

Supplementary information

Fig. S1 (a) Daily air temperature and (b) monthly precipitation at the Haibei research station from April to October in 2017. Early, early growing season, May 1st. Middle, middle growing season, August 3rd. Late, late growing season, September 23rd.

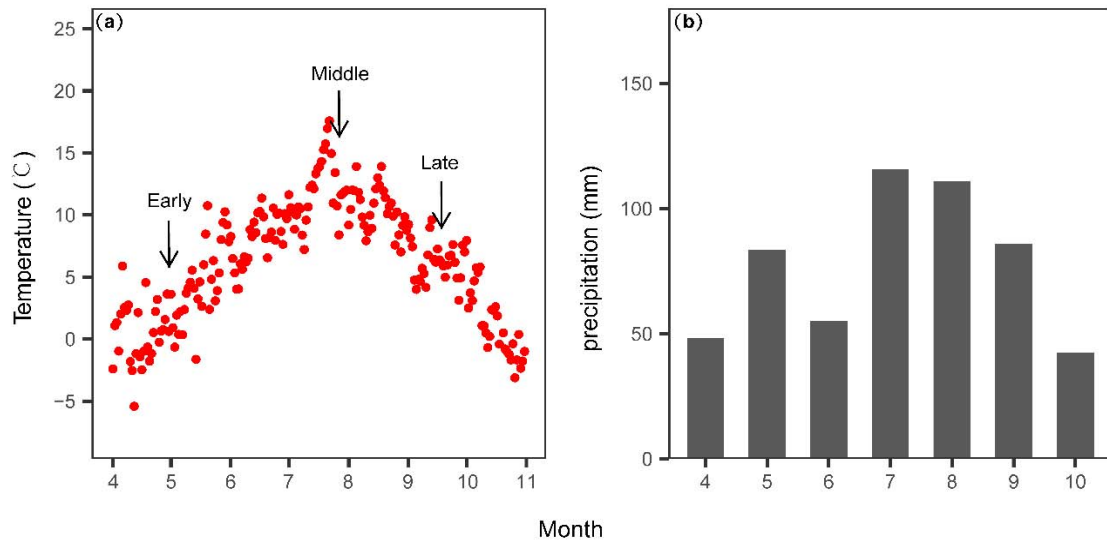


Fig. S2 Soil temperature (°C) at different depths (5, 10, 20, 30, 40, 60, 80 and 100 cm) of the alpine meadow from June to October in 2018.

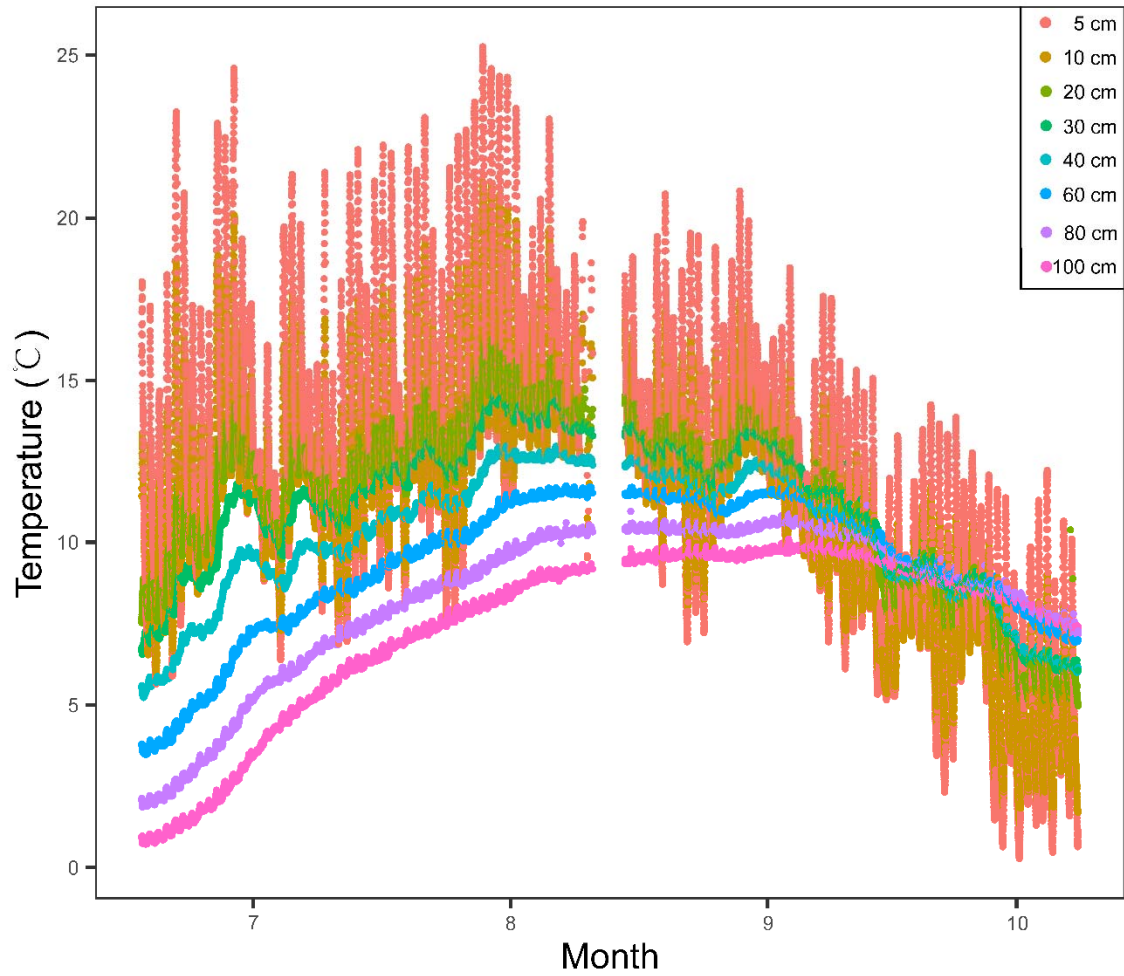


Fig. S3 Volumetric soil water content ($\text{m}^3 \text{m}^{-3}$) at different depths (10, 20, 30, 40, 60 and 100 cm) of the alpine meadow from June to October in 2018.

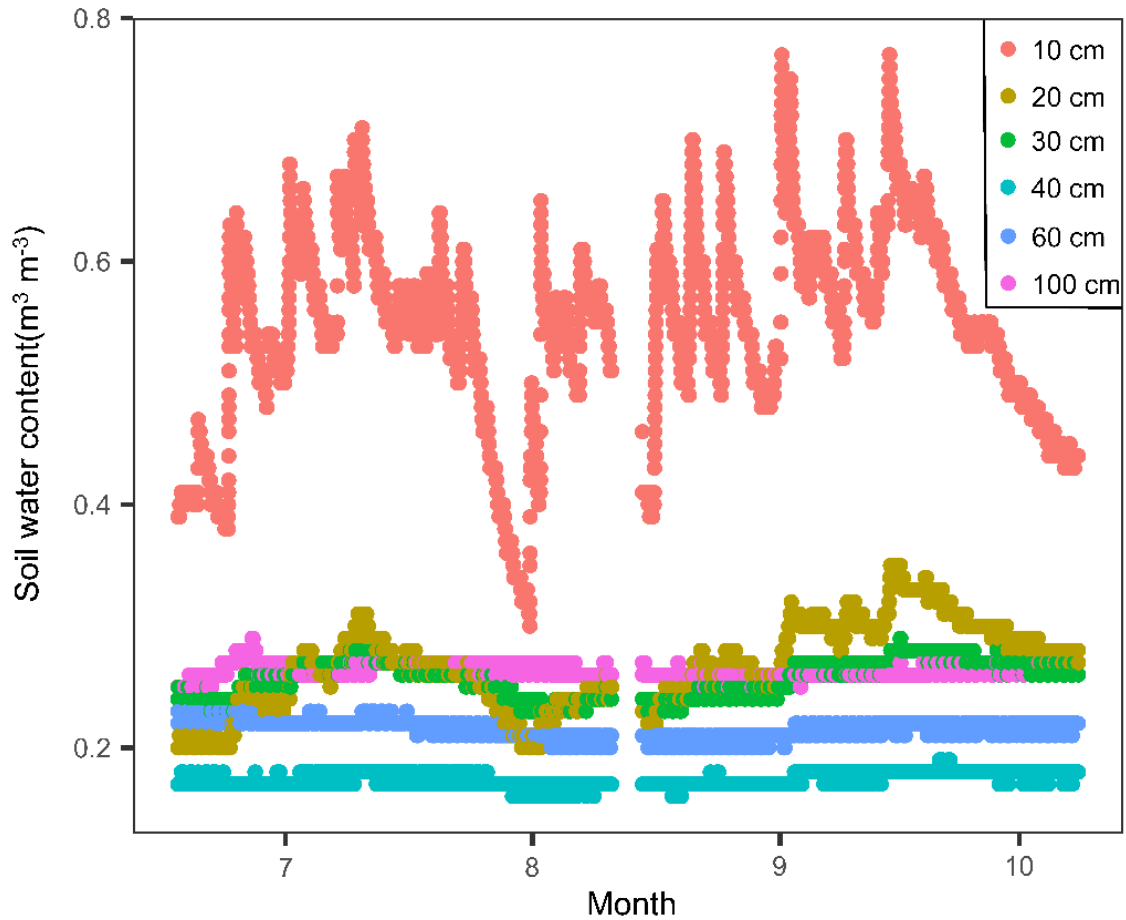


Fig. S4 (a) Soil organic carbon (SOC), (b) total nitrogen (TN), (c) the ratio of SOC to TN (C/N), (d) $\delta^{13}\text{C}$, and (e) $\delta^{15}\text{N}$ at different soil depths (0-10, 10-20, 20-30, 30-50, 50-70 and 70-100 cm) measured in the late growing season (September 23rd) in 2017. Values are the mean \pm standard error ($n = 8$, averaged across meadow and shrubland). Asterisks indicate statistically significant differences between different soil depths (* $P < 0.05$, ** $P < 0.01$, *** $P < 0.0001$).

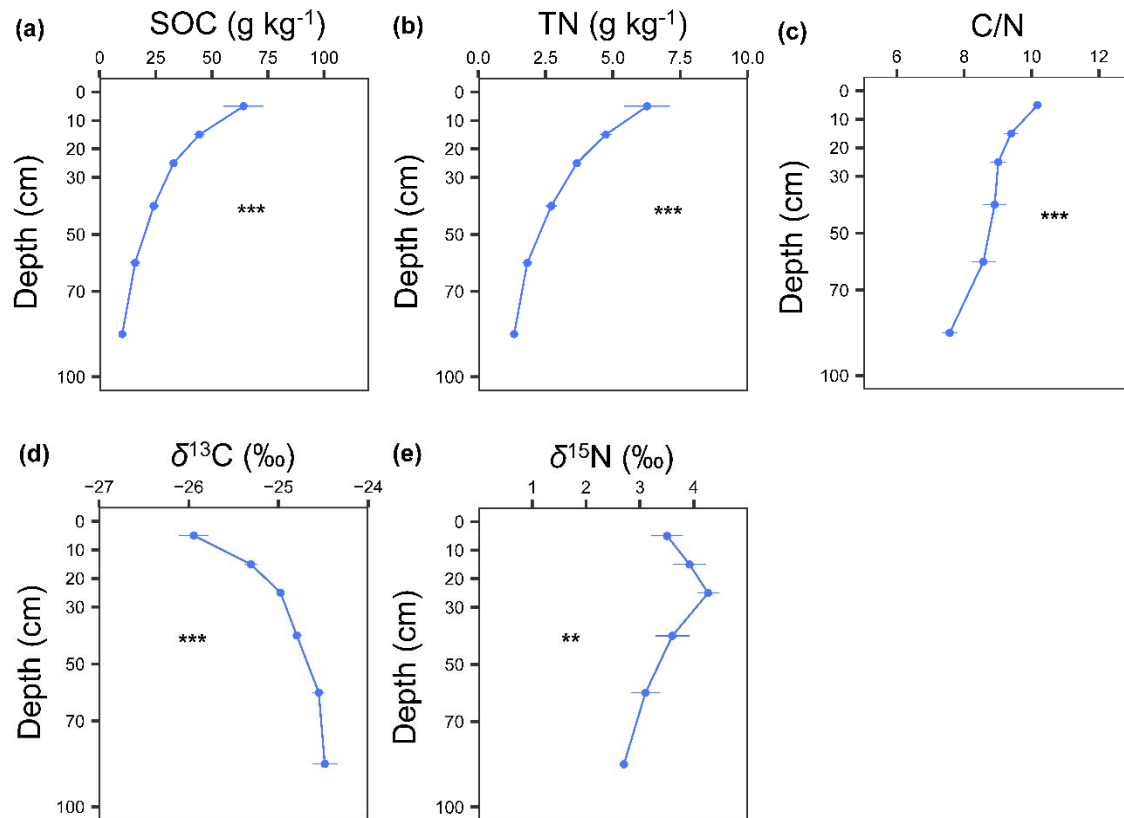


Fig. S5 Soil properties in two alpine ecosystems (meadow and shrubland) at different soil depths and different sampling times in 2017. (a) soil pH, (b) plant belowground biomass (BGB), (c) gravimetric soil water content (SWC), (d) extractable organic carbon (EOC), (e) extractable total nitrogen (ETN), and (f) nitrate nitrogen (NO₃⁻-N). Different colors mean different times of the growing season. Early, early growing season. Middle, middle growing season. Late, late growing season. Points are the mean ± standard error (n = 4). Asterisks indicate statistically significant differences between different times of the growing season (* P < 0.05, ** P < 0.01, *** P < 0.001).

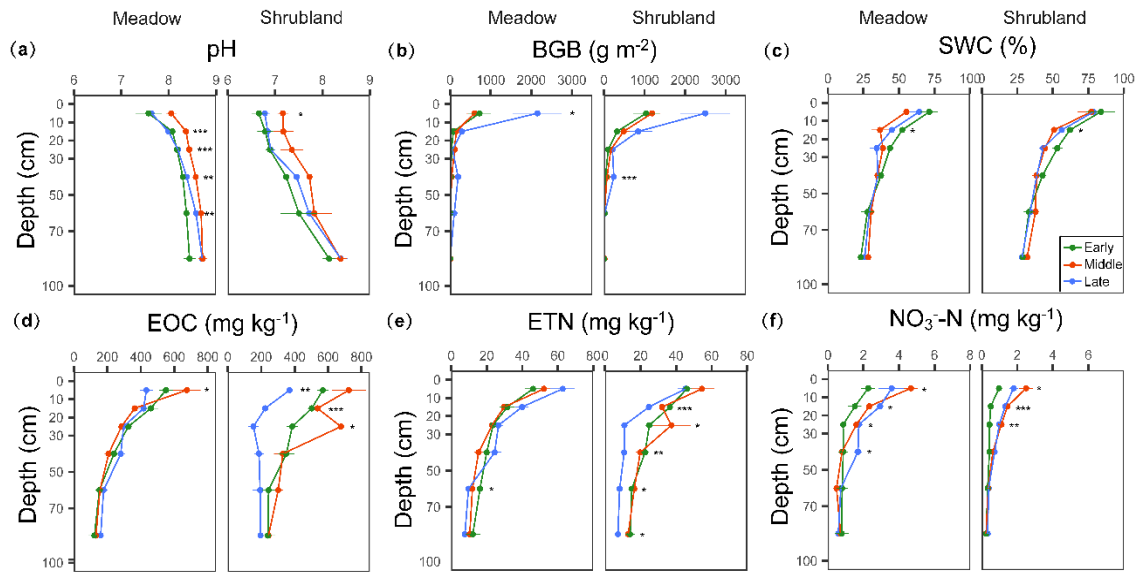


Fig. S6 Soil extracellular enzyme activities and their vector properties in two alpine ecosystems (meadow and shrubland) at different soil depths and different sampling times in 2017. (a) β -1, 4-glucosidase (BG), (b) neutral phosphatase (NP), (c) vector length, and (d) vector angle. Different colors mean different times of the growing season. Early, early growing season. Middle, middle growing season. Late, late growing season. Points are the mean \pm standard error ($n=4$). Asterisks indicate statistically significant differences between different times of the growing season (* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$).

