
# i-Tree ECO

## Overview and Process




# What is ECO (UFORE)?


- ✓ = Urban Forest Effects model
- ✓ Specialized analysis for urban ecosystems
- ✓ Collection of: 1. field methods & 2. model analysis tools
  1. Method for establishing permanent plots & collecting data in complex urban areas
  2. Combination of science-based mathematical models that quantify urban forest structure, functions, and values
- ✓ ***i-Tree ECO is the interface with the UFORE model***; model is *operated* by the Forest Service with *user data*

# Overview & Process

- Ecosystem
  - ✓"Single functional units of interacting abiotic, biotic, and cultural (anthropogenic) components"
  - ✓Includes all trees
    - Public & private (Public trees can be <5% of all trees)
    - All land uses, Native/exotic
    - Tree inventory option
  - ✓Not individual tree management, but we can manage the population (urban forest ecosystem)
  - ✓"Snapshot" of your urban forest

# Overview & Process

- Status of UFORE
  - ✓ Fully operational as program
    - Over 10 years in development
    - In SAS code at USFS Syracuse
      - Direction: David Nowak, Project Leader
    - Old way: Data entered into Excel, Converted to text, imported to SAS code
    - Being converted to desktop app (Windows); to be released next year
  - ✓ i-Tree 3.0: ECO interface (“shell”) makes everything now much easier

# What is ECO?

- ECO calculates for city & land uses
  - ✓Structure, e.g.
    - Tree numbers & cover
    - Species & size distribution
  - ✓Function, e.g.
    - Air pollution removal
    - Total carbon stored & sequestered
    - Effect on building energy use
    - Biogenic emissions
  - ✓Value based on structure, function

# Function and Value

*Table 4*
**Comparison of Urban and Rural Trees**

| FEATURE | URBAN | RURAL | TOTAL |
|---|---|---|---|
| *Number of Trees (millions)* | 83.7 | 579.4 | **663.1** |
| *% of Trees* | 12.6% | 87.4% | **100.0%** |
| *Carbon Storage (in million tons)* | 7.9 | 31.3 | **39.2** |
| *% of Carbon* | 20.1% | 79.9% | **100.0%** |
| *Replacement Value ($ billions)* | $41.8 | $164.0 | **$205.8** |
| *% of Replacement Value* | 20.3% | 79.7% | **100.0%** |

**Total pollution removal by trees and shrubs:Minneapolis, MN**

| | Trees (mt) | Shrubs (mt) | Trees (U.S.$) | Shrubs (U.S. $) |
|---|---|---|---|---|
| O3 | 7.19821 | 1.63145 | 6903.08 | 1564.56 |
| PM10 | 41.7158 | 10.4963 | 281665 | 70871 |
| SO2 | 108.62 | 26.4965 | 733405 | 178904 |
| NO2 | 107.464 | 29.3941 | 484449 | 132509 |
| CO | 12.3728 | 3.02593 | 20452.2 | 5001.86 |
| Total (m-tons) | 277.37081 | 71.04428 | 1526874.28 | 388850.42 |

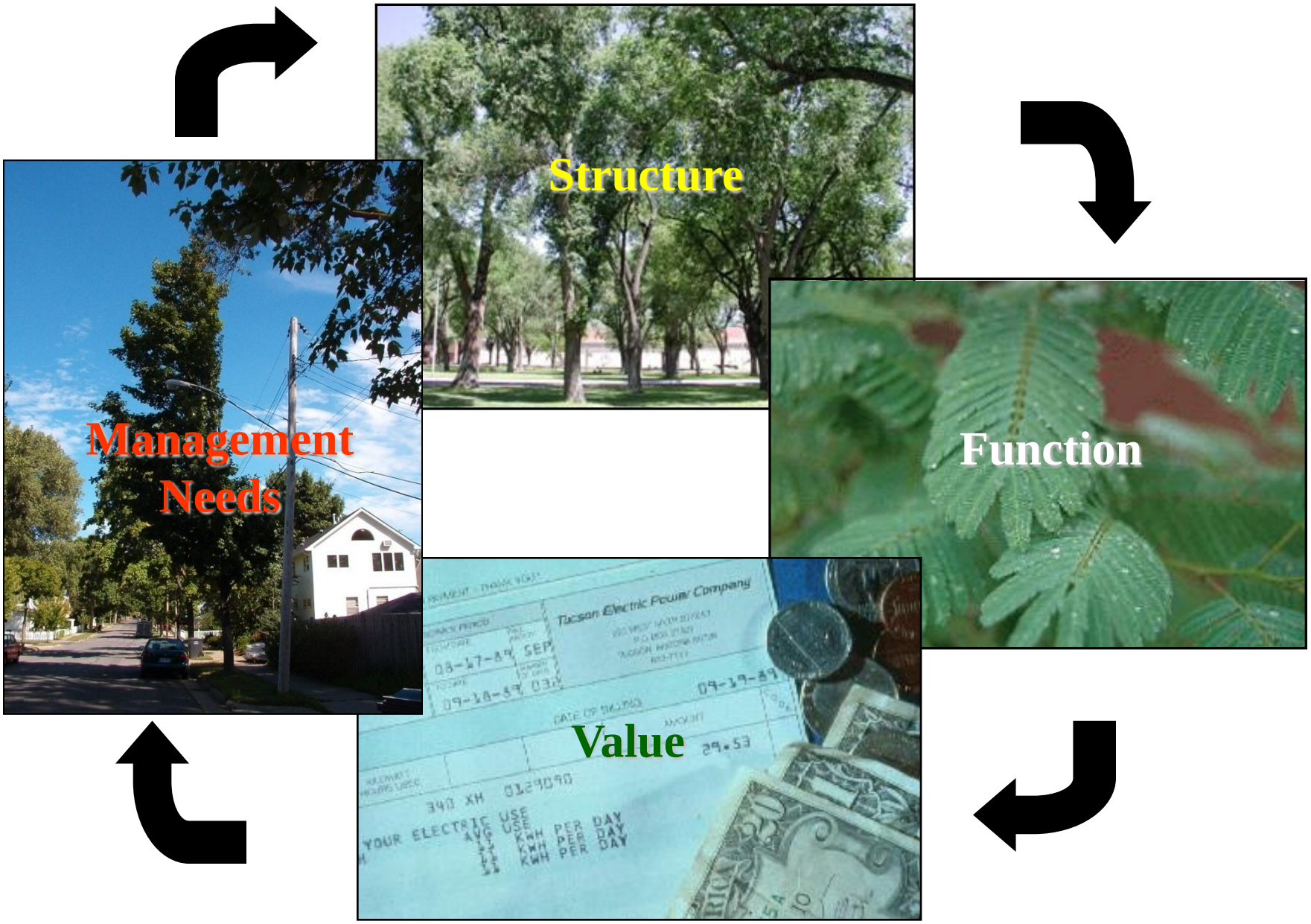
# What is ECO?

- Similarities to STREETS
  - ✓ Similar questions
    - Structure, function, value
    - Implications for management
  - ✓ Similar goals
- Differences
  - ✓ Different populations
    - STREETS (model): street trees
    - ECO (Ufore interface): whole ecosystem (Individual trees)
  - ✓ Some differences in methods & data often b/c of differing populations

***Or….?***

# Overview & Process

- How does it work?
  - ✓ Uses field data to calculate structure from a statistical sample
  - ✓ Uses structure, weather, pollution data to calculate function
  - ✓ Uses function data to calculate value
  - ✓ Uses value results to draw conclusions and make management recommendations
  - ✓ User need not worry about running model

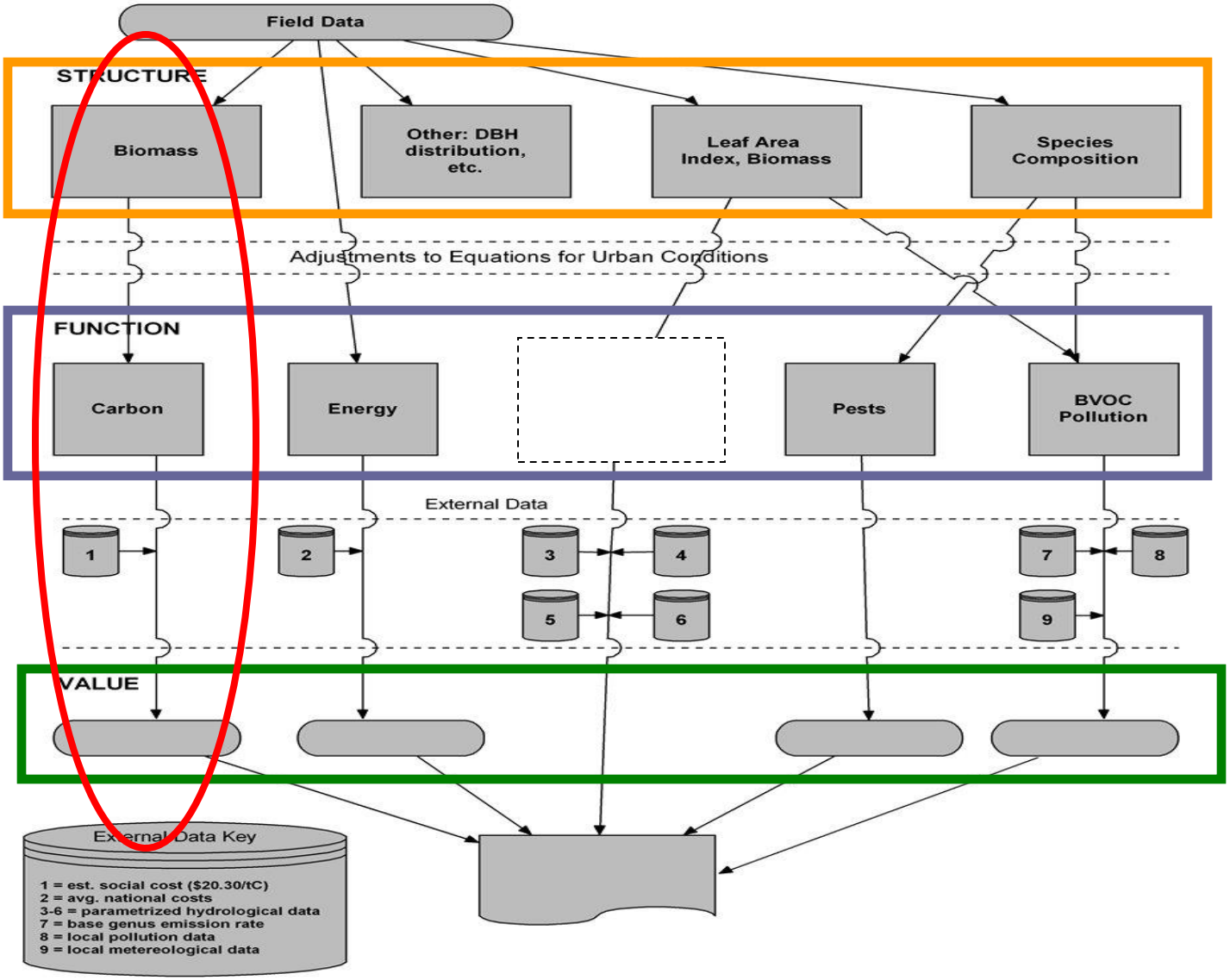

Structure
Function
Value
Management Needs
Tucson Electric Power Company

# Before we go any further…

- Models ….
  - ✓depending on your objective or audience-

    ***will need to know a little about the model….***

## UFORE: How the Model Works



# ECO needs 4 inputs

- i-Tree users only need to worry about # 1 and 2

1. Field data
2. Community-specific data
   - ✓ "Why" you are using UFORE
   - ✓ Study area and size
3. *Hourly weather data*
   - ✓ *Optional: Air quality improvement data*
4. *Hourly pollution concentration data*

✓ # 3 and 4 provided by i-Tree ECO folks….

# Overview & Process

- Let's see how ECO carbon storage & sequestration works…
- Function of tree size and condition
  - ✓ Larger & healthier trees = more carbon stored
- UFORE estimates whole tree biomass using above-ground biomass equations and species , DBH, height data

# Regression of DBH as predictor of biomass

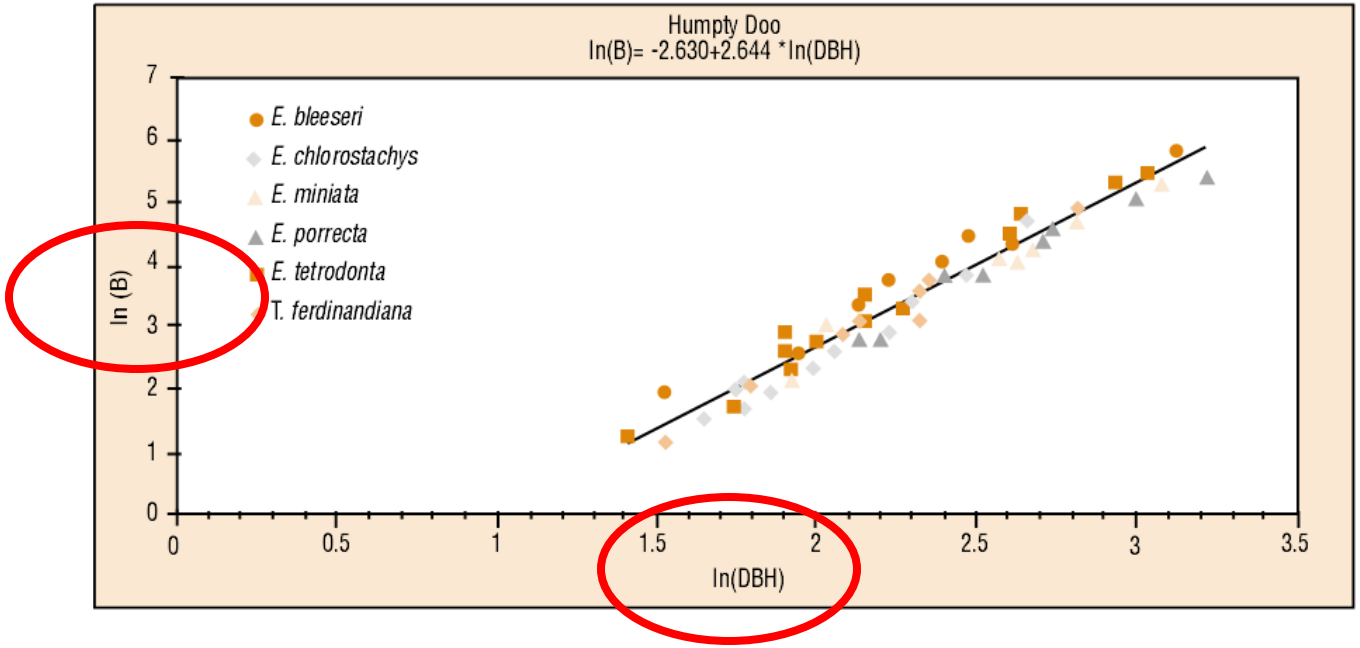



Figure 2: Relationship at Humpty Doo between Ln(Biomass) and Ln(DBH) for six species (n = 58). The line plotted accurately depicts the slope of the relationships but not the intercept: the latter differed among species.

http://www.greenhouse.gov.au/ncas/reports/pubs/tr05afinal.pdf

# Overview & Process

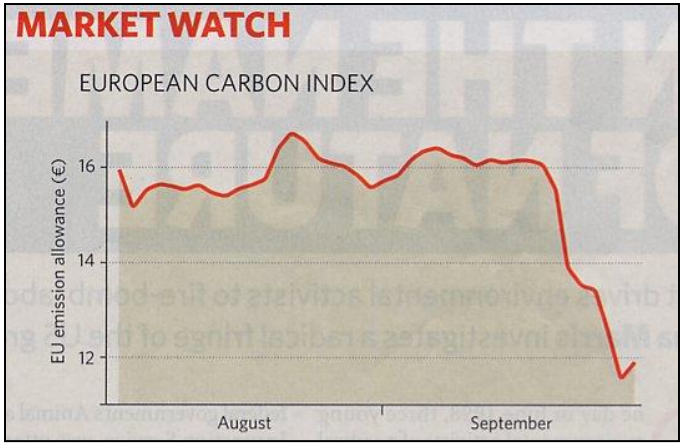
- Adjustment
  - ✓ Incorporates location and field data; e.g. healthy trees growing in parks vs. dying trees in industrial areas
- How much of biomass is carbon?
  - ✓ Stored Carbon ≅ biomass x 0.5
  - ✓ Carbon x 3.67 = Carbon dioxide

# Carbon sequestration

- Gross carbon sequestration
  - ✓ Calculated using ***species, DBH class, growth*** and ***mortality rate*** data
  - ✓ Adjusts growth (C storage) for
    - Site
    - Growing season length
    - Condition of tree (dieback)
  - ✓ Adjust mortality (C release) for
    - % of condition class Rapid release (above ground, populated areas)
    - Slow release (below ground, unpopulated areas)
- Net annual carbon sequestration = Gross C sequestration – C released due to mortality

# Overview & Process VI

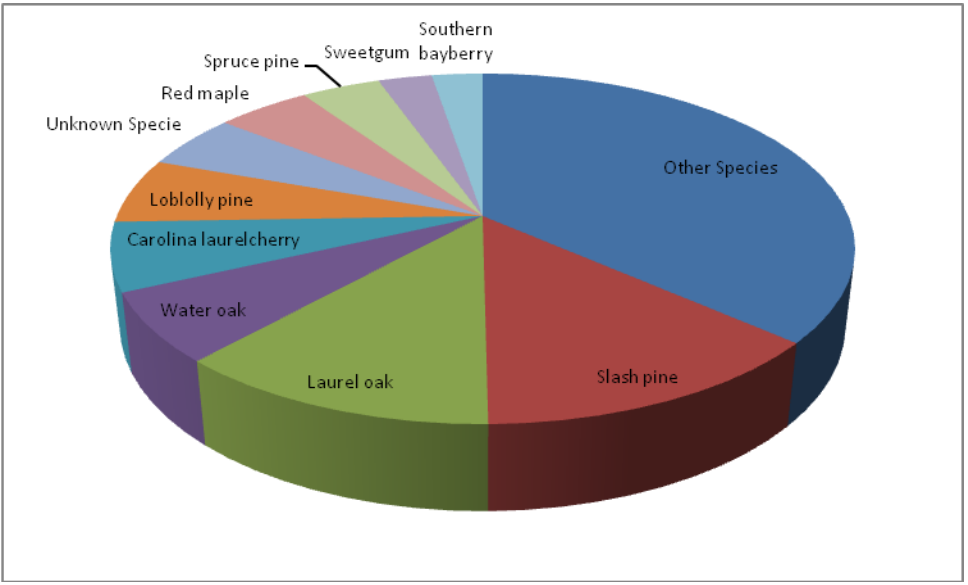
- Value
  - ✓ Multiply net annual stored C by $22.80/tC

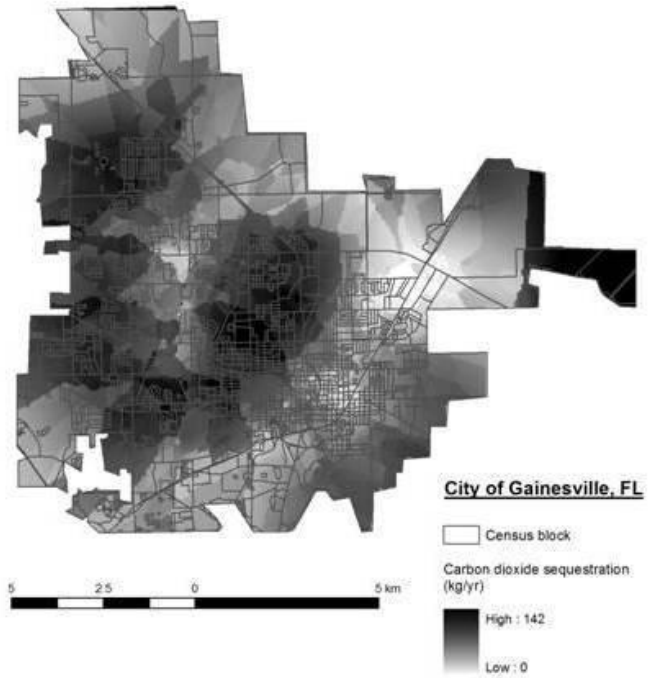


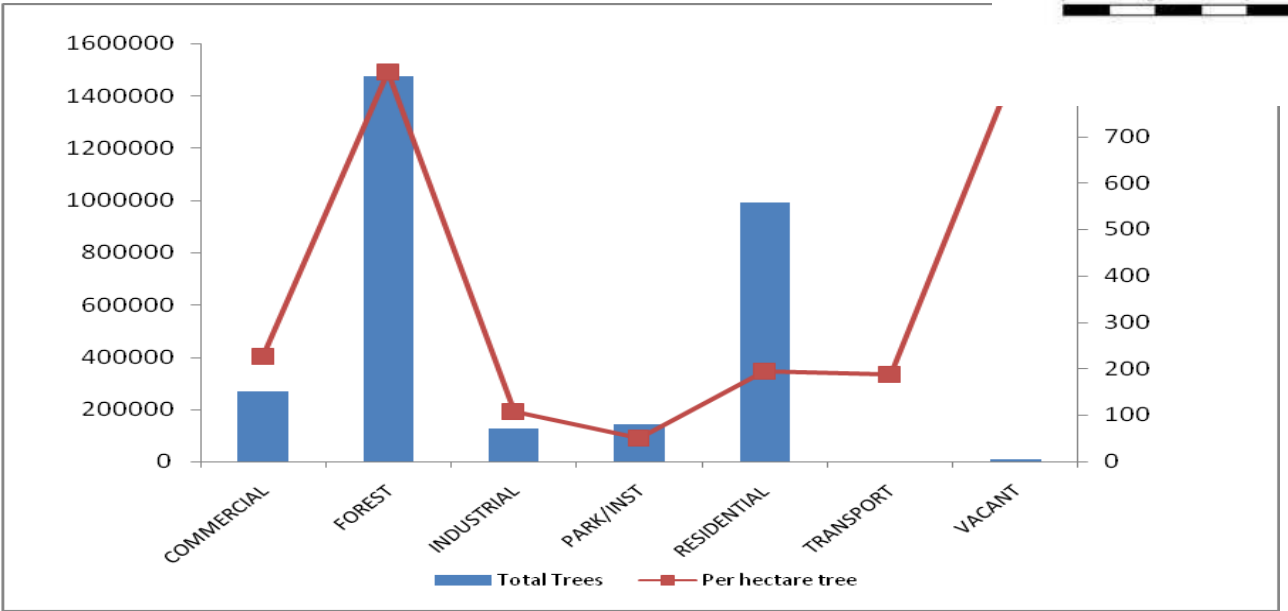

  - ✓ "Rough order-of-magnitude assessment"

**Nature 443 (October 5, 2006)**

# Gainesville's urban forest structure



| Table 5 | |
|---|---|
| **Structural Value** | **Amount** |
| *Replacement Value* | $205.8 billion |
| *Carbon storage* | $ 0.7 billion |
| **Total Structural Value** | **$206.5 billion** |
| **Annual Functional Value** | **Annual Amount** |
| *Carbon Sequestration* | $ 29.0 million |
| *Air Pollution Removal* | $295.7 million |
| *Energy Savings* | $131.1 million |
| **Total Annual Functional Value** | **$455.8 million** |

*Table 6*
**Land Cover Change 1992-2000[a]**

| LAND COVER TYPE | 1992 Sq. Miles | 2000 Sq. Miles | CHANGE Sq. Miles | % CHANGE |
|---|---|---|---|---|
| *Forest* | 2,798 | 2,312 | -485.6 | -17.4% |
| *Agriculture/Rangeland* | 3,840 | 3,846 | 6.0 | 0.2% |
| *Residential* | 659 | 989 | 329.5 | 50.0% |
| *Urban Built* | 275 | 425 | 149.8 | 54.5% |
| **Total Land Cover** | **7,572** | **7,572** | **-00.3a** | **0.0%** |

[a] *Changes in land cover should be considered approximate due to differences in methodologies used for the two study periods. Urban Green areas for 2000 redistributed across cover types to match 1992 cover classification system. Water areas not included.*

Source:
http://www.houstonregionalforest.org/Report/

**Gainesville, Fl & Hurricanes: Species with LOW wind resistance rating:**

| Tree | % Urban forest leaf area |
|---|---|
| Slash Pine: | 17% |
| Laurel oak: | 18% |
| Water oak: | 7% |
| Loblolly Pine: | 9% |

*What does this mean?*

*Approx. 50% of canopy susceptible to high winds!*

# What's the point?!

- We can begin to understand, and therefore trust the numbers
- Because of that, we can use the numbers
  - ✓Advocacy
  - ✓Strategic planning
  - ✓Action
- ECO, like STREETS, is a powerful tool for promoting sustainable management of urban forest resource.

# Why UFORE?

- What good is it?
  - ✓Aid planning and management
  - ✓Improve forest design, ordinances
  - ✓Baseline info, community's tree resource
  - ✓Justify programs
- Do not have to worry about the model; USFS does it for you

# Flexibility

- UFORE originally a research tool
- Being used for management applications
- Standardized, repeatable methods used by USFS
- i-Tree ECO makes modeling accessible to everybody
- Hardest part is getting the field data!

# Final UFORE thoughts

- Very “accessible” model
  - ✓ Most scientifically reviewed (available) “urban forest function” model
  - ✓ Uses actual field measurements, weather-pollution data from your community
  - ✓ Proven and tried Urban Forest Inventory & Analysis
  - ✓ Pluses and minuses

*UFORE publications in:*

*Urban Forestry & Urban Greening, Arboriculture and Urban Forestry, Journal of Environmental Management, Atmosphere & Environment, Environmental Pollution, Environmental Science and Policy, others*

# Before we move on...

## ... to i-Tree STORM