Table 1. Data sources for the DHSVM control simulation including forcing, vegetation, soil and geology. The datasets were scaled to 20 m, hourly resolutions, using nearest neighbor methodology.

Catchment characteristic	Dataset source	Dataset use and citation and notes	Spatial Resolution	Temporal resolution	Dates gathered
Meteorological forcings (excluding precipitation)	*National Land Data Assimilation System (NLDAS2, phase 2 gridded product)*	Bias corrected air temperature, wind speed, incident shortwave radiation, relative humidity, longwave radiation [Mitchell et al., 2004; Xia et al., 2012]	12km (1/8 degree)	Hourly	Oct 2000 – Oct 2013
	Gordon Gulch South Facing Meteorology Station (GGL_SF_Met)	Bias correct NLDAS2 for wind speed, incident shortwave radiation [Anderson and Ragar, 2020]	Point measurements	10-minute	Oct 2012 – Oct 2013
	Gordon Gulch North Facing Meteorology Station (GGL_NF_Met)	Bias correct NLDAS2 for air temperature [Anderson and Ragar, 2020]	Point measurements	10-minute	Oct 2012 – Oct 2013
	Betasso meteorology station, BT_Met (2000 m, 14.5 km east of Gordon Gulch)	Bias correct NLDAS2 relative humidity [Anderson and Ragar, 2020]	Point measurements	10-minute	Oct 2010 – Oct 2013
Precipitation	*Gordon Gulch South Facing Meteorology Station, (GGL_SF_Met)*	Used during June-September when available (2012, onwards) [Anderson and Ragar, 2020]	Point measurements	10-minute	Oct 2000 – Oct 2013
	Betasso meteorology station, BT_Met (2000 m, 14.5 km east of Gordon Gulch)	Used to gap-fill missing GGSF data during June-September [Anderson and Ragar, 2020]; unheated precipitation gauge until October 2011	Point measurements	10-minute	Oct 2000 – Oct 2013
	Sugarloaf CO94 National Atmospheric Deposition Program (NADP, 2500m, 2 km south of Gordon Gulch)	Used during October-May, gap-filled with C1 data [NADP, 2020]; heated precipitation gauge	Point measurements	Daily	Oct 2000 – Oct 2013
	C1 Niwot Ridge (3022m, 6.5 km west of Gordon Gulch)	Gap fill missing Sugarloaf data using linear relationship [Jennings et al., 2018]	Point measurements	Daily	Oct 2000 – Oct 2013
Streamflow	*Gordon Gulch stream gage, GGL_SW_0_Dis (Figure 1)*	Full streamflow record, derived from annual stage-discharge relationships [Anderson and Ragar, 2020]	Point measurements	10-minute	Apr 2010 – Aug 2013
Vegetation	*National Land Cover Database (NLCD)*	Vegetation type [NLCD, 2019]	30m	NA	2011
Soil	*Natural Resources Conservation Services (NRCS)*	Soil type [NRCS, 2019]	30m	NA	2011

Table 2. Optimized parameters of DHSVM and associated units, value ranges that were tested within Latin-Hypercube sampling optimization, and brief definition. Value ranges were selected based on previous DHSVM calibration [Badger et al., 2020; Livneh et al., 2014, 2015; Yao and Yang, 2009] and field measurements [Anderson and Ragar, 2020; Hinckley et al., 2012].

Parameter name	Unit	Manual calibration value ranges	Selected parameter value (spatially uniform)	Definition
Lateral conductivity	m/s	10^{-5} -10^{-2}	0.009	Rate of water movement through soil pores
Exponential factor	m^{-1}	0-5	3	Controls decay of hydraulic conductivity of with depth
Porosity	m^3/m^3	0.4-0.6	0.46	Ratio of void space to total volume
Field Capacity	m^3/m^3	0.18-0.41	0.21	Water holding capacity of soil after drainage
Minimum resistance	s/m	200-700	300	Stomatal opposition of water movement through vegetation pores

Table 3. Annual precipitation range, average annual snow fraction and average annual runoff ratio for the control and warming simulations. While precipitation was held constant across simulations, the warming simulation (with differences in temperature, longwave radiation and relative humidity shown in Figure 2) experienced a decrease in snow fraction and decrease in runoff ratio.

Hydrologic Variable	Control Simulation	Warming Simulation
Annual precipitation range (mm)	459-537	459-537
Average annual snow fraction (%)	36	31
Average annual runoff ratio	0.17	0.12
Sum of water in soil (mm)	18	17
Sum of saturated sub-surface flow (mm)	1169	255
Average water table depth below surface (m)	-1.6e-05	-1.3e-05

Table 4. Aridity indices, evaporative indices and runoff ratios for control and warming simulations. In the warming simulation, the aridity index increased with a lessened increase in evaporative index and lessened decrease in runoff ratio.

Simulation	Aridity Index (PET/P)	Evaporative Index (ET/P)	Runoff Ratio (Q/P)
Control	1.5	0.83	0.17
Warming	2.85	0.88 (expected ~0.92)	0.12 (expected ~0.07)