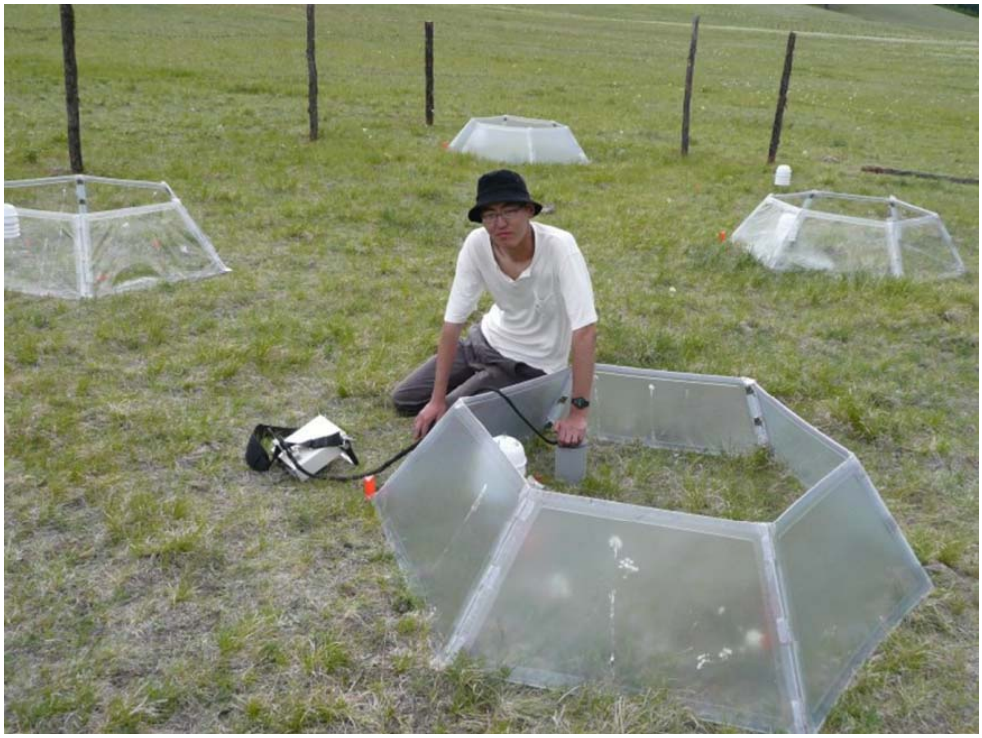
Application Note

Measurement of soil CO_2 efflux under experimental warming in Northern Mongolia



Some of the most extreme temperature increases associated with global climate change are expected to occur in northern Mongolia, and increases in both temperature and the length of the growing season are already apparent (Nandintsetseg and Goulden 2003). The ecology around Lake Hövsgöl in northern Mongolia is of special interest because taiga forest and steppe grasslands come together there and are under two strong ecological pressures: (1) increases in overgrazing as local culture changes to a more sedentary lifestyle, and (2) increases in mean temperature and length of growing season driven by the climate change trends in high latitude locations.

One component of an international collaborative project funded by NSF and led by Drs. Peter Petraitis, Brenda Casper, Brent Helliker of the Department of Biology and Dr. Alain Plante of the Department of Earth & Environmental Science at the University of Pennsylvania will examine how further increases in atmospheric temperature and livestock grazing will affect plant communities and soil processes. In a pilot study, passively heated open topped chambers (OTC's) constructed of a fiberglass material that transmits visible but not infrared radiation were placed in the steppe grassland of Dalbay valley on the eastern shore of Lake Hövsgöl to raise soil and air temperatures. Over a two-week period during peak growing season, the chambers raised above-ground temperatures an average of 2.4°C compared to adjacent locations without chambers.

Increased soil temperature was expected to increase decomposition of soil organic matter and rates of soil respiration (Raich and Schlesinger 1992; Rustad et al. 2001). Soil respiration was measured daily inside and outside the chambers using an EGM-4 Environmental Gas Monitor for CO_2 and SRC-1 closed system chamber.

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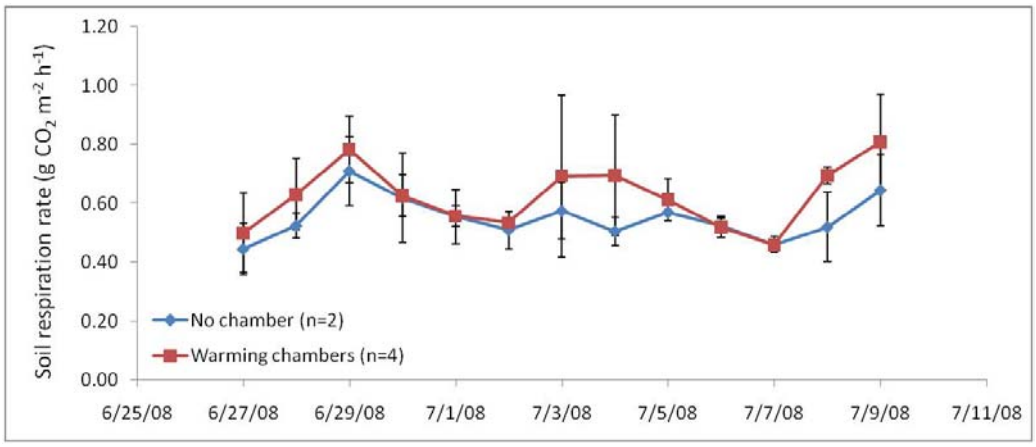

Measured soil CO_2 efflux rates were higher in the warming chambers compared to adjacent control locations. It is possible that increases in respiration rates will exceed increases in plant productivity, resulting in a net loss of ecosystem carbon in this steppe grassland area.

Thank you to Dr. Alain Plante (Assistant Professor of Soil Biogeochemistry, Univ. of Pennsylvania, Philadelphia, PA USA) for providing the information contained in this application note.

Nandintsetseg B., Greene J.S. and Goulden C.E. 2007. Trends in extreme daily precipitation and temperature near Lake Hovsgol, Mongolia. International Journal of Climatology 27: 341-347.

Raich J.W. and Schlesinger W.H. 1992. The global carbon dioxide flux in soil respiration and its relationship to vegetation and climate. Tellus Series B-Chemical and Physical Meteorology 44: 81-99.

Rustad L.E., Campbell J.L., Marion G.M., Norby R.J., Mitchell M.J., Hartley A.E., Cornelissen J.H.C. and Gurevitch J. 2001. A meta-analysis of the response of soil respiration, net nitrogen mineralization, and aboveground plant growth to experimental ecosystem warming. Oecologia 126: 543-562.

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