Synthesis on the carbon budget and cycling in a Danish, temperate deciduous forest - DTU Orbit (12/05/2019)

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A synthesis of five years (2006–2010) of data on carbon cycling in a temperate deciduous forest, Sørfjord, Denmark, was performed by combining all available data from eddy covariance, chamber, suction cup, and biometric measurements. The net ecosystem exchange of CO2 (NEE), soil respiration, tree growth, litter production and leaching of dissolved inorganic and organic carbon were independently estimated and used to calculate other unmeasured ecosystem carbon budget (ECB) components, based on mass balance equations. This provided a complete assessment of the carbon storage and allocation within the ecosystem. The results showed that this temperate deciduous forest was a moderate carbon sink (258±41 g C m⁻² yr⁻¹) with both high rates of gross primary production (GPP, 1881±95 g C m⁻² yr⁻¹) and ecosystem respiration (Re, 1624±197 g C m⁻² yr⁻¹). Approximately 62% of the gross assimilated carbon was respired by the living plants, while 21% was contributed to the soil as litter production, the latter balancing the total heterotrophic respiration. The remaining 17% were either stored in the plants (mainly as aboveground biomass) or removed from the system as wood yield. The soil organic carbon stock was considered unchanged over the period of observation, given the high degree of uncertainty associated with the small loss detected (33±85 g C m⁻² yr⁻¹). The ECB component data were generally consistent, except for one of the derived fluxes, the aboveground autotrophic respiration, which appeared to be higher than expected. The potential causes for this, i.e. underestimation of soil respiration and/or overestimation of Re are discussed. The plausibility analyses reported here, using multiple ECB data sets together with simple mass conservation equations and the evaluation of data consistency on the basis of the estimated residual terms is widely applicable to other experimental sites, even when some of the carbon fluxes and stock changes are not measured independently.

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