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Plant functional traits as predictors of ecosystem carbon fluxes across climatic gradients in alpine grasslands.

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Ecosystem carbon fluxes are regulated by biotic and abiotic factors and are therefore susceptible not only to direct effects of climate change but also to indirect effects, mediated through shifts in plant diversity and vegetation composition. Plant functional traits, traits related to specific functional mechanisms selected by environmental factors, are increasingly used to determine the response of vegetation composition and ecosystem processes to environmental change. Functional traits not only vary between species, but also show large variability within species along environmental gradients. In this study we investigate to which extent locally collected plant functional traits drive ecosystem carbon fluxes in alpine grasslands. We used a climate grid consisting of 12 sites covering both temperature and precipitation gradients where we measured net ecosystem exchange (NEE), gross ecosystem productivity (GPP) and ecosystem respiration (Reco), using the static chamber flux method during two growing seasons, and estimated vegetation composition and above-ground biomass. Plant functional traits were collected at each site for the species that made up 80% cumulated abundance and used to calculate community abundance-weighed means and trait variability. The traits were selected based on relevance to growth, carbon fixation and decomposition; including vegetative height, leaf area, leaf thickness, specific leaf area, leaf dry matter content, leaf carbon and nitrogen content and leaf C:N ratio. GPP was lower in colder alpine sites compared to warmer sub-alpine and lowland sites, while increased precipitation did not have pronounced effects on GPP. Vegetative height, specific leaf area and leaf thickness where found to be significant predictors of GPP (R2m = 0.15, R2c = 0.51). The variance explained by these traits largely overlapped with variance explained by climate (R2m = 0.30, R2c = 0.49), though climate in itself explained another sizeable proportion of variance. The measured functional traits were poor predictors of ecosystem respiration, as the largest part of the variance was explained by climate (R2m = 0.15, R2c = 0.17). These results show that functional traits can partly account for differences in GPP along climatic gradients, but there is additional climate-driven variation that cannot be accounted for by plant functional traits.