Title: Mechanistic modeling of methane cycle at SPRUCE

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Summary:

This project will improve and apply a highly mechanistic microbial functional group based model to understand and predict methane (CH_4) cycling at SPRUCE. Our recently developed methane model considers four key mechanisms for CH_4 production and consumption: methanogenesis from acetate or from single-carbon compounds and CH_4 oxidation using molecular oxygen or other inorganic electron acceptors. Four microbial functional groups perform these processes: acetoclastic methanogens, hydrogenotrophic methanogens, aerobic methanotrophs, and anaerobic methanotrophs. Incorporated into Community Land Model (CLM), the module is further used to integrate measurements of CH_4 fluxes and mechanisms of CH_4 production and consumption obtained from SPRUCE project to better understand and predict soil biogeochemical processes in response to warming and elevated CO_2.

The primary tasks include, (1) understanding the dynamics of dissolved organic carbon, acetate acid, carbon dioxide and methane along soil profile; (2) understanding acetoclastic methanogenesis, hydrogenotropic methanogenesis, aerobic methanotrophs, and anaerobic methanotrophs along soil profile; (3) examining how these biogeochemical processes along soil profile contribute to the surface CH_4 flux; (4) predicting the impacts of whole-ecosystem warming and elevated CO_2 on the below-ground soil biogeochemical processes and thus the surface CH_4 flux.

This project integrates the data from research groups of microbial genomics and soil biogeochemistry within SPRUCE and contributes to the ongoing development of CLM_SPRUCE and ACME models.