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Combining land-use statistics with process-based modeling to estimate the European forest carbon balance

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Forest inventories, eddy covariance measurements and terrestrial ecosystem models have been used independently to estimate the forest carbon balance of Europe's forest ecosystems on a continental scale. Here, we present a synergistic concept to overcome the isolation on these three approaches by incorporating forest age-structure, land-use change and wood harvest into the generalized process-based ecosystem model LPJ-DGVM that has previously been shown to perform well at a range of eddy-covariance sites. We use forest statistics to evaluate both simulated tree growth and C dynamics, and by doing so provide an essential step forward in delivering a comprehensive estimate of net carbon exchanges of the terrestrial biosphere. By doing so, we created a framework in which to study the impacts of future environmental changes on European forests. A new formulation of carbon allocation in trees is used to improve the simulated age-dependent forest growth rate, and a generic representation of forest management in even-aged stands is employed to scale single stands results to the landscape scale. Application of the advanced model for 77 European provinces shows that model-based estimates of biomass development with age compare favorably with inventory-based estimates for different tree species. Model estimates of biomass densities on province and country-levels, and trends in growth increment along an annual mean temperature gradient are in broad agreement with inventory data.

The model is able to reproduce the present-day age structure of forests and the ratio of biomass removals to increment on a European scale based on observed changes in

climate, atmospheric CO2 concentration, forest area and wood demand between 1948 and 2000. Continental-scale net ecosystem production averages 190 TgC yr^{-1}, which is substantially lower than the estimate based on the upscaling of eddy covariance measurement (Janssens et al. 2003). Most likely reasons for this difference are the uncertainty in modeled soil carbon stock changes and the scaling of point measurements to the continental scale. Trees in European forests are modeled to sequester carbon at a rate of 100 TgC yr^{-1}, which corresponds well to forest inventory-based estimates (Nabuurs et al., 2003).

Literature:

Janssens, I. A., A. Freibauer, et al. (2003). "Europe's terrestrial biosphere absorbs 7 to 12% of European Anthropogenic CO_2 Emissions." Science 300: 1538-1542.

Nabuurs, G. J., M. J. Schelhaas, et al. (2003). "Temporal evolution of the European forest sector carbon sink from 1950 to 1999." Global Change Biology 9(2): 152-160.