Geophysical Research Abstracts,
Vol. 10, EGU2008-A-11811, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-11811
EGU General Assembly 2008

Deterministic hydrological model to reconstruct the last 400 years of runoff and climate variations using the properties of the varved lake sediments in the Canadian Arctic

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The aim of this study is to develop a deterministic hydrological model in order to reconstruct the last 400 years of runoff using the properties of varved sediments from Sawtooth Lake-Ellesmere Island. Varved sediments can provide well-constrained records of interannual-to centennial-scale variation of climatic and hydrologic cycles, such as the North Atlantic Oscillation and Arctic Oscillation. Using image analysis technique of microscopic views, we can determine some properties of varved sediments, including the grain size of each year of sedimentation. Grain size and sediment input are mainly controlled by complex hydroclimatic processes within the watershed and such a direct correlation is not obvious. In order to better understand the relation between meteorological data and the waterflow to the lake, we developed a hydrological model. This deterministic model is based on a simple water balance equation at the scale of the watershed and uses the following parameters: the runoff, the evapotranspiration, the snowmelting and the soil's humidity storage. To estimate the evapotranspiration, Penman-Monteith's model was used. The snow melting was determined using the concept of "degree day". The model forced by climatic data successfully reproduced the flow measurements obtained during 1998. Moreover, the predicted runoff correlates well with the varves properties for the last 50 years. Hence, we used our model to reconstruct the climate of the last 400 years using the varved sediment. Our reconstruction compares well with the decadal and multi-decadal variations of the

North Atlantic Oscillation and Arctic Oscillation.