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Soil carbon stocks and fluxes in Pedunculate Oak chronosequence in Croatia

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Soil respiration is important flux in forest ecosystem, and coupled with ecosystem productivity gives information on forest ecosystem carbon balance. It is mainly driven by root growth rate, and soil microorganism activity which are influenced by micro-site meteorological and stand parameters (i.e. soil temperature, soil moisture and substrate quantity and quality). In ideal even-age managed forests, micro-site parameters are assumed to vary with respect to stand age (resulting from stand development), thus affecting soil respiration. Purpose of this study is to estimate soil carbon stocks and soil respiration throughout the rotation period under the current, close-to-nature, forest management practice in Pedunculate Oak forests.

A chronosequence experiment, consisting of eight stands aged from 5 to 167 years, was set up in April 2010. Surface soil efflux was measured during 2011, with portable soil respiration system using closed dynamic chamber method, at one subplot per stand. Partitioning to autotrophic and heterotrophic components was done using the results of meta-analysis (Subke et al. 2006) and Global database of soil respiration data (Bond-Lamberty and Thomson 2010). Soil and air temperature and soil moisture were recorded at half-hour intervals at one subplot per stand. Litterfall was periodically collected at each subplot. Soil organic layer and mineral layer to total depth of 40 cm were sampled at 16 sampling points per stand. Mineral part was divided into four subsamples according to predetermined depths (5, 10, 20 and 40 cm). Roots were extracted from soil samples, and fine root (d<2mm) biomass was measured. Soil samples were analyzed for C and N content with elemental analyser. For each stand in chronosequence we estimated annual soil respiration, annual litterfall, fine root carbon stock, soil organic carbon in organic and mineral layers, and C/N.

On average, soil temperature was highest, and soil water content was lowest in the two youngest stands. Annual litterfall ranged from 1.5 to 3.8 t C ha-1 yr-1 and had no age dependence. The exception was the youngest stand with 0.2 t C ha-1 yr-1. Fine roots carbon stocks ranged from 2.3 to 6.0 t C ha-1, with higher values observed in two youngest stands. Carbon stocks in soil organic layer ranged from 4.1 to 10.3 t C ha-1 while mineral layer C stocks (top 40 cm) ranged from 63.0 to 112.2 t C ha-1. Annual soil respiration throughout the chronosequence was estimated at 6.5 to 10.5 t C ha-1 yr-1, with highest values observed in the youngest stand, and lowest in the oldest stand. Observed dynamic of annual soil respiration is discussed with the respect to specific micro-site parameters.