

High-resolution downscaled climate-change simulations of snowfall in the Colorado Headwaters region

J. Dudhia, R.M. Rasmussen, K. Ikeda, C.-H. Liu, G. Thompson, F. Chen, M. Tewari, and D. Gochis
NCAR, Boulder, CO, USA (dudhia@ucar.edu)

Climate change is expected to accelerate the hydrologic cycle, increase the fraction of precipitation that is rain, and enhance snowpack melting. The enhanced hydrological cycle is also expected to increase snowfall amounts due to increased moisture availability. Four high-resolution simulations of annual snowfall over Colorado, U.S.A. have been conducted. The simulations are verified using SNOWpack TELEmetry (SNOTEL) data. Results are presented regarding the grid spacing needed for appropriate simulation of snowfall. Climate sensitivity is explored using a Pseudo Global Warming approach. The mean climate change between CCSM's simulations of 1995-2005 and 2045-2055 is imposed on WRF simulations of current seasons using NARR data with a 2 km grid. The current-day results show that proper spatial and temporal depiction of snowfall adequate for water resource and climate change purposes can be achieved with the appropriate choice of model-grid spacing and parameterizations. The Pseudo Global Warming simulations indicate enhanced snowfall on the order of 10-25% over the Colorado Headwaters region, with the enhancement being less in the core Headwaters region due to topographic reduction of precipitation upstream of the region (rain shadow effect). The main climate change impact is the enhanced melting at the lower elevation bound of the snowpack, and increased snowfall at higher elevations. The changes in peak snow mass are generally near zero due to these two compensating effects, and simulated wintertime total runoff is above current levels,