Paleoclimate reconstructions using lake sediment geochemistry: implications for GCM validations

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Recently, it has been shown that a one thousand year temperature history produced by the ECHO-g General Circulation Model (GCM) was in good agreement with regional borehole paleoclimate reconstructions for the same period. This is an exciting result in the validation of GCM data, but boreholes lack relevant details about small-scale temperature variation and changes surface hydrology, which could be instrumental to GCM validation at high spatial resolutions. Biological and geochemical signals in lake sediment cores have long been used to reconstruct past climates, often with better resolution than is available through borehole techniques. Geochemically, lake sediments can offer insight into past temperatures through the abundance of stable oxygen isotopes found in carbonate shells and sediments. Similarly, watershed paleohydrology can be inferred based on both sediment size analysis and C/N ratio of organic matter, which reflects the amount of terrestrial organic matter being deposited in the lake environment and thus, paleoflow conditions. Other lake sediment proxies are also available for examining natural and anthropogenically induced changes in the watershed and lake environments. Stable isotopes of carbon can be used to examine lake paleoproductivity, which may also reflect changes in paleotemperature and paleohydrology. Deposition of bedrock compounds such as sulphate can also be a useful tool to examine the intensity of weathering processes or possibly reveal changes in watershed acidification due to acid rain events. The objective of this study is to undertake a thorough characterization of these geochemical parameters from two lake cores in Antigonish County, and attempt a detailed multi-proxy reconstruction of watershed and lake paleoenvironment. The results of geochemical analyses will be calibrated using available instrumental data for the area, yielding quantitative data on environmental changes in the area. This work could provide a basis for larger and more comprehensive regional studies, which can eventually be used to validate the small-scale changes in temperature and precipitation predicted by GCM's such as ECHO-g.