

Hualapai Valley INA

Groundwater Basin Profile



Basin Summary Statistics

Size¹: 1,213 square miles

Elevation²: Range: 1,081-7,971 ft; Median: 3,364 ft

Top 3 land cover types by area³: Shrub/Scrub (91%), Evergreen Forest (3.3%), Barren Land (1.7%)

Major surface watershed(s)⁴: Truxton Wash/Red Lake, Colorado River

Groundwater subbasins¹: None

Groundwater-derived streamflow fraction⁵:

0.73 (Very High)



Mean Annual Hydrologic Cycle Components (1980-2020)
HUALAPAI VALLEY INA

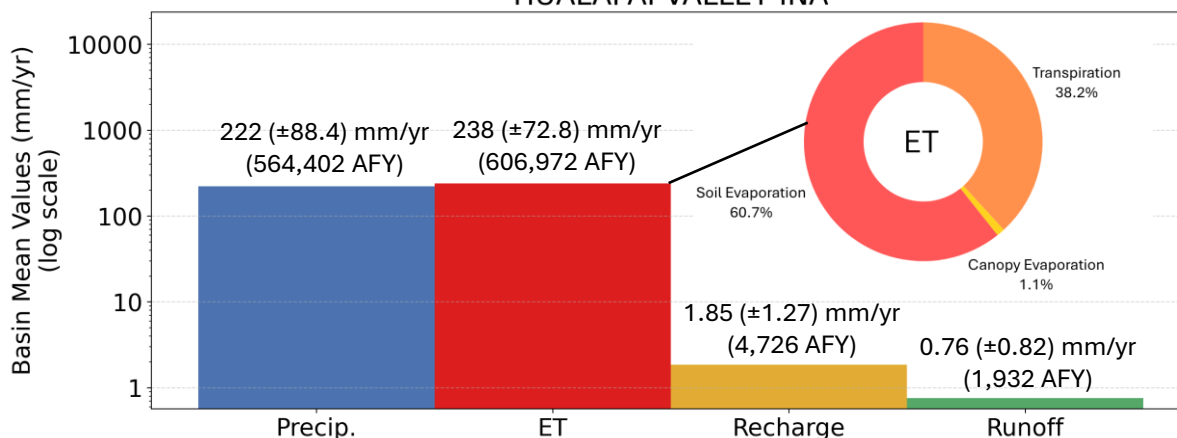


Figure 1 (above). Bar chart showing Noah-MP modeling results of the historical mean annual hydrologic cycle components (precipitation [P], evapotranspiration [ET], natural recharge, and runoff) in the basin from 1980-2020.⁶ ET is partitioned into soil evaporation, canopy evaporation, and transpiration. It is possible for ET to be greater than P when there are other sources such as groundwater, surface water, or water in storage.

Mean Monthly Hydrologic Cycle Components (1980-2020)
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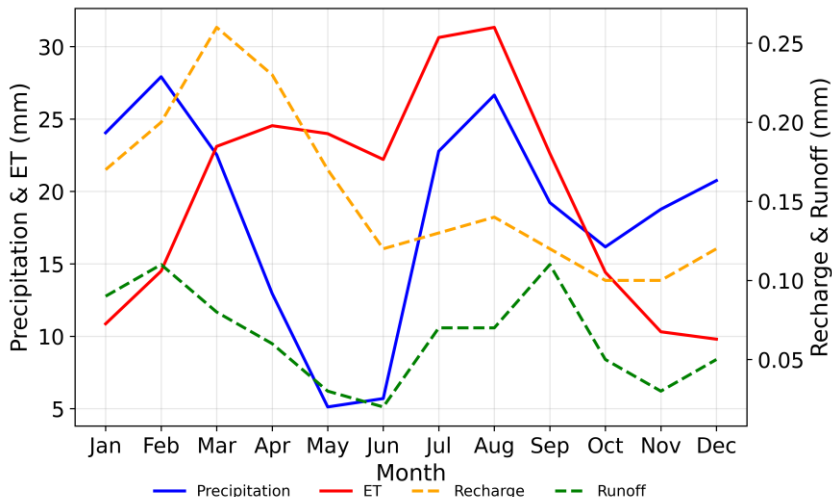


Figure 2. Graph showing monthly mean precipitation, ET, recharge, and runoff for the groundwater basin (1980-2020) from Noah-MP modeling results.⁶

On annual timescales, evapotranspiration (ET) exceeds precipitation (P) on average in the Hualapai Valley INA, resulting in low basin-wide averages for natural recharge (1.85 mm) and runoff (0.76 mm). ET is greater than P from March through mid-September. Soil evaporation makes up 60.7% of total ET in the basin, while transpiration comprises 38.2% and canopy evaporation accounts for the remainder (1.1%). P exceeds ET during the late fall and winter months when there is lower atmospheric demand.

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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/towns⁷ and Native American Reservation boundaries⁸ are shown (as applicable) to help orient the reader.

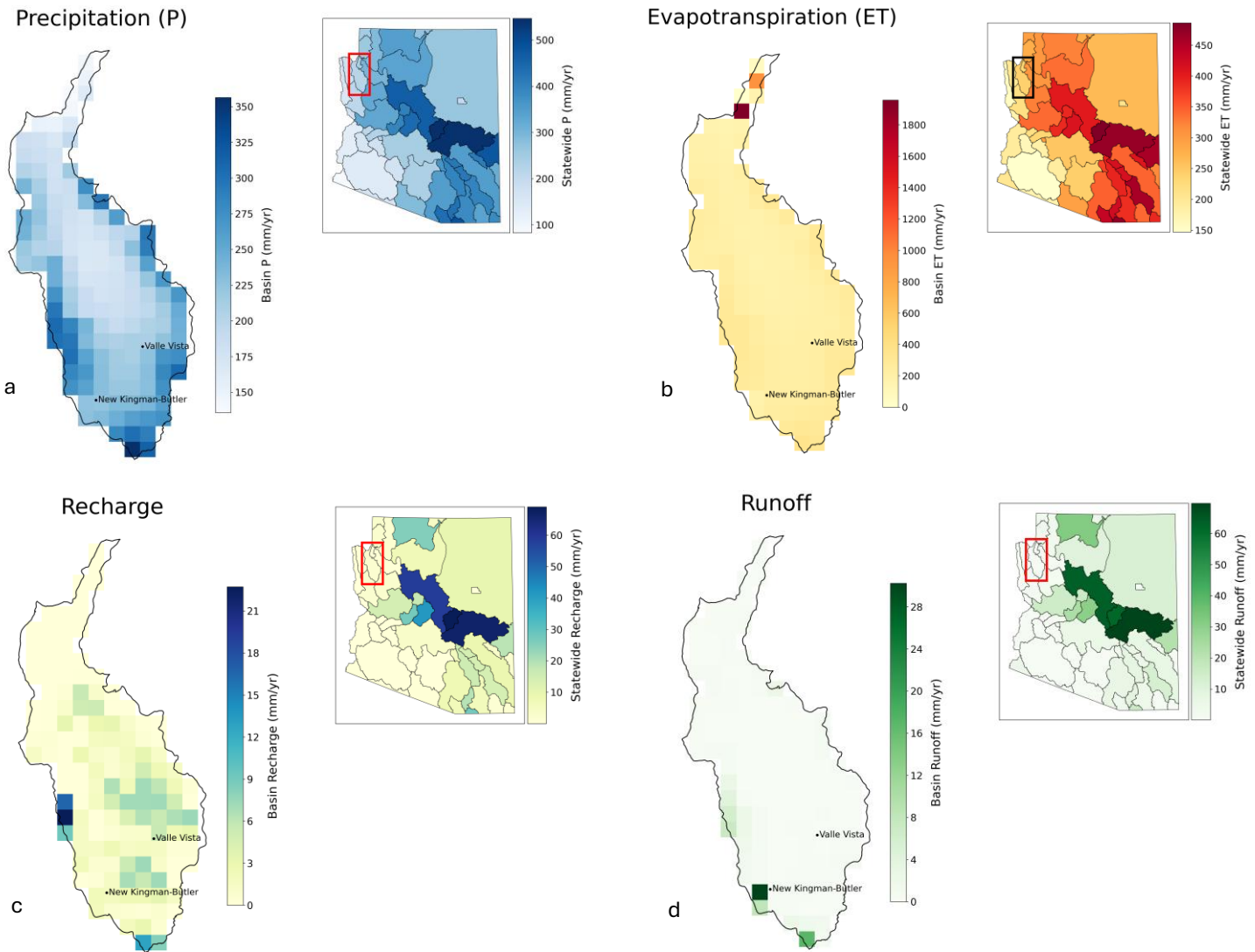
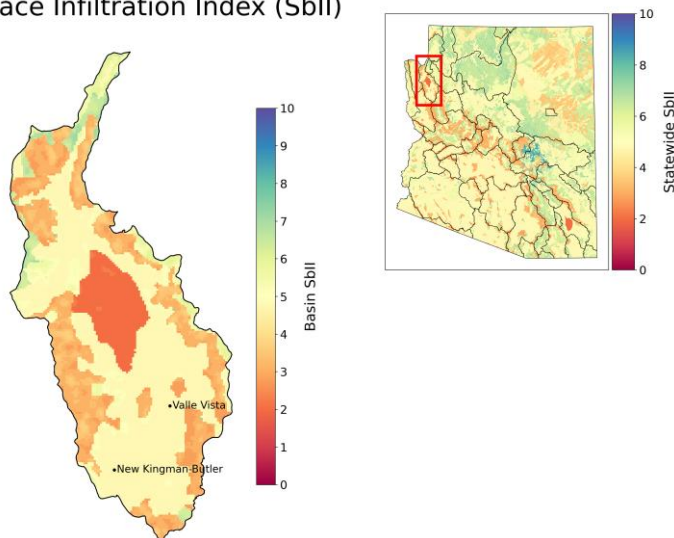


Figure 4 (below). Subsurface infiltration index (SbII) showing infiltration potential of the subsurface across the groundwater basin on a scale of 1-10 based on geologic features.⁹

Subsurface Infiltration Index (SbII)



The Hualapai Valley INA is ringed by mountains to the west, south, and east, where P can exceed 350 mm/yr. ET is highest over the open water of the Colorado River in the northern portion of the basin (>1,000 mm/yr). Runoff and natural recharge are minimal across the basin, with the highest values (~30 mm/yr and 20 mm/yr, respectively) occurring at the mountain front of the Cerbat Mountains. Infiltration potential varies across the basin; however, the Red Lake Playa is highlighted as an area of particularly low infiltration potential due to the presence of low permeability, fine-grained sediment. The northern tip of the basin has higher infiltration potential due to karst-type geology.

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

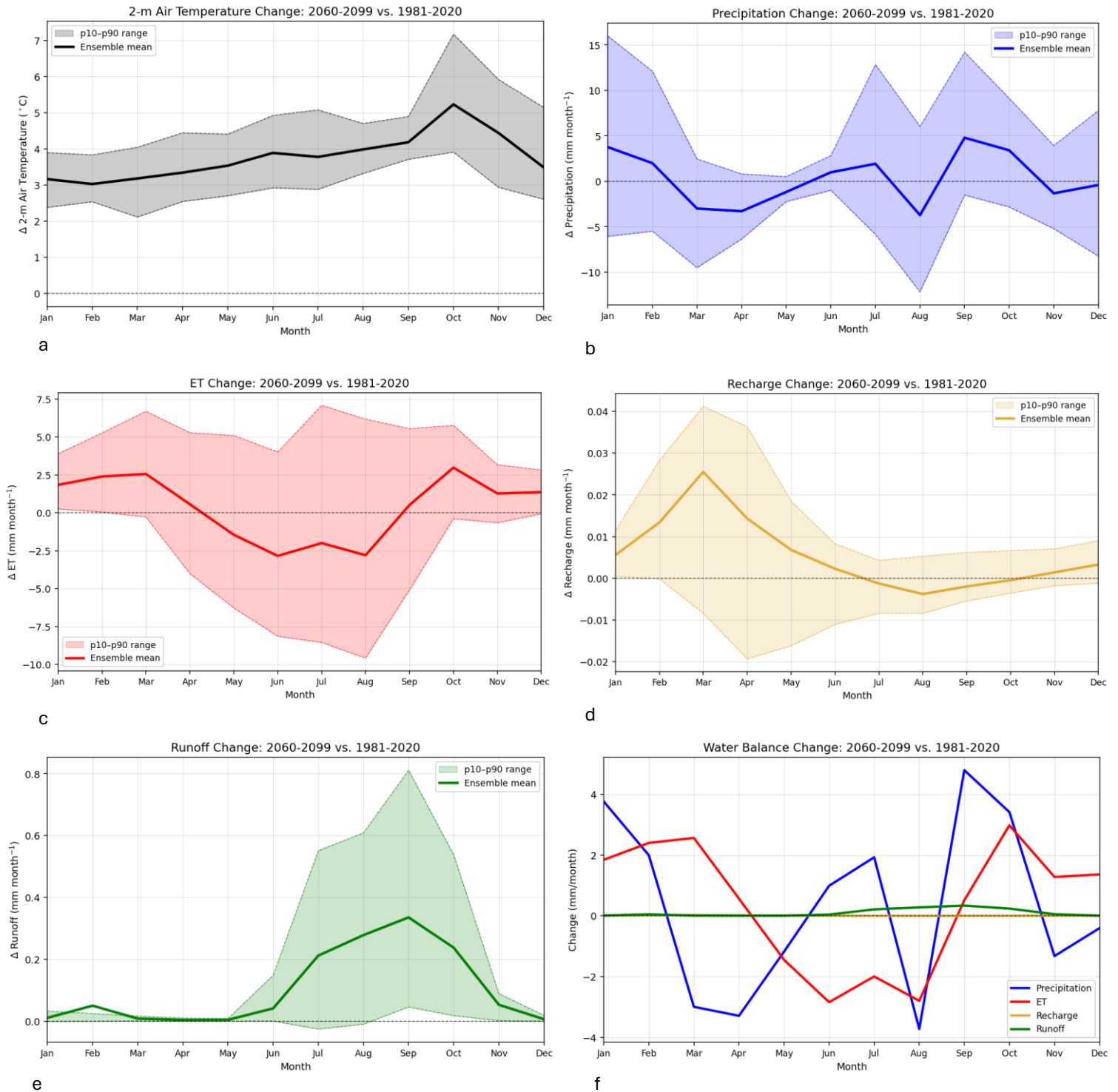


Figure 5. Plots (a)-(e) show projected changes in (a) temperature, (b) precipitation, (c) evapotranspiration (ET), (d) natural recharge, and (e) runoff statewide, comparing end of the 21st century to the historical record from 1981-2020 under the IPCC Scenario SSP3-7.0.¹⁰ Plot (f) shows the change in 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.



Climate change projections across the Hualapai Valley INA show drier springs (12-26% drier March through May) and a drier August (13%) and November (8%). September and October are projected to be 21-26% (3.5-4.8 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. Natural recharge remains near zero and slightly negative (approximately -0.04 mm/month) throughout the year.* While remaining below 0.4 mm/month, runoff is projected to increase by 0.22 to 0.34 mm/month from July to October by the end of the century. Projected increases in temperature range from approximately 3.1 °C in February to 5.3 °C in October. Higher temperatures and greater water availability from precipitation lead to a projected 15% increase in evapotranspiration (ET) in January (1.9 mm) and October (3.0 mm) compared to the baseline period.

*Projected negative recharge values are attributed to increased capillary rise from the aquifer through the vadose zone due to climate factors, resulting in water loss from the system. Because the Noah-MP model does not include groundwater pumping, this indicates that climate-driven factors play a significant role in groundwater storage decline in Arizona.

References

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