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200 years of water supplies spatiotemporal variations in northern Québec (Canada) and their relationships with atmospherics and teleconnexion indices.

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The La Grande hydro power generation system is the most important hydropower system in North America. This hydro generation system is located in northern Quebec (eastern Canada), a remote area in which long-term hydrological series are lacking. The longest time series covers a maximum of five decades. Thus, the current knowledge on long-term hydrological natural variability is limited and this may have a significant impact on the decisions related to power generation planning. Natural proxies are, in this case, the best alternative for the extension of the climatic series beyond instrumental records. In the absence of lacustrine laminated sediments, tree-ring series represent the only natural indicators available in the area. In this high boreal climate, trees provide two types of indicators: riparian trees ice-scars and annual tree-rings. Our objective was to reconstruct 200 years of spring, summer and annual water supply variability of 4 Reservoirs in northern Quebec along a 1000 kilometers East-West gradient. Thus, ring widths, ring densities and stable isotope ratios (carbon and oxygen), from 57 Black Spruce (Picea mariana Mill.) sites, were used to perform paleohydrological reconstructions.
The statistical relationships between the hydrological variables and tree-ring series were established based upon the data available from 1960 to 2000. The water supplies were then reconstructed back to 1800 using the following two methods; the partial least squares method (PLS) and the best analogue method (BAM). Then, these reconstructions were combined to give a composite reconstruction.
Reconstruction verification shows that the annual and summer water supply reconstruction quality is good. Conversely, the verification tests disqualified our spring water supply reconstruction. The reconstructed long-term water supply variations over the last two centuries are dominated by decadal to sub-decadal fluctuations, and yet, there are distinct long hydrological periods during which water supplies change in intensity and variability. Important water supplies spatio-temporal variations are observed. Large scale circulation variability explains a major part of this spatial and temporal variability in streamflow. Western hydrological variations are leading mainly by Atlantic Multidecadal Oscillation (AMO) while Eastern hydrological variations are leading mainly by winter Arctic oscillation (AO). Our results suggest also that the correlation between atmospheric indices and water supplies are not stationary through time.