

Pinal AMA

Groundwater Basin Profile



Basin Summary Statistics

Size¹: 4,096 square miles

Elevation²: Range: 528-6,847 ft; Median: 1,792 ft

Top 3 land cover types by area³: Shrub/Scrub (83%), Cultivated Crops (10%), Developed – Open Space (1.8%)

Major surface watershed(s)⁴: Santa Rosa Wash, Aguirre Valley, Lower Santa Cruz, Middle Gila River

Groundwater subbasins¹: Santa Rosa, Aguirre Valley, Maricopa-Stanfield, Vekol Valley, Eloy

Groundwater-derived streamflow fraction⁵:

0.46 (Moderate)



Mean Annual Hydrologic Cycle Components (1980-2020)
PINAL AMA

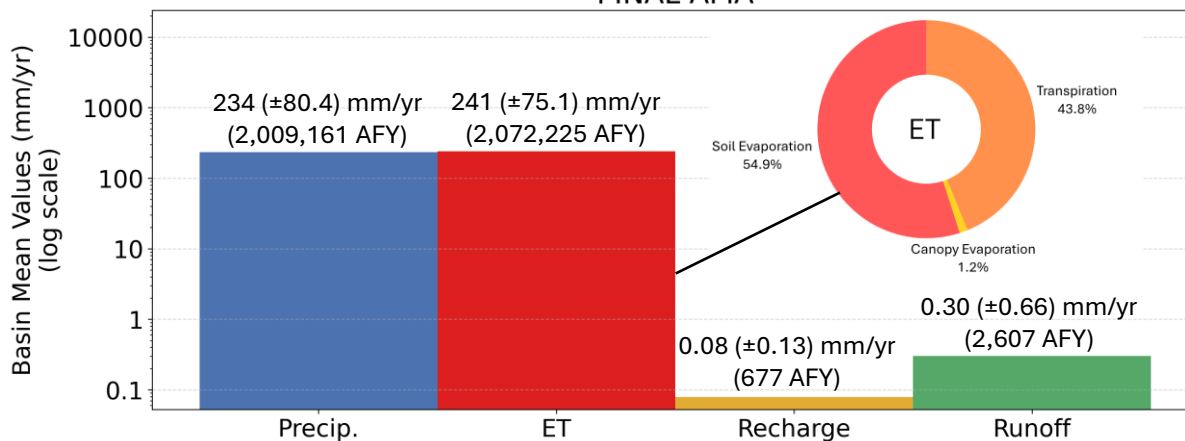


Figure 1 (above). Bar chart showing Noah-MP modeling results of the historical mean annual hydrologic cycle components (precipitation [P], evapotranspiration [ET], natural recharge, and runoff) in the basin from 1980-2020.⁶ ET is partitioned into soil evaporation, canopy evaporation, and transpiration.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

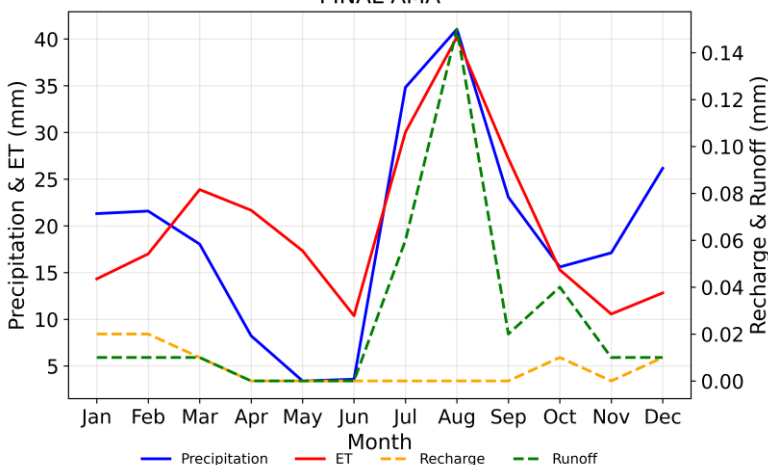


Figure 2. Graph showing monthly mean precipitation, ET, recharge, and runoff for the groundwater basin (1980-2020) from Noah-MP modeling results.⁶

On annual timescales, evapotranspiration (ET) is greater than precipitation (P) on average across the basin, resulting in near zero annual averages for natural recharge (0.08 mm) and runoff (0.30 mm). ET is greater than P from mid-February to June, and tracks with P from June to October due to enhanced water availability from the North American Monsoon. Soil evaporation makes up 54.9% of total ET in the basin, while transpiration comprises 43.8% and canopy evaporation accounts for the remainder (1.2%).



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.

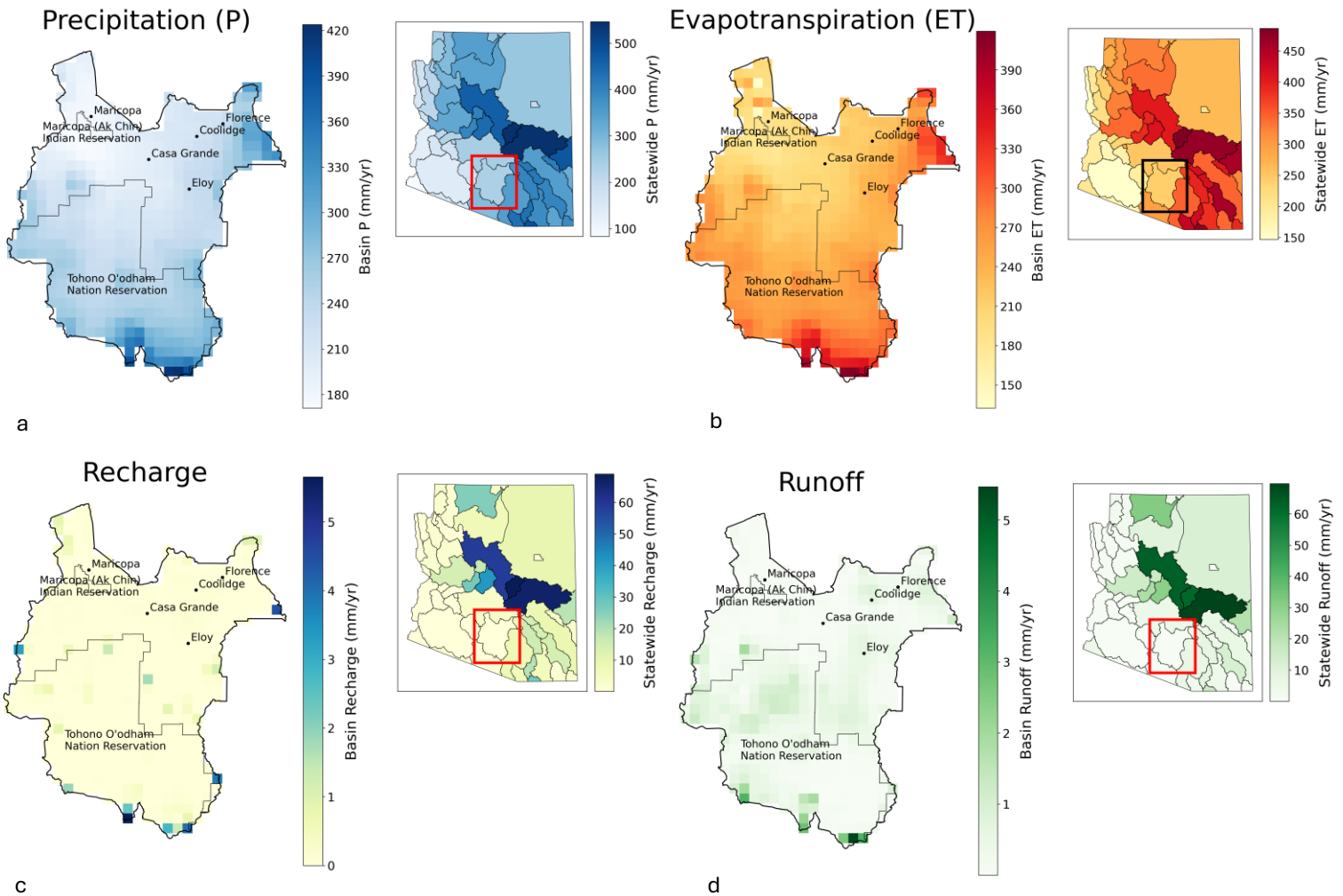
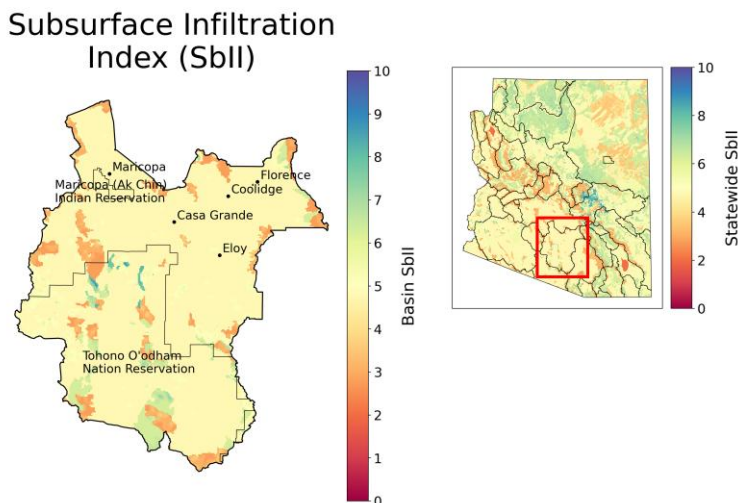


Figure 4 (below). Subsurface infiltration index (SbII) showing infiltration potential of the subsurface across the groundwater basin on a scale of 1-10 based on geologic features.⁹



Precipitation in the Pinal AMA is highest in the Quinlan and Comobabi Mountains in the southern portion of the basin. These regions receive 400 mm/yr of precipitation on average. The Quinlan and Comobabi Mountains also have the highest evapotranspiration (~400 mm/yr), natural recharge (~4 mm/yr), and runoff (~4 mm/yr) in the basin. Subsurface infiltration potential is moderate across the basin with pockets of high infiltration potential from the presence of karst-type geology.



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

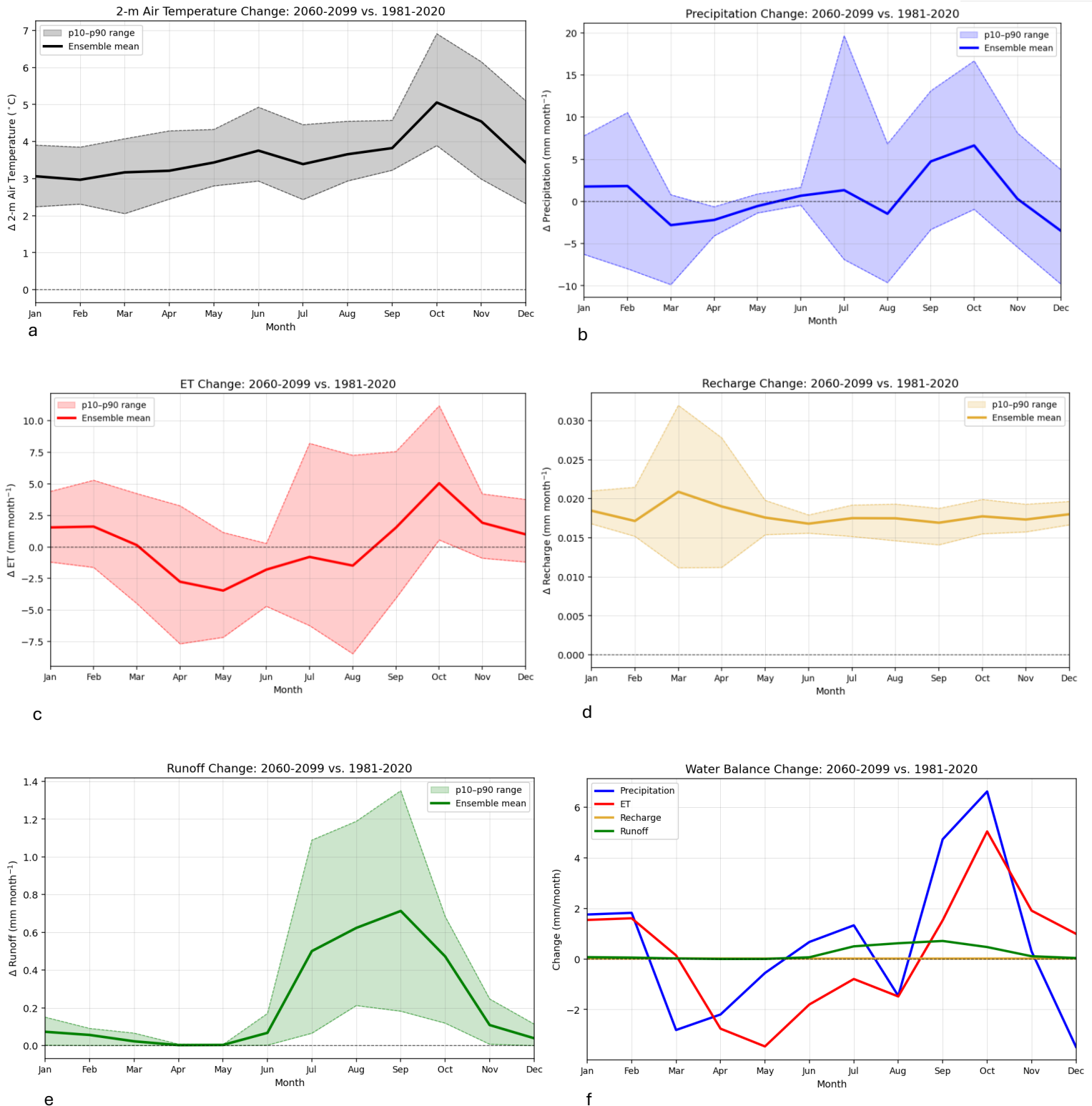


Figure 5. Plots (a)-(e) show projected changes in (a) temperature, (b) precipitation, (c) evapotranspiration (ET), (d) natural recharge, and (e) runoff statewide, comparing end of the 21st century to the historical record from 1981-2020 under the IPCC Scenario SSP3-7.0.¹⁰ Plot (f) shows the change in 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 Pinal AMA show drier springs (14-34% drier March through May) and a drier August (3%) and December (12%). September and October are projected to be 21-38% (4.8-6.7 mm) 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 (-0.01 to -0.02 mm/month) throughout the year.* While remaining below 0.8 mm/month, runoff is projected to increase by 0.48-0.73 mm/month from July to October by the end of the century. Projected increases in temperature range from approximately 3.0 °C in February to 5.1 °C in October. Higher temperatures and greater water availability from precipitation lead to a projected 30% (5.1 mm) increase in evapotranspiration (ET) in October compared to the baseline period, while less water availability in April-May leads to projected declines in ET (13-22% or -2.9 to -3.5 mm/month) during the warmer months.

*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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