Geophysical Research Abstracts
Vol. 21, EGU2019-17099, 2019
EGU General Assembly 2019

Warming does not lead to soil carbon loss in alpine grasslands on the Tibetan Plateau

Biao Zhu, Yin Chen, and Yanhui Hou

Institute of Ecology, College of Urban and Environmental Sciences, Peking University, Beijing, China (biaozhu@pku.edu.cn)

The response of soil carbon storage to warming is critical for the climate due to the large flux of carbon between soil and atmosphere. Despite evidence that warming enhances carbon fluxes to and from the soil, how soil carbon stock respond to warming remains uncertain. Here we combine three complementary methods to explore the responses of soil carbon stock to warming in the alpine grassland on the Tibetan Plateau. These methods include sampling sites along temperature (elevation) gradients, measuring soils from two OTC warming experiments, and conducting a meta-analysis of field warming experiments across the plateau.

Firstly, we sampled soils along two elevational gradients with similar vegetation (Kobresia meadow): 3200-4200 m on Mt. Qilian and 4400-5200 m on Mt. Nianqingtanggula. In the first gradient, with decreasing elevation (or warming), belowground biomass (BGB) did not change, while aboveground biomass (AGB), microbial biomass carbon (MBC) and soil organic carbon (SOC) all increased. In the second gradient, with decreasing elevation (or warming), AGB did not change, while BGB, MBC and SOC all declined. Moreover, the turnover rate of bulk SOC estimated by its 14C content, did not show clear trend with elevation in both gradients. These results suggest the responses of SOC dynamics to warming were inconsistent along the two elevation gradients.

Secondly, in a seven-year OTC warming experiment in an alpine meadow (Kobresia humilis), four different levels of warming (0.4∼2.0 C) with or without clipping, did not have significant effect on AGB, BGB, MBC, SOC and its two fractions (particulate organic matter (POM) and mineral-associated organic matter (MAOM)). Moreover, in a 20-year OTC warming experiment in two alpine meadows (dominated by Kobresia humilis and Potentilla fruticosa respectively), warming by 1-2 C did not change AGB, BGB, MBC, SOC and its two fractions (POM and MAOM), except that it reduced microbial biomass (MBC) and necromass (amino sugar) and MAOM-C in the surface soil of Potentilla fruticosa meadow.

Finally, the meta-analysis of all existing warming experiments in alpine grassland on the plateau showed that warming overall had a minor effect on soil carbon stock. Such minor effect was independent of ecosystem (meadow or steppe), and the method, magnitude and duration of warming. Although evidence from more long-term, coordinated and distributed experiments and data from subsoils and permafrost are needed, our integrative analysis suggests that warming may not lead to soil carbon loss in alpine grasslands on the Tibetan Plateau.