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Advances in next generation sequencing technologies, omics, and bioinformatics are revealing a tremendous and unsuspected diversity of microbes, both at a compositional and functional level. Moreover, the expansion of ecological concepts into microbial ecology has greatly advanced our comprehension of the role microbes play in the functioning of ecosystems across a wide range of biomes. Super-imposed on this new information about microbes, their functions and how they are organized, environmental gradients are changing rapidly, largely driven by direct and indirect human activities. In the context of global change, understanding the mechanisms that shape microbial communities is pivotal to predict microbial responses to novel selective forces and their implications at the local as well as global scale. One of the main features of microbial communities is their ability to react to changes in the environment. Thus, many studies have reported changes in the performance and composition of communities along environmental gradients. However, the mechanisms underlying these responses remain unclear. It is assumed that the response of microbes to changes in the environment is mediated by a complex combination of shifts in the physiological properties, single-cell activities, or composition of communities: it may occur by means of physiological adjustments of the taxa present in a community or selecting towards more tolerant/better adapted phylotypes. Knowing whether certain factors trigger one, many, or all mechanisms would greatly increase

confidence in predictions of future microbial composition and processes. This Research Topic brings together studies that applied the latest molecular techniques for studying microbial composition and functioning and integrated ecological, biogeochemical and/or modeling approaches to provide a comprehensive and mechanistic perspective of the responses of micro-organisms to environmental changes. This Research Topic presents new findings on environmental parameters influencing microbial communities, the type and magnitude of response and differences in the response among microbial groups, and which collectively deepen our current understanding and knowledge of the underlying mechanisms of microbial structural and functional responses to environmental changes and gradients in both aquatic and terrestrial ecosystems. The body of work has, furthermore, identified many challenges and questions that yet remain to be addressed and new perspectives to follow up on.