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Land-atmosphere coupling over North America in the Canadian Regional Climate Model (CRCM5) simulations for current and future climates

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The strength and characteristics of land-atmosphere (L-A) coupling over North America in current and future climates are assessed using the fifth generation of the Canadian Regional Climate Model (CRCM5). The L-A coupling is first assessed, in current climate, by analyzing the coupled (interactive soil moisture) and uncoupled (prescribed soil moisture) CRCM5 simulations driven by ERA-Interim reanalysis for the 1981-2010 period. Results indicate strong soil moisture-temperature coupling over the Great Plains, which is in line with previous studies. In addition coupling is also found to significantly modulate extreme temperature conditions such as the percentage of hot days, the frequency and maximum duration of hot spells for this region. The soil moisture-precipitation coupling in CRCM5, on the other hand, is weak compared to the soil-moisture temperature coupling. Coupling is noted mostly over the semi-arid regions of the western US for the case of persistent extreme precipitation events (defined as consecutive days with precipitation greater than the long term 90 percentile), probably due to its more transition zone like conditions, which is favorable for L-A coupling, in these circumstances.
To study projected changes to L-A coupling in future climate, coupled and uncoupled CRCM5 simulations, driven by CMIP5 GCMs, were performed, for current (1981-2010) and future (2071-2100) climates. Coupling regions in the GCM-driven current climate CRCM5 simulations are similar to those obtained with ERA-Interim driven CRCM5 simulations discussed above. In future climate, soil-moisture-temperature coupling regions extend beyond the Great Plains, for instance to mid-west and the eastern part of the US, while the regions of soil-moisture-precipitation coupling have a more complex spatial structure.