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Nonstationarity in hydro-climatology of Great Lakes

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A study of changes in hydro-climatology of the Great Lakes was performed incorporating the nonparametric Mann-Kendall trend detection test and a recently developed Bayesian multiple change point detection model. The Component Net Basin Supply (C-NBS) and its components (runoff, precipitation, evaporation) and also water levels of Great Lakes were analysed for gradual (i.e. trend) and abrupt (i.e. shift) type nonstationary behaviours at seasonal and annual scales. It was found that the C-NBS experienced significant upward trends only in the lower Great Lakes (Erie, Ontario) during summer portion of the year. At an annual scale upward trends were observed only in Lake Ontario. Change point analysis suggests an upward shift in Great Lakes C-NBS in late 1960s and early 1970s. A combination of gradual and abrupt change analysis of Great Lakes water levels suggests a common upward shift along with a change in trend direction around early 1970s. It is also found that precipitation and runoff are in a plateau and in some cases in a decreasing course preceded by an increasing trend in the early twentieth century. Results obtained from this study show that the hydro-climatology of Great Lakes is characterized with nonstationary behaviour. Changes in this behaviour have caused the Great Lakes water levels to decrease during the last few decades. This study provides valuable insights into the nature of the nonstationary behaviour of hydro-climatic variables of the Great Lakes and contributes useful information to future water management planning.