Sensitivity of a high elevation Rocky Mountain catchment to altered climate and CO_2

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Abstract. We explore the hydrologic and ecological responses of a headwater mountain catchment, Loch Vale watershed, to climate change and doubling of atmospheric CO2 scenarios using the Regional Hydro-Ecological Simulation System (RHESSys). A slight (2 degC) cooling, comparable to conditions observed over the past 40 years, led to greater snowpack and slightly less runoff, evaporation, transpiration, and plant productivity. An increase of 2 degC yielded the opposite response, but model output for an increase of 4 degC showed dramatic changes in timing of hydrologic responses. The snowpack was reduced 50%, and runoff and soil water increased and occurred 4-5 weeks earlier with 4 degCwarming. Discharge was much more responsive to changes in precipitation amount, particularly precipitation changes during winter and spring, and long-term records of peak discharge from Colorado streams also show this to occur. Implications for response of high mountain basins to climate change are that total discharge and the timing of runoff are more responsive to precipitation than to temperature at temperature increases below 4 degC, particularly in sparsely-vegetated mountain basins where the snowpack accumulates.