THE GLOBAL CARBON BALANCE OF FORESTS BASED ON FLUX TOWERS AND FOREST AGE DATA

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Terrestrial gross primary production and energy fluxes have been successfully scaled from ecosystem eddy covariance observations to the global scale. However, this has not been possible for net ecosystem productivity (NEP) because (i) forest age is an important determinant of NEP, (ii) the age distribution of eddy covariance sites is not representative of global forests, (iii) and there was no globally gridded forest age map available. Here we combine maps of forest age with local NEP-age relationships and environmental predictors using machine-learning algorithms to produce new global maps of forest NEP. Globally, forest NEP is a sink of CO2 of 4.9 to 5.3 PgC a-1, mainly in temperate forests and in tropical forests. After removing from NEP the carbon losses that are not observed at flux tower locations, i.e., forest fire emissions, harvested biomass, emissions from leached dissolved organic carbon in rivers, and non-CO2 compounds emissions to the atmosphere such as like volatile organic compounds, the net carbon balance (NBP) estimate of forests is 2.9 PgC a-1 matching well independent forest inventory estimates and atmospheric inversions. This new global estimate of the flux-tower forest carbon balance adds a key piece of information to reduce uncertainties on the still debated location of the global land carbon sink.