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Long-term warming has minor effect on soil carbon storage in two alpine ecosystems on the Tibetan Plateau

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Soils in alpine ecosystems on the Tibetan Plateau store a large amount of carbon. The responses of the soil carbon to climate warming are poorly understood. Here we report the effect of long-term warming (1997-2017) on soil carbon storage in two alpine ecosystems on the Tibetan Plateau. Open-top chambers were used to elevate air temperature (1-2 ºC) and soil temperature (∼1 ºC) in a Kobresia humilis meadow and a Potentilla fruticosa shrubland in Haibei station since 1997. We measured plant and soil (0-50 cm, every 10 cm, including roots and microbes) variables in September 2017.

Plant species richness and diversity were not affected by warming in the meadow, but tended to decline with warming in the shrubland. Plant aboveground biomass did not change with warming in the meadow or shrubland, while the proportion of functional groups in aboveground biomass shifted with warming (legumes and forbs declined but grasses increased). Plant belowground biomass and its vertical distribution (proportion of roots in different soil layers) were also not sensitive to warming. Moreover, soil total carbon, total nitrogen and C/N ratio in every layer were not significantly affected by warming in both ecosystems. Microbial biomass carbon and nitrogen were not affected by warming, except that they declined by 23% and 35% respectively, in the 0-10 cm of the shrubland. Similarly, two hydrolytic enzymes involved in carbon and nitrogen degradation (β-1,4-glucosidase and β-1,4-N-acetyl-glucosaminnidase) only showed decreasing trend (36% and 32%) in the 0-10 cm of the shrubland, and two oxidative enzymes (phenol oxidase and peroxidase) were not responsive to warming in all soil layers and both ecosystems. We are currently doing in-depth analysis of the soil organic matter (molecular composition and turnover rate, by density fractionation, NMR and FTIR, and 13C and 14C isotope) and microbial community (structure and function, by DNA sequencing and functional gene) to further investigate the microbial drivers of soil carbon dynamics. Collectively, our data suggest that soil carbon storage in the two alpine ecosystems were not significantly affected by 20 years of warming.