LETTERS

On "Estimating Carbon Budgets for U.S. Ecosystems"

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In a recent *Eos* article, *Potter et al.* [2006] describe an approach to developing terrestrial biogenic carbon budgets at regional to continental scales. Their primary scaling tool is the Carnegie-Ames-Stanford (CASA) model, and spatially explicit inputs include climate as well as vegetation type and vegetation greenness (from satellite imagery). Net primary production (NPP) is simulated with a light use efficiency approach, and heterotrophic respiration (R_h) is based on turnover rates of several litter and soil carbon pools.

This approach is well-suited to characterizing the response of net ecosystem production (NEP, NPP–R_h, as in the work by *Lovett et al.* [2006]) to interannual variation in climate, but it is worth pointing out that it largely misses the effects of forest management on NEP. These management effects have a significant influence on the absolute carbon exchange with the atmosphere, and on the kind of carbon accounting needed for carbon dioxide emissions inventories.

Generally, there are strong trends in NEP with stand age in forests because of decomposition of residues in early secondary succession and a decline in NPP in late succession [*Ryan et al.,* 1997; *Campbell et al.,* 2004]. In a conifer forest in the Pacific Northwest, two adjacent stands with the same greenness (i.e., fPAR, the fraction of incident photosynthetically active radiation that is absorbed by the plant canopy) of 0.9 could differ widely in NEP. One could be 50 years old and at its maximum NPP but with relatively low R_h, since much of the residue from the stand originating disturbance has been decomposed, thus having an NEP of 400 grams of carbon per square meter per year. Next to it could be an old-growth stand (450 years old) with the same fPAR but with a balance of NPP and R_h such that NEP is zero on average across 10 or 20 years. Simulations and eddy covariance flux tower data at the ecosystem scale show that a major influence on forest NEP is disturbance, with important secondary influences of climate [*Thornton et al.,* 2002].

Another factor limiting the sensitivity of the Potter et al. analysis to management-scale disturbances is that while the satellite fPAR does detect large disturbances such as forest fires and regional droughts [*Potter et al.,* 2003, 2005], the fPAR data are at eight-kilometer resolution and are the result of maximum value compositing of finer resolution data. Thus, in cases of small clear-cuts, as are common in many regions of the United States, there would be little effect on CASA NPP. Landsat resolution (~30 meter) remote sensing is capable of tracking forest disturbances [*Cohen et al.,* 2002], and if that information is used in process-model-based scaling of NEP [e.g., *Law et al.,* 2004], then NEP estimates can reflect effects of both disturbance and interannual variation in climate.

The critical need for Landsat data to monitor global land use and forest disturbance highlights the importance of the Landsat Data Continuity Mission, recently in danger of losing momentum but now apparently on track at NASA. The long term nature of the Landsat record (1972 to present), and its information content with respect to forest management activities, mean that it could contribute significantly to bringing management-scale disturbance effects into the carbon budget analyses of Potter et al. and others.

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