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Soil organic carbon dynamics in the forest-grassland limit.

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An upward shift of the treeline at the extent of former grasslands has been observed in the last decades in several regions along the world. Implications of the land use change from grasslands to forests are not clear yet in regard to soil organic carbon stocks, greenhouse gas fluxes and composition of the soil organic matter.

In order to investigate the consequences of forest expansion at the regional scale, an extensive grassland—forest comparison was conducted at the altitudinal limit of the forest. We considered two contrasting geographical areas: one Mediterranean -The Sistema Central in Spain- and one temperate area -the Austrian Alps-. Ten and seven sites were investigated, respectively. At each of the sites, the forest floor and the topsoil was sampled in grasslands and adjacent coniferous forest areas. Mineral soils were incubated for 6 months in the laboratory under standardized conditions and both bulk concentration and the isotopic signature of soil organic carbon and nitrogen were determined across the study sites.

Grasslands were not consistently different from forests in terms of soil organic carbon concentrations and cumulative soil carbon dioxide effluxes. However, soil C:N ratio was significantly narrower in grasslands than in forests, and this results was consistent for both Spanish and Austrian sites. Isotopic signature of C and N resulted to be significantly different between grasslands and forests for Spanish soils, only, suggesting a combined influence of land use change and climate. In Spain, grasslands soils were enriched in 15N but depleted in 13C as compared to forests soils. Interestingly, mean temperature negatively influenced C concentrations in Spanish grasslands, but had no clear effect on forests.

Our results did not show a clear trend of net soil organic carbon gain or loss due to forest expansion, but rather a change in the characteristics of the soil mineralization conditions after vegetation shifted. Changes in transformation processes and therefore in the soil organic matter were dynamically modulated by the aboveground vegetation, but also by the climate. In addition, influence of climate under mediterranean conditions seemed to be more determinant than in temperate, continental environments.