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Drying Ratio of the Colorado Mountains under Climate Change Conditions

Rita Nogherotto (1), Vanda Grubišić (1), and the NCAR Team

(1) University of Vienna, Department of Meteorology and Geophysics, Vienna, Austria (vanda.grubisic@univie.ac.at, +43-1-4277-9537), (2) National Center for Atmospheric Research, Boulder, CO, USA

Results of high-resolution simulations of seasonal snowfall over the Colorado Headwaters region (Rasmussen et al. 2010) under the current and future warmed climate conditions show that global warming is expected to accelerate the hydrological cycle, increasing the precipitation over the Colorado Headwaters region by 10-25%, with the enhancement being less in the high-elevation parts of the region. Global models predict a 4-7% increase over the same region. It is therefore critical to examine climate change impacts in this region using higher resolution models in order to more realistically simulate orographic precipitation and evaporation processes.

In this study we examine the efficiency of mountains in the Colorado Headwaters region in producing the orographic precipitation. Drying ratio, defined as the ratio of total precipitation to the incoming water vapor flux, is used as the measure of efficiency. As an integral quantity, the water vapor flux reflects the effects of both the water vapor availability and the vertical profile of the horizontal wind. The sensitivity of the drying ratio to the model horizontal resolution (2-36 km) is explored with a series of current climate simulations; its sensitivity to climate change is explored under a future warmed climate scenario. The analysis is based on high-resolution climate-runoff WRF simulations for the Colorado Headwaters region for the current and future warmed climate for four water years, one dry (2001/2002), two average (2003/2004 and 2005/2006) and one wet year (2007/2008), exploiting the Pseudo-Global-Warming (PGW) approach for the future climate simulations.