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Highly variable functional response of microbial communities to experimental temperature disturbances

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Climate change is expected to alter the frequency and intensity of climate excursions, such as heat, drought and freeze-thaw events, requiring a thorough mechanistic understanding of the response of microbially-mediated nutrient cycling processes to such transient but severe disturbances. Here, we investigated the resistance and resilience of major gross processes of microbial carbon (C), nitrogen (N) and phosphorus (P) cycling, determined by isotope pool dilution assays, as well as potential enzyme activities in decomposing beech litter to two contrasting temperature disturbances (freeze-thaw and heat treatment for 9 days) in four different litter types. Microbial processes were substantially altered by the temperature disturbances but both the magnitude and direction of the disturbance effect varied among them. Phosphorus processes and hydrolytic enzyme activities showed lowest resistance as well as resilience, whereas N processes were more resistant and C processes intermediate. In general, responses of microbial processes were mainly consistent across disturbances but partially dependent on litter-specific microbial communities. The transient disturbances affected the relative availability of essential nutrients through a decoupling of microbial C, N and P cycling processes. Understanding the underlying mechanisms through which a decoupling of the supply of these elements as a result of microbial responses to environmental disturbances occurs will help to better predicting ecosystem responses to global change.