Geophysical Research Abstracts
Vol. 16, EGU2014-9459, 2014
EGU General Assembly 2014

The Late Quaternary environmental history and identification of teleconnections that contribute to natural climate variability in the Northwest Territories, Canada

Andrew Macumber (1), R Timothy Patterson (1), Jennifer M Galloway (2), Hendrik Falck (3), and Graeme T Swindles (4)

(1) Ottawa Carleton Geoscience Center, Carleton University, Ottawa, Canada (andrewmacumber@cmail.carleton.ca), (2) Geological Survey of Canada, Calgary, Canada, (3) Northwest Territories Geoscience Office, Yellowknife, Canada, (4) Leeds University, Leeds, United Kingdom

Recent climate changes affecting the Canadian Subarctic have prompted policy planners to seek a better understanding of regional climate variability and the associated environmental response. The dearth of consistent long-term instrumental records greatly hinders accurate modeling of regional climate. Previous studies have tracked temporal changes in treeline movement at a centennial scale but this resolution is insufficient for the identification of the oscillatory nature of large scale oceanic and atmospheric climate systems that contribute to regional climate variability. Regional climate models would also benefit greatly from a thorough understanding of the possible range of environmental responses; translating future climate in terms of environmental impact.

Oceanic climate anomalies, such as the El Niño/Southern Oscillation and the Pacific Decadal Oscillation, contribute to continental climate variability via global teleconnections. Little is known about which of these systems modulate the Canadian Subarctic and if so to what extent. Our goal was to analyze proxy time series for waveform patterns similar to those of oceanic and atmospheric climate systems. Deposition of sediment into lakes is affected by various catchment processes sensitive to climate variability, including: sediment availability, changes in snowpack, presence or absence of vegetation, and average precipitation. Particle size distributions (PSD) of lake sediment represent a mixing of depositional processes. Thus the variability of PSD over time reflects the variability in catchment conditions. We employed end member analysis to 'unmix' the PSD and construct time series of their relative abundance. We then performed spectral and wavelet analysis and were successful in identifying several periodicities similar to those of known climate systems.

Biotic proxies are an important tool for tracking historical environmental conditions due to their sensitivity to environmental change and subsequent preservation in lake sediment. We utilize Arcellacea (testate lobose amoebae), an epibenthic freshwater protist, valued for their rapid generation times, resistance to dissolution and great abundance in lake sediment. A suite of limnological, geochemical, physical and sedimentological parameters collected from 56 lakes spanning North from Yellowknife into the southern arctic ecozone of the Northwest Territories was used to characterize lakes and the arcellacean populations they contain. We observed a shift in community structure across the treeline ecotone confirming that arcellaceans are a valuable proxy for tracking treeline movement. This information coupled with downcore studies of ancient arcellacean populations was used to reconstruct the environmental history for the region and constrain the range of environmental response to past climate variability.

The identification of climate systems that contribute to regional climate variability will greatly improve the accuracy of regional climate models. Understanding the range of environmental responses to historic climate variability will allow future climate scenarios to be translated in terms of environmental impact. This knowledge is valued by policy planners as it will facilitate their assessment of present and future infrastructure in the Canadian Subarctic.