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How plant functional composition influences resilience of subalpine grassland functioning to winter and summer climate extremes

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Alpine grassland ecosystems are presumed to be highly sensitive to climate change, yet their long history of climate variability, and multiple centuries of land use may have selected for mechanisms of ecological resilience to climate variability and climate extremes. We used a large experimental design to explore patterns and mechanisms for responses of subalpine grasslands to combined winter (snow removal) and summer (drought) weather extremes depending on plant functional composition and management. Plant functional composition was manipulated by establishing grass mixtures with three species representing a conservation to exploitation gradient planted at varying relative abundances. Overall, functional composition was the primary determinant of all observed parameters for plant individual performance, intraspecific plant trait responses, litter decomposition and nitrogen recycling processes. The functioning of grassland ecosystems dominated by conservative plants was remarkably resistant to extreme weather reatments, while grassland ecosystems dominated by more exploitative plants were more resilient. Management altered these responses mostly in the case of exploitative communities. Belowground allocation to carbohydrate reserves and to microbial nitrogen pools were identified as two key mechanisms underpinning these resilient responses. Longer-term impacts of climate change may however unfold through the exhaustion of plant reserves and decreasing nitrogen returns to soils.