IMPACT OF CLIMATE CHANGE ON CANADIAN SURFACE WATER AND GROUNDWATER RESOURCES: A CONTINENTAL-SCALE HYDROLOGIC MODELLING STUDY USING MULTIPLE HIGH-RESOLUTION RCM PROJECTIONS

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It is now generally accepted within the scientific community that the climate is changing, and that future climate change may have significant impact on water resources in both quantity and quality. In some regions, especially those that are already exhibiting water shortages, a further reduction in the available surface water and groundwater supplies due to climate change may have serious societal consequences. In other regions, increased precipitation and extreme events could lead to flooding of rivers and excessively high water table conditions. To the best of our knowledge, however, most hydrologic modelling studies in the literature that explore the impacts of climate change on water resources availability suffer from a combination of one or more of the following deficiencies: (1) the hydrologic model is driven by the output from a low-resolution global climate model (GCM); (2) only a single future emission scenario is considered; (3) only a single climate model is used to drive the hydrologic model; (4) only surface water or groundwater (usually the first) is simulated; and (5) the study domain is commonly limited to a relatively small catchment scale. In this study, the 3D physically-based model HydroGeoSphere, which simulates 2D surface water flow on the land surface and 3D variably-saturated subsurface flow in a fully-coupled manner, is employed to assess the potential impacts of global warming on Canadian water resources. High-resolution climate projections obtained with multiple state-of-the-art regional climate models (RCMs) nested in a sophisticated GCM under multiple IPCC future emissions scenarios are used to drive the 3D Canada-scale HydroGeoSphere model. The computations also explore the uncertainty/sensitivity in the hydrologic responses under different future emissions scenarios and also as a result of the different outputs obtained from the different climate models used to drive HydroGeoSphere. In our analysis, the hydrologic responses of concern include the flows in major Canadian rivers, lake levels, groundwater recharge/discharge patterns and depths to the water table.