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Microbial activity and C accumulation in organic and mineral layers of five Italian forests

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Forest ecosystems act as a substantial carbon sink and store about 40% of all soil C. The amount of organic matter sequestered in the soil depends on the quantity and the quality of plant litter delivered to the soil as well as on the extent of litter decomposition. Therefore, carbon storage and turnover vary spatially and temporally under the influence of climate, vegetation type, root density and activity, as well as of disturbances such as fire. Microbial biomass and activity are the main determinants of soil organic matter turnover and sensitive indicators to describe ecological conditions in soils.
The aim of this study was to assess, along the whole soil profile (organic and mineral layers) microbial activity and organic matter turnover in the soils of five Italian forests: three Stone pine forest across a chronosequence encompassing a 40y, a 70y and a 100y old forest within Vesuvius National Park; and two coeval, 80 y old beech forests located in Northern and in Southern Italy, different for climatic and edaphic conditions. Microbial biomass and respiration, active and total fungal mycelium as well as N and C accumulation were determined.

In the chronosequence, the 40y old forest showed the highest fungal biomass (mg/g d.w.) and respiration values (mg CO_2 g d.w.-1 h-1) compared to the others forests, both in the organic layers and in the mineral soil at 0-40 cm depth. Organic matter turnover seemed to be influenced by depth and age of the stand. C and N concentration in the organic layers of the three stands did not change remarkably with forest age. In contrast, in the mineral layer, C and N concentrations were about threefold higher in the 70y old compared to the 40y old forest stand. A further increase (by 2,4 for C and by 1.5 for N) was observed in the 100y old compared to the 70y old forest stand.

In the two beech forests, microbial activity did not show significant differences between the Northern and the Southern forest. The active fungal biomass and microbial respiration of organic matter per gram of soil were higher in pine forests soil than in beech forests. The data suggest that the beech forest is a larger Carbon sink than the pine forest.