	5.30	7.80
Bare Soil	0.0	0.0	0.0	0.0	0.0

Green Infrastructure

	Value	Area	+	Value	+	Value	+	Value	+
Tree Pit	0.0	0.0	+	0.0	+	0.0	+	0.0	+
Rain Garden	0.0	0.0	+	0.0	+	0.0	+	0.0	+
Green Roof	0.0	0.0	+	0.0	+	0.0	+	0.0	+
Rain Barrel	0.0	0.0	+	0.0	+	0.0	+	0.0	+
Porous Pavement	0.0	0.0	+	0.0	+	0.0	+	0.0	+

Total Cover
 100.0 | 26237500.1 | 100.0 | 100.0 | 100.0

Directly Connected Impervious Area
 Directly Connected IA: 4.21 | 133656.44% | 12.07 | 2.77 | 4.21

Canopy Parameters

	Value	Value	Value	Value
Tree Leaf Area	5.0	5.0	5.0	5.0
Shrub Leaf Area	2.0	2.0	2.0	2.0
Herbaceous Leaf Area	2.0	2.0	2.0	2.0

Next: Step 3) Parameterize and Calibrate Model

Rain Garden

	(%)	Area (m ²)
GI Footprint	0	0
Land Cover		
Tree Cover	0	0
Shrub Cover	0	0
Herbaceous Cover	0	0
Soil Cover	0	0
Total Cover	0	0
Canopy Properties		
Tree LAI		5
Shrub LAI		2
Herbaceous LAI		2
Soil Properties		
Max Ponding Depth (m)		0
Root Zone Depth		0
Storage Zone Depth		0
Soil Porosity		0
Infiltration Rate		0
Soil Type		
Hydraulic Properties		
Contributing Area (m ²)		0
Impervious (%)		0
Pervious (%)		0
Underdrain		False

Cancel OK

Preview of i-Tree Hydro Version 6



Step 3) Parameterize & Calibrate Model
✕

These parameters define project area soil and vegetation properties and model conditions. Starting with the Suggested Default Values, these parameters can be adjusted in one of two ways: (1) manually based on prior knowledge, testing or research and (2) through calibration to observed streamflow values.

Note: Calibration of a parameter set is available only when modeling a watershed with observed streamflow values. Calibration of a parameter set adjusts the hydrological parameters to reduce the differences between the predicted streamflow and observed streamflow values across the time step set within the calibration window on the right.

Current parameter set: Suggested Default Values

Save Save As Delete

Parameters:

We start with a preliminary value for the amount of water coming through the gauge.

Annual Average Flow at Gauging Station (cms) 336805555556

Then we select a soil type to account for the way water moves into and through the ground.

Soil Type Sandy Clay Loam

Wetting Front Suction (m) 0.12

Wetted Moisture Content (m) 0.48

Surface Hydraulic Conductivity (cm/h) 0.2700

Condition of the soil in terms of root penetration and water content is set next.

Depth of Root Zone (m) 0.05

Initial Soil Saturation Condition (%) 50

Calibration

Time Step Hourly

Calibrate Compare Parameter Sets

Advanced Settings

Leaf Transition Period (days) 28

Leaf On Day (Day of year 1-365) 127

Leaf Off Day (Day of year 1-365) 280

Tree Bark Area Index 1.7

Shrub Bark Area Index 0.5

Leaf Storage (mm) 0.2

Pervious Depression Storage (mm) 1.0

Impervious Depression Storage (mm) 2.5

Scale Parameter of Power Function 2

Scale Parameter of Soil Transmissivity 0.023

Transmissivity at Saturation (m²/h) 0.13

Unsaturated Zone Time Delay (h) 10

Time Constant for Surface Flow: Alpha (h) 1.0

Time Constant for Surface Flow: Beta (h) 2.0

Watershed area where rainfall rate can exceed infiltration rate (%) 100

Help for items on this page:

Soil Type

properties are important for correctly modeling infiltration and runoff generation processes. In general terms, pick the best soil type that describes most of your watershed area. Values range from extremely porous sand through relatively impervious clay, with many soil types found in between.

units: none

Based on the soil type, Hydro will supply values for:

Wetting Front Suction

- Wetting front suction (m), controls the maximum infiltration rates. It is used to describe the rate at which water is pulled into the soil when it is dry during the early part of the infiltration process. Estimated from soil physical properties used in Green-Ampt lookup tables.

Next: Step 4) i-Tree Hydro Run Model

Cancel
OK
Next



Preview of i-Tree Hydro Version 6



4) Run Model

Scenario 1	BaseCase	Parameter Set 1	Autocalibrate default value
Scenario 2	Alternate Case 1	Parameter Set 2	Custom Parameter Values
OutPut Unit	Metric		

Hide Processing

Cancel Run

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Location Input

State :

Location : Address Latitude,Longitude

Duration and Frequency Input

Input/Output Units : SI (cm) BG (in)

Duration : Rainfall Distribution Type :

Recurrence Interval :

Rain Depth (cm/in) :

IDF Table (in inches)

Duration	One yr rec	Two yr rec	Five yr rec	Ten yr rec	Twenty Five yr rec	Fifty yr rec	Hundred yr rec
12hr	1.965	2.218	2.699	3.162	3.894	4.534	5.238
24-hr	2.253	2.547	3.101	3.632	4.467	5.193	5.990
2-day	2.536	2.903	3.577	4.207	5.180	6.012	6.917
3-day	2.786	3.170	3.879	4.542	5.566	6.443	7.396
4-day	3.011	3.407	4.138	4.822	5.879	6.784	7.769
7-day	3.582	4.034	4.854	5.608	6.758	7.732	8.782
10-day	4.091	4.598	5.501	6.319	7.547	8.575	9.673
20-day	5.577	6.232	7.356	8.339	9.767	10.927	12.138
30-day	6.845	7.634	8.955	10.081	11.673	12.936	14.228
45-day	8.480	9.458	11.053	12.373	14.183	15.574	16.961
60-day	9.895	11.050	12.898	14.393	16.397	17.898	19.361

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Thoughts & Questions



www.itreetools.org

Videos

Documentation

Online tools

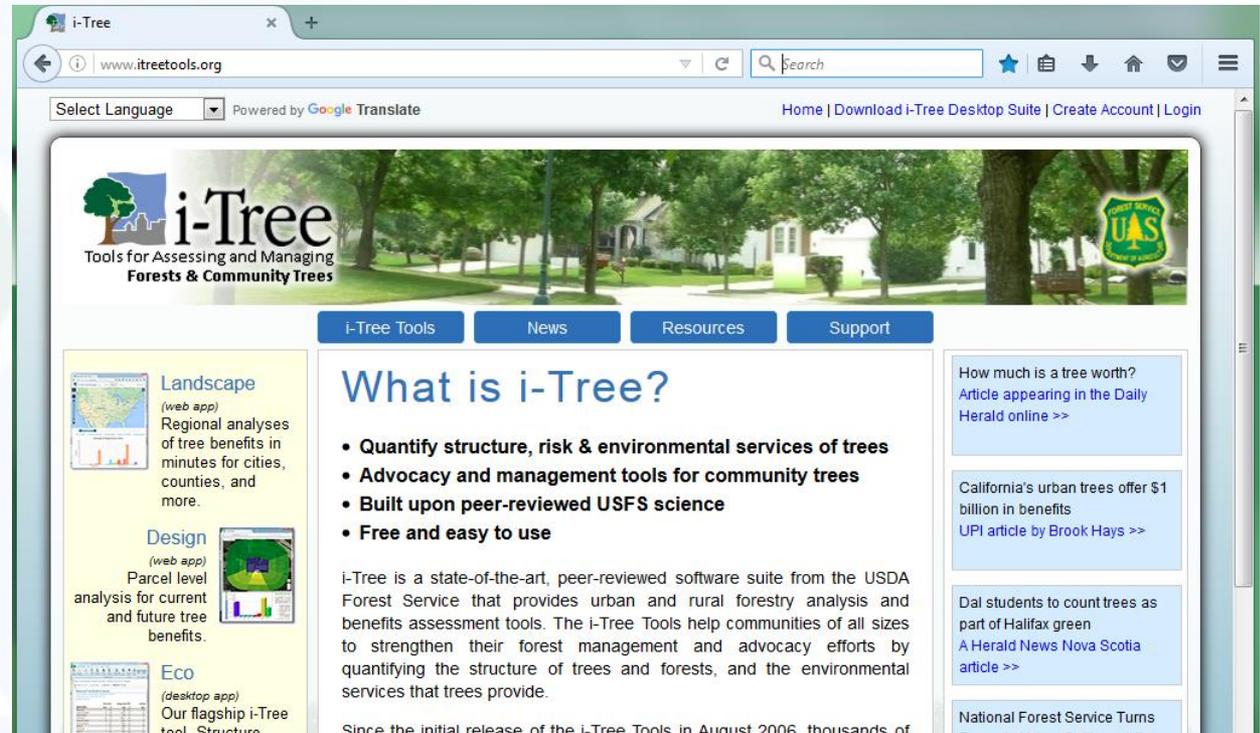
Support

Examples

Downloads

Newsletters

info@itreetools.org



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Thank you!

Robbie Coville

robert.coville@davey.com

Dr. Ted Endreny

te@esf.edu



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Do you?

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In-depth technical slides to address questions

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Hydro: Model Assumptions



Topographic index

- Affected by DEM resolution

- Increasing DEM resolution – small cell sizes
 - TI values decrease for most cells
 - Minimum, median values decrease
 - TI values may increase for river/stream network cells
 - Maximum value may increase

- Decreasing DEM resolution – larger cell sizes
 - Has the opposite effect



Hydro: Model Assumptions



TI Syracuse,
NY



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Hydro: Model Assumptions



Hydraulic Conductivity – Transmissivity

- Same everywhere in the watershed
- Decay profiles – decays with soil depth
 - Exponential vs. Power

$$K_s(z) = K_o \exp(-fz)$$

$$K_s(z) = K_o (1 - fz)^n$$

- Default model setting is power law decay
- Changed in hydrological parameters screen



Hydro: Model Assumptions



Saturation/infiltration excess

- Effects pervious areas
 - Tree cover over pervious, shrub/herbaceous, bare soil
- Percentage of watershed area that is controlled by infiltration excess – rest is saturation excess

Land cover

- Average or sampled – typically only an estimation
- DCIA value – estimated
- Problems with NLCD resolution



HP: Modeling Metrics



Calibration

➤ Method:

- Determining optimal model parameter set
 - Optimization algorithm - PEST
- Repeated model runs
 - Comparing predicted and observed values
- Maximize goodness of fit metrics

➤ Problems:

- Equifinality – Different parameter sets, same optimum
- Disagreement between field data and model parameters



HP: Modeling Metrics



Calibration Metrics

- Values range from $-\infty$ to 1
 - Negative – Worse than observed average value
 - Zero – Equal to observed average value
 - Positive – Better than observed average value

- Volumetric Efficiency
 - Criss and Winston, 2008

- Baseflow fit
 - Perrin et al., 2001

- Peak flow fit
 - Nash – Sutcliffe Efficiency (1970)

- Overall fit
 - Ye et al., 1997

$$NSE = 1 - \frac{\sum (Q_{calc} - Q_{obs})^2}{\sum (\bar{Q}_{obs} - Q_{obs})^2}$$



HP: Modeling Metrics



Validation

- Using optimized parameter set to predict forward
 - Without further alteration/optimization
- Necessary to build confidence in the model
 - Trust structure and calibrated parameter set

Verification

- Alter model structure or routines
 - Switch model routines – different governing equations
 - Revise model code – numerical solutions, code structure

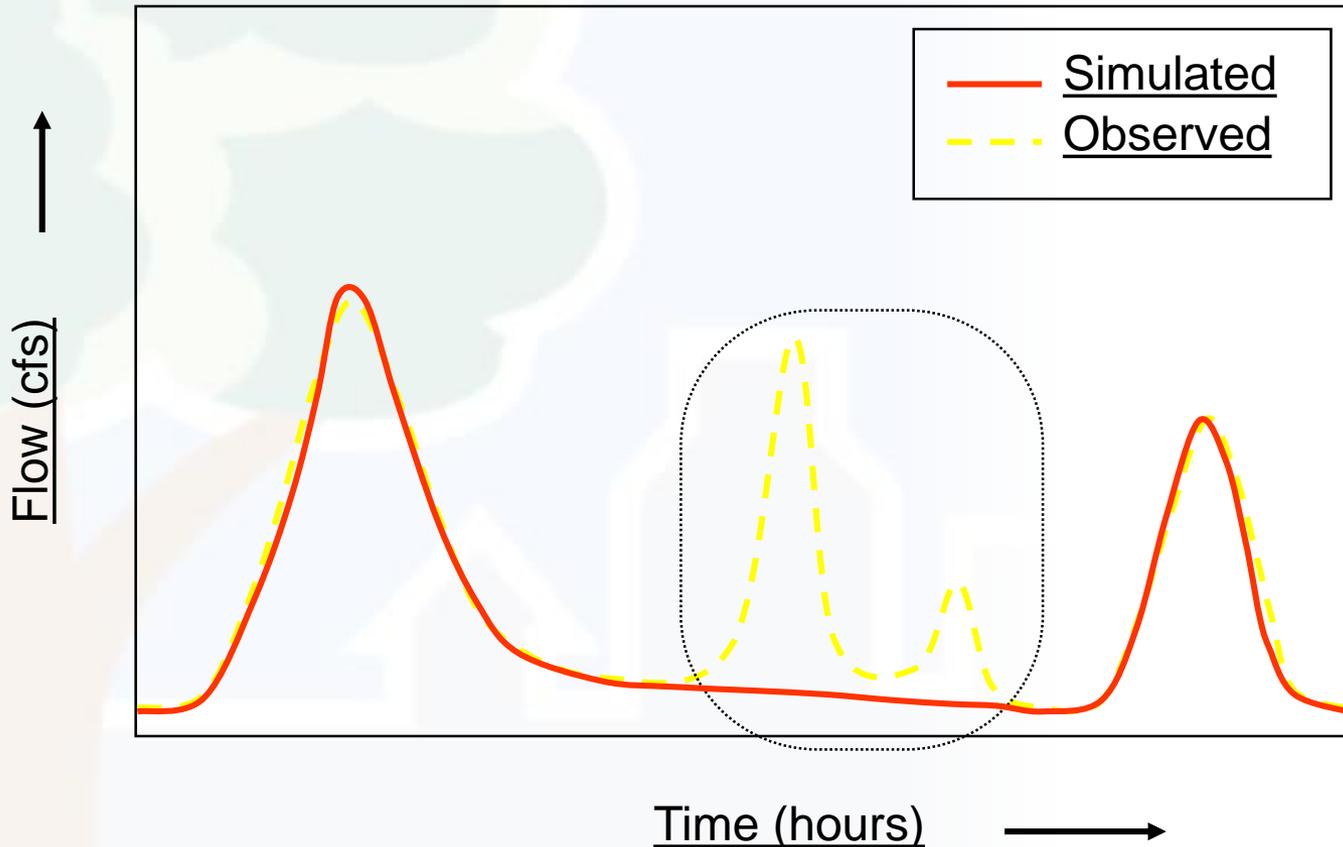


HP: Modeling Metrics



Common calibration problems

- Weather station isn't representative, gage errors



- Check weather station location, dominant weather patterns

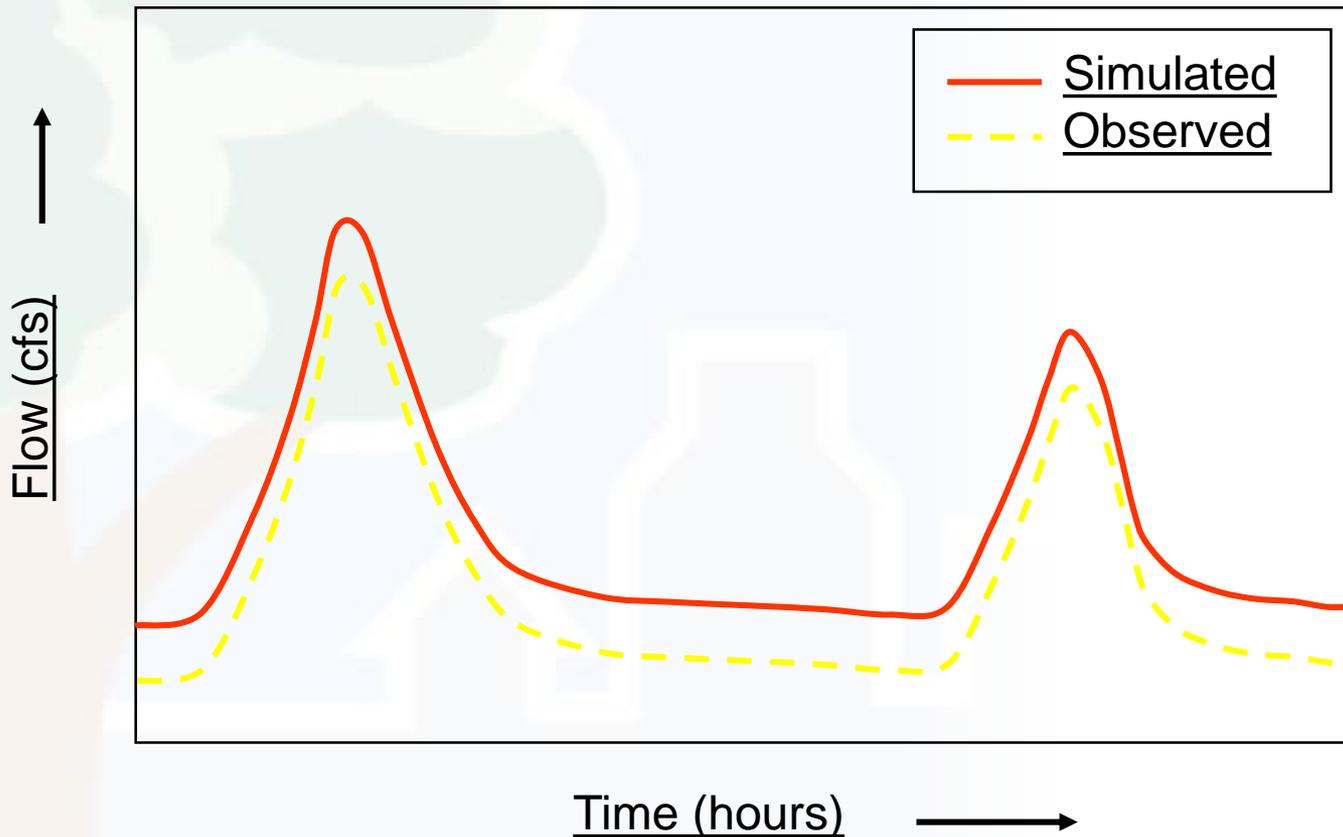
- Check input data period for errors

HP: Modeling Metrics



Common calibration problems

- High base flow, too little evapotranspiration



Check landcover estimates

Check weather data (net rad., temp, windspeed)

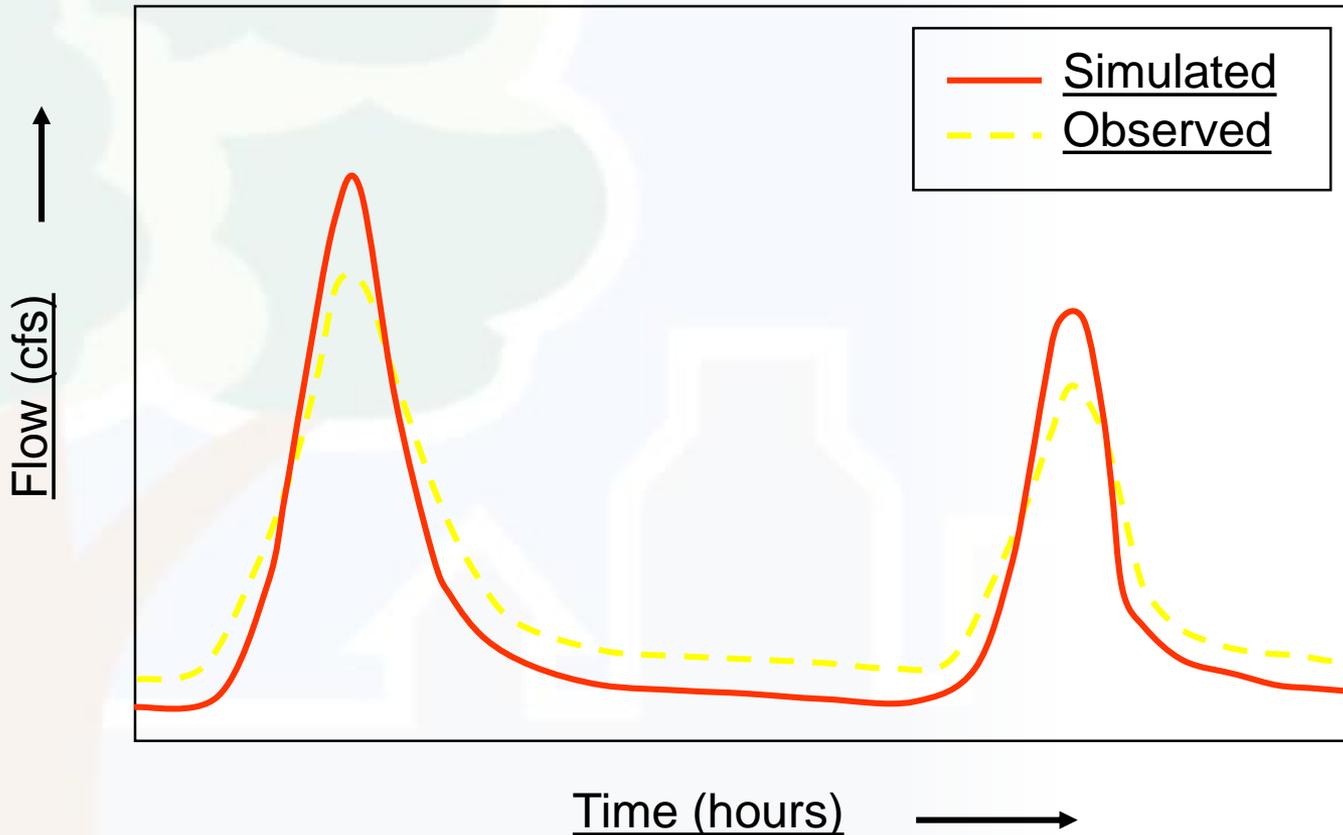
LAI, K_{sat} values

HP: Modeling Metrics



Common calibration problems

- Incorrect partitioning of baseflow/overland flows



Check landcover estimates

Check contributing area/DEM footprint

LAI, K_{sat} values