MATTEODO Magalì (2018) : Response of Swiss subalpine-alpine vegetation to recent climate changes and consequences on soil organic matter dynamics

Abstract

Impacts of current climate change on flora of alpine and nival summits are well known, but they are less understood in subalpine-alpine vegetation types. Moreover, at such elevations, only a few studies are describing soils, humus forms, and factors controlling their distribution. The impact of climate change on the soil organic matter (OM) component is currently under debate. In this context, the identification of ecosystem factors governing OM dynamics in soils is essential. The present research aims to investigate (i) the reaction of main subalpine-alpine vegetation types to recent climate changes, (ii) their associated soil and humus forms, (iii) the ecosystem controls on humus forms and OM stability in the alpine ecosystem.

Three study sites were selected in the Northern Alps and Western Central Alps of Switzerland. Eight vegetation types, typical of the subalpine-alpine belt and spanning a gradient of soil acidity and moisture, were targeted. Recent plant surveys were compared with historical ones (25-50 years), corresponding soils and humus forms were described, and the stability of the OM component was assessed thermally using Rock-Eval pyrolysis.

Both calcareous and siliceous grasslands showed high stability in terms of plant species composition and cover. On the other hand, vegetation types related to long snow cover (snowbeds) changed. Several species, coming from the surrounding grasslands, increased in frequency and cover, likely as a consequence of earlier melting dates and longer growing seasons.

The eight vegetation types displayed a large diversity of soil types and humus forms. But, the plant's community type played a secondary role in the humus form distribution, which was in contrast, mostly determined by the lithology of the soil's parent material, the climate, and the topography. Mull forms were observed all along the whole elevation gradient (1698-2697 m), but mostly at the lowest elevations and on calcareous parent material. Instead, Moder and Mor forms were associated to the highest elevations and siliceous parent materials. The concave topography was determinant for the occurrence of Anmoor forms. Roots were abundant in the investigated soils, particularly on steep slopes. The existing keys for the identification of humus forms proved partly unsuitable for the alpine ecosystem and some adaptations are suggested. Ecosystem controls on soil OM dynamics differed substantially according to the soil layer considered. The vegetation type influenced OM thermal stability in the litter layer, but not in the topsoil and subsoil. Indeed, the supply rate of fresh organic material and the physical and chemical characteristics of the pedogenic environment appeared to control OM stability. This study confirms that factors influencing the outcome of OM in soils are numerous, horizon and soil specific, and highly interconnected. Vegetation shifts, induced by recent climate changes, will likely have limited impact on soil OM dynamics in subalpine-alpine belts.