Poster #1-36

Assessing the Degradation State of Soil Organic Matter in the Permafrost Region

Julie Jastrow[1*], Callie Sharp[1], Clara Deck[2], Timothy Vugteveen[1], Scott Hofmann[1], Roser Matamala[1], Jeremy Lederhouse[1], Gary Michaelson[3], Umakant Mishra[1], and Chien-Lu Ping[3]

[1] Argonne National Laboratory, Lemont, IL
[2] University of Maine, Orono, ME
[3] University of Alaska Fairbanks, Palmer, AK

Contact: jdjastrow@anl.gov

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Project Website: http://tessfa.evs.anl.gov/

The composition and potential decomposability of soil organic matter (SOM) in the permafrost region are key uncertainties in efforts to predict carbon release from thawing permafrost. The cold and often wet environment is the dominant factor limiting decomposer activity, and SOM is often preserved in a relatively undecomposed state that can be poorly associated with soil minerals. Thus, the impacts of climatic change on future SOM mineralization rates are likely to depend at least initially on the existing degradation state of SOM. Physical size fractionation is a commonly used method for characterizing and classifying the relative degradation state of peats and organic soils, with decreasing size being indicative of greater decomposition. Similarly, for mineral soils, size fractionations are used to isolate relatively undecomposed particulate organic matter (POM) from SOM that is more decomposed and/or occurs in association with soil minerals. Given that permafrost-region soils range from peats to low-carbon mineral soils and environmental conditions constrain the rate of plant residue decomposition, we are exploring size fractionation as an indicator of the relative degradation state of SOM for this region. Further, we are investigating whether the mid infrared (MIR) spectra of un-fractionated bulk soils can be used to predict the distribution of SOM among size fractions. To date, we have size-fractionated over 500 soils representing a range of vegetation types, parent materials, and genetic horizons (with <0.2 to >49% organic C) across a latitudinal transect from the Kenai Peninsula to Utqiaġvik, Alaska. A large proportion of bulk SOM was found in POM pools for all soil horizon types. Even for mineral horizons, about 40% (on average) of bulk soil organic carbon occurred as POM, indicating that SOM was relatively undecomposed compared to that of typical mineral soils in more temperate regions. Analyses using a subset of these samples confirmed that the MIR spectra of bulk soils can be calibrated to reasonably predict the distribution of SOM among size fractions for permafrost-region soils. We are currently evaluating the capability of these calibrations to predict the size-distribution of SOM for the remainder of the dataset, which includes samples from independent locations. Successful development of MIR calibration models could enable widespread, high-throughput estimates of the relative degradation state of SOM stocks across the permafrost region, which are needed to benchmark and constrain local, regional, and earth system models.