COMMENTARY

Where Did the US Forest Biomass/Carbon Go?

Christopher William Woodall

In Apr. 2012, with the submission of the 1990–2010 US Greenhouse Gas (GHG) Inventory to the United Nations Framework Convention on Climate Change (UNFCCC), the official estimates of aboveground live tree carbon stocks within managed forests of the United States will drop by approximately 14%, compared with last year's inventory. It does not stop there, dead wood carbon stocks will drop by 16%. While our estimates of stocks will decrease, the annual sequestration rate (1990–2010) will show a slight increase, similar to previous submissions. Are these changes an effort to obscure the role of forests in mitigating GHG emissions or biomass available to our forest industries? No. Quite to the contrary, this year-to-year adjustment is the result of the USDA's continuous effort to reduce the uncertainty of US forest biomass/carbon estimates. UNFCCC guidelines require that, each time an Inventory is published, the complete trend from 1990 onward is presented. If methods used to determine GHG sources/sinks change, then the full trend line back to 1990 must be recalculated. This ensures that GHG Inventories adhere to the principles of consistency, transparency, accuracy, comparability, and completeness. Each year, when the Environmental Protection Agency (EPA) submits the US National GHG Inventory to the UNFCCC, the trend over time shifts (US EPA 2011).

If trend lines shift because of continual improvement to the data and methods used to estimate forest biomass/carbon, then what is this year's improvements? First, instead of using two separate sets of tree volume and biomass equations for the USDA Forest Service's Forest Inventory and Analysis program (FIA) and EPA inventories, there is now only one that better aligns with site quality indices. This is akin to moving from an accountant penciling in multiple accounting books toward using one software package. FIA's new approach to biomass estimation (Woodall et al. 2011) combines regional volume equations with national ratios of biomass by tree component (e.g., bole and top) to better align biomass with regional volume equations while not sacrificing national consistency across the diverse tree growth habits of the United States (Domke et al. in press). Second, FIA now has a field inventory of standing dead trees across the nation that replaces models that were generalizations of regional averages by broad forest types (Woodall et al. in press). Instead of missing the impact of disturbances (e.g., droughts and insect outbreaks), we now more fully gauge their impact on standing dead tree biomass/carbon estimates in yearly time-steps as opposed to decades. Third, beyond simply counting standing dead trees, emerging research on standing dead tree wood density reduction and structural deductions (Domke et al. 2011) will improve the accuracy of standing dead tree carbon stock estimates. Do all of these improvements come at a cost? The movement from simulation to empirical measurement means that our carbon trend line is now more sensitive to both geographic variability in tree biomass and annual disturbance events…a result of decreased estimate uncertainty (Figure 1). Real-world volatility may now replace the "smoothed" depictions of our modeled past.

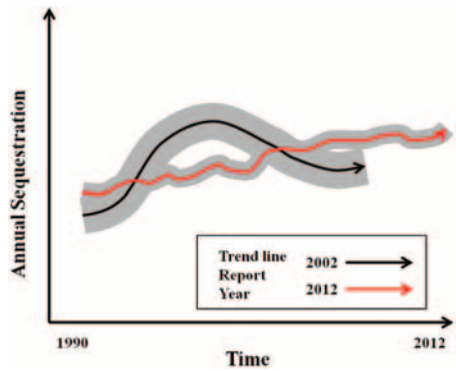

Figure 1. Hypothetical illustration of variation in annual forest carbon sequestration trend lines from 1990 to 2012 by two report years (2002 and 2012) (gray bands represent associated uncertainty with an improved forest inventory reducing levels of uncertainty).

As we strive to increase the accuracy of the United State's forest biomass/carbon inventory future, "resetting" of trend lines should be expected. The Forest Service hopes to replace simulated estimates of downed dead wood stocks with estimates based on measurement of more than 5,000 FIA plots across the United States, incorporate empirical measurements of forest floor depth and attributes into estimates of this component, refine the modeling of soil organic carbon stocks, and improve the accounting of timber products and harvest/mill residues. As foresters seek to improve their ability to estimate biomass/carbon for a diverse array of forest ecosystem components, a conundrum emerges. Although we strive to reduce the uncertainty associated with the estimates of forest biomass/carbon, we may unknowingly increase the publicly perceived uncertainty. As annual trend lines continue to fluctuate (Figure 1) it will be easy to state that, "foresters cannot make up their mind what is actually in forests." Rather, it is evidence of our profession's continuous pursuit of scientific rigor and passion to do a better job at what society/economies ask of us.

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Christopher Woodall (cwoodall@fs.fed.us) is research forester, USDA Forest Service and is lead coordinator of the US's National Greenhouse Gas Inventory of Forests.