Geophysical Research Abstracts
Vol. 12, EGU2010-2988, 2010
EGU General Assembly 2010

Carbon Dynamics of Forest Floor and Stem in Black Spruce Forest Soils, Interior Alaska

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Our automated open/close chamber system (AOCC) consists of eight chambers, a pump, CO_2 gas analyzer, and a datalogger for CO_2 data on the lichen, tussock, feather moss, and sphagnum moss of a black spruce forest, Interior Alaska, during the growing seasons of 2007 and 2008. During the observing periods of 2007 and 2008, the seasonal NEE was 0.127 ± 0.049 and -0.039 ± 0.025 $mgCO_2/m^2/s$ in tussock regime, and 0.006 ± 0.011 and 0.028 ± 0.017 $mgCO_2/m^2/s$ in sphagnum moss, respectively. Air temperature is a more significant regulator than soil temperature in determining the GPP and Re of forest floor vegetations. Air temperature explained 77–95% of the variability in GPP and Re of the floor vegetations. The contributions (%) of simulated seasonal GPP to the black spruce forest during non-growing periods (DOY 1–120 and 244–365) and during the growing period (DOY 121–243) of 2007 are 63–72%, 20–25%, and 8–18%, respectively. This indicates that the floor CO_2 exchange, as well as the contribution of winter carbon emission, is a component of the regional carbon budget that cannot be neglected. As the result of simulated GPP and Re in tussock during 2007, tussocks are found to have on atmospheric CO_2 release, similar to results of observation for 63-day of 2007.

On the other hand of stem respiration rates of black spruce (*Picea Mariana*), the continuous measurement of stem respiration was conducted in black spruce stands of different ages (4.3 to 13.5 cm in DBH) in Interior Alaska during the growing seasons of 2007 and 2008, using a pump, CO_2 analyzer, chambers, and data-logger. The averaged whole stem respiration rate is 0.011 ± 0.005 $mgCO_2/m^2/s$ (range 0.005 ± 0.002 to 0.015 ± 0.008 $mgCO_2/m^2/s$, CV 45%) in black spruce stands, indicating remarkably diurnal and seasonal variations of stem respiration among the stems during the growing season. It is found that metabolism exhibits 1.5-fold higher in the younger black spruce stand than in the older. Temperatures in the air and stem are significant regulators in determining stem respiration. The annual stem respiration rates simulated by Q_{10} value based on air temperature are 41.2 and 36.8 gC/m^2during 2007 and 2008, respectively, which corresponds to 5.2 and 5.0% of ecosystem respiration and GPP during 2007. This suggests that stem respiration is a significant component in the scaling-up of the regional carbon budget in a black spruce forest, Interior Alaska. Quantification of the effects of regional change on the black spruce forest carbon balance and atmosphere-forest interactions requires a better understanding of respiration response.