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The ecology of wild microorganisms in a changing climate

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Climate warming can alter microbial activity, potentially altering the composition of the atmosphere and feeding back to climate, as well as health of soils that support production of food and fiber. The vast variation in microbial metabolism, physiology, and traits means that different microorganisms are likely to respond differently to the same forcings. For example, some microorganisms appear to thrive with warming, some are unresponsive, and others decline. Such differences in responses likely result in different contributions by microorganisms to terrestrial feedbacks to climate change, like carbon storage and loss from soils, as well as the release and exchange of the potent greenhouse gases nitrous oxide and methane. Characterizing the magnitude and significance of differential biological responses and feedbacks to environmental forcing is a major focus of ecosystem science and functional ecology. Doing so for microorganisms is challenging, but vitally important given the size and uncertainty of microbial feedbacks to the changing climate. Addressing these issues requires quantitative measurements of microbial responses to warming, responses that can be translated into the material flows in nature that constitute the feedbacks of interest. Further, we need to aim toward quantifying microbial responses under field conditions, under conditions where we can simultaneously characterize the magnitude of the feedback and thus have common context for connecting the two. Examples of efforts to make these connections will be presented, from warming experiments across biomes. Quantitative field-based microbial ecology can push the field by revealing the biology and evolution of the key drivers of important feedbacks to the changing climate and atmosphere, and may help identify organisms that are especially effective in promoting the ecosystem processes that protect the climate.