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Effects of changing land use and climate on soil respiration and its components in mountain grassland

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In mountain areas changes in land use and climate have been more pronounced than in many other parts of Europe. Soil respiration is the largest source of CO_2 in terrestrial ecosystems and exhibits particularly high rates in Central European mountain meadows. Based on a multi-annual dataset and a number of ecosystem manipulation experiments we analyse possible effects of land management, land use and climate change on soil respiration and its components (including root, autotrophic and heterotrophic microbial) in mountain grasslands in the Austrian Central Alps. Our results indicate that 1) land management and land use change affect soil CO_2 production and diffusion across the soil profile, as well as specific respiratory rates and the relative importance of the source components, 2) in spite of a rapid transfer and respiratory utilisation of fresh photosynthates in the plant-soil system, soil CO_2 fluxes in mountain grasslands are well buffered against short-term changes in assimilate supply, as could be induced e.g. by land management practises or weather extremes, and 3) while climate affects soil respiratory fluxes via gross primary productivity at an annual scale, droughts occurring at shorter timescales have only minor effects on soil respiration and cause disproportionately larger reductions of canopy photosynthesis. In case the observed decoupling of soil CO_2 fluxes from photosynthesis in response to land management and climate changes is to persist also at longer timescales, it might affect the ecosystem C balance significantly and result in a net C loss from mountain grassland soils.