



Soils evolution and treeline fluctuations under late Holocene climatic changes: a case study from Upper Valtellina (European Alps, Italy)

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High-altitude areas in the European Alps have been widely investigated through time for reconstructing the Holocene climate fluctuations, by analyzing both biological and abiological indicators. In high-altitude areas the ongoing temperature increase caused some effects in the natural environments such as the upward shift of the vegetation belts and, in particular, of the treeline. In fact, the treeline is considered a sensitive climate indicator; in high-altitude areas, the vegetation growth and dynamics are strongly influenced not only by climate but also by abiotic factors, like geomorphological processes and soil development.

The aim of this study is the reconstruction of late Holocene soil evolution and environmental changes at the treeline on the SW slope of the Monte Confine in the Upper Valtellina, Central Italian Alps.

We performed a detailed reconstruction of the treeline altitudinal dynamics together with the field and laboratory characterization of a transect of nine soil profiles developing at an altitude ranging from 1800 m a.s.l. (closed forest) to 2600 m a.s.l. (species line), in order to understand the relationship between colonization by arboreal vegetation and soil development.

The upward shift of the treeline was assessed analyzing tree age distribution on the slope by means of a tree-ring based approach. The treeline elevation over time (based on the years in which the trees reached 2 m in height) increased from 2505 m a.s.l. (period 1990-1999) to 2531 m (period 2000-2009) to 2545 m (in 2013) with a rate of upward shift of up to 2.6 m/y in the period 2000-2009.

The investigated soils showed a decreasing development with increasing altitude, in fact at higher altitude we found less developed soils (i.e. Ranker), on the contrary in the forest area (about 2000 m a.s.l.) we found a more developed soil (i.e. Podzol). Moreover, the soil development may also be affected by the conditions of the slope, characterized by broad alpine grasslands that are interrupted by abundant rock outcrops, especially at the highest elevations.

The integrate analysis of geopedological and dendrochronological data will provide high resolution information about the responses of biological and abiological systems through the Holocene and to the ongoing climate change.