LONG-TERM WARMING LED TO SOIL CARBON LOSS AND MICROBIAL ACCLIMATION IN ICELANDIC GRASSLANDS

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Carbon dioxide levels and global temperatures are rising steadily. Soil microorganisms have key roles in ecosystem and climate feedbacks to these changes. Whether soil becomes a source or sink of greenhouse gases in a warmer future depends on complex and iterative feedback processes between the vegetation, soil carbon and nitrogen pools and the microbiota, but microbial responses to long-term warming are not yet understood.

Here we show how microbiota in sub-Arctic grassland soils warmed at 6°C above ambient temperatures for eight (8y) and more than 50 years (50y) have reached different states compared to control plots (+0°C), as demonstrated by altered soil composition and different microbial gene expression patterns. The warmed soils were characterized by reduced contents of carbon, nitrogen, phosphorus, microbial biomass, and RNA. Microbial gene expression for e.g. glycolysis, lipid metabolism, and amino acid metabolism was higher in both the 8y and 50y warmed soils while gene expression for the microbial transcriptional and translational machinery was lower. We saw a substantial reduction in the number of fungal, protist, *Actinobacteria* and *Chloroflexi* transcripts, while *δ*- and *α-Proteobacteria*, *Planctomycetes*, *Verrucomicrobia* and viral transcripts increased after 50y warming. After 8y warming the number of transcripts for only a few bacterial families within *α-Proteobacteria* and *Actinobacteria* increased.

We conclude that increased temperatures and decreased availability of carbon and nitrogen trigger microbial investments into carbon, nitrogen and energy metabolisms, while RNA and protein metabolisms are downregulated. These substantial changes in microbial behavior are associated with sustained decomposition rates despite reduced microbial biomass and substrate availability after long-term soil warming.