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Convection-Permitting Regional Climate Simulations over the Contiguous United States Including Potential Climate Change Scenarios

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The WRF model with a domain size of 1360x1016x51 points, using a 4 km spacing to encompass most of North America, is employed to investigate the water cycle and climate change impacts over the Contiguous United States (CONUS). Four suites of numerical experiments are being conducted, consisting of a 13-year retrospective simulation forced with ERA-I reanalysis, a 13-year climate sensitivity or Pseudo-Global Warming (PGW) simulation, and two 10-year CMIP5-based historical/future period simulations based on a revised bias-correction method. The major objectives are: 1) to evaluate high-resolution WRF's capability to capture orographic precipitation and snow mass balance over the western CONUS and convective precipitation over the eastern CONUS; 2) to assess future changes of seasonal snowfall and snowpack and associated hydrological cycles along with their regional variability across the different mountain barriers and elevation dependency, in response to the CMIP5 projected 2071-2100 climate warming; 3) to examine the precipitation changes under the projected global warming, with an emphasis on precipitation extremes and the warm-season precipitation corridor in association with MCS tracks in the central US; and 4) to provide a valuable community dataset for regional climate change and impact studies.

Preliminary analysis of the retrospective simulation shows both seasonal/sub-seasonal precipitation and temperature are well reproduced, with precipitation bias being within 10% of the observations and temperature bias being below 1 degree C in most seasons and locations. The observed annual cycle of snow water equivalent (SWE), such as peak time and disappearance time, is also realistically replicated, even though the peak value is somewhat underestimated. The PGW simulation shows a large cold-season warming in northeast US and eastern Canada, possibly associated with snow albedo feedback, and a strong summer warming in north central US in association with precipitation reduction. There is an increase in annual rainfall/precipitation, but a sharp reduction in snowfall/snowpack in response to the global warming. A pronounced seasonal feature is the suppressed summertime precipitation in central US for the warmer climate. More detailed analysis of the modeling results is presently under way and will be presented in the meeting.