Constructing State and Local Inventories of Forest and Soil Emissions and Sinks

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Outline

{Focus on state/regional inventories}

- Components of forest and soil GHG inventories
- Inventory methods
- Data sources and analyses
- Caveats

Emissions ←→ Inventory

- Emission is release of GHG
- Sink is absorption of GHG
  - Such as carbon sequestration removing carbon dioxide from the atmosphere
  - 1 ton carbon = $3\ ^{2}/_{3}$ tons carbon dioxide
- For sequestration
  - Inventory is stock at a point in time
  - Emission/sink is difference between stocks (inventories) at beginning and end of accounting period

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Components of Forest Inventories

- Wood in forests
  - Live trees, including roots
  - Dead trees
  - Forest floor
  - Shrubs
- Wood fiber in products
- Forest soil?
- Discarded products in landfills?

Soil GHG Inventory

- Carbon to a specified depth (often 20 cm)
- Methane?
- Nitrous oxide?

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Live Tree Inventory Methods

- Statistically sample species, size and frequency of individual trees
- Equations predict biomass from species, height, diameter, region
- Biomass dry weight ≈ ½ carbon
- Expand from individual trees to area
- Alternate method: use average tree diameter to estimate carbon per area

Dead Tree Inventories

- Standing trees can be counted in live tree surveys
- Down trees tallied separately on plots or transects
- Equations predict carbon from size and degree of decomposition

Forest Floor

- Sample to determine carbon per unit of thickness and area
- Measure thickness during tree surveys
- Stock often small but may be very large
- Don’t double count—sometimes counted with soil

Shrubs

- Statistically sample species, size, and frequency
- Equations estimate biomass and carbon per individual
- Scale up to area
- Carbon stock almost always small; occasionally moderate

Carbon in Wood Products

- Proportion of tree carbon that goes into products varies by type of product (e.g. lumber, paper)
- Use regional data for proportion of harvest going into each type of product
- Extrapolate from studies to estimate amount of carbon into products and life span of each product type

Forest Soil

- Addressed later with soil inventories
- Don’t double count
  - Determine which sector will count forest soil

Carbon in Landfills

- Estimate as fraction of products going out of use
- Extrapolate methane emissions from studies
- Don’t double count—which category?
- Alternate method: Track mass deposited in landfills and estimate as a fraction of total mass

Soil Carbon Inventory

- Often modeled, using land use and soil type
- Specify depth—most common is 20 cm
- Methane: dry soil is sink; wetlands and rice paddies usually a source
- Nitrous oxide: mainly from fertilizer
- Clarify which sector will count methane and nitrous oxide

Forest Methods Descriptions

- Intergovernmental Panel on Climate Change *Guidelines for National Greenhouse Gas Inventories*, revised 1997
- IPCC *Good Practice Guidance for Land Use, Land-Use change and Forestry*, 2003
- U.S. EPA *Inventory of U.S. Greenhouse Gas Emissions and Sinks*

Soil Methods Descriptions

- Intergovernmental Panel on Climate Change *Guidelines for National Greenhouse Gas Inventories*, revised 1997
- Eve, MD, M Sperow, K Paustian, and RF Follett. 2002. National-scale estimation of changes in soil carbon stocks on agricultural lands. *Environmental Pollution*. 116: 431-438.

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Data Sources—Forest

- Birdsey, RA and GM Lewis. 2003. Carbon in U.S. forests and wood products, 1987-1997: state-by-state estimates. GTR NE-310, USDA Forest Service.
- State and regional studies
- In development: Carbon on line estimator http://ncasi.uml.edu/COLE/

Data Sources—Soil

- USDA Natural Resources Conservation Service National Resources Inventory http://www.nrcs.usda.gov/TECHNICAL/NRI/
- Local studies

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Caveats: Data

- Often old—stated dates are often extrapolated from older measurements
- Stated number may be inferred from a different measurement
  - Old tree size numbers inferred from wood volume reports
  - Dead wood biomass sometimes inferred from live wood and stand type

Caveats: Soil Carbon Data

- National Resources Inventory measurements not publicly available to preserve confidentiality
- May have to depend on Natural Resources Conservation Service to analyze NRI data

Caveats: Data and Scale

- Scale matters: Many studies are reliable at the largest time/space scale reported but not reliable for smaller scales
  - Example: US forest carbon estimate fairly reliable for US, not for a single county

Caveats: Data and Errors

- Errors often unquantified
- Monte-Carlo simulation may not provide reliable quantification of error
- Errors are large at small scales
- Soil carbon maps often based on biased measurements

Caveats: Data Gaps

- No comprehensive data on suburban biomass carbon
- No comprehensive non-agricultural soil carbon data
- Limited deep soil carbon data
- Limited assessment of fate of exported soil carbon (e.g. erosion)

Caveats: Calculation Factors

- Biomass factors that use average tree diameter and stand type can have significant errors
- Errors result from using factors for conditions outside the range from which the factor was developed

Caveats: Calculation Factors, cont.

- Wood product carbon factors based on limited data

Caveats: Models

- Models are often better for estimating change than for estimating stock
- Even the best model is only as good as the modeler
- Carbon on line estimator is not yet reliable

Caveats: Assessments

- Often make large assumptions about conditions, data, or calculation factors
  - Authors should state assumptions and give estimates of the degree to which errors in the assumptions may affect final estimates
- Improve confidence in results by comparing assessments made using very different methods

Summary

- Standard inventory methods are available
- Data is available on the pools likely to have the largest changes
- Check to see if data and analyses are really what they are claimed to be
- Use data and methods appropriately

Thank you

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