Geophysical Research Abstracts
Vol. 18, EGU2016-9943, 2016
EGU General Assembly 2016

Investigation of climate response to land-use and land-cover change in CRCM5 projections over North America

Adelina Alexandru and Laxmi Sushama

Département des Sciences de la Terre et de l'Atmosphère,Université du Québec à Montréal (UQAM)- Centre ESCER (Étude et Simulation du Climat à l'Échelle Régionale), Montréal (Québec), Canada

This study investigates the impact of land-use and land-cover changes (LULCC) on the regional climate of North America using the fifth generation Canadian Regional Climate Model (CRCM5). The ability of CRCM5 in simulating the main characteristics of the regional climate is first assessed by comparing an ERA-Interim-driven CRCM5 simulation against observations for the 1971–2000 period. Results show that CRCM5 reproduces relatively well the main features of the North American current climate, with some cold bias over western and southern areas and a warm bias over the northern regions of the continent. Furthermore, a tendency of CRCM5 to overestimate precipitation and total runoff over the areas known to receive high amounts of precipitation during different seasons was also noticed.
To assess the impact of LULCC on projected changes to climate, two CRCM5 transient climate change simulations driven by CanESM2 for the 1950–2100 period, corresponding to RCP4.5, are performed, with and without LULCC. For the simulation with LULCC, land-cover data sets are taken from the Global Change Assessment Model (GCAM) representing the RCP4.5 scenario for the period 2006-2100. LULCC in RCP4.5 scenario point to significant reduction in cultivated land (e.g. over the Canadian Prairies and Mississippi basin) due to intense afforestation. Projections based on both transient simulations, i.e. with and without LULCC, suggest a general warming by the end of the 21st century, with maximum changes over the northern regions in winter. An accentuated decrease in precipitation is projected over the central regions in summer and over Mexico for all seasons, while an increase in precipitation is projected for the rest of the continent for the other seasons. These changes are also reflected in the climate indices projected by CRCM5 for the period 2071-2100.
Results suggest that the biogeophysical effects of LULCC on climate, assessed through differences between the all-forcing (atmospheric and LULCC) run and the atmospheric forcing run (with constant land cover), lead to warmer conditions, especially in winter (warming above 1.5°C). The investigation of the underlying mechanisms leading to this response shows high sensitivity of the results to changes in albedo as a response to LULCC. Additional roughness, evaporative cooling and water soil availability also seem to play an important role in modulating the regional climate, especially for the summer season in certain afforested areas (e.g., southestern US). Overall, at the seasonal scale, results show that afforestation may contribute up to 25% of projected changes over the high afforested areas such as the Mississippi Basin and the Canadian Prairies.