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Projected changes to surface wind characteristics and extremes over North America in CRCM5

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Changes in the tendency of wind speed and direction have significant implications for long-term water cycle, air pollution, arid and semiarid environments, fire activity, and wind energy production. Furthermore, changes in wind extremes have direct impacts on buildings, infrastructures, agriculture, power lines, and trees. This study evaluates projected changes to wind speed characteristics (i.e. seasonal and annual mean, seasonal and diurnal cycles, directional distribution, and extreme events) for the future 2071-2100 period, with respect to the current 1981-2010 period over North America, using four different simulations from the fifth-generation Canadian Regional Climate Model (CRCM5) with two driving GCMs under RCP (Representative Concentration Pathways) 4.5 and 8.5 scenarios. The CRCM5 simulates the climatology of mean sea level pressure gradient and associated wind direction over North America well when compared to ERA-Interim reanalysis dataset. The CRCM5 also reproduces properly the spatial distributions of observed seasonal and annual mean wind speeds obtained from 611 meteorological stations across North America. The CRCM5 simulations generally suggest an increase in future mean wind speed for northern and eastern parts of Canada, due to a decrease of future mean sea level pressure and more intense low pressure air circulation systems already situated in those regions such as Aleutian and Icelandic Lows. Projected changes to annual maximum wind speed show more spatial variability compared to seasonal and annual mean wind speed as extreme wind speed is influenced more by regional-scale features associated with instantaneous surface temperature and air pressure gradients. The CRCM5 simulations suggest some increases in the future 50-year return levels of wind speed, mainly due to changes in the inter-annual variability of annual maximum wind speed. However, the projected changes vary in spatial pattern with the driving GCM fields and emission scenarios considered. These inconsistent projected changes illustrate the need for a broader set of simulations including other RCMs, driving GCMs, and emission scenarios to properly evaluate uncertainties in the future projections.