ARIZONA TRI-UNIVERSITY
RECHARGE AND WATER RELIABILITY PROJECT

Prescott AMA Groundwater Basin Profile

Basin Summary Statistics

Size[1]: 480 square miles
Elevation[2]: Range: 4,281-7,864 ft; Median: 5,076 ft
Top 3 land cover types by area[3]: Shrub/Scrub (55%), Evergreen Forest (19%), Grassland Herbaceous (8.3%)
Major surface watershed(s)[4]: Upper Verde River, Agua Fria River
Groundwater subbasins[1]: Little Chino Valley, Upper Agua Fria
Groundwater-derived streamflow fraction[5]:

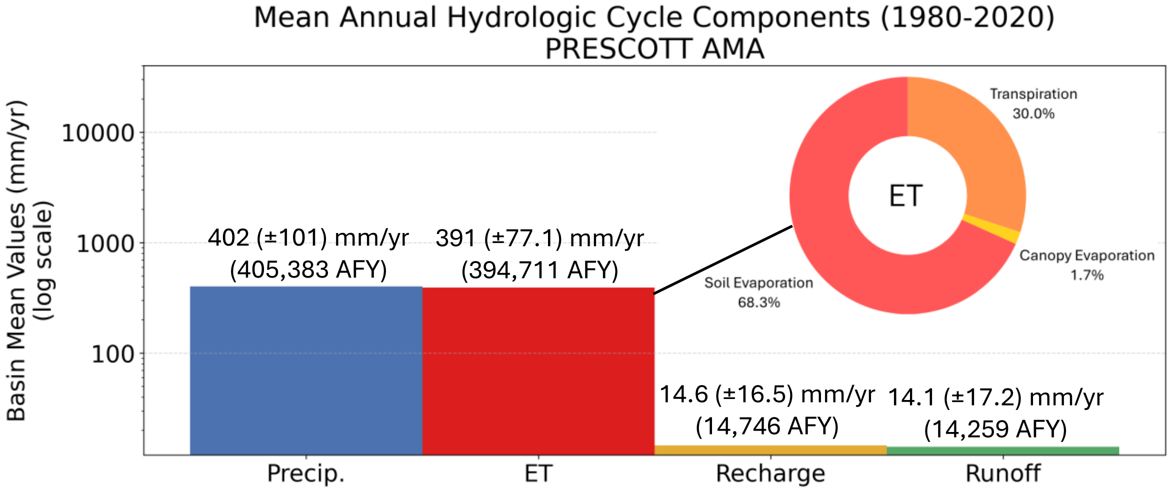


Figure 1 (above). Bar chart showing Noah-MP modeling results of the historical mean annual hydrologic cycle components (precipitation [P], evapotranspiration [ET], natural recharge, and runoff) in the basin from 1980-2020.[6] ET is partitioned into soil evaporation, canopy evaporation, and transpiration.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

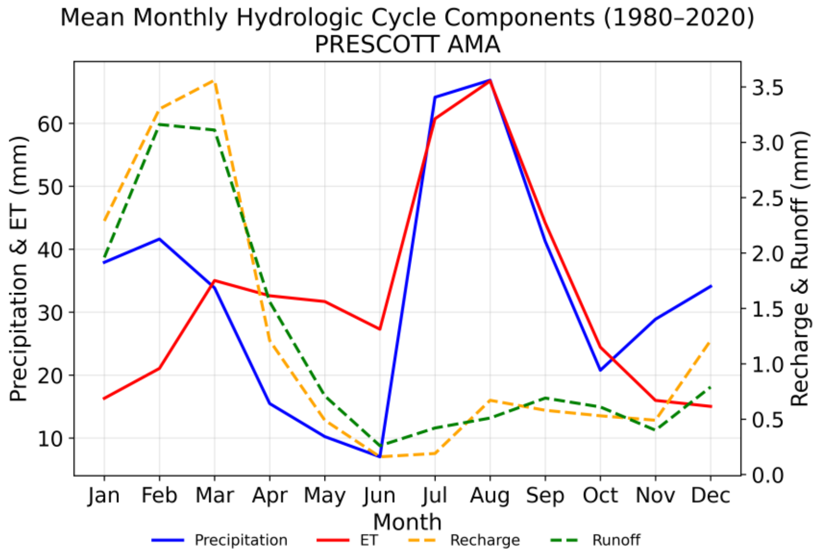


Figure 2. Graph showing monthly mean precipitation, ET, recharge, and runoff for the groundwater basin (1980-2020) from Noah-MP modeling results.[6]

Precipitation (P) in the Prescott AMA is affected by the North American Monsoon during the summer months. On annual timescales, P exceeds evapotranspiration (ET); however, ET exceeds P seasonally from March to mid-June by as much as 20 mm (in May). Soil evaporation makes up 68.3% of total ET, while transpiration comprises 30.0% and canopy evaporation accounts for the remainder (1.7%). Natural recharge (14.6 mm/yr) and runoff (14.1 mm/yr) peak in March due to springtime snowmelt.

Prescott AMA

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.

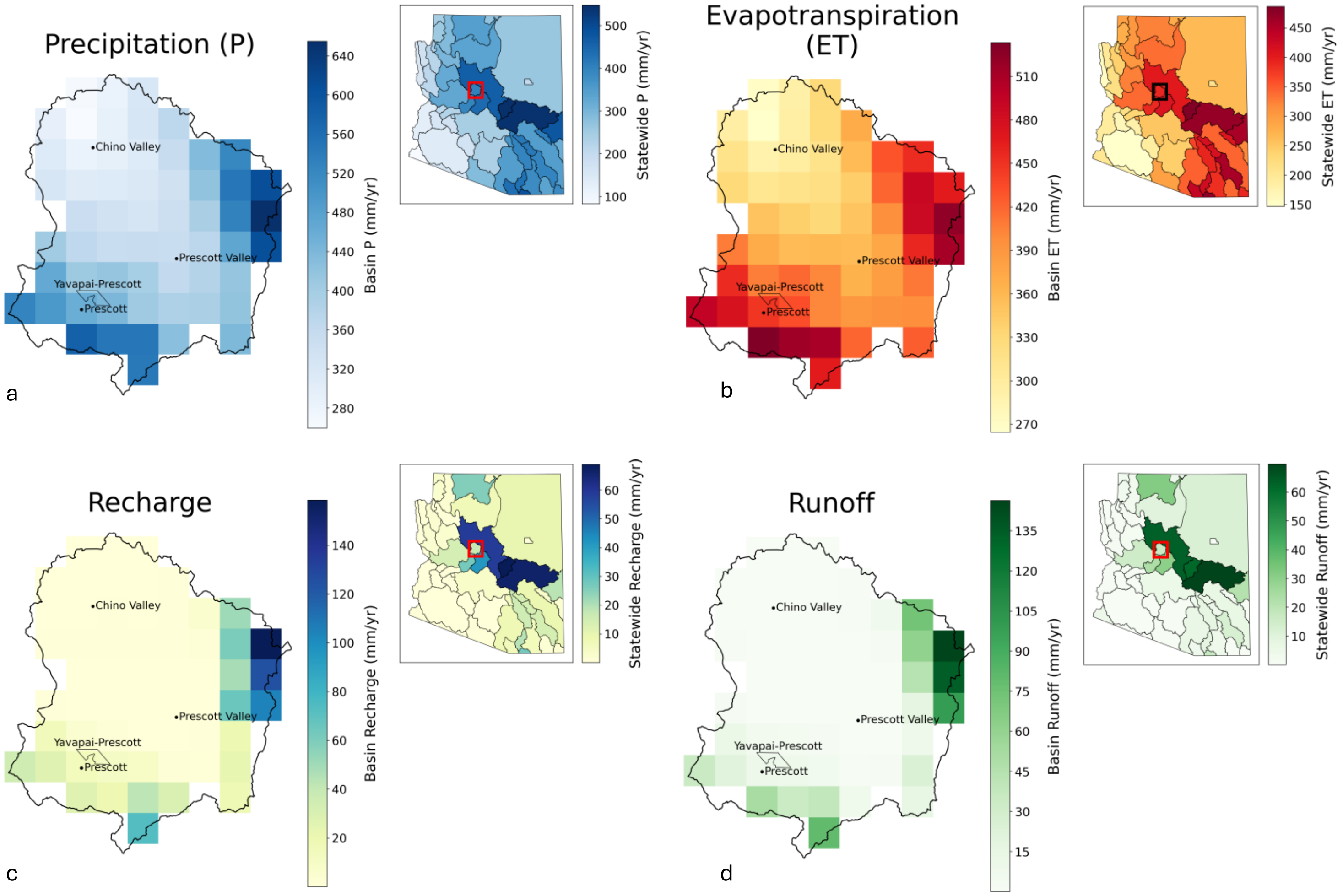
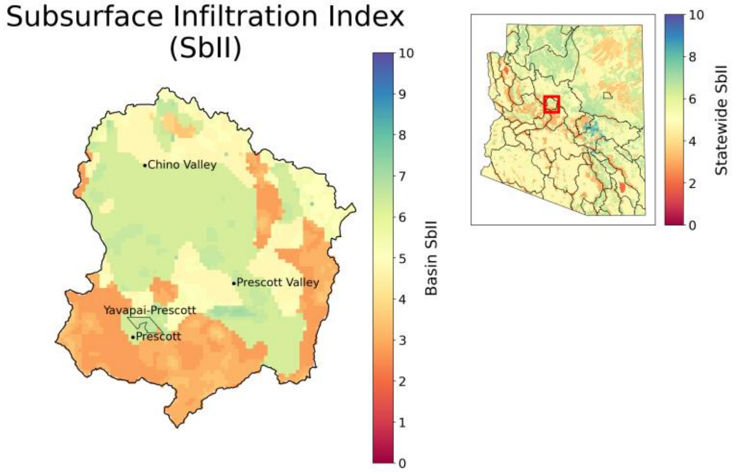


Figure 4 (below). Subsurface infiltration index (SbII) showing infiltration potential of the subsurface across the groundwater basin on a scale of 1-10 based on geologic features.[9]



Precipitation (P) in the Prescott AMA is greatest in the Bradshaw Mountains to the south and the Black Hills to the east where P can exceed 600 mm/yr on average. Evapotranspiration (ET, ~500 mm/yr), natural recharge (~100 mm/yr) and runoff (~100 mm/yr) are also highest in these high elevation regions. Infiltration potential varies across the basin, with the areas of highest potential along alluvial fan deposits to the east and west of Granite Creek.

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

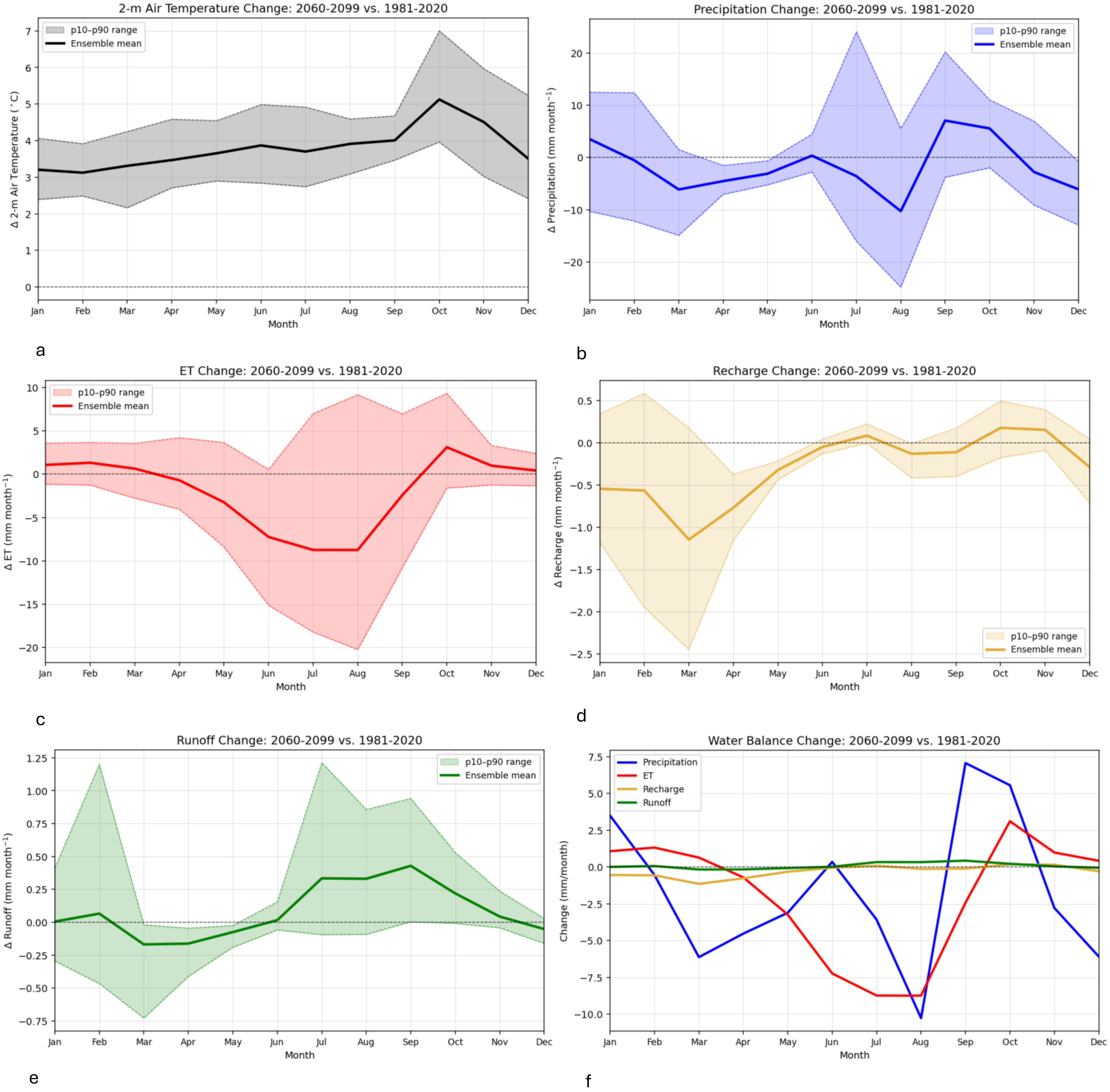


Figure 5. Plots (a)-(e) show projected changes in (a) temperature, (b) precipitation, (c) evapotranspiration (ET), (d) natural recharge, and (e) runoff statewide, comparing end of the 21st century to the historical record from 1981-2020 under the IPCC Scenario SSP3-7.0.[10] Plot (f) shows the change 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.

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Climate change projections across the Prescott AMA show drier springs (18-32% drier March through May) and a drier July (5%), August (15%), November (11%), and December (18%). September and October are projected to be 17-24% (5.4-6.9 mm) wetter on average by the end of the century, which is consistent with a projected increase in extreme events associated with hurricane and tropical cyclone activity. Declines in natural recharge are projected for most months of the year, with declines of 26-50% (-0.58 to -1.2 mm/month) in the highest recharge months (January-April). Slight increases in recharge are projected for July (0.09 mm)*, October (0.17 mm), and November (0.15 mm). Runoff is projected to decrease by -0.07 to -0.17 mm/month March through May and increase by 0.22-0.43 mm/month from July though October. Projected increases in temperature range from approximately 3.2 °C in February to 5.2 °C in October. Less precipitation in July and August leads to a projected 13-14% (-8.7 mm/month) decrease in evapotranspiration (ET), while higher temperatures and greater water availability lead to a projected 12% (3.1 mm) increase in ET in October compared to the baseline period.

*Despite showing less water loss from the system (i.e., a positive increase in Figure 8(d)), recharge projections are slightly negative (-0.01 mm) in July. 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

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