

Paria

Groundwater Basin Profile



Basin Summary Statistics

Size¹: 408 square miles

Elevation²: Range: 3,082-7,355 ft; Median: 6,037 ft

Top 3 land cover types by area³: Shrub/Scrub (96.5%), Barren Land (2.4%), Open Water (0.71%)

Major surface watershed(s)⁴: Paria River, Colorado River

Groundwater subbasins¹: None

Groundwater-derived streamflow fraction⁵:

0.55 (High)



Mean Annual Hydrologic Cycle Components (1980-2020)
PARIA

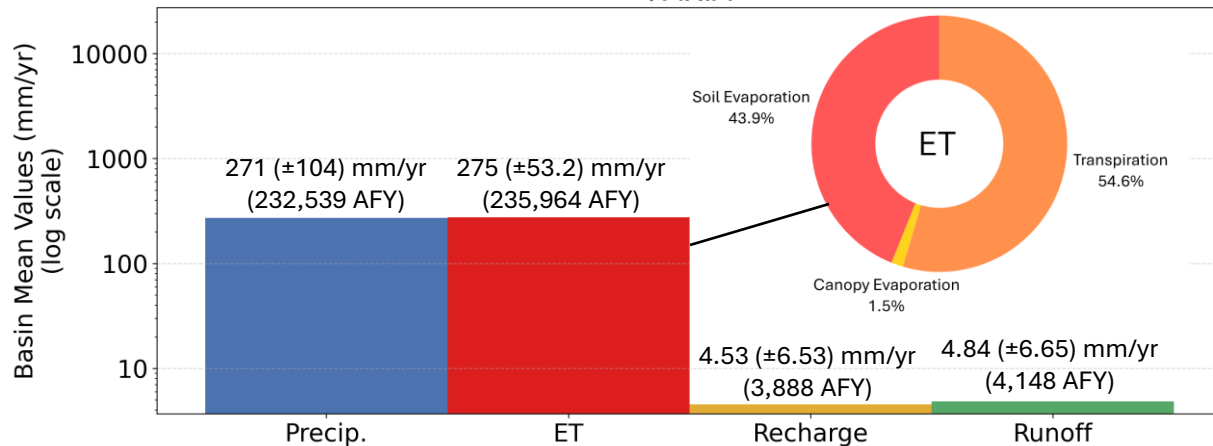


Figure 1 (above). Bar chart showing Noah-MP modeling results of the historical mean annual hydrologic cycle components (precipitation [P], evapotranspiration [ET], natural recharge, and runoff) in the basin from 1980-2020.⁶ ET is partitioned into soil evaporation, canopy evaporation, and transpiration. 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)
PARIA

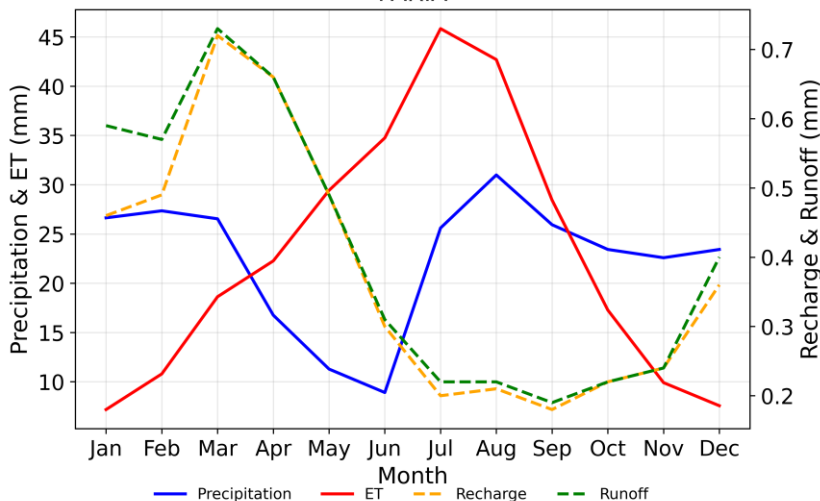


Figure 2. Graph showing monthly mean precipitation, ET, recharge, and runoff for the groundwater basin (1980-2020) from Noah-MP modeling results.⁶

Precipitation (P) in the Paria 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. Transpiration makes up the majority (54.6%) of total ET in the basin, while soil evaporation comprises 43.9% and canopy evaporation accounts for the remainder (1.5%). Natural recharge (4.53 mm/yr) and runoff (4.84 mm/yr) peak in March due to springtime snowmelt. Groundwater is estimated to supply 55% of total streamflow in the Paria basin.



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.

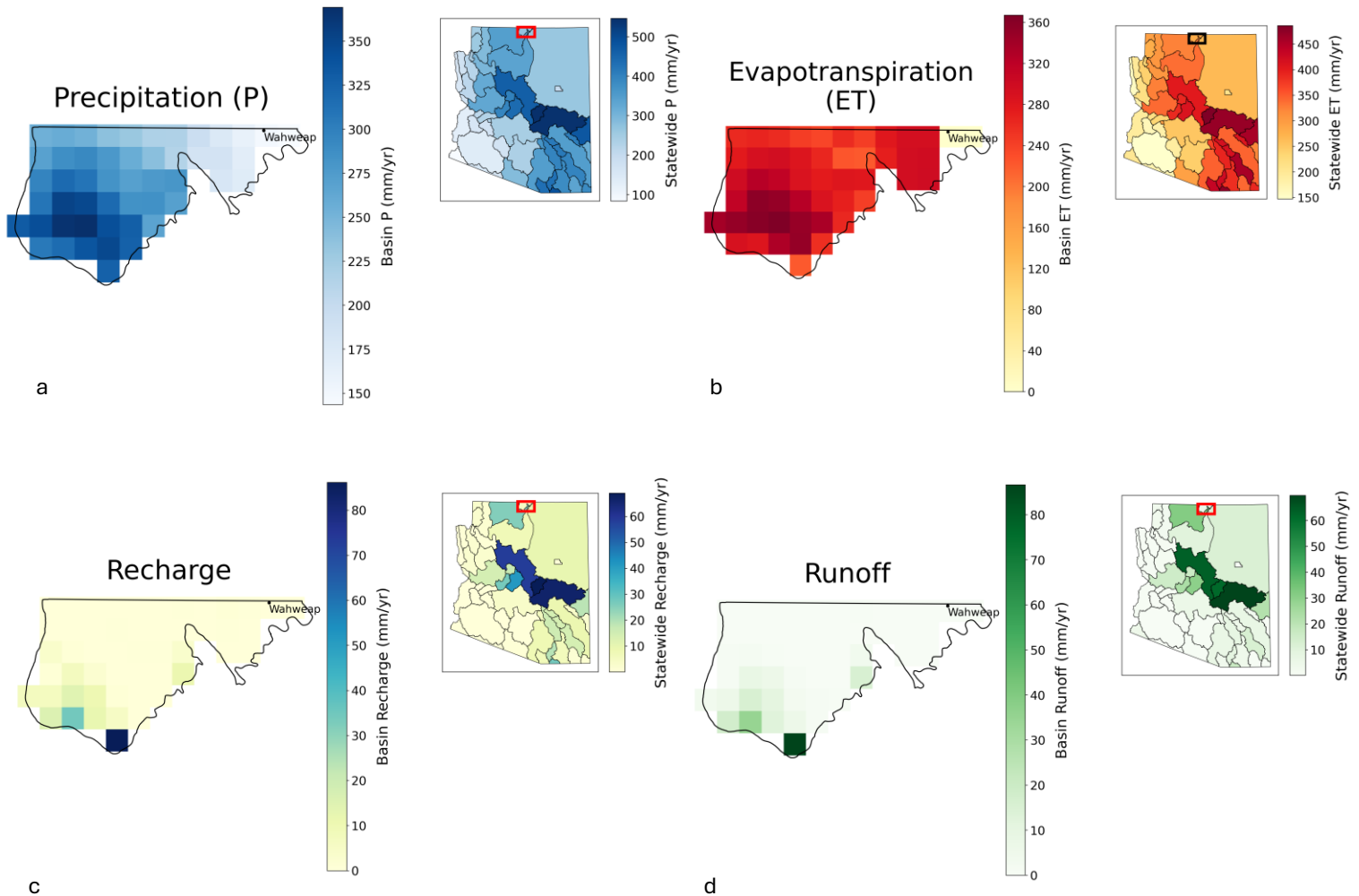
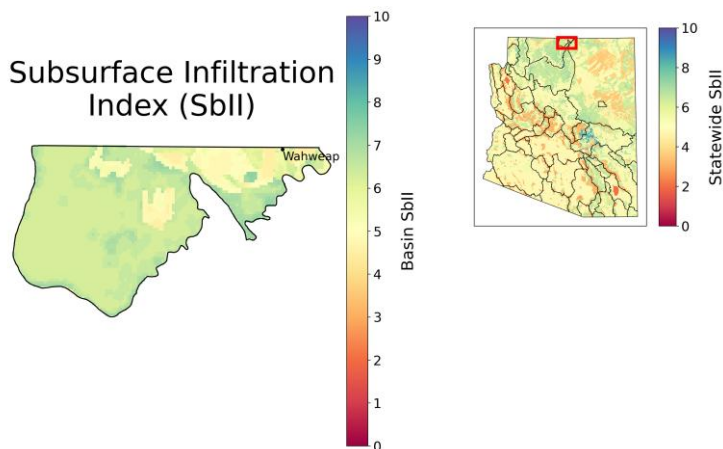


Figure 4 (below). Subsurface infiltration index (SbII) showing infiltration potential of the subsurface across the groundwater basin on a scale of 1-10 based on geologic features.⁹



Precipitation (P) in the Paria basin is greatest in southwest portion of Paria Plateau, where P exceeds 350 mm/yr on average. ET (~350 mm/yr) is also highest in this region. Natural recharge (80 mm/yr) and runoff (80mm/yr) are highest at the southern mountain front of the Plateau. The basin has relatively high infiltration potential due to the presence of karst-type geology.



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

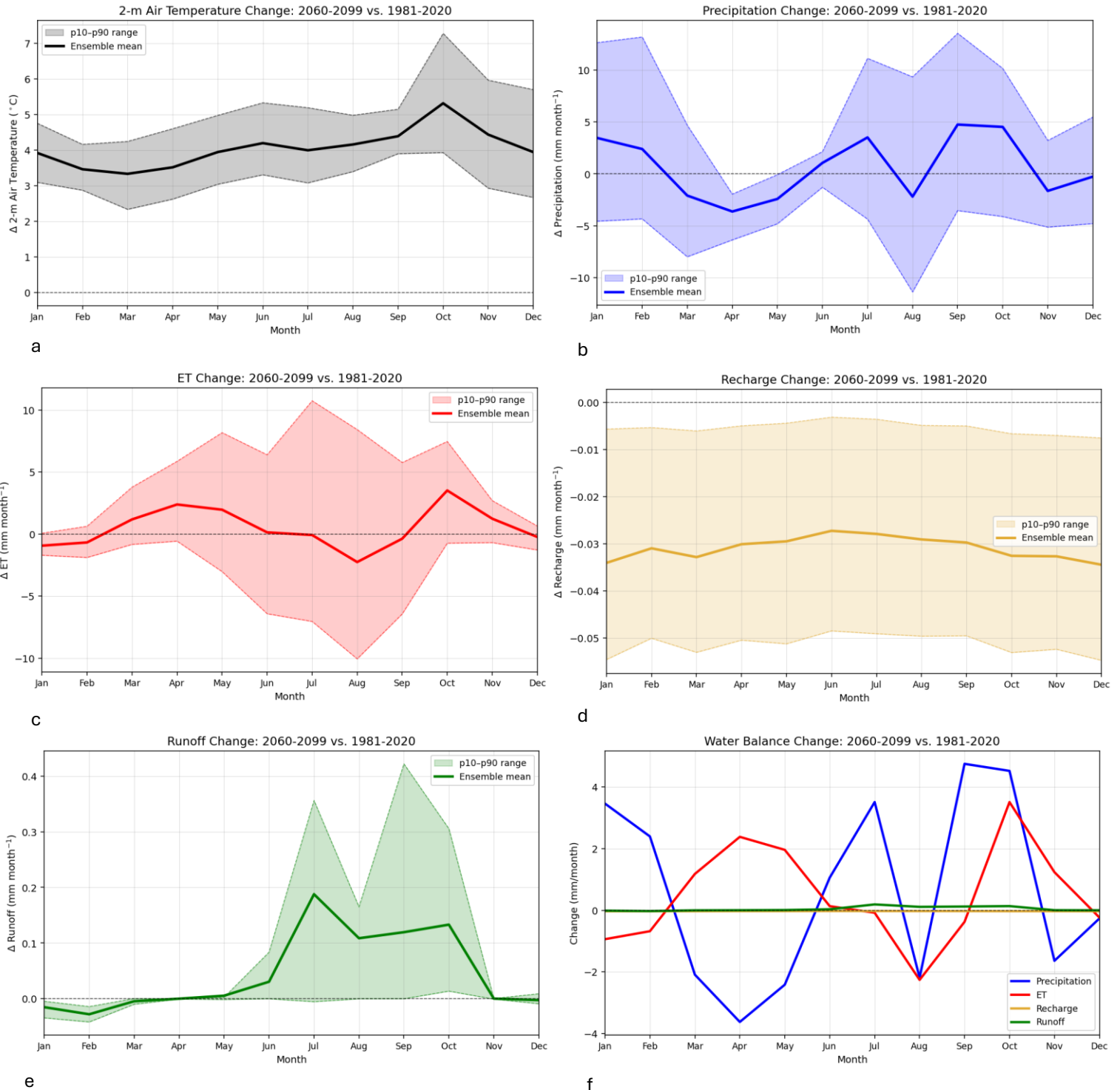


Figure 5. Plots (a)-(e) show projected changes in (a) temperature, (b) precipitation, (c) evapotranspiration (ET), (d) natural recharge, and (e) runoff statewide, comparing end of the 21st century to the historical record from 1981-2020 under the IPCC Scenario SSP3-7.0.¹⁰ Plot (f) shows the change in 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 Paria basin show drier springs (8-26% drier March through May), and a drier August (7%) and November (8%). September and October are projected to be 17-20% (4.6 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 is projected to remain near zero and slightly negative (approximately -0.04 mm/month) throughout the year.* While runoff is projected to remain near zero for most of the year, minor increases of 0.10-0.20 mm/month are projected for July-October. Projected increases in temperature range from approximately 3.3 °C in March to 5.4 °C in October. Higher temperatures and greater water availability from precipitation lead to a projected 22% (3.5 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 (6% or -2.2 mm).

*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

1. ADWR Groundwater Basin and Subbasin shapefiles. Retrieved from: <https://gisdata2016-11-18t150447874z-azwater.opendata.arcgis.com/>
2. USGS Digital Elevation Model data. Retrieved from: <https://apps.nationalmap.gov/downloader/>
3. Annual National Land Cover Database – Land Cover (2024). Retrieved from the Multi-Resolution Land Characteristics Consortium: <https://www.mrlc.gov/data>
4. USGS HUC8 Watersheds. Retrieved from: <https://hydro.nationalmap.gov/arcgis/rest/services/wbd/MapServer>
5. Mroczek, C., Springer, A. E., Gupta, N., Sankey, T., & Lucas, B. (2025). Regional base-flow index in arid landscapes using machine learning and instrumented records. *Journal of Hydrology: Regional Studies*, 62, 102778. <https://doi.org/10.1016/j.ejrh.2025.102778>
6. Gupta, A., Qiu, Y., Behrangi, A., & Niu, G. (2026). Noah-MP 40-Years Climatology for Water Balance over Ground Water Basins in Arizona, HydroShare, <http://www.hydroshare.org/resource/a3cc182071124849a463b6132213af23>. (Figures by Hinkley, M. & Mohsenzadeh Karimi, S.)
7. AZGeo City Points shapefile. Retrieved from AZGeo Data Hub: <https://azgeo-open-data-agic.hub.arcgis.com/datasets/azgeo::city-points/about>
8. Federal American Indian Reservation boundaries shapefile. Retrieved from: https://services2.arcgis.com/FiaPA4ga0iQKduv3/arcgis/rest/services/Federal_American_Indian_Reservations_v1/FeatureServer
9. Lima, R., Springer, A., Sankey, T. (2026). Arizona Subsurface Infiltration Index v.2, HydroShare, <https://doi.org/10.4211/hs.abcd8aa1a793463ab33677ce9d46db58>
10. Qiu, Y. (2026). Future Projection of Hydroclimate over Arizona Version 2, HydroShare, <https://doi.org/10.4211/hs.a5751f0af305483682501f79d9af0bd7>

