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Evolution of precipitation extremes in two large ensembles of climate simulations

Jean-Luc Martel (1), Alain Mailhot (2), Guillaume Talbot (2), François Brissette (1), Ralf Ludwig (3), Anne Frigon (4), Martin Leduc (4), and Richard Turcotte (5)

(1) École de technologie supérieure, Montreal, Canada, (2) Institut national de la recherche scientifique, Quebec, Canada, (3) Ludwig Maximilian University, Munich, Germany, (4) Ouranos Consortium, Montreal, Canada, (5) Direction de l'expertise hydrique – MDDELCC, Quebec, Canada

Recent studies project significant changes in the future distribution of precipitation extremes due to global warming. It is likely that extreme precipitation intensity will increase in a future climate and that extreme events will be more frequent.

In this work, annual maxima daily precipitation series from the Canadian Earth System Model (CanESM2) 50-member large ensemble (spatial resolution of 2.8°x2.8°) and the Community Earth System Model (CESM1) 40-member large ensemble (spatial resolution of 1°x1°) are used to investigate extreme precipitation over the historical (1980-2010) and future (2070-2100) periods. The use of these ensembles results in respectively 1 500 (30 years x 50 members) and 1200 (30 years x 40 members) simulated years over both the historical and future periods. These large datasets allow the computation of empirical daily extreme precipitation quantiles for large return periods. Using the CanESM2 and CESM1 large ensembles, extreme daily precipitation with return periods ranging from 2 to 100 years are computed in historical and future periods to assess the impact of climate change.

Results indicate that daily precipitation extremes generally increase in the future over most land grid points and that these increases will also impact the 100-year extreme daily precipitation. Considering that many public infrastructures have lifespans exceeding 75 years, the increase in extremes has important implications on service levels of water infrastructures and public safety. Estimated increases in precipitation associated to very extreme precipitation events (e.g. 100 years) will drastically change the likelihood of flooding and their extent in future climate. These results, although interesting, need to be extended to sub-daily durations, relevant for urban flooding protection and urban infrastructure design (e.g. sewer networks, culverts). Models and simulations at finer spatial and temporal resolution are therefore needed.