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Greenhouse gas fluxes in mountain grassland differing in land use

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Mountain grassland covers large areas, thus influences the global greenhouse gas (GHG) balance and is strongly affected by changes in land use. Effects of such changes on the GHG-balance have so far not been well documented. As a contribution to the EU-project GHG Europe we are studying the net ecosystem exchange (NEE) of carbon dioxide (CO_2), methane (CH4) and nitrous oxide (N2O) on a mountain meadow, an adjacent and an abandoned pasture at 1820-1970m a.s.l. in the Austrian Central Alps. The GHG balance is estimated from manual and auto-chamber measurements, combined with already published CO_2-NEE over almost a decade. Winter CO_2-fluxes, primarily soil respiration underneath the snowpack, are estimated with solid state CO_2-sensors using a validated diffusion model. We found that abandon the management decreases the NEE of CO_2 while its component, soil respiration (Rs), increases. The decrease is explained by differences in leaf area index, biomass and leaf-area-independent changes that were likely related to photosynthetic physiology. The increase in Rs can be explained by higher belowground carbon input due to missing grazing or mowing. The abandoned pasture showed the highest uptake rates of CH4 and a slight uptake of N2O, possibly due to better soil aeration. Spring freeze-thaw events caused slight CH4 emissions in the managed grassland. The meadow and pasture had just low emission rates of N2O even at freeze-thaw cycles and organic fertilization. These results suggest that in mountain grassland the main contributor to the GHG balance are CO_2 fluxes that can largely be influenced by land use changes.