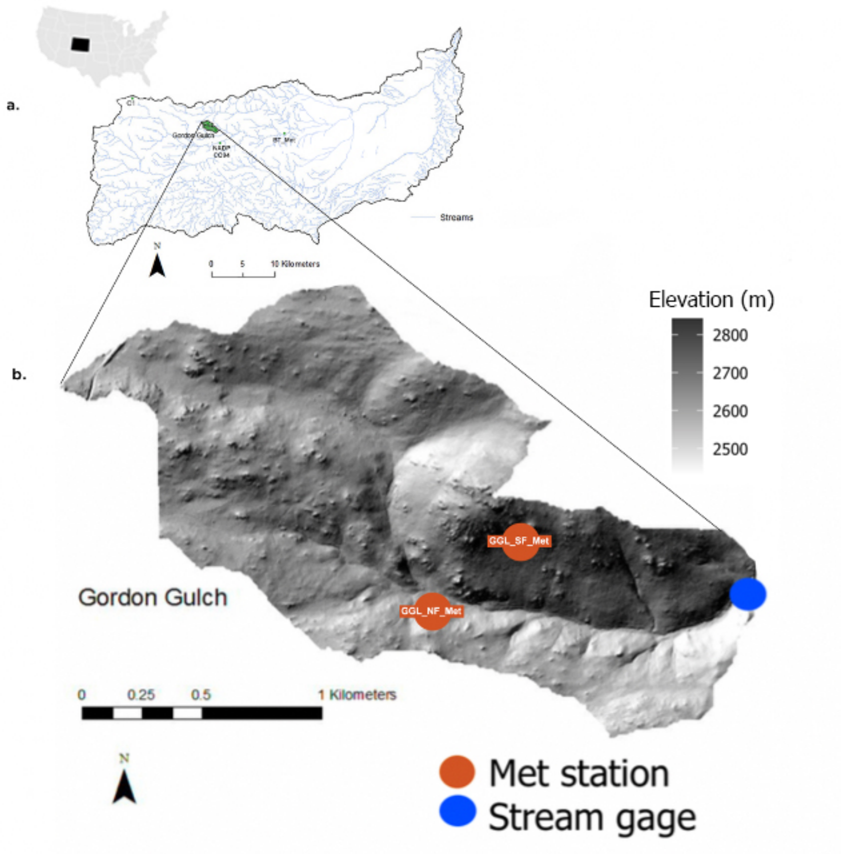


Figure 1. In North-Central Colorado, (a.) Gordon Gulch is an upper montane sub-catchment of Boulder Creek, located 20km west of Boulder, CO. Meteorological stations near Gordon Gulch include Boulder Creek CZO's BT_Met in Betasso Preserve, National Atmospheric Deposition Program's Sugarloaf CO94 station, and Niwot Ridge C1 (b.) Gordon Gulch has two on-site meteorological stations (one on the north facing slope, Boulder Creek CZO's GGL_NF_Met, and one on the south facing slope, GGL_SF_Met) and one streamflow gage. Surrounding the east-west flowing stream are prominent north and south facing aspects.

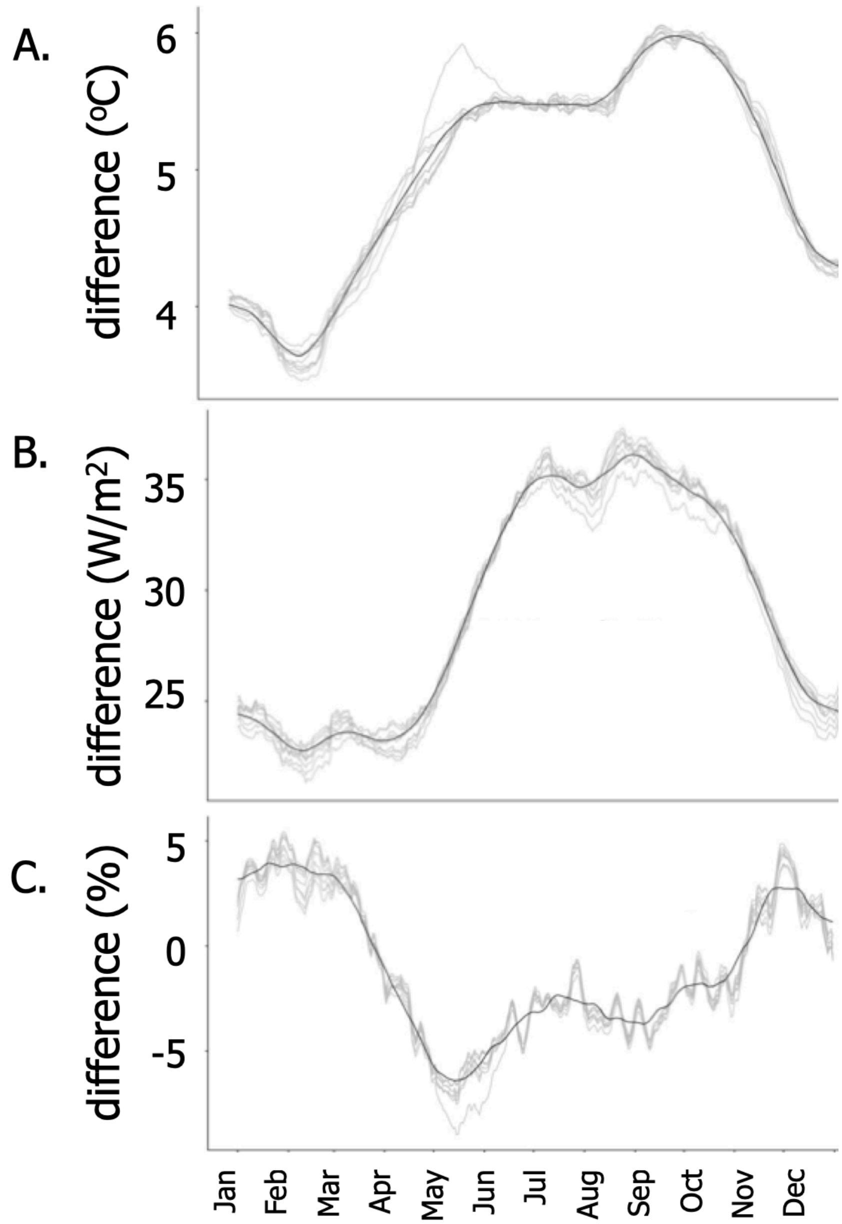


Figure 2. The average daily difference between the WRF warming simulation (representing end-of-century, 2070-2100, climate) and the WRF historical simulation (representing a present-day climate) in A.) temperature (in degrees Celsius); B.) longwave radiation (LW, in W/m2) and; C.) relative humidity (in %). The difference value represents the daily average value (per variable) of all 9 WRF grid cells (from all 13 WRF pseudoglobal warming simulation years) minus the daily average value (per variable) of the same 9 WRF grid cells (from the present-day historical simulation). The gray lines represent the differences in each variable for each of the 9 WRF grid cells extracted from the Liu et al [2017] dataset. The black line is a moving 15-day average of each variable and is the value used for the warming simulation.

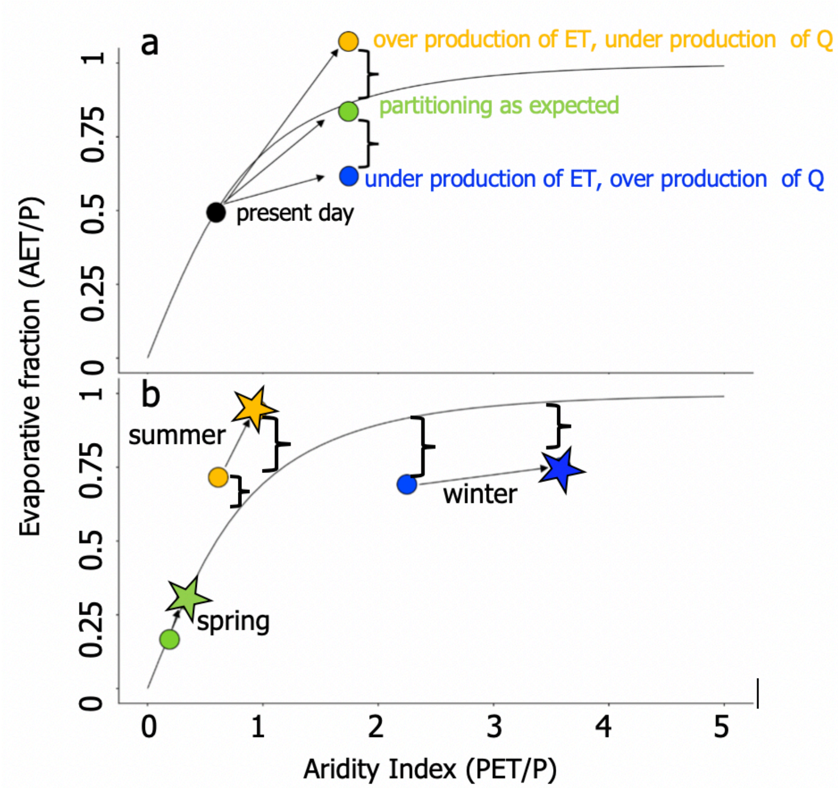


Figure 3. Conceptual use and interpretation of the Budyko framework on annual and seasonal time frames (a.) Hypothetical annual hydrologic behavior of a catchment under control conditions (black point) and warming conditions (yellow, green, blue points) against Budyko's hypothesis (black line). Anomalies from the curve indicate over or under production of ET and Q. (b.) Hypothetical seasonal hydrologic behavior of a catchment under control (point) and warming conditions (star). Water and energy limitations are caused by warming and subsequent changes in SWI and water and energy limitations between months.

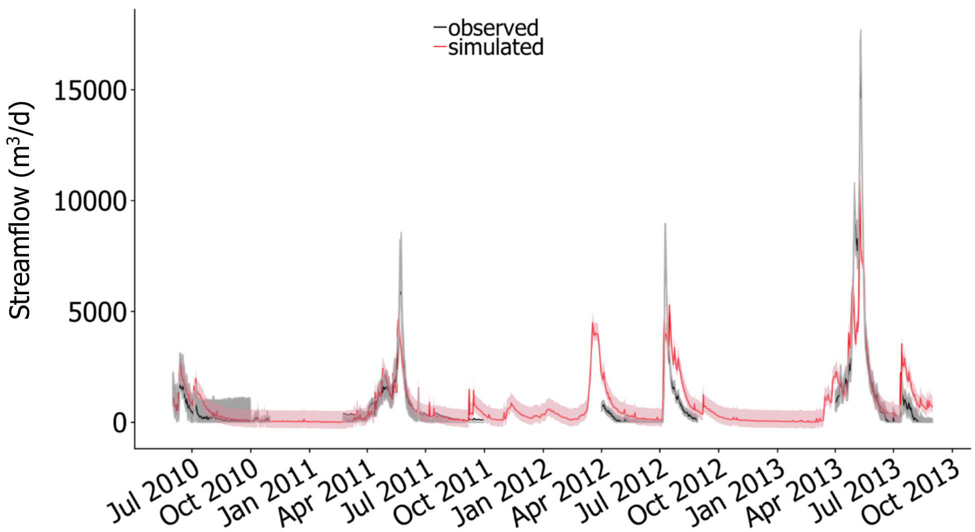


Figure 4. Streamflow time series in m3/day. Observed Gordon Gulch streamflow (black) bounded by 95% confidence intervals (based on the annual stage-discharge relationship, gray) and DHSVM simulated streamflow (red) bounded by 10% model uncertainty (based on the top performing 10% of all simulations, pink).

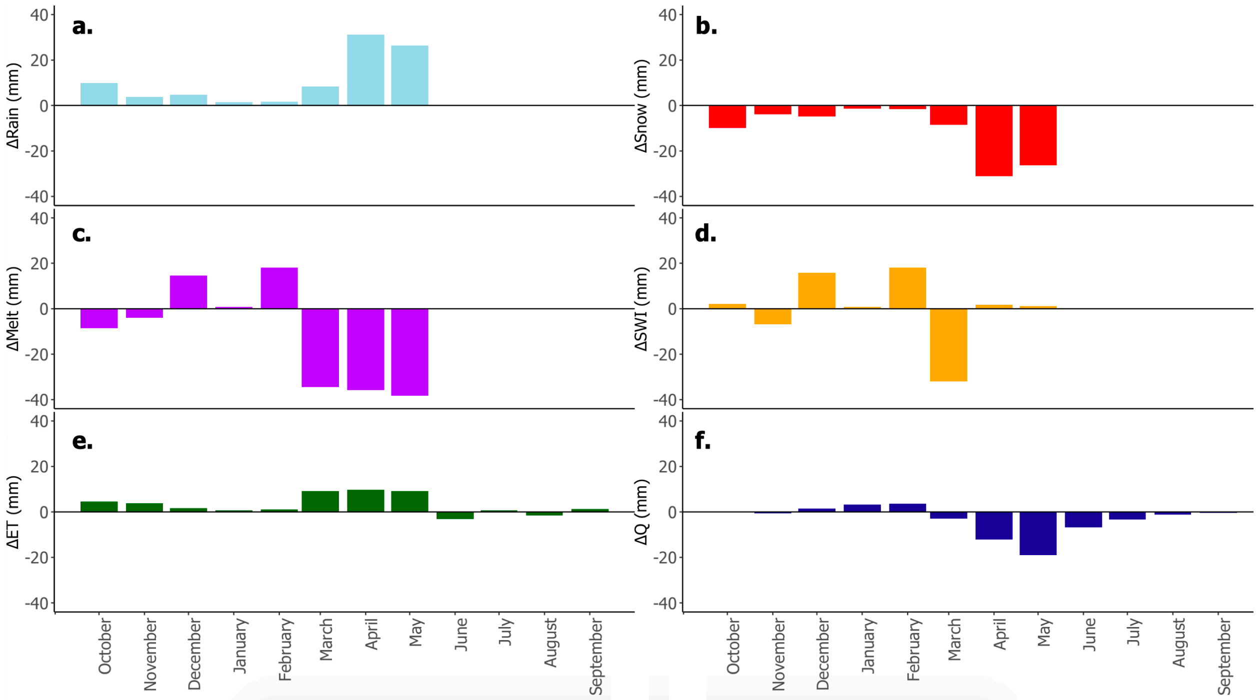


Figure 5. Differences (in mm/month) in rainfall, snowfall, snowmelt, SWI, ET, and Q between warming and control simulations (a-f, respectively). Positive values indicate greater values in the warming simulation versus the control simulation.

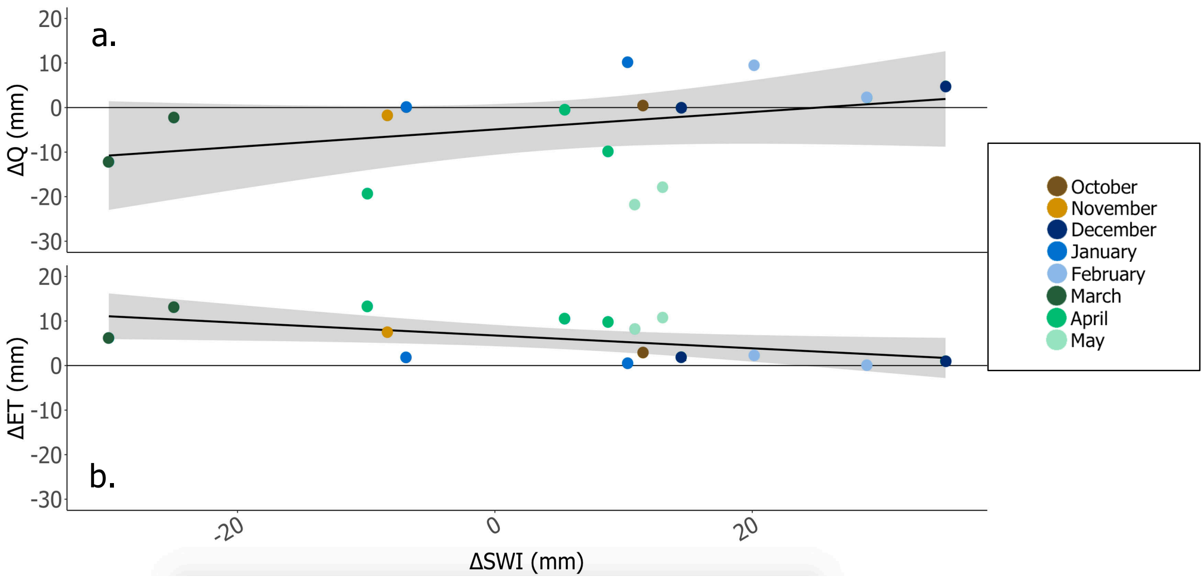


Figure 6. (a) The relationship between monthly changes in discharge (Q) and surface water inputs (SWI) between warming and control simulations. (b) The relationship between the change in Evapotranspiration (ET) and change in SWI between control and warming simulations. Summer months have been removed for clarity as SWI did not change in summer months.

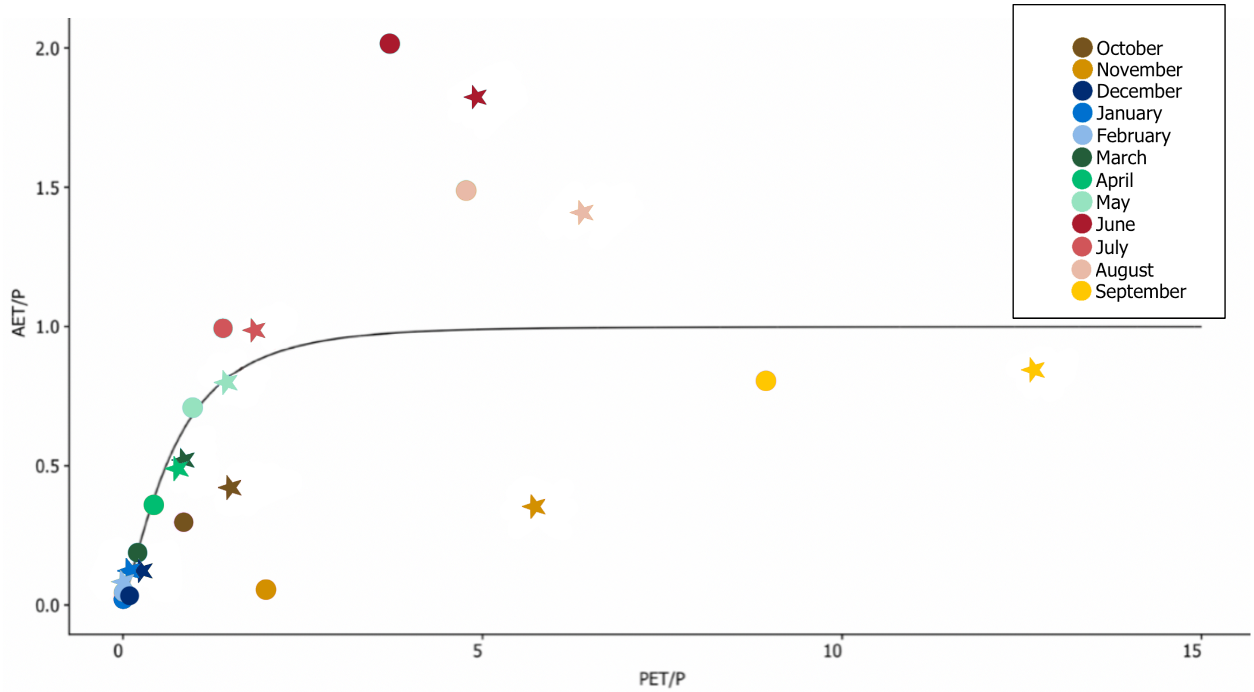


Figure 7. Monthly aridity indices and evaporative indices within the Budyko space for the control simulation (point) and warming simulation (star). We compared monthly averages between the two simulations. In warming simulation winter months (blue stars) and early-spring months (green stars), the catchment partitions less available SWI to ET and thus more to Q compared to Budyko's hypothesis (black line), plotting vertically lower than the corresponding control simulation (blue circles, green circles) and plotting below Budyko's curve. This is a time of energy-limitation. Conversely, summer months (red circles and corresponding red stars) are water-limited due to a shift toward SWI generation earlier in the year, causing the warming simulation (stars) to plot vertically lower than the control simulation (circles).

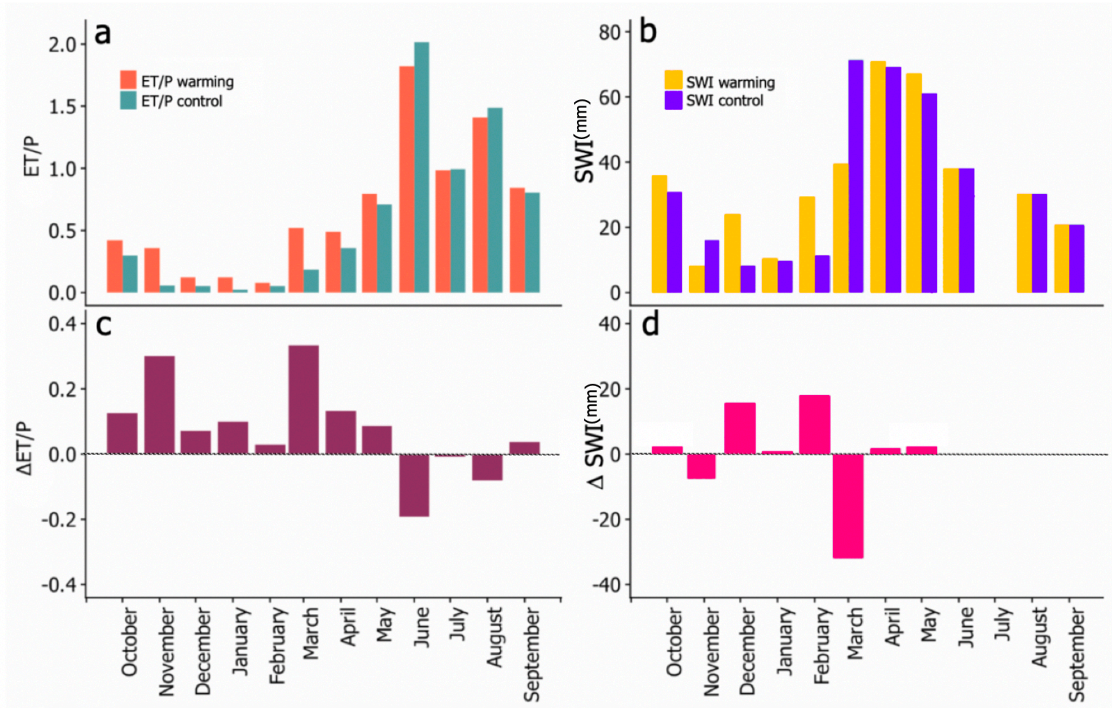


Figure 8. (a.) ET/P and (b.) SWI in control and warming conditions. Difference values of (c.) average monthly ET/P and (d.) average monthly SWI between simulations. Changes in ET/P align with water availability in the form of SWI. Most notably, when ΔSWI is positive, ΔET/P is positive in winter months. ΔET/P is negative in summer months due to water limitations and the input of SWI earlier in the year; e.g. a significant decrease in ΔSWI in March caused a large decrease in ΔET/P in June.