Geophysical Research Abstracts
Vol. 18, EGU2016-9355, 2016
EGU General Assembly 2016

A 9000 year perspective on carbon accumulation rates under changing hydro-climate and vegetation conditions in a mountain peatland, northern Carpathians, Romania

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Peatlands, in particular ombrogenous bogs, which entirely depend on water from precipitation, are sensitive to changes in the balance between precipitation and evapotranspiration; and therefore highly suitable for hydro-climatological reconstruction. Peatlands also represent a large carbon pool in the terrestrial biosphere. However, little is known about the C sequestration processes in mountain peatlands under various competing drivers of change (climate, vegetation, fire). We applied a multi-proxy approach (bulk density, loss on ignition, total organic carbon, testate amoebae, δ^{13}C in *Sphagnum*, plant macrofossils, pollen and charcoal) to a peat sequence from a mountain ombrogenous bog (Tăul Muced) to explore how changes in hydro-climate conditions, peat plant composition and fire have affected long-term physical peat properties and the rate of carbon accumulation over the last 9000 years. Carbon accumulation at this site ranged from 7 to 105 g C cm^{-2} yr^{-1} (mean 23 $\pm$ 14 g C cm^{-2} yr^{-1}). We found that high moisture availability (P-E) as inferred from testate amoebae and δ^{13}C values in *Sphagnum* increased the carbon sink capacity of peatland. The strength of the relationship between the rate of carbon accumulation and climate appears particularly evident over the last millennium when high C accumulation rates correlated with the warm and wet conditions of the Medieval Climate Anomaly and lower C accumulation rates with the dry conditions of the Little Ice Age. We also found a significant positive correlation between the rate of C accumulation and changes in vegetation; rates were lowest (17 g C cm^{-2} yr^{-1}), during periods of mixed *Sphagnum* (primarily *S. magellanicum* and *S. angustifolium*) and vascular plant (Cyperaceae, *Eriophorum vaginatum*) growth and increased (31 g C cm^{-2} yr^{-1}) during the accumulation of *Sphagnum* peat, regardless the dominant *Sphagnum* species. We did not find indication of peatland fire during the investigated interval. Our study represents one of the first investigating the carbon-sink capacity of mountain peatlands in the Carpathians and consolidates the geographical coverage of proxy reconstructions of hydro-climate variability in a poorly studied region.