Cold environments as “hot spots” for Microbial adaptation and evolution: Arctic snowpacks in the context of change

C. LAROSE, L. MACCARIO, L. SANGUINO-CASADO, A. DOMMERGUE AND T. VOGEL

Snow cover is a dynamic habitat with a limited lifetime that acts as a medium and a mediator transmitting and modifying interactions among microorganisms, plants, animals, nutrients, the atmosphere and soil. Due to the cold conditions and the limited supply of liquid water, snow has long been considered as an entrapment and storage system for microorganisms, nutrients, soluble inorganic and organic matter and contaminants delivered by wet and dry deposition. However, this view has begun to change with the publication of a number of studies that examined microbial diversity, ecology, and function in the cryosphere. Recent reports suggest that microorganisms impact nutrient dynamics, composition and abundance, that they may shift surface albedo of snow and ice and that they impact hydrochemistry. Despite our increased knowledge of snowpack microbial community structure and dynamics, important questions remain as to the functional potential of these communities and their role in modifying and adapting to snow ecosystems, especially in the context of biogeochemical cycling and climate change. Here, we explored both microbial community structure and function in Arctic snowpacks (Greenland and Svalbard) by applying a global approach using metagenomics and metatranscriptomics. Microbial community structure and function at different seasons (spring, summer, winter) were also compared. The biogeography of Arctic microbial communities appears to be influenced by environmental factors, such as snow physics and chemistry relative to geographic distance. Snow metagenome analyses demonstrated major shifts in function distribution during the season indicating that the snowpack is a dynamic ecosystem. The results from this study offer insights into how arctic microorganisms are interacting with their environment.