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High Resolution Simulation of a Colorado Rockies Extreme Snow and Rain Event in both a Current and Future Climate

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Modeling of extreme weather events often require very finely resolved treatment of atmospheric circulation structures in order to produce and localize the large moisture fluxes that result in extreme precipitation. This is particularly true for cool season orographic precipitation processes where the representation of the landform can significantly impact vertical velocity profiles and cloud moisture entrainment rates. This study presents results for high resolution regional climate modeling study of the Colorado Headwaters region using an updated version of the Weather Research and Forecasting (WRF) model run at 4 km horizontal resolution and a hydrological extension package called WRF-Hydro. Previous work has shown that the WRF modeling system can produce credible depictions of winter orographic precipitation over the Colorado Rockies if run at horizontal resolutions < 6 km. Here we present results from a detailed study of an extreme springtime snowfall event that occurred along the Colorado Front Range in March 2003. Results from the impact of warming on total precipitation, snow-rain partitioning and surface hydrological fluxes (evapotranspiration and runoff) will be discussed in the context of how potential changes in temperature impact the amount of precipitation, the phase of precipitation (rain vs. snow) and the timing and amplitude of streamflow responses. The results show using the Pseudo Global Warming technique that intense precipitation rates significantly increased during the event and a significant fraction of the snowfall converts to rain which significantly amplifies the runoff response from one where runoff is produced gradually to one in which runoff is rapidly translated into streamflow values that approach significant flooding risks. Results from a new, CONUS scale high resolution climate simulation of extreme events in a current and future climate will be presented as time permits.