Geophysical Research Abstracts
Vol. 20, EGU2018-11357, 2018
EGU General Assembly 2018

Evaluation of Coupled CRCM5-FLake in Reproducing Lake-Induced Snowfall in the Great Lakes Basin

Janine A. Baijnath-Rodino (1), Claude R. Duguay (1), and Oleksandr Huziy (2)

(1) Interdisciplinary Centre on Climate Change and Department of Geography and Environmental Management, University of Waterloo, Waterloo, Canada (janineannb@gmail.com), (2) Université du Québec à Montréal, Montreal, Canada (guziy.sasha@gmail.com)

Heavy lake-induced snowfall is prominent along the Canadian leeward shores of Lakes Superior and Huron in December and January, and is driven by extra-tropical cyclones or lake-effect processes. During these months, cold and dry air advects over the relatively warm lakes, generating turbulent moisture and heat fluxes to the lower planetary boundary layer (PBL), producing heavy snowfall. Lake-induced snowfall can produce whiteout snowsqualls and heavy snowfall accumulations in highly localized areas, which can have a detrimental impact on residential, agricultural, and economic sectors within the Great Lakes Basin (GLB). There is therefore a need to forecast lake-induced snowfall as accurately as possible, both in time and space. Although previous studies have evaluated lake-induced snowfall using modeled simulations, many employed coarse resolution global climate models (GCMs) and regional climate models (RCMs) that make it difficult to delineate meso-beta scale snow bands. This study aimed to evaluate the high-resolution (0.11°) Canadian Regional Climate Model Version 5 (CRCM5) interactively coupled to the 1-Dimensional Freshwater Lake model (FLake) in reproducing lake-induced snowfall within the GLB. Total monthly gridded snow water equivalent (SWE) and wintertime precipitation were separately averaged over the 1995-2014 period, and statistical indices of model performance (root mean square error (RMSE) and the mean bias error (MBE)) were computed between the simulated and gridded interpolated (Daymet Version 3) dataset. Furthermore, seven separate lake-effect snowfall (LES) events were examined to evaluate the model's performance in reproducing the timing, location, and accumulation of specific snowfall events during high (2013-2014) and low (2011-2012) ice seasons. Observations were taken from Environment and Climate Change Canada's (ECCC) archive weather observation stations and Ontario archive radar images. The North American Regional Re-analysis (NARR) and the National Oceanic and Atmospheric Administration (NOAA) Ice Atlas and Coast Watch provided additional observational datasets. Coupled CRCM5-FLake is found to under-predict SWE and precipitation along the snowbelts. Negative biases in simulated SWE and precipitation in these regions suggest that the coupled model may un-realistically represent lake effect processes, such as the evolution of LST and ice cover due to un-realistic parameterizations of lake depth. Furthermore, comparisons of LES events also show that the coupled model mostly under-predicts the daily accumulated precipitation associated with each event, but still tends to accurately capture the timing and the general location of the snowsqualls along the snowbelts, though not for highly localized snow bands. Thus, this study also analyzed simulated and observed LES predictor variables, including 850 mb air temperature, lake surface temperature (LST) and ice cover concentration. The lake-wide results indicate over-estimation of LST for both Lakes Superior and Huron during the months of December and January, and under-estimation of ice cover concentrations for both lakes in December.