Technical Notes

Periodic Updates on Current Technology
From Urban Forestry South

Date: April 7, 2010

i-Tree Application: Eco and Streets

Subject: Comparison of carbon storage and sequestration values

Executive Summary: Carbon estimates from i-Tree Eco and Streets differ. Eco reports carbon as elemental C while Streets reports carbon as carbon dioxide (CO_2) equivalent; the models also use different approaches to calculating storage and sequestration. The purpose of this report is to help those planning an i-Tree project understand how the data for each model are used to estimate environmental services of urban trees, and to better prepare them to discuss the results.

Brief Report: Two street tree inventories (Decatur, GA and Albany, GA) were recently analyzed using i-Tree Eco (UFORE). The same data were formatted for i-Tree Streets (STRATUM) and analyzed. Carbon storage and sequestration values were compared (see tables below).

Explanation: Two different approaches are used by these models to calculate carbon storage and sequestration. In addition, carbon values are reported differently.

Eco uses predictive biomass equations from 64 species taken from various research articles from around North America. Adjustments are made to account for these forest-grown trees and to include below-ground biomass. Tree diameter data are used to estimate biomass. The Eco results quantify elemental carbon that is stored or sequestered. To calculate annual sequestration, Eco uses reported annual increment adjusted for local climate, land use type, the amount of light the crown receives and tree condition[1].

Streets uses predictive models to estimate tree height as a function of DBH from data collected from 20 - 25 predominant tree species in each reference city[2]. The DBH and predicted tree height measurements are used to estimate tree volumes to calculate biomass. The dry-weight biomass is converted to elemental carbon and then further converted to CO_2 by multiplying by 3.67 (molecular weight for CO_2). Adjustments are also made to account for below-ground biomass. Growth rates for sequestration calculations are averaged from the collected reference city tree data on a per species basis. The results for Streets quantify the amount of carbon dioxide that is stored or sequestered.

Conclusion: When comparing carbon storage and carbon sequestration values from i-Tree Eco and i-Tree Streets, keep in mind that Eco estimates elemental carbon while Streets estimates carbon dioxide. Also, Eco uses local growth factors such as climate, land use type, crown competition, and condition to calculate carbon sequestration while Streets averages these factors into their predictive growth models. Models are a simplification of reality and both of these models provide estimates for carbon storage and sequestration that can help natural resource managers. Before starting an inventory project, know the objectives of your project and understand how these results will be used, so as to choose the better model for your purposes.

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[1] See UFORE Methods for clarification: http://www.itreetools.org/resource_learning_center/reports/ufore_methods.pdf
[2] See Piedmont Community Tree Guide: Benefits, Costs, and Strategic Planting, http://www.urbanforestrysouth.org/resources/library/piedmont-community-tree-guide-benefits-costs-and-strategic-planting/view

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Street tree data collected in two Georgia communities and analyzed using both i-Tree Eco (UFORE) and i-Tree Streets (STRATUM). Results for i-Tree Eco are reported for elemental carbon (C) and those for Streets are for carbon dioxide (CO_2).[3]

Albany, GA data		i-Tree Eco		i-Tree Streets	
Species	N	C storage (kg)	C Seq. (kg/yr)	CO_2 storage (kg)	CO_2 Seq. (kg/yr)
A. buergerianum	23	345	72	3423	624
A. rubrum*[4]	7	371	34	1894	313
A. saccharum*	17	430	45	1753	491
C. illinoensis	11	13483	265	63508	3650
C. florida*	38	3558	192	27849	2555
M. grandiflora*	21	8517	289	26124	1498
P. taeda*	17	4397	122	36528	2548
P. chinensis	11	166	31	1353	441
P. calleryana*	43	15053	502	63714	5172
Q. nigra*	8	10246	247	52981	2575
Q. phellos*	20	6547	128	69395	2583
Q. rubra*	28	131	32	1028	478
Q. virginiana	258	797440	11992	2964044	123803

Decatur, GA data		i-Tree Eco		i-Tree Streets	
Species	N	C storage (kg)	C Seq. (kg/yr)	CO_2 storage (kg)	CO_2 Seq. (kg/yr)
A. rubrum*	3	496	36	2642	318
B. nigra*	3	1479	69	1498	360
I. opaca*	4	229	26	985	99
J. nigra	2	6230	120	32095	908
L. formosana	2	1780	42	7325	541
Q. alba*	5	16637	300	67387	3194
Q. nigra*	1	878	32	1691	297
Q. phellos*	123	18306	939	131256	15656
T. ascendens	5	4796	118	49117	2057
U. parvifolia	3	913	46	5102	914

[3] To compare results, multiply i-Tree Eco values by 3.67 to obtain CO_2 equivalents.
[4] An asterisk signifies a species that was measured in the reference city (Charlotte, NC) to develop predictive tree height curves.

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