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Climate change impact on spring flood volume in northeastern Canada watersheds using a climate ensemble

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In a warmer future climate, intensification of the global hydrological cycle is expected which will lead to a change in the intensity and frequency of hydrological extremes. This can have significant impact in many sectors, including the energy sector. For the province of Québec, where hydropower is the main source of energy, it is thus important to assess extreme flows in the context of a changing climate. Multi-model ensembles are recommended to be used in the climate scientific community since they provide a way to quantify the uncertainty associated with climate projections. In the current study, streamflows for the reference period (1961-2000) and for the 2050 horizon are simulated with the lumped hydrological model SSARR driven by 87 climate scenarios from the (cQ)2 climatic ensemble. This ensemble, in addition to providing the opportunity to quantify the uncertainties due to natural variability and climate model imperfection, allows the assessment of the potential impact of methodological choices such as the post-processing method, the greenhouse gas emission scenario, or even the resolution of the climate model.

In this study, projected changes to 20-year return levels spring flood volume of nine Québec watersheds are evaluated. On average, an increase of 5% is projected, but some differences exist between results from different post-processing methods. Results for the different basins vary from -4 to 18%. There is a strong consensus in the hydrological scenarios on the sign of the changes, with almost 70% projecting a positive change. On the other hand, it seems that the choice of the greenhouse gas emission scenario does not have an impact on the simulated spring flood volume. At last, the Canadian Global Climate Model (CGCM) and Canadian Regional Climate Model (CRCM) were used to demonstrate that the resolution of the climate model has an impact on the simulated spring flood volume.