Thermokarst lake history and stable tundra vegetation since the 18th century in a Low Arctic setting
Yukon Territory, Canada

Research Questions
1. How did the regional vegetation react to recent climatic warming?
2. How did the lake basin develop during the last centuries?

Key findings
1. Stable regional vegetation during the last 300 years, slight increase of extraregional Alnus over the last century
2. Higher amount of lake marginal vegetation pre 1910 → lake level changes.

Results

Figure 1. Location of study area. (a) The studied lake is situated on the Yukon Coastal Plain within the reconstructed limit of Glacial maximum (white line). Map based on Landsat imagery. (b) Sedges, mosses and dwarf shrubs characterize the flat treeless landscape (photograph of studied lake: J. Walker). (c) The short core from a thermokarst lake was retrieved from a rubber dinghy using a gravity corer.

Figure 2. Pollen percentage diagram. The pollen sum is based on terrestrial pollen excluding Cyperaceae and Ranunculaceae taxa, which represent semiaquatic vegetation in the core.

Figure 3. Principal component analysis biplot. The sample scores from the upper part of the core (Zone 2) differ from sample scores from the lower part (Zone 1).

Figure 4. Age depth model based on 210Pb/137Cs dating. The filled dots represent 210Pb/137Cs dates, the open dots are extrapolated from the mean of dated samples. Dots with error bars represent AMS 14C dates which are within a similar range but show a much higher uncertainty and were not used in the age model.

Figure 5. Stratigraphic diagram of semiaquatic and sedimentary parameters.

Discussion
1. Recent climatic warming and related vegetation change

The regional climatic warming that took place during the last century (Burn and Zhang 2009, Figure 6) is not well represented in the pollen record. The local to subregional vegetation largely remained stable. We attribute the slight increase in Alnus pollen since about AD1910 to either an approaching Alnus shrubline or an increase in Alnus within its current distribution range south and east of the study area.

2. Lake level changes

Changes in organic carbon content and carbon to nitrogen ratio are in accordance with changes in pollen from semiaquatic vegetation (Figure 5). We attribute this to changes in lake marginal vegetation productivity and fluctuations in the ratio of aquatic to terrestrial vegetation debris. We suggest that either partial draining and refilling (Figure 7b) or geomorphological change caused by thawing permafrost (Figure 7c) led to a lower and more variable lake level.