Geophysical Research Abstracts
Vol. 21, EGU2019-3258, 2019
EGU General Assembly 2019

How do plants, microorganisms and soil organic carbon in a long-term abandoned alpine pasture respond to re-grazing at short- and long-term?

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Traditionally grazed alpine pastures have shaped the landscapes of the European Alps for centuries. However, especially steep alpine areas tend to be abandoned since the 1950s, significantly changing plant and organism diversity, as well as soil functions. We aim at evaluating the potential for a sustainable revitalization of abandoned alpine pastures via extensive grazing. This project relies on a strong collaboration between scientists, farmers, Bavarian State Agricultural Advisors, and nature conservation authorities. More specifically, this study aims at investigating the impact of re-grazing on plants, microorganisms, nutrient cycles, as well as soil physical and chemical characteristics. In May 2018, we set up a pilot grazing experiment at Brunnenkopfalm (1500-1700 m.a.s.l.) in the northern limestone Alps (Ammergauer Alpen), which was an abandoned pasture since 1955. Around 50.000 square meter were fenced and re-grazing was induced between May and August by a herd of rustic, local and endangered cattle, i.e. Murnau-Werdenfelser breed (ca 1/ha). The site contains five fenced grazing exclosure (control) plots and five grazed plots for intense scientific monitoring (plot size 100 m2 each). Each plot was split into 1 m^2 subplots used as replicates along the six years of experiment. Three replicates will be re-sampled in 2-3 year-intervals in order to investigate the long-term impact of grazing on plants (coarse/fine root and shoot biomass, C, N) and soil characteristics (C, N, aggregate stability, organic matter composition), at three depths (0-5, 5-15 and 15+ cm). After two (June 2018) and nine (October 2018) months of grazing, we investigated the short-term grazing effect along a gradient from non-grazed to heavily-grazed areas. We quantified microbial biomass and classified major microorganism groups using the fumigation-extraction method to obtain microbial biomass, as well as the analysis of phospholipid-derived fatty acids (PLFA). We depicted faster cycling carbon pool by analysing the dissolved organic carbon (DOC) for total organic carbon. To analyse the chemical composition of the DOC in more detail and thus account for possible chemical alterations due to grazing, we used 13C nuclear magnetic resonance spectroscopy (13C-CPMAS-NMR). We will present preliminary results of the ongoing project. From the first data of the short grazing period, it becomes already clear that an increase in dissolved OC and microbial biomass is associated with more intense grazing. Our results will help to depict the impact of abandonment and re-grazing on key soil functions and ecosystem services, and thus, to provide urgently needed knowledge to develop management strategies that preserves alpine pastures from degradation.