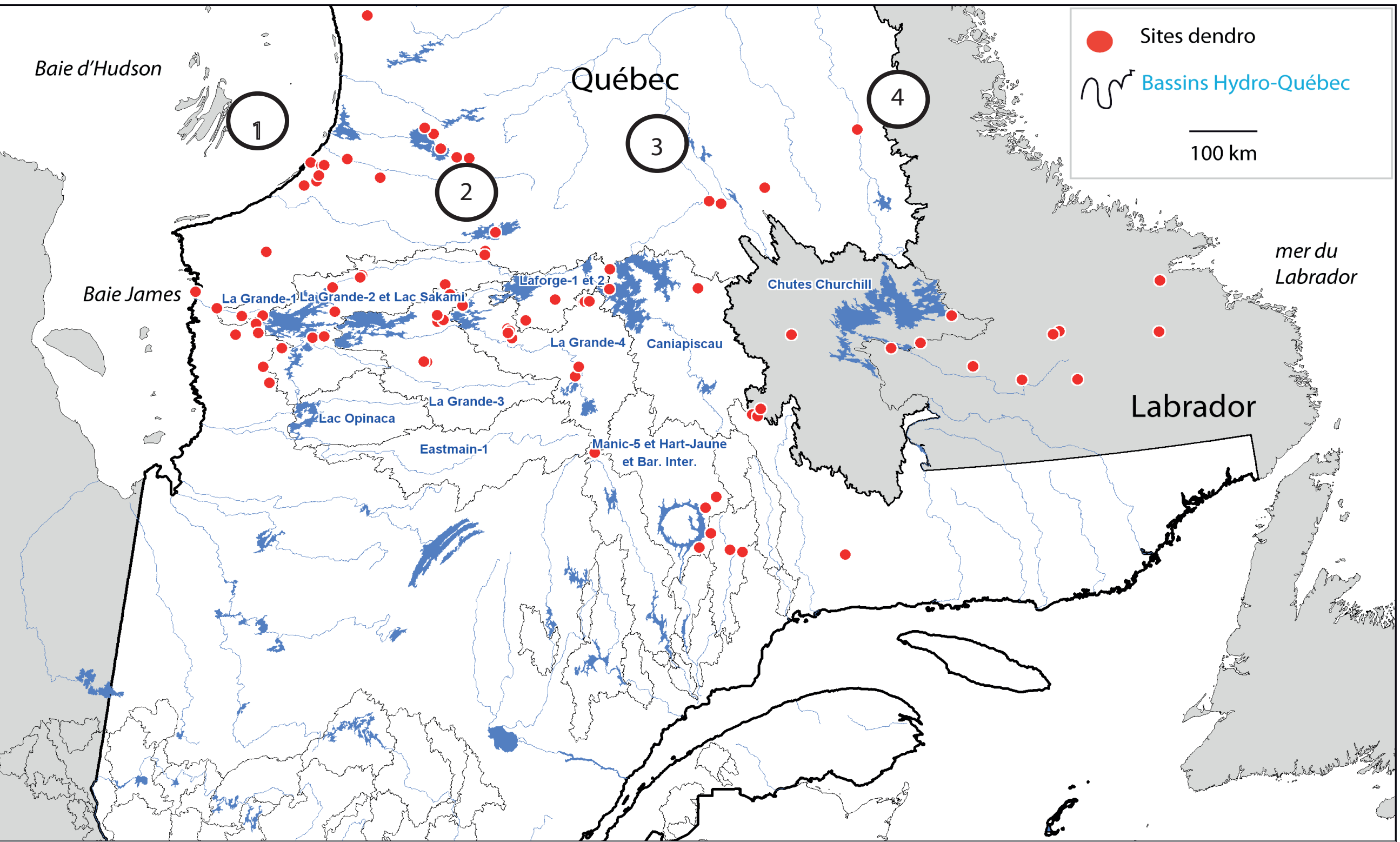


Introduction

The La Grande hydro power generation system is one of the most important hydropower systems in North America. This hydro generation system is located in Northern Quebec (Eastern Canada), a remote area where long-term hydrological series are lacking. The longest time series covers a maximum of five decades. Thus, current knowledge on long-term hydrological natural variability is limited to this short period, which may have a significant impact on the decisions related to power generation planning.

Natural proxies are, in this case, the best alternative to extend climatic series beyond instrumental records. In the absence of lacustrine laminated sediments, tree-ring series represent the only natural indicators available in the area.

Our first objective was to reconstruct 200 years of annual water supply variability of four basins located on an East-West transect. *Picea mariana* Mill. tree-ring width, tree-ring density and stable isotope ratios (d13C and d18O) (Begin et al. 2015) were measured to perform multi-proxy reconstructions using the annual time series. Our second objective was to improve the understanding of how atmospheric drivers determine spatiotemporal variability in water availability over the XX century. The relationships between water availability and both the Atlantic and Pacific atmospheric circulation indices (NAO, AMO, AO, ENSO, PDO, PNA) were analyzed.

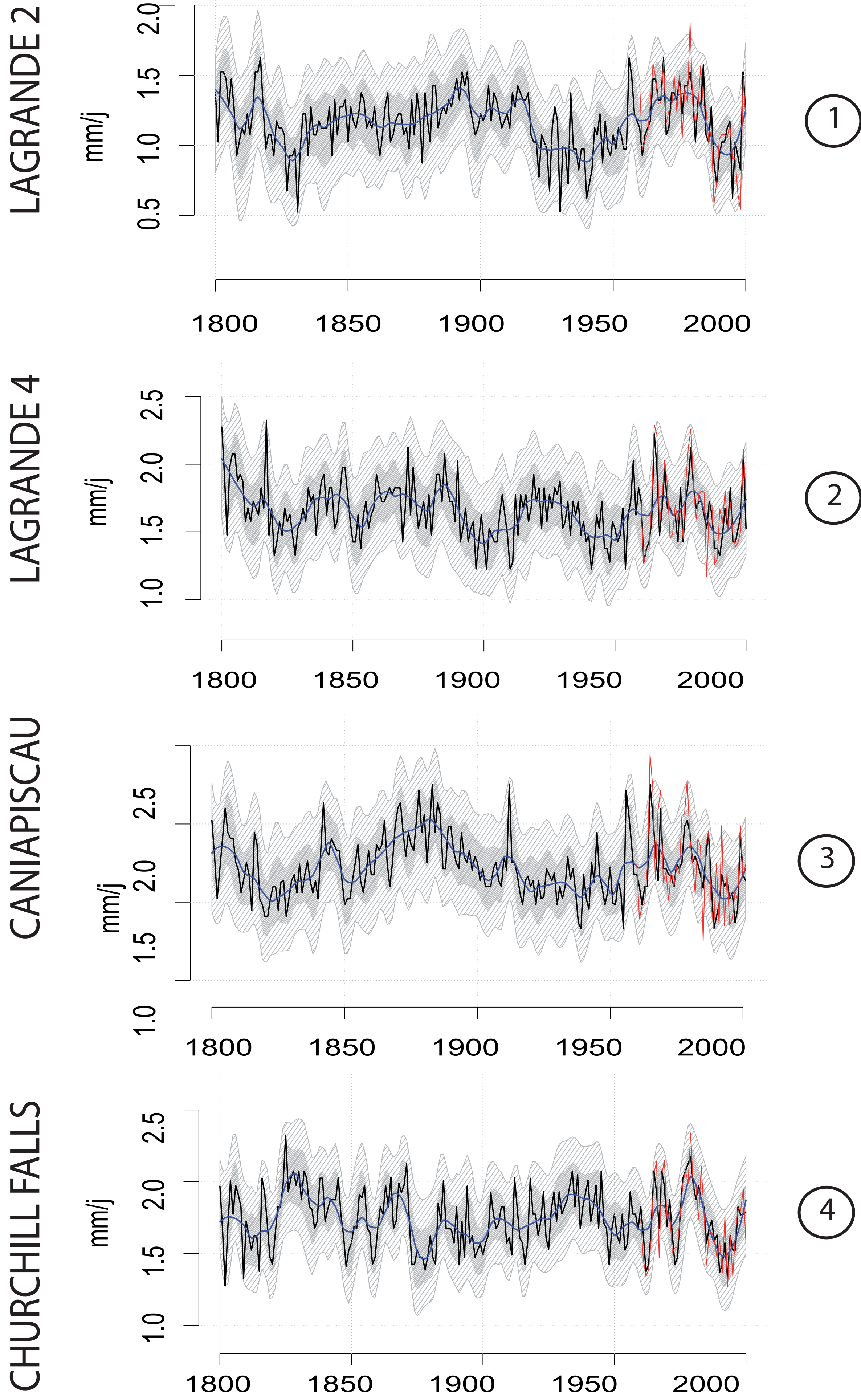


Studied area with mains catchments and Picea mariana sampled sites.

Methods

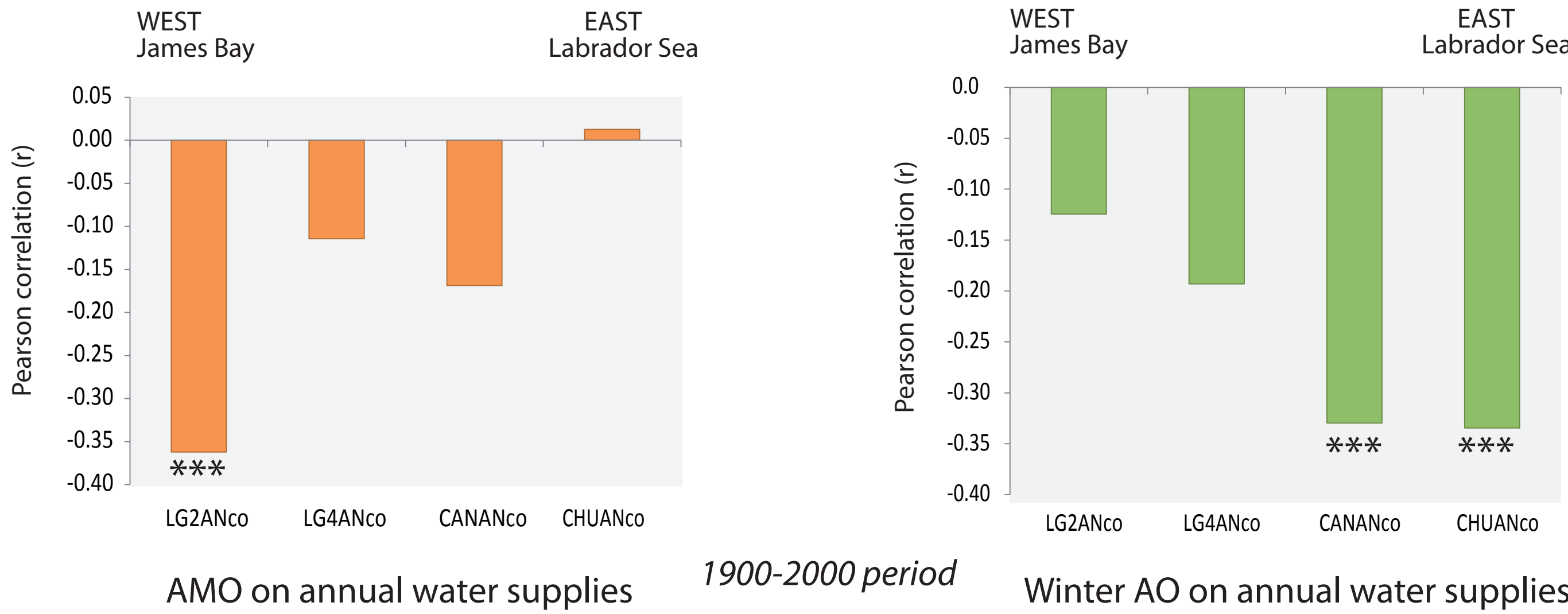
The statistical relationships between the hydrological variables and the tree-ring proxies were established based for the period 1960 to 2000. Water supplies were then reconstructed back to 1800 using the following two methods: the partial least squares method (PLS) and the best analogue method (BAM). To reduce the number of proxies, a stepwise regression (SWR) was performed. Thus, three reconstructions per seasonal and annual hydrological variables were performed, one using PLS applied to the entire tree-ring series, one using PLS applied to a selected tree-ring series, and one using BAM applied to selected tree-ring series. These 3 reconstructions were combined by resampling to give a composite final reconstruction (Nicault et al 2014). Then correlation analysis were carried out among atlantic and pacific atmospheric circulation indices and hydrological past variability

Annual water supply reconstructions

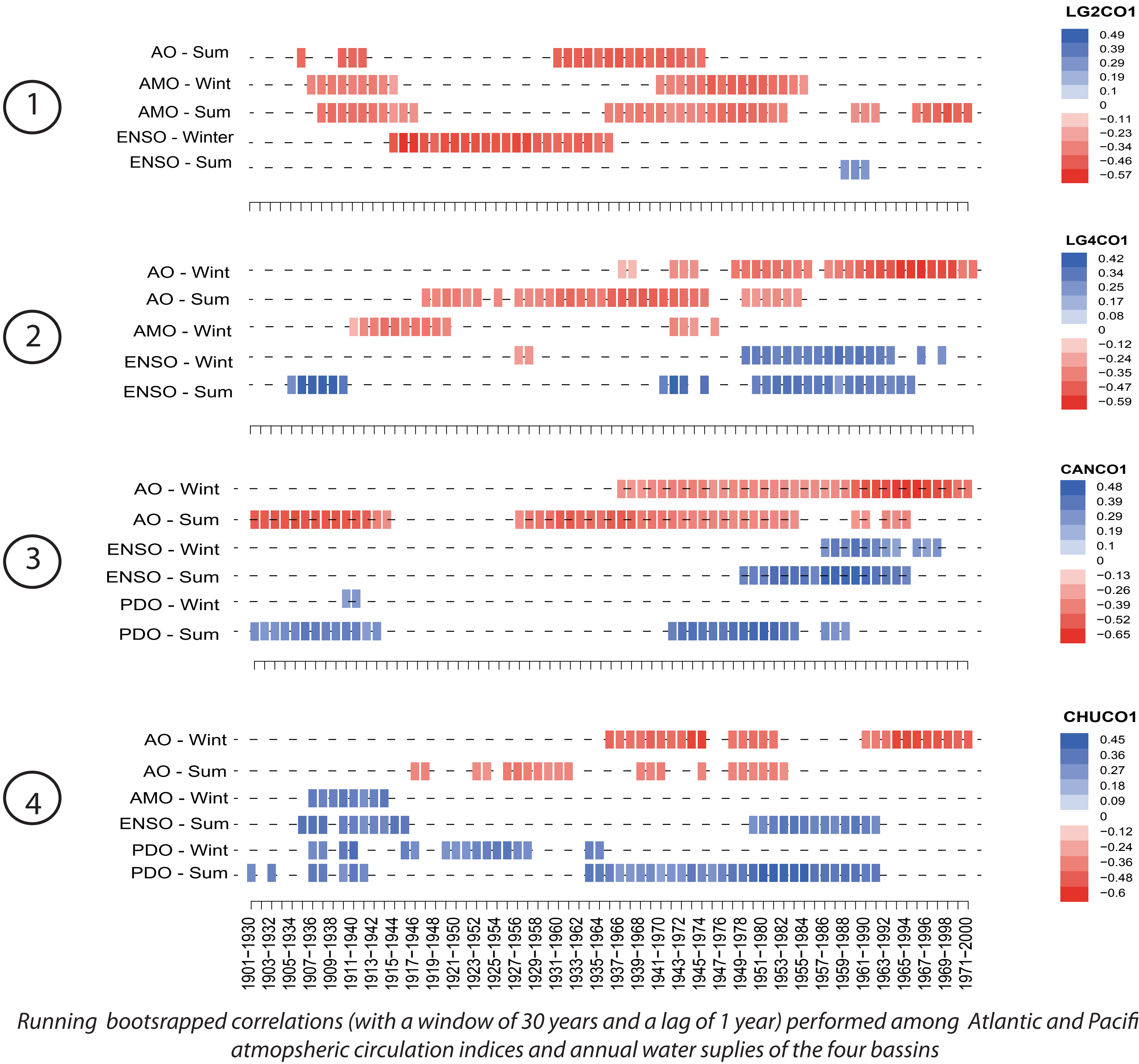


Composites reconstructions of annual water supplies, with 90% and 95% confidence interval, for LG2, LG4, Caniapiscou and Smalwood reservoirs.

Influence of climatic drivers on water availibty varies in space



Influence of climatic drivers on water availibty varies in time



References

Nicault A., Boucher É., Bégin C., Guiot J., Perreault L., Roy R., Savard M.M., and Y. Begin, 2014. Hydrological reconstruction from tree-ring multi-proxies over the last two centuries at the Caniapiscou Reservoir, northern Québec, Canada. Journal of hydrology. , 513, 435-445.

Bégin C., Gingras M., Savard M., Marion J., Nicault A., Bégin Y. 2015 Assessing tree-ring carbon and oxygen stable isotopes for climate reconstruction in the Canadian northeastern boreal forest. Palaeogeography, Palaeoclimatology, Palaeoecology, 423, 91-101.

AMO : Multidecadal Atlantic Oscillation (Schlesinger, M.E. and Navin Ramankutty 1994)

AO : Artic Oscillation (Thompson & Wallace , 1998)

ENSO : El Nino Southern Oscillation (Curtis and Adler, 2000)

PDO : Pacific decadal Oscillation (Mantua, 2002)

Conclusions

The reconstructed long-term water supply variations over the last two centuries show distinct long hydrological periods during which water supplies change in intensity and variability. Strong spatio-temporal variations of water supply are observed. Large scale circulation variability explains a major part of 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 correlations between atmospheric indices and water supplies are not stationary through time. Different climate internal forcing, both from the atlantic and Pacific circulation, could influence water supplies variability together or alternately

