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Nonstationary Analysis of Annual Maximum Streamflow of Canada

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Both natural climate change and anthropogenic impacts may cause nonstationarities in hydrological ex-tremes. In this study, long-term annual maximum stream[U+FB02]ow (AMS) records from 145 stations over Canada were used to investigate the nonstationary characteristics of AMS, which include abrupt changes and monotonic temporal trends. The nonparameteric Pettitt test was applied to detect abrupt changes, while temporal monotonic trend analysis in AMS series was conducted using the nonparameteric Mann–Kendall and Spearman tests, as well as a parametric Pearson test. Nonstationary frequency analysis of the AMS series was done using a group of nonstationary probability distributions. The nonstationary characteristics of Ca-nadian AMS were further investigated in terms of the Hurst exponent (H), which represents the long-term persistence (LTP) of stream[U+FB02]ow data. The results presented here indicate that for Canadian AMS data, abrupt changes are detected more frequently than monotonic trends, partly because many rivers began to be regulated in the twentieth century. Drainage basins that have experienced signi[U+FB01]cant land-use changes are more likely to show temporal trends in AMS, compared to pristine basins with stable land-use conditions. The nonstationary characteristics of AMS were accounted for by [U+FB01]tting the data with probability distributions with time-varying parameters. Large H found in almost 2/ 3 of the Canadian AMS dataset indicates strong LTP, which may partly represent the presence of long-term memories in many Canadian river basins. Furthermore, H values of AMS data are positively correlated with the basin area of Canadian rivers. It seems that non-stationary frequency analysis, instead of the traditional stationary hydrologic frequency analysis, should be employed in the future.

Reference: Tan, X., and Gan, T. Y., 2015, Nonstationary analysis of annual maximum streamflow of Canada, Journal of Climate, DOI: 10.1175/JCLI-D-14-00538.1