Geophysical Research Abstracts
Vol. 15, EGU2013-5014, 2013
EGU General Assembly 2013

Breath from the little ice age makes non-sorted circles CO_2 sources

Marina Becher, Johan Olofsson, and Jonatan Klaminder
Department of Ecology and Environmental Science, Umea University, Umea, Sweden

The mass-movement of soil induced by differential heave and thaw cycles (cryoturbation) is thought to reduce respiration losses from high latitude soils as it translocate carbon into cold mineral soil layers where microbial processes proceeds at slow rates (Bockheim, 2007). However, it is not straightforward to always view cryogenic processes as processes that contribute positively to the build-up of carbon in patterned ground systems, such as non-sorted circles. In these systems differential heave and ice-formation may affect plant growth negatively and thus lower the carbon input to the soil. In this study, we test the hypothesis that; increased cryogenic activity within non-sorted circles reduces the rate in which plant fixate CO_2 from the atmosphere.

To test our hypothesis we measured gross ecosystem photosynthesis (GEP) and soil respiration (R) in 3 fields of non-sorted circles (total amount of 15 circles, total 190 measurements) formed along a permafrost gradient close to Abisko, Northern Sweden. Measurements were conducted every second week for one summer and GEP and R fluxes were used to calculate the net ecosystem exchange (NEE) of CO_2 in the fields. In the fields, the churning of carbon into mineral soil layers by cryoturbation occurred mainly in the past under different climatic conditions, i.e. mainly during the little ice age and a period around 1100 AD as indicated by 14C dating (Becher et al., 2013).

In contrary to our hypothesis, we did not find any major difference in GEP between the fields in the permafrost gradient that seems to depend on contemporary cryogenic activity in the centre of the circles. However, we note that all circles respired more carbon than was fixated by photosynthesis. We therefore suggest that respiration losses from the pool buried mainly during the little ice age is strongly affecting the carbon balance of the circles. Consequently, non-sorted circles in northern Sweden may currently act as carbon sources.

References

Becher, M., C. Olid, and J. Klaminder, 2013. Buried Soil Organic Inclusions in Non-sorted Circles Fields in Northern Sweden: Age and Paleoclimatic Context. J. Geophys. Re., in press.
Bockheim, J.G., 2007. Importance of Cryoturbation in Redistributing Organic Carbon in Permafrost-Affected Soils. Soil Sci. Soc. Am. J., 71:1335-1342.