Geophysical Research Abstracts
Vol. 12, EGU2010-12174-2, 2010
EGU General Assembly 2010

Linkage between seasonal hydrology and carbon flux dynamics in tundra ponds: Samoylov Island, Lena River Delta, Siberia

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Arctic ponds have been recently recognized as being highly sensitive to changing climate. To date, ponds and lakes are disappearing in Alaska, Siberia and Canadian High Arctic because of climate warming (Fitzgerald et al. 2003; Smith et al. 2005; and Smol et al. 2007). While numerous limnological studies have been done on arctic ponds located in the Canadian High Arctic (Douglas and Smol, 1994; Hamilton et al. 2001; Lim et al., 2001), there is a limited number of studies on tundra ponds located in other circumpolar environments (e.g. Northern Siberia). Duff et al. (1999) describes tundra lakes in northern Russia as clear, dilute, oligotrophic lakes with low nutrients and dissolved organic carbon concentration. While numerous ponds and lakes exists in the Lena River Delta averaging to 2120 lakes of all sizes for every 1000 km2, no studies have been done to understand carbon flux dynamics of these freshwater ecosystems.

In this study hydrological monitoring based on water balance framework was applied to a series of ponds and lakes located on Samoylov Island, 120 km south of the Arctic Ocean in the southern central Lena River Delta (72º 22' N, 126 º 30' E) from July to September 2008. To better understand spatial differences in pond hydrology and carbon flux dynamics, the physical and biochemical data was collected from 42 tundra ponds. The selection of the ponds was based on their size (small, medium, large) and depth values ranging from 10 to 120 cm. The estimation of the seasonal water budget in 2008 showed that losses through evapotranspiration were offset by similar precipitation inputs and resulted in the equilibrium storage values in the study ponds prior to the freeze-back. Preliminary analysis showed that more than 50% of the ponds had DOC > 6.5 mg/l which exceeds average value of other Arctic ponds reported in literature (Duff et al. 1999 and Hamilton et al. 2001). Elevated DOC concentrations (> 8 mg/l) were found in the small and medium ponds with depth values ranging from 15 to 30 cm. The values of other environmental variables were significantly correlated with high correlations among Ca, Mg and Sr (r = 0.89 to 0.92). Similar to Duff et al. (1999) significant but weak correlations were found between conductivity, Al, Ca, Fe, Mn and DOC values. While arctic pond ecosystems are highly sensitive to the harmful effect of ultraviolet radiation, such elevated DOC values in the study ponds might contribute to better resilience of the pond ecosystem.