Geophysical Research Abstracts
Vol. 17, EGU2015-8173, 2015
EGU General Assembly 2015

Flood variability over 1871-2012 in Northern Québec: comparison of hydrological reconstructions based on tree-rings and on geopotential height field reanalysis

Pierre Brigode (1,2), François Brissette (1), Daniel Caya (2), Antoine Nicault (3), Luc Perreault (4), Anna Kuentz (5), Thibault Mathevet (6), and Joël Gailhard (6)

(1) ETS, DRAME, Montréal, Canada (brigode.pierre@ouranos.ca), (2) Ouranos, Montréal, Canada, (3) ECCOREV, Aix-en-Provence, France, (4) IREQ, Varennes, Canada, (5) SMHI, Norrköping, Sweden, (6) EDF, DTG, Grenoble, France

For the next couple of decades, the impacts of climate change on hydrological extremes are likely to be masked by climate natural variability. Thus, a better understanding and quantification of natural climate variability on hydrological extremes would be helpful for short-term adaptation. However, studying natural variability requires long instrumental records, which are inexistant in remote regions such as Northern Québec. Different methods have been proposed to extend observed hydroclimatic time-series, based on other data sources such as tree rings or sedimentological datasets. For example, tree ring multi-proxies have been studied for the Caniapiscau Reservoir in Northern Québec (Canada), leading to the reconstruction of spring flood series (Boucher et al., 2011) and of annual and seasonal mean flow series (Nicault et al., 2014), for the last 150 years. Here, we apply a different reconstruction method on the same catchment, using historical reanalysis of geopotential height fields, to compare the flood series obtained and study the observed flood variability over the 1871-2012 period.
The applied method, named ANATEM (Kuentz et al., 2013), aims firstly at producing climatic time series (temperature and precipitation) which are then used as inputs to one or several hydrological model previously calibrated in order to obtain streamflow time series. The climatic reconstruction is based on the analog method, using the link between atmospheric pressure situations and local climatic variables and thus requires (i) a geopotential height field reanalysis (here the NOAA reanalysis, available over the 1871-2012 period (Compo et al., 2011)), and (ii) the available observed temperature and precipitation time series (here available over the 1960-2012 period). The hypothesis of the analog method is that two different days having similar atmospheric circulations are expected to produce similar temperature and precipitation patterns. Using this hypothesis, the method generates daily climatic series over the entire period of availability of geopotential fields (here the 1872-2012 period) by re-sampling observed local data available on a shorter period (here the 1960-2012 period), based on similarity of geopotential height fields. Finally, a large ensemble of daily climatic series is generated by considering an ensemble of analog days. Then, four rainfall-runoff models (HSAMI, HMETS, MORDOR and GR4J) previously calibrated on the observed data are used to transform this ensemble of long climatic series into an ensemble of streamflow simulations. The obtained simulations are firstly compared with the available streamflow observations and secondly with the streamflow series generated with the tree-rings multi-proxies. Finally, the different long flood series produced will be used in a flood frequency framework in order to quantify the added value of such reconstruction methods for the estimation of flood quantile (here the 20-year return period flood).

References:
Boucher, É., Ouarda, T. B. M. J., Bégin, Y. & Nicault, A. (2011) Spring flood reconstruction from continuous and discrete tree ring series. Water Resources Research. 47(7), W07516. doi:10.1029/2010WR010131.
Compo, G. P., Whitaker, J. S., Sardeshmukh, P. D., Matsui, N., Allan, R. J., Yin, X., Gleason, B. E., et al. (2011) The Twentieth Century Reanalysis Project. Quarterly Journal of the Royal Meteorological Society. 137(654), 1–28. doi:10.1002/qj.776.
Kuentz, A., Mathevet, T., Gailhard, J., Perret, C. & Andréassian, V. (2013) Over 100 years of climatic and hydrologic variability of a Mediterranean and mountainous watershed: the Durance River. In Cold And Mountain Region Hydrological Systems under Climate Change: towards improved projections, Vol. 360 of IAHS Publication, pages 19-25. Presented at the IAHS-IAPSO-IASPEI Assembly, Gothenburg, Sweden, 2013.
Nicault, A., Boucher, E., Bégin, C., Guiot, J., Marion, J., Perreault, L., Roy, R., Savard, M. M. & Bégin, Y. (2014) Hydrological reconstruction from tree-ring multi-proxies over the last two centuries at the Caniapiscau Reservoir, northern Québec, Canada. Journal of Hydrology. 513, 435–445. doi:10.1016/j.jhydrol.2014.03.054.