Soil Organic Matter Response to Climate Warming in a Subarctic Peatland

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Introduction

Climate change will result in increased temperature of northern latitudes ultimately affecting carbon (C) cycling of peatland ecosystems. Increased temperature will likely alter the balance of primary production and decomposition in peatlands, yet the magnitude of biological responses is poorly understood. At an experimental warming site of a peatland in Northern Sweden, respiration rates increased during the summer and spring after nine years of ~1°C increased warming treatments[2]. Soil organic matter (SOM) quality is a strong regulator of peat respiration in response to increased temperature; therefore, ^{13}C Solid State NMR was used to determine SOM chemical composition and humification index after 15 years of warming.

Experimental

Warming treatments of increased soil temperature of 1°C were ambient, winter warming, winter and summer warming (no spring), and year round warming. Upper 20 cm of the peat was sampled and divided into live vegetation (L), active acrotelm (A), and more decomposed catotelm (C) layers. Soil below 20 cm (D1 and D2) was sampled until reaching frozen soil or rock. CPTOSS ^{13}C Solid State NMR sprectra of dried, ground samples were obtained using a Bruker Avance II 500 MHz Spectrometer with a 3.2 mm H/C/N MAS probe at the AMRIS Facility. Spectra peaks were integrated to determine percent of C functional groups: carboxyl, aromatic, O-alkyl, methoxyl, and alkyl. Humification Index was calculated as ⇧ alkyl/O-alkyl.

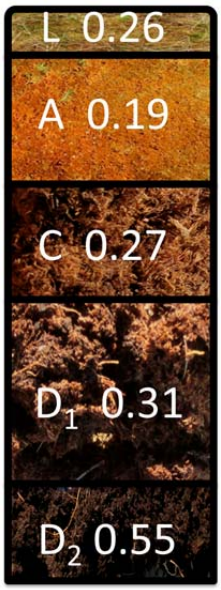

Fig.1 Carbon quality of the peat horizons based on the average humification

Results and Discussion

SOM functional groups changed through soil profile: decreased aromaticity and O-alkyl (labile C) and increased alkyl and humification index. The humification index (alkyl/O-alkyl) is an index of organic matter stability and decomposition relating to the progressive decrease of carbohydrates and increase of lipids, lignin, and humification[2]. Soil surfaces of no spring and year warming treatments were elevated by up to ~20 cm compared to ambient and winter warming. Lower humification index of 0.19±0.02 for 0-20 cm year warming soil and increased elevation may be due to accelerated accretion of labile SOM organic matter. More labile SOM in year warming soil from 0-20 cm may contribute to the significant increase in respiration measured by Dorrepaal et al.[1]

Conclusions

Results from this study suggest that climate warming may have two affects: 1) increased inputs of labile SOM material due to augmented primary productivity and 2) higher respiration rates due to processing a larger concentration of labile inputs.

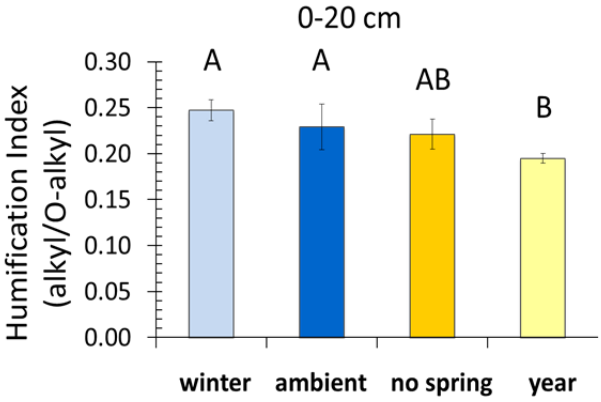

Fig. 2 Humification index for 0-20 cm soil significantly decreased from ambient and winter warming to year warming.

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References

[1] *Dorrepaal, E. et al., Nature,* ***460****, 616-619 (2009).*
[2] *Baldock, J.A. et al., Australian Journal of Soil Research,* ***35:5****, 1061-1083 (1997).*