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Future temperature increases and associated drought risks over North America based on NARCCAP simulations

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This study presents the effects of future temperature and hence evapotranspiration increases on drought risk over North America, based on ten current (1970–1999) and corresponding ten future (2040–2069) Regional Climate Model (RCM) simulations from the North American Regional Climate Change Assessment Program. The ten pairs of simulations considered in this study are based on six RCMs and four driving Atmosphere Ocean Coupled Global Climate Models. The effects of temperature and evapotranspiration on drought risks are assessed by comparing characteristics of drought events identified on the basis of Standardized Precipitation Index (SPI) and Standardized Precipitation and Evapotranspration Index (SPEI). The former index uses only precipitation, while the latter uses the difference (DIF) between precipitation and potential evapotranspiration (PET) as input variables. As short- and long-term droughts impact various sectors differently multi-scale (ranging from one- to 12-month) drought events are considered. The projected increase in mean temperature by more than 2°C in the future period compared to the current period for most parts of North America results in large increases in PET and decreases in DIF for the future period, especially for low latitude regions of North America. These changes result in large increases in future drought risks for most parts of the USA and southern Canada. Though similar results are obtained with SPI, the projected increases to the drought characteristics such as severity and duration and the spatial extent of regions susceptible to drought risks in future are considerably larger in the case of SPEI-based analysis. Both approaches suggest that long-term and extreme drought events are affected more from the future increases in temperature and PET than short-term and moderate drought events, particularly over the high drought risk regions of North America.