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# Wintertime CO$_{2}$ efflux along the trans-Alaska pipeline

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This research was conducted to estimate $CO_2$ efflux through the snowpack along the trans-Alaska pipeline (ca. 660 km) from 2005 to 2010 during the winter season. The pipeline is existed along the boreal forest and tundra of Alaska. *In-situ* Wintertime $CO_2$ efflux was measured with a dynamic chamber system that consisted of a chamber (22 cm in diameter and 6 cm high), pump, NDIR ($CO_2$ analyzer), and a laptop computer. Soil temperature and snow depth were measured with a portable thermocouple and from snow pit-wall. The difference in wintertime $CO_2$ efflux was remarkably showed in boreal forest and tundra during last six winter seasons, suggesting the latitudinal $CO_2$ efflux gradient. The efflux was also presented inter-annual variation, indicating the temperature dependence. This may be due to the difference of observation period (e.g., January, February, March, and April). Mean $CO_2$ efflux was 0.43$\pm$0.17 $gCO_2$-C/$m^2$/day in soil temperature of -12$\pm$4.7 ˚C during the seasonally snow-covered period, and 0.88$\pm$0.51 $gCO_2$-C/$m^2$/day in soil temperature of -1.8$\pm$3.0 ˚C during the snow-thawing period. Before and during the snow-thawing season of 2010, mean $CO_2$ efflux between both seasons appeared to show the magnitude of an order. The efflux ranged from 0.021$\pm$0.004 $gCO_2/m^2$/day near coastal tundra to 1.7$\pm$0.24 $gCO_2/m^2$/day in white spruce forest during the snow-thawing season. A relationship between mean $CO_2$ efflux at each site and mean soil temperature at 5 cm below the surface along the trans-Alaska pipeline is a good exponential, which the equation is as follows: $CO_2$ *efflux* = $885 \cdot exp(0.335 \cdot Ts)$ ($R^2$=0.86; $p<0.001$). $CO_2$ efflux in a white spruce forest during the snow-thawing season is measured in four directions from the bottom stem. The measurements show apparent differences of $CO_2$ efflux between the exposed soil and the snow-covered soil in the four directions. This may be due to the fast decomposition of soil organic carbon and/or active root respiration in the exposed soil caused by strong radiation in the spring. The efflux increases in the order of east, south, west, and north at 60 cm from the stem. Although the snow-thawing period is relatively short, $CO_2$ efflux during that season in white and black spruce forest soils of Alaska should not be overlooked.