Urban Forest GHG Accounting & Assessment

Forest Inventory Symposium
October 19, 2009
Sacramento, CA

Greg McPherson
US Forest Service
PSW Research Station
Center for Urban Forest Research
Davis, CA
Today
Today
Today

- Intro
- What do we have now?
- What did we have in 1990?
- What will we have in 2020?
- Research questions
Carbon Storage

• Biomass equations
  – Open growing trees
  – Reduction factors (0.8)
  – Species assignments

• Vary by species and size
Carbon Sequestration

- Regional tree growth rates
- Regress dbh on age
- Regress ht on dbh
- Top 20 species
Carbon Sequestration

- Regional tree growth rates
- Vary by region
  - Species
  - Mature size
  - Growth rate
- Sequestered/yr
  - 20 to 100 kg
  - 50 to 220 lb

![Annual Net CO2 Reductions for 3 Species (North & Central Coast)](image)
Energy Conservation
Reduced GHG Emissions

- Building Energy Performance Simulations
  - Tree size, type, location
  - Climate
  - Building
  - Utility
Energy Conservation
Reduced GHG Emissions

- Climate
- Building
- Utility
- Tree
Energy Conservation
Reduced GHG Emissions

- Climate
- Building
- Utility
- Tree
- Reduced/yr
  - 0 to 140 kg
  - 0 to 300 lb
Other GHG Benefits

- Fuel for biopower
- Wood products
- Biomass/yr
  - 10 to 45 kg
  - 25 to 100 lb
- Tree Carbon Calculator
  - [http://www.fs.fed.us/ccrc/topics/urban-forests/](http://www.fs.fed.us/ccrc/topics/urban-forests/)
Emissions from Tree Care

- Vehicles
- Equipment
  - Aerial lift
  - Chipper
  - Chain saw
- Other
- Emissions/yr
  - 5 to 25 kg
  - 10 to 50 lb
Santa Monica

Large tree – West-facing, 20-40ft

Stored CO2 and Emissions Reductions for Large Tree (Camphor Tree)

Year After Planting

0 2 4 6 8 10 12 14 16 18 20

0 1 0 2 0 3 0 4 0 5 0 6 0 7 0 8 0 9 1 0 0

CO2 Stored  Emission Reduction
What do we have now?

• Field Survey
  – UFORE /FIA Plots
  – Species, size, canopy cover, condition, location

• Storage

• Sequestration

• Energy Conservation

• Emissions survey
What do we have now?

- Remote Sensing
  - Tree canopy cover
  - Potential tree planting sites
  - Land use
- Scale-up storage
  - t/m2 of plot area
  - t/m2 of tree canopy
  - t/m2 by land use
- Sequestration & Emissions
What did we have?

• Field Surveys
  – SUFES Plots 1995
  – Other biomass data

• Remote Sensing
Aerial Photos & Energy Simulations

- 177 million trees
- 5 trees per capita
- 242 million empty sites
- 120 million plantable
- 6,400 GWh AC savings
What will we have?

- 50 million trees, 15 yr
- 6,400 GWh/yr, $485M
- Reduced emissions 1.8 Mt/yr
- Sequester 4.5 Mt/yr
- Total 6.3 Mt/yr
What will we have?

- 50 million trees, 15 yr
- 6,400 GWh/yr, $485M
- Reduced emissions 1.8 Mt/yr
- Sequester 4.5 Mt/yr
- Total 6.3 Mt/yr
- 4% of CAT target
What will we have?

- **Baseline: existing urbanized**
  - Trend from 1990 to present
  - Replacements
  - Planting new sites

- **Baseline: new urbanized**
  - Tree density by land use
  - Replacements
  - Planting new sites

- **Planting scenarios**
  - Tree mix, location, density
  - Energy & emissions
What will we have?

- Baltimore: 4% loss/yr
- Sacramento: 5% loss/yr
- NYC: 4% loss/yr

Signs of stewardship include: presence of signage on or around the tree; clean recent pruning cuts; plantings in the street tree pits; mulch placed in pit and evidence of weeding.

<table>
<thead>
<tr>
<th>All trees</th>
<th>13,405 trees planted</th>
<th>Survival rate</th>
<th>74.3%</th>
<th>19.7%</th>
<th>6.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>5,160 trees planted</td>
<td>Survival rate</td>
<td>96.2%</td>
<td>1.7%</td>
<td>2.0%</td>
</tr>
<tr>
<td>None</td>
<td>8,245 trees planted</td>
<td>Survival rate</td>
<td>60.6%</td>
<td>31.0%</td>
<td>8.5%</td>
</tr>
</tbody>
</table>
Stewardship
Results

Chinese Pistache (storage)

- Urban sp specific
- Forest general equation
- Urban general equation
Key Research Questions

• Accuracy of remote sensing alone for current forest
  – General equations
• Accuracy of remote sensing for backcast
  – Tree canopy cover
• Accuracy of forecast
  – 1994 to 2006
• Urban tree biometrics
• Energy conservation
• Life-cycle analysis
Discussion

www.fs.fed.us/psw/programs/cufr