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Impact of dynamic vegetation on CRCM5 simulated climate over North America

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Regional climate change can strongly impact on local surface vegetation characteristics, which can in turn modulate the regional climate by modifying key surface characteristics. To capture these feedbacks a dynamic vegetation model, the Canadian Terrestrial Ecosystem Model (CTEM), has been implemented in the 5th generation of the Canadian Regional Climate Model (CRCM5). CTEM can grow vegetation from bare ground and includes processes of photosynthesis, autotrophic and heterotrophic respiration, phenology, turnover, mortality and allocation. Two recent-past experiments (1971-2010) of CRCM5 are compared – one with dynamic vegetation and the other with static vegetation – in order to assess the impact of dynamic vegetation on the regional climate over North America. Simulated vegetation attributes, temperature and precipitation were compared to those observed. CTEM overall improves the model (CRCM5), although it introduces new biases in some regions such as western USA, due to large differences in the leaf area index (LAI), greatly affecting biosphere-atmosphere interactions with respect to energy and water fluxes. As expected, the biosphere-atmosphere coupling is stronger in the simulation with dynamic vegetation and introduces a long-term vegetation memory in CRCM5. Dynamic vegetation better captures the impact of climate anomalies on the biosphere. For example, the positive LAI-temperature feedback during anomalously warm years, which leads to higher temperatures in the following years, is very well captured by the model. Accordingly, this study shows that changes in the biosphere could significantly impact the climate, given climate change, particularly over vegetation-atmosphere coupling hotspots.