THE UNDERPINNINGS OF LAND-USE HISTORY: THREE CENTURIES OF GLOBAL GRIDDED LAND-USE TRANSITIONS, WOOD HARVEST ACTIVITY, AND RESULTING SECONDARY LANDSCAPES

G.C. Hurtt[1,2], S. Frolking[1], M.G. Fearon[1], B. Moore III[1],
E. Shevliakova[3], S. Malyshev[3], S.W. Pacala[3], and R.A. Houghton[4]

[1]*Institute for the Study of Earth Oceans and Space, University of New Hampshire, Durham, NH 03824; george.hurtt@unh.edu*

[2]*Department of Natural Resources, University of New Hampshire, Durham, NH 03824*

[3]*Department of Ecology and Evolutionary Biology, Princeton University, Princeton, NJ 08544-1003*

[4]*Woods Hole Research Center, Woods Hole, MA 02543*

To accurately assess the impacts of human land-use on the Earth System, information is needed on the current and historical patterns of land-use activities. Previous global studies have focused on developing reconstructions of the spatial patterns of agriculture. Here, we provide the first global gridded estimates of the underlying land conversions (land-use transitions), wood harvesting, and resulting secondary lands annually, for the period 1700-2000. For input, we used two existing datasets of global gridded land-use history—HYDE [*Klein Goldewijk* 2001] and SAGE [*Ramankutty & Foley* 1999], a new reconstruction of national wood harvest that we spatially disaggregated to a global gridded product, and model estimates of the spatial distribution of plant carbon density and its recovery. Since these do not fully constrain the problem, we added assumptions related to four additional factors: the residence time of agricultural land, the inclusiveness of wood harvest statistics, the priority for land conversion and logging (e.g. primary- or secondary-land), and the spatial pattern of wood harvest within countries. In order to estimate uncertainty and characterize model sensitivity, a set of 216 alternative reconstructions was derived using different assumptions. We estimate that the accumulated global wood harvest 1700-2000 was approximately 112 Pg C including slash. To provide this, 12-15 million km^2 of primary forest and 4-6 million km^2 of secondary forest were harvested. Estimates of biomass cut in land conversion to agriculture (including shifting cultivation in the tropics) were 163-244 Pg C, exceeding global wood harvest every year until the 1960s, when agricultural expansion slowed while wood harvest continued to increase. From 1700-2000, secondary land area increased by 10-44 million km^2; about half of this was forested. Wood harvest and shifting cultivation generated 70-90% of the secondary land by 2000; permanent abandonment and relocation of agricultural land accounted for the rest. While the history of land-use transitions and wood harvest can probably never be known with certainty everywhere, estimates can be constrained with available information. Results from this study are consistent with multiple inputs, and compare favorably to several additional lines of evidence including: estimates of global wood harvest and land clearing for agriculture, secondary area, rates of clearing due to shifting cultivation, area of shifting cultivation and its rate of increase, and secondary land area and age in U.S. forests. Because of the importance of land-use transitions and wood harvest to the structure and carbon balance of terrestrial ecosystems, the results of this study are being used as input to a new generation of Earth System models. Our approach is also being combined with more detailed information on agricultural management, and with scenarios for future carbon emissions to generate consistent land-surface dynamic maps for use in future projections of carbon and climate.

REFERENCES

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