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

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The influence of snow variation on climate variability over North America is assessed using the fifth generation of Canadian Regional Climate Model (CRCM5). For this, we first carried out a suite of CRCM5 simulations driven by ERA-Interim reanalysis, whereby the snow was either prescribed (uncoupled) or allowed to evolve interactively (coupled) during the model integration. Results indicate a systematic influence of snow on the inter-annual variability of air and surface temperature throughout winter and spring seasons. In the coupled simulations, where the snow depth and snow cover were allowed to evolve freely, the inter-annual variability of surface and near surface air temperatures were found to be larger and explains up to 70% of the surface temperature variation over northern Great Plains and Canadian Prairies. The impact of snow is found to be stronger in spring than in winter, since in spring season both albedo and hydrological effects contribute to the variability in temperature. To study projected changes to snow-atmosphere coupling in future climate, coupled and uncoupled CRCM5 simulations, driven by coupled GCMs, were performed, for current (1981-2010) and future (2071-2100) climates. Coupling regions in the GCM-driven current climate simulations are similar to those obtained with ERA-Interim driven CRCM5 simulations discussed above. In future climate, snow-temperature coupling shows some change in spatial structures and in magnitudes. These results suggest that accurate initialization of snow condition could potentially be helpful to improve seasonal prediction skill over these snow-atmosphere coupling hotspot regions.