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Selecting GCM scenarios for climate change impact assessment

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Statement of the Problem: One of the main challenges in climate change impact assessment studies is selecting suitable climate change scenarios to be used in a regional environmental modelling system. Using all available Global Circulation Model (GCM) scenarios would be one way to build the complete picture of the range of climate change and variability but may not always be feasible for such studies. On the other hand, there is no recommended standard number of GCM scenarios to use while the number of GCMs is increasing at a rapid pace. This can be a more challenging case when it comes to understanding responses of hydrological regimes to climate change. This is because first using many GCMs to a hydrological model to simulate the hydrological responses is computationally intensive. Second, even though some selected extreme climate change scenarios may appear to be useful, the non-linearity in the impact response can lead to quite different results.

Purpose: The purpose of this study is to shed some light on this issue, this study was undertaken to develop a methodology for selecting representative climate change scenarios that capture all plausible future climate variability affecting the hydrological response of a watershed.

Methodology: The study employs three different methods; fuzzy clustering, k-means clustering, and change factors (CFs) to select climate change scenarios out of a combination of 33 GCM scenarios from the Coupled Model Intercomparison Project, phase 5 (CMIP5) in the Muskeg watershed in Alberta, Canada. The Soil and Water Assessment Tool (SWAT) was calibrated and validated to simulate streamflow under the selected GCM scenarios for the period of 2046-2065 relative to the baseline of 1986-2005 in the watershed. Flow duration curves (FDCs) were constructed to represent peak, mid-range average flow, and low daily flows, for each climate scenario.

Findings: Results revealed that the fuzzy clustering-based method performed well compared to the k-means clustering and change factors (CFs) methods.

Conclusion & Significance: This study gives clear guidance on how to reduce the number of climate change scenarios based on selecting representative scenarios that capture all plausible future variability affecting the hydrological response. However, the most appropriate climate scenarios for a region will not necessarily be the most appropriate for another region due to different climate and geomorphological characteristics.

Biography

Babak Farjad is currently a Postdoctoral Fellow at the University of Calgary. His work involves developing a hydrological modelling system to evaluate and predict the impacts of climate change and human activities on hydrology of the Lower Athabasca River basin in Alberta, Canada. His PhD research was on developing a modeling framework to investigate the impact of climate and land-use/cover change on hydrological processes in the Elbow River watershed in southern Alberta, Canada.

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