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A mid-20th century benchmark estimate of global vegetation biomass carbon stocks

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Vegetation biomass carbon stocks play a vital role in the climate system, but the analysis of long-term carbon budgets is hindered by the lack of benchmarked estimates from the 20th century. Here, by integrating inventory-based information on land use and carbon densities in a closed-budget land accounting approach, we establish a mid-20th century global carbon stocks account. Our approach integrates global forest assessments from the mid-20th century, previously ignored in global land change studies, and inventory-based land use reconstructions across the 20th century with contemporaneous information on potential carbon stocks, the likely presence/absence of woody cover and the extent of shifting cultivation in the tropics. In a scenario-based analysis, we find that vegetation stored 540 PgC in biomass (median of 1728 cases per world region; inner quantiles 455-618 PgC). We focus on two Focal Cases, with total carbon stocks of 454-469 PgC, representing reasonable assumptions of carbon densities in forests and other wooded lands to reveal the distribution of carbon stocks across 8 land categories and 14 world regions. We found that ecosystems in Southern America, Western Africa and the erstwhile Soviet Union stored more than 27, 16 and 12% of all carbon stocks, predominantly in forests. Carbon stocks in Other Vegetated Lands, calculated as a residual from all known land uses, demonstrated the highest uncertainties. Comparisons with early-21st century carbon stocks estimates revealed significant reductions in global carbon stocks, but with distinct subcontinental characteristics, providing first evidence of a carbon stocks transition following a forest area transition underway in industrialised regions in the Global North as well as indicating the maximum possible carbon sequestration from restoration initiatives in a realistic timeframe in the future. Our integrative methodology can be used to reconstruct global carbon stocks over the 20th century to supplement other carbon flux-based modelling efforts, thus helping to constrain present and future simulations of global biomass carbon stocks.