Vertical soil evolution of microbial biomass over a deforestation & culture chronosequence

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Abstract

Luvisols are part of the world most productive soils and are widely used for intensive farming, like in North-West Europe. The wideness of deforestation over those lands emphasizes the necessity to study soil evolution triggered by those land use changes. Recent works on loessic luvisols revealed deep alkalinization dynamics through decennial to secular scale following soil liming. Therefore, soil land use changes strongly influenced soil physico-chemical characteristics (notably pH). However, soils host a)H) belowground biodiversity, which is implied in numerous ecosystem services and related to soil properties. This aspect is still debated and poorly studied at the long term (century) scale and in the deep soil horizons.
Through a synchronic approach the geohistorical analysis brought the deep time perspective with a deforestation and culture chronosequence on loessic luvisols located in North France. Five plots were studied; an ancient forest (about 1500 years), an ancient field (at least medieval) and 3 ancient forests plots deforested and cultivated since 5, 30, 170 years. We do characterize soils physico-chemical (granulometry, pH, organic carbon, major and trace nutrients, CEC, Base-cation Saturation ratio) and biological properties (bacterial and fungal abundance and biomass).

Multivariate and mixed-effect model analysis revealed the predominant role of depth (and O2 availability), deforestation and pH over soil microbial biomass distribution. Total soil carbon was more correlated to bacterial than fungal biomass, as expected both biomasses are strongly decreasing between topsoil and 50cm depth.
The fungic biomass and Fungi/Bacteria ratio strikingly increase from 50 to 200cm depth in the ancient forest soil but not in the cultivated soils. This study outlines a rapid collapse of deep fungal biomass in the first 5 years following deforestation. We thus infer that deep soil microbial ecosystems, especially their fungic part are very poorly resistant to land use changes such as deforestation and culture.

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