Kanab Plateau Groundwater Basin Profile

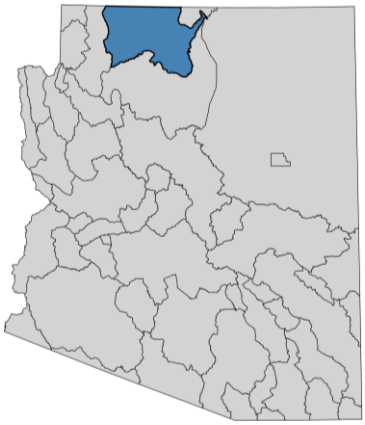
ARIZONA TRI-UNIVERSITY

RECHARGE AND WATER RELIABILITY PROJECT

Basin Summary Statistics

Size[1]: 4,247 square miles
Elevation[2]: Range: 1,608-9,209 ft; Median: 5,410 ft
Top 3 land cover types by area[3]: Shrub/Scrub (75%), Evergreen Forest (21%), Barren Land (1.2%)
Major surface watershed(s)[4]: Kanab Creek, Colorado River
Groundwater subbasins[1]: None
Groundwater-derived streamflow fraction[5]:

0.41 (Moderate)



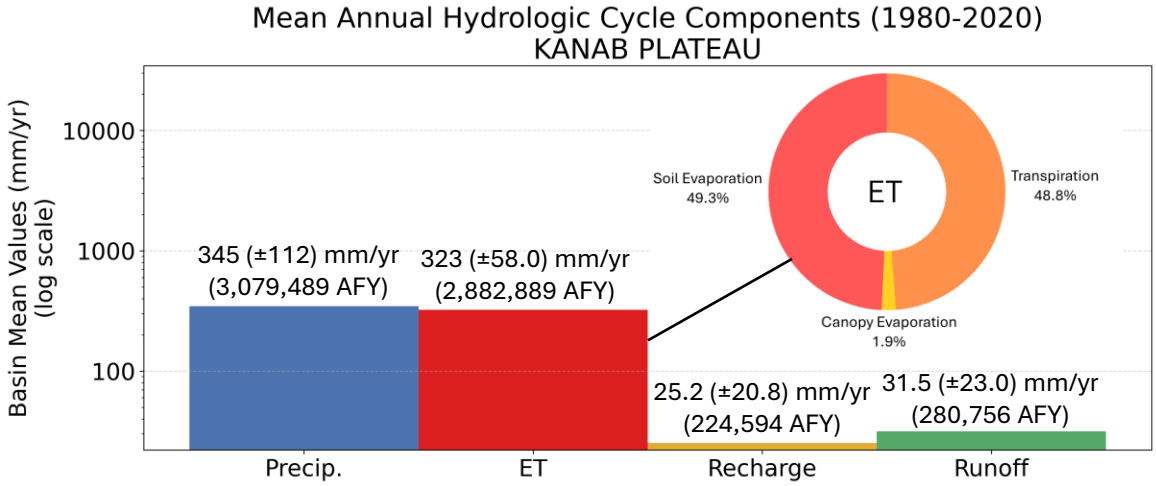


Figure 1 (above). Bar chart showing Noah-MP modeling results of the historical mean annual hydrologic cycle components (precipitation [P], evapotranspiration [ET], natural recharge, and runoff) in the basin from 1980-2020.[6] ET is partitioned into soil evaporation, canopy evaporation, and transpiration. It is possible for ET to be greater than P when there are other sources such as groundwater, surface water, or water in storage.

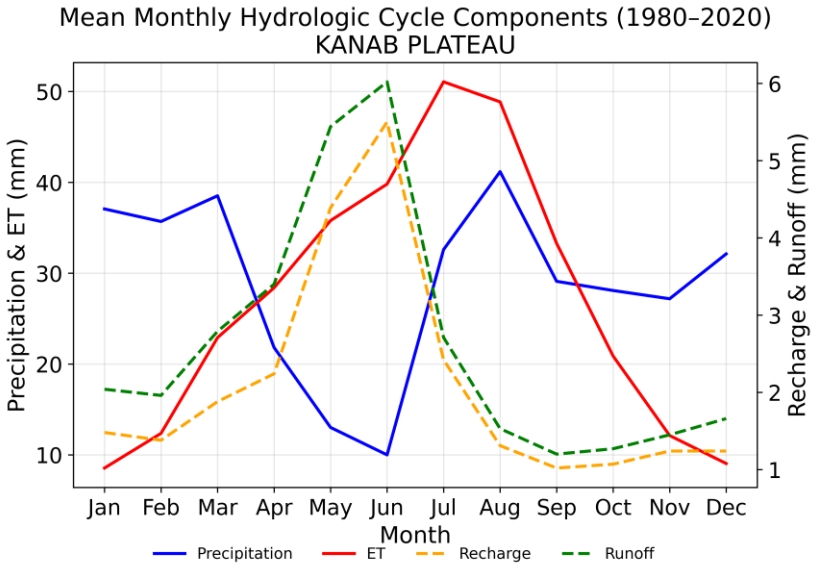


Figure 2. Graph showing monthly mean precipitation, ET, recharge, and runoff for the groundwater basin (1980-2020) from Noah-MP modeling results.[6]

Precipitation (P) in the Kanab Plateau basin is affected by the North American Monsoon during the summer months and large frontal systems during the winter. The greatest atmospheric losses occur during the summer months, where evapotranspiration (ET) exceeds P from mid-March through mid-September. Soil evaporation makes up 49.3% of total ET in the basin, while transpiration comprises 48.8% and canopy evaporation accounts for the remainder (1.9%). Natural recharge (25.2 mm/yr) and runoff (31.5 mm/yr) peak in June due to springtime snowmelt. Groundwater is estimated to supply 41% of total streamflow in the Kanab Plateau.

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Figure 3 (below). Gridded depiction of mean annual water fluxes across the groundwater basin from Noah-MP modeling (1980-2020): (a) precipitation, (b) evapotranspiration, (c) recharge, (d) runoff.[6] Major cities/towns[7] and Native American Reservation boundaries[8] are shown (as applicable) to help orient the reader.

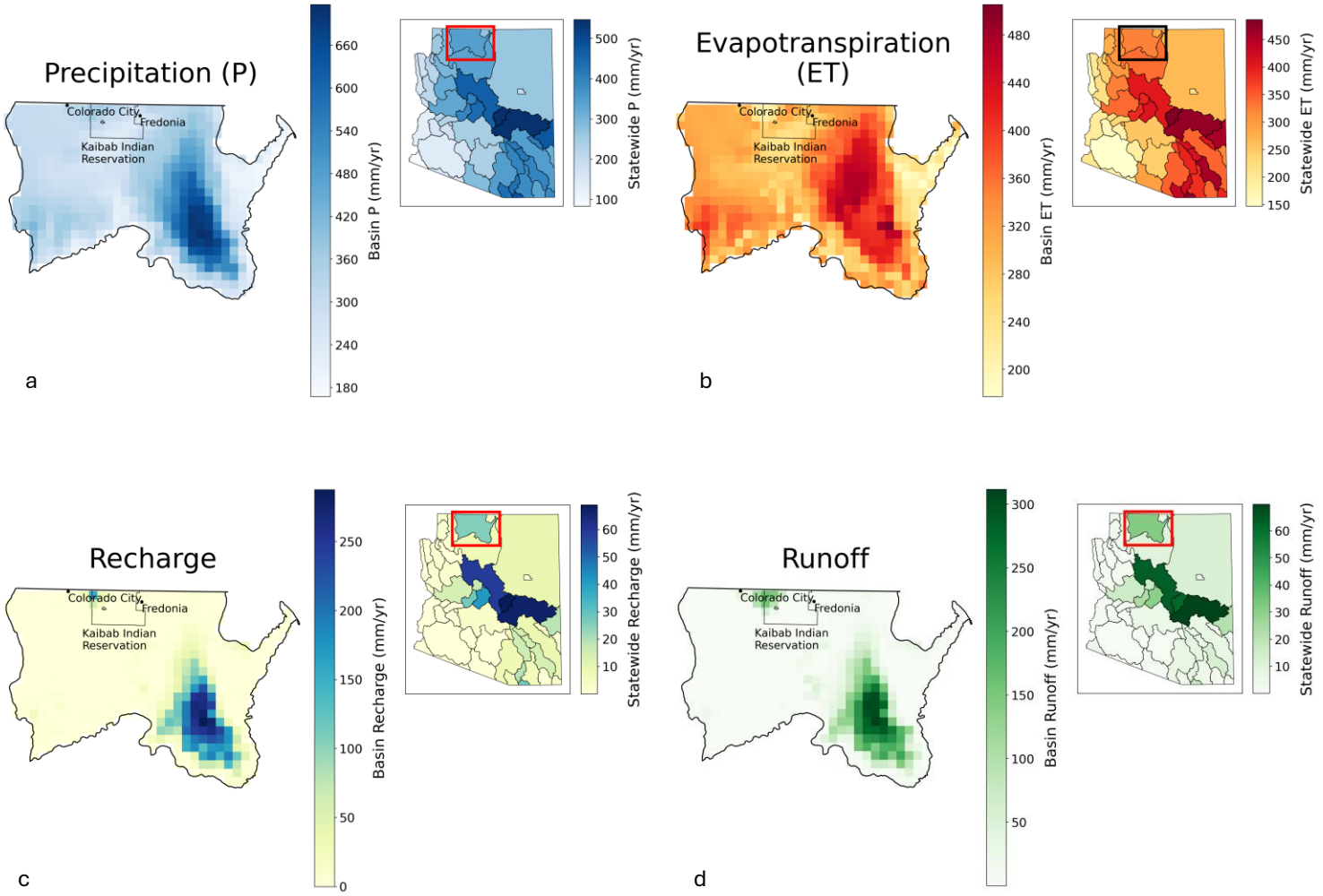
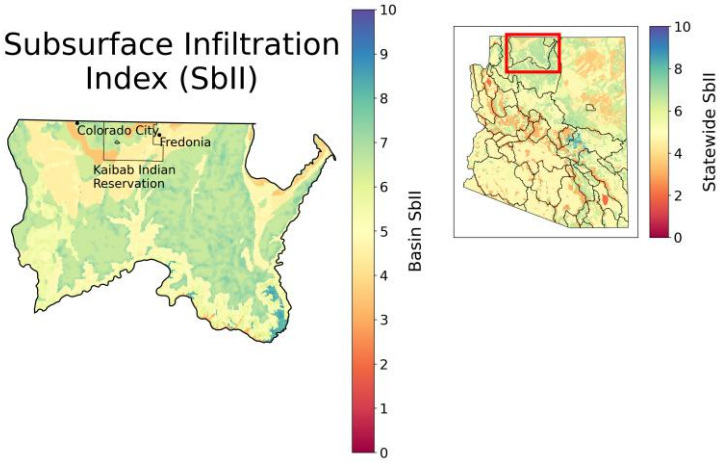


Figure 4 (below). Subsurface infiltration index (SbII) showing infiltration potential of the subsurface across the groundwater basin on a scale of 1-10 based on geologic features.[9]



Precipitation (P) in the Kanab Plateau is greatest in southeast portion of the basin near the North Rim of the Grand Canyon, where P exceeds 680 mm/yr on average. ET (~480 mm/yr), natural recharge (~260 mm/yr) and runoff (~280 mm/yr) are also highest in this region. The basin has relatively high infiltration potential due to the presence of karst-type geology and faults.

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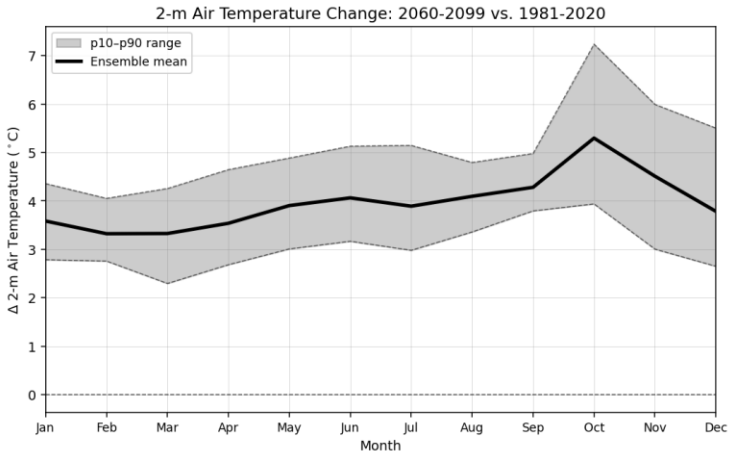
Climate Change Projections:
Changes in Temperature, Precipitation, ET, Recharge, and Runoff
(2060-2099 vs. 1981-2020)



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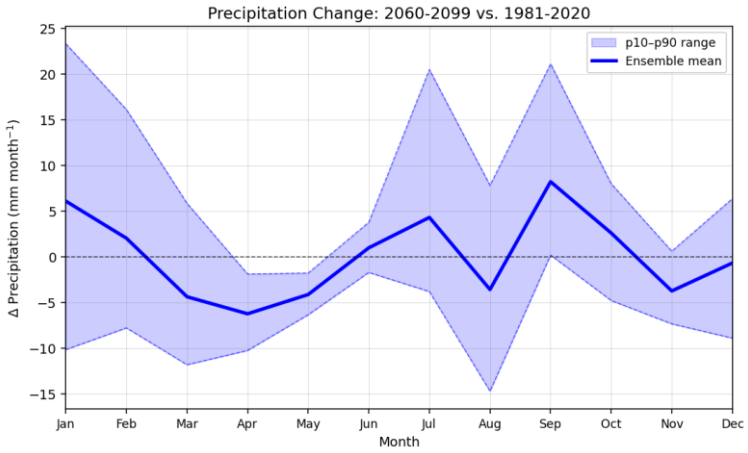

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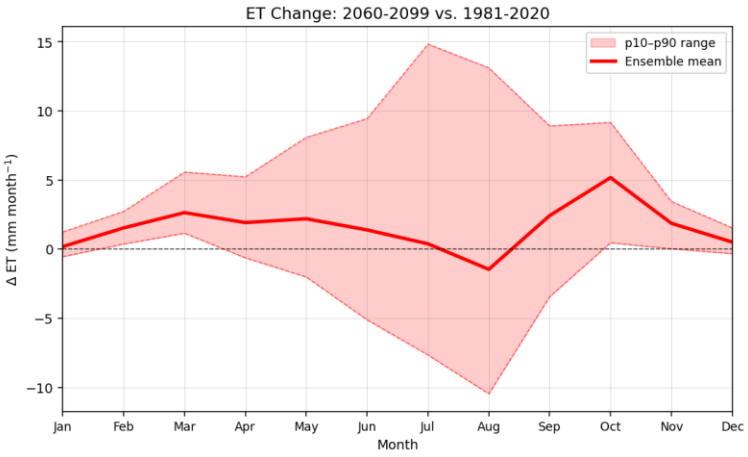

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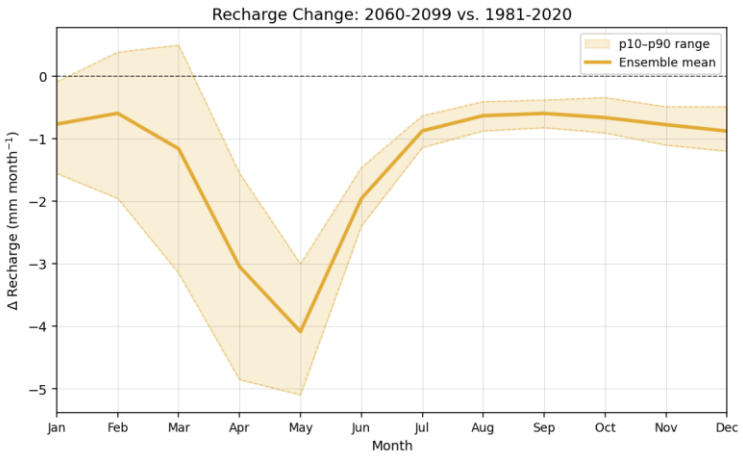

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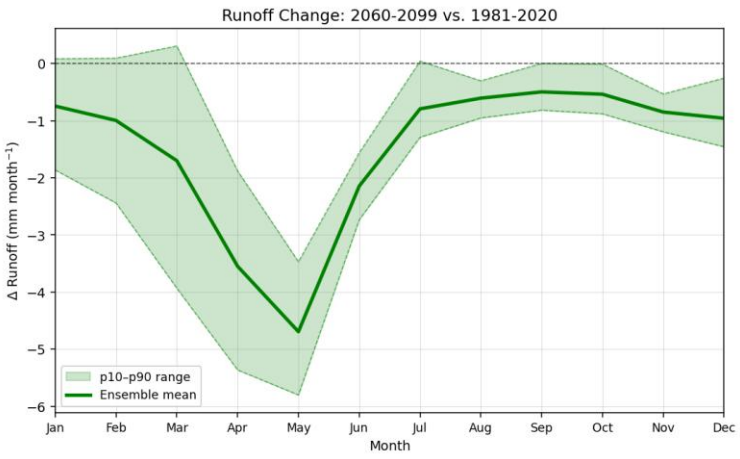

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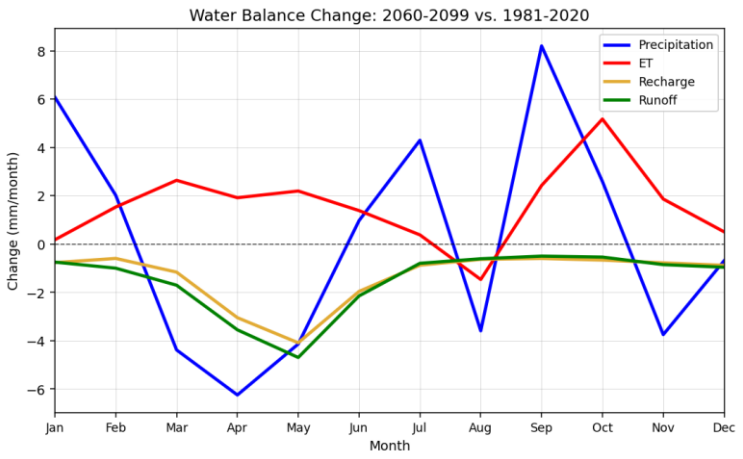

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Figure 5. Plots (a)-(e) show projected changes in (a) temperature, (b) precipitation, (c) evapotranspiration (ET), (d) natural recharge, and (e) runoff statewide, comparing end of the 21st century to the historical record from 1981-2020 under the IPCC Scenario SSP3-7.0.[10] Plot (f) shows the change in the water balance components (P, ET, recharge, and runoff) on a single graph for direct comparison. The analysis uses 14 dynamically downscaled global climate models (GCM) at 9-km resolution and the Noah-MP land surface model. The ensemble mean of the 14 GCMs is shown in bold for each component of the hydrologic cycle, with the 10-90th percentile shaded to show model projection uncertainty.

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Climate change projections across the Kanab Plateau show drier springs (11-29% drier March through May), and a drier August (8%) and November (15%). September and October are projected to be 9-29% (2.7-8.2 mm/month) wetter on average, which is consistent with a projected increase in extreme events associated with hurricane and tropical cyclone activity by the end of the century. Declines in natural recharge are projected for all months of the year, with projections in the highest recharge months (March-June) showing declines of 31-76% (-1.2 to -4.1 mm/month). Similarly, runoff is expected to decline in all months of the year, with declines of 36-75% in March-June (-1.7 to -4.7 mm/month). Projected increases in temperature range from approximately 3.3 °C in March to 5.3 °C in October. Higher temperatures and greater water availability from precipitation lead to a projected 26% (5.2 mm) increase in evapotranspiration (ET) in October compared to the baseline period, while less water availability in August leads to a projected decline in ET (3% or -1.3 mm).

References

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