

Duncan Valley Groundwater Basin Profile



Basin Summary Statistics

Size¹: 550 square miles

Elevation²: Range: 3,279-7,471 ft; Median: 4,237 ft

Top 3 land cover types by area³: Shrub/Scrub (94%), Evergreen Forest (2.1%), Grassland Herbaceous (1.8%)

Major surface watershed(s)⁴: Upper Gila - Mangas

Groundwater subbasins¹: None

Groundwater-derived streamflow fraction⁵:

0.65 (High)



Mean Annual Hydrologic Cycle Components (1980-2020)
DUNCAN VALLEY

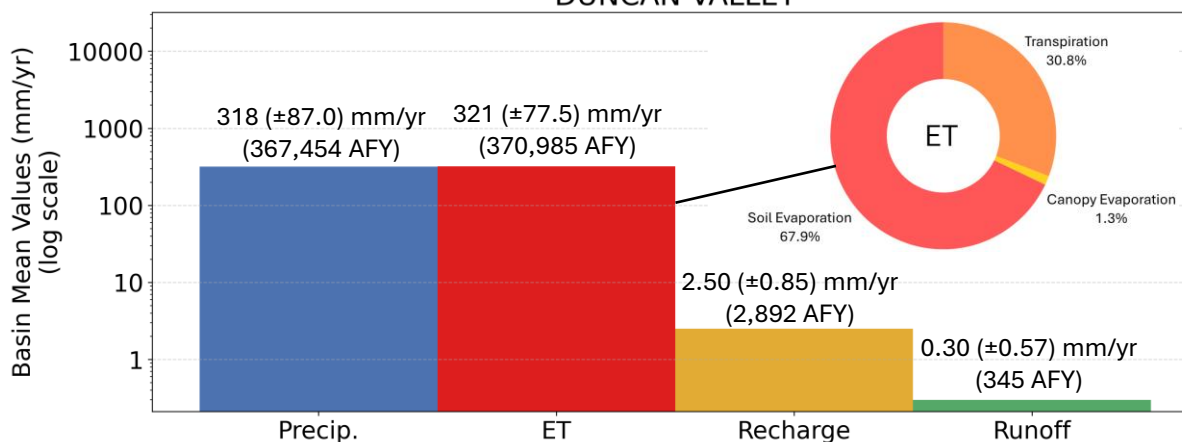


Figure 1 (above). Bar chart showing Noah-MP modeling results of the historical mean annual hydrologic cycle components (precipitation [P], evapotranspiration [ET], natural recharge, and runoff) in the basin from 1980-2020.⁶ ET is partitioned into soil evaporation, canopy evaporation, and transpiration.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

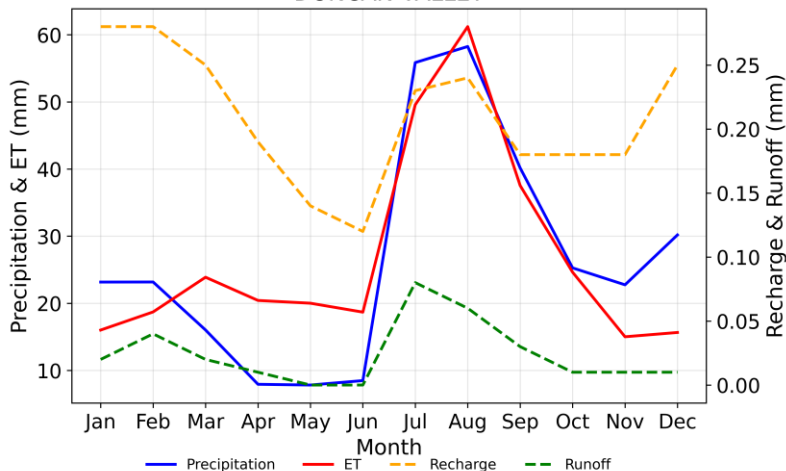


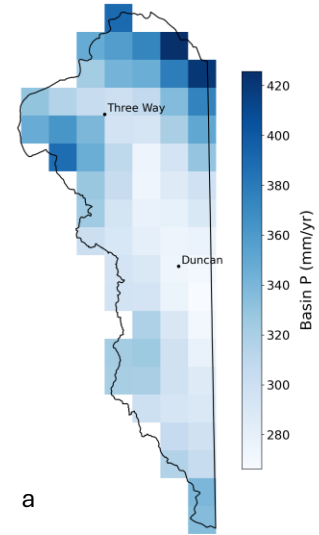
Figure 2. Graph showing monthly mean precipitation, ET, recharge, and runoff for the groundwater basin (1980-2020) from Noah-MP modeling results.⁶

On annual timescales, evapotranspiration (ET) is approximately equal to precipitation (P) on average across the basin, resulting in low averages for natural recharge (2.50 mm) and runoff (0.30 mm). P in the Duncan Valley basin is affected by the North American Monsoon during the summer months. ET is greater than P from March to June and tracks with P from July to October. Soil evaporation makes up 67.9% of total ET in the basin, while transpiration comprises 30.8% and canopy evaporation accounts for the remainder (1.3%).

Duncan Valley



Precipitation (P)



Evapotranspiration (ET)

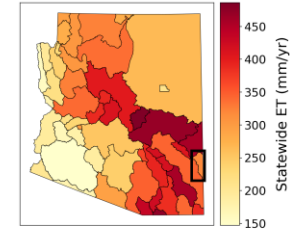
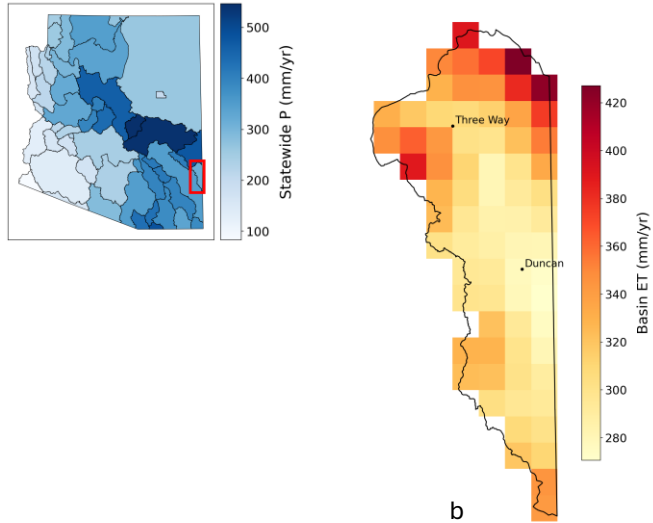
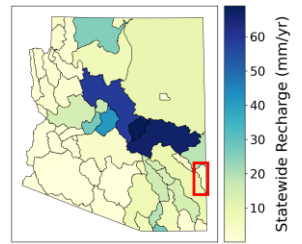
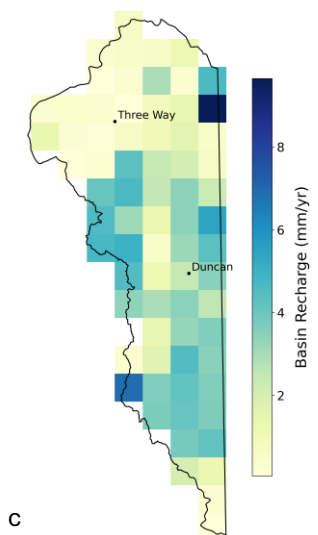
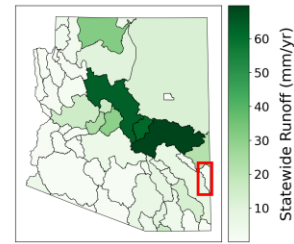
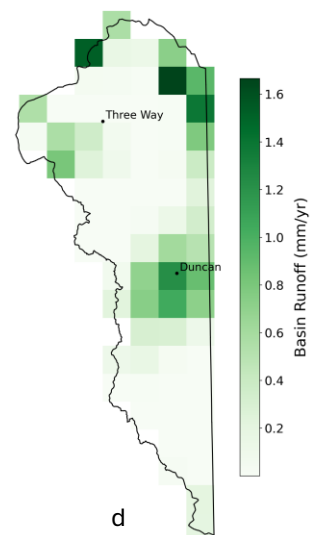


Figure 3 (left). Gridded depiction of mean annual water fluxes across the groundwater basin from Noah-MP modeling (1980-2020): (a) precipitation, (b) evapotranspiration, (c) recharge, (d) runoff.⁶ Major cities/towns⁷ and Native American Reservation boundaries⁸ are shown (as applicable) to help orient the reader.

Recharge



Runoff



Subsurface Infiltration Index (SbII)

Precipitation in the Duncan Valley basin is highest in mountainous region to the northeast. This region receives over 400 mm/yr of precipitation on average. Evapotranspiration (ET) is also highest in this region (~400 mm/yr). Natural recharge ranges from 2-4 mm/yr across much of the basin, with slightly higher values (8 mm/yr) at the higher elevations. Runoff is minimal across the basin, but is highest near the mountains to the north (~1.5 mm/yr). Subsurface infiltration potential is generally moderate to high across the basin, particularly in the Gila River valley due to the presence of moderately consolidated conglomerate containing limestone.

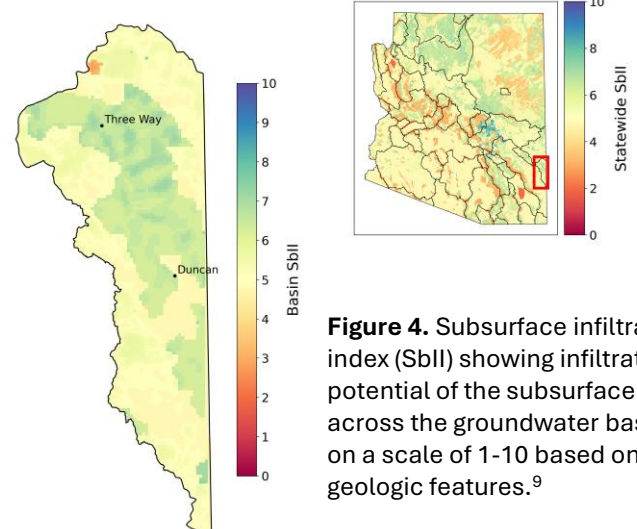
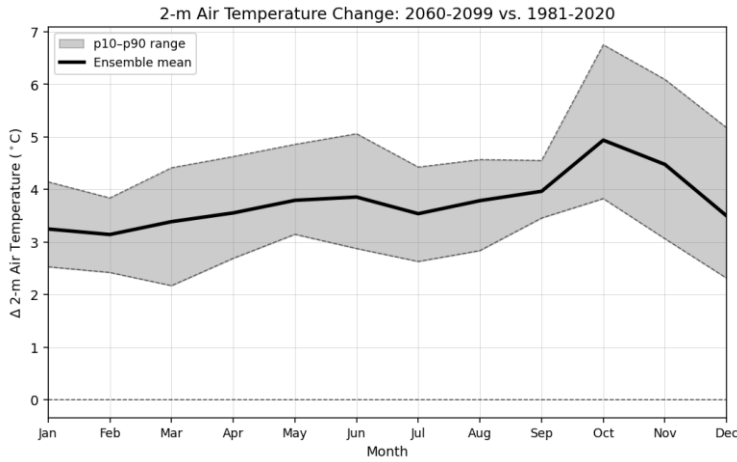


Figure 4. Subsurface infiltration index (SbII) showing infiltration potential of the subsurface across the groundwater basin on a scale of 1-10 based on geologic features.⁹

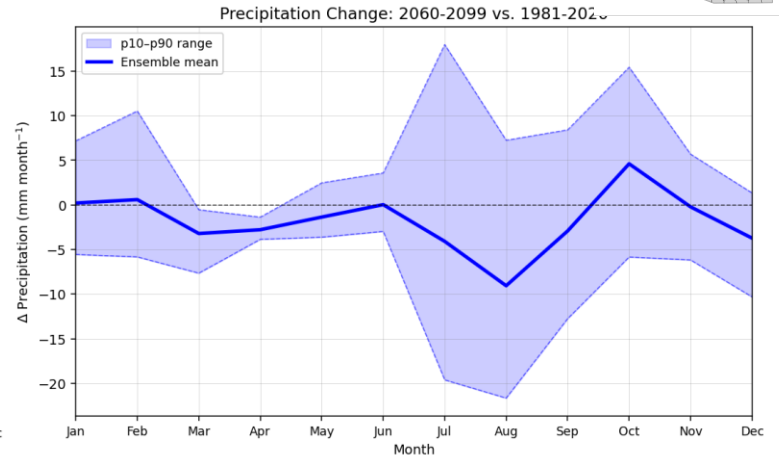
Duncan Valley



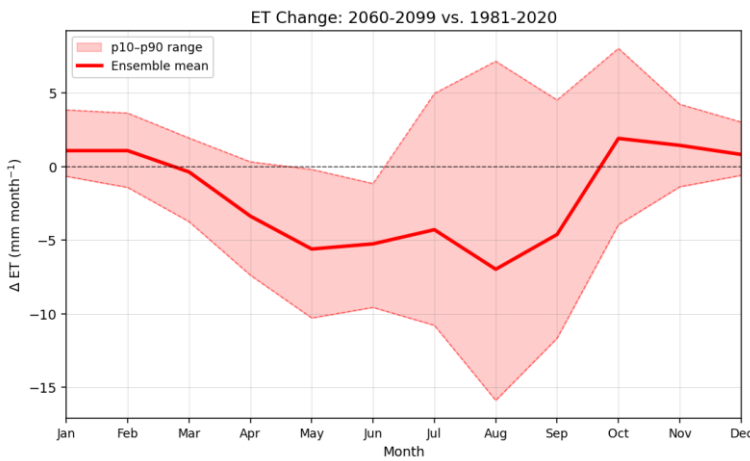
Climate Change Projections: Changes in Temperature, Precipitation, ET, Recharge, and Runoff (2060-2099 vs. 1981-2020)



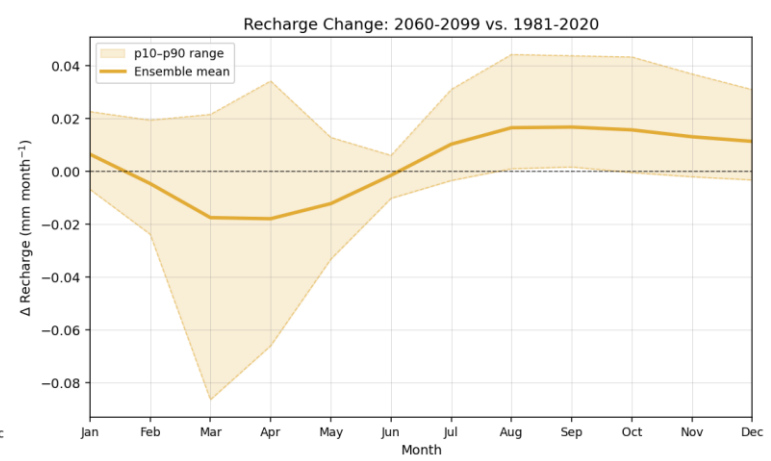
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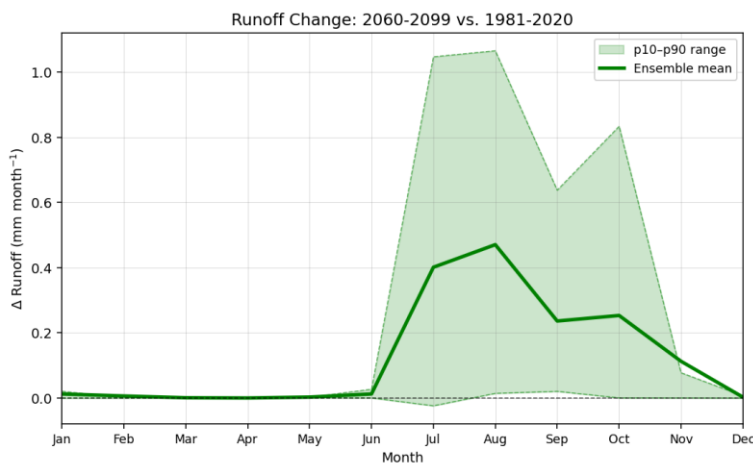
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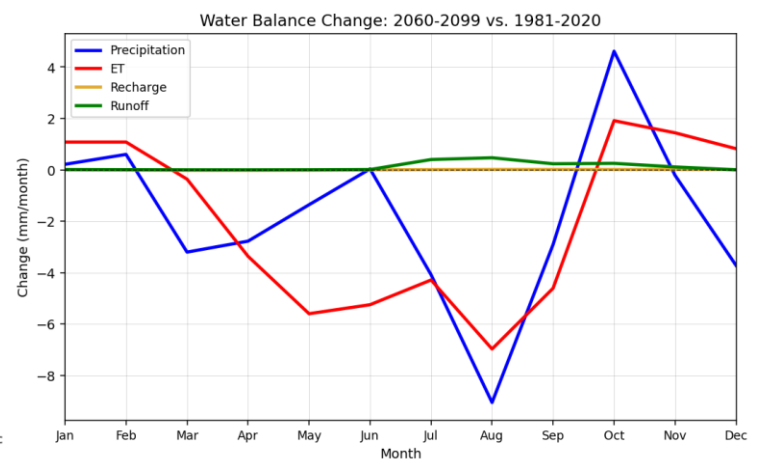
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e



f

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 Duncan Valley basin show less precipitation throughout much of the year, with the exception of October, which shows an 8% (4.7 mm) increase in precipitation. The greatest declines in precipitation are projected for March-May (16-40% drier), July-September (7-15%), and December (12%). Recharge is projected to remain near zero throughout the year and slightly negative June through February (-0.01 to -0.02 mm/month).^{*} While remaining below 0.6 mm/month, runoff is projected to increase by 0.12-0.46 mm/month from July to November by the end of the century. Projected increases in temperature range from approximately 3.2 °C in February to 5.0 °C in October. Less water availability from April to September leads to projected declines (9-25% or -3.4 to -7.0 mm/month) in evapotranspiration (ET) during the warmer months, while higher temperatures and greater precipitation are consistent with a projected 7% (1.8 mm) increase in ET in October 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

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-agric.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>

