Influence of Snow Cover Area on Net Ecosystem Exchange during Snowmelt at Daring Lake, NWT

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EXTENDED ABSTRACT

A significant portion of the biospheric flux of CO_2 (net ecosystem exchange, NEE) occurs during the snow season in Arctic regions. During snowmelt, spatial and temporal patterns of NEE are influenced by the distribution of snow (Elberling *et al.* 2008). To date, model estimates of net ecosystem exchange (NEE) have not included a representation of cryospheric influences on NEE.

The main objective of this study was to assess the potential for incorporating estimates of snow cover area in models of NEE. This was accomplished by examining: 1) temporal associations between snow cover depletion, soil temperature, air temperature and NEE; 2) the fit of Landsat observations of snow cover area against game camera observations at the sub-pixel (<30m) and regional (1/3^o) scale over four sites; 3) the influence of snow cover area on NEE; and 4) the potential for NEE to be estimated as a function of snow cover area. This study was conducted at a low Arctic site (64^{o}N, 111^{o}W) characterized by 200-300mm in annual precipitation and a mean annual temperature of -12.5 to -10.5 C (Lafleur *et al.* 2008), and containing locations of fen, mixed shrub and tall shrub tundra.

Findings from this project indicated that snowmelt induces an increase in soil respiration, followed by a rise in photosynthetic uptake of CO_2. The low thermal conductivity of snow also decouples soil and air temperatures, and these accordingly become more closely associated following snowmelt. Landsat estimates of local snow cover area agree well (<7 days) with local scale observations of the timing of <50% snow cover area. Regional (1/3^o) scale estimates of snow cover area were affected by cloud cover and the presence of snow on lakes, resulting in earlier estimates of snowmelt onset and later estimates of snowmelt end, respectively. However, the timing of <50% snow cover area from interpolated observations at both the pixel and regional scale agreed well with sub-pixel scale observations from game cameras.

Estimates of NEE during snowmelt from a diurnal sin function and remote sensing estimates of snow cover area indicated good fit. Parameters developed for the mixed tundra and fen sites were applied to generate estimates of NEE at the mixed tundra site from a diurnal function and snow cover area (May to June, 2004-2006). The normalized root mean squared error (NRMSE) values for these estimates ranged from 7-16%. NEE for 2004-2006 was then estimated using the diurnal function and regional (1/3^o) estimates of the timing of <50% snowcover. The NRMSE values for these estimates ranged from 9-19%. Using non-site-specific parameters did not increase the error values found. A potential may therefore exist to reduce uncertainty in model estimates of Arctic NEE during snowmelt using regional scale remotely sensed estimates of snowmelt timing.

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