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Carbon balance of a maritime pine forest over a 11-year long period.

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We combined eddy flux measurements, ecological inventories, soil inventories and ^{14}C age-determination of the soil organic matter fractions to achieve a complete picture of the carbon cycle in Le Bray forest, a mature stand of maritime Pine in southwestern France, from 1996 to 2006. Despite measurements uncertainties, sampling errors and lack of data concerning the fluxes of dissolved carbon or non CO_2 volatile carbon, we found a good agreement between the independent measurements and models.

The forest acted as a net sink, annual net C-CO_2 flux, NEE, varying between -57 gC.m^{-2} for 2002, the driest year of the period, to -750 gC.m^{-2} (2004) with a 1996-2006 average of - 420 gC.m^{-2}. Over this time period, the annual carbon flux showed a decreasing trend which paralleled a decrease in LAI and was attributed to (1) tree ageing and (2) recent droughts in 2002 and 2005 and heat wave in 2003.

On average, 280 gC.m^{-2} were stored annually in the tree aerial biomass as a net aboveground increment in biomass. The belowground biomass increment, not measured, was assumed to represent a constant 25% of aboveground biomass increment, i.e. the root biomass fraction being 20% of total biomass. The ratio of biomass increment to annual net ecosystem exchange of C-CO_2 flux, NEE, varied according to

annual precipitations, being constant during normal years whereas the biomass growth exceeded the net C-CO_2 flux during dry years. The balance was restored during the year following drought.

Soil carbon accumulation was determined using a simple box model parameterised from ^{14}C measurements in coarse and fine organic fractions. The net annual flow of carbon into the soil was estimated to a mean value of 75 $gC.m^{-2}.y^{-1}$, allocated to OL, OF and OH layers. This net carbon deposition into organic layers of soil decreased from 1996 to 2006 due to decreasing input in dead organic matter to the soil (litterfall). The mean residence time of carbon in soil fractions was estimated from a simple box model calibrated with ^{14}C measurements to 1 - 24 years for OL to OH horizons and 10 -135 years for A1 horizon (0-10 cm depth).

We conclude that 85% of the net carbon uptake by the ecosystem, NEE, was allocated to the tree growth whereas 15% was input into organic horizons of the ground floor. This research was supported by the Carboeurope project.