

Yuma Groundwater Basin Profile



Basin Summary Statistics

Size¹: 792 square miles

Elevation²: Range: 71-3,113 ft; Median: 296 ft

Top 3 land cover types by area³: Barren Land (43%), Shrub/Scrub (25%), Cultivated Crops (19%)

Major surface watershed(s)⁴: Lower Colorado, Lower Gila, Yuma Desert

Groundwater subbasins¹: None

Groundwater-derived streamflow fraction⁵:

0.02 (Very Low)



Mean Annual Hydrologic Cycle Components (1980-2020)
YUMA

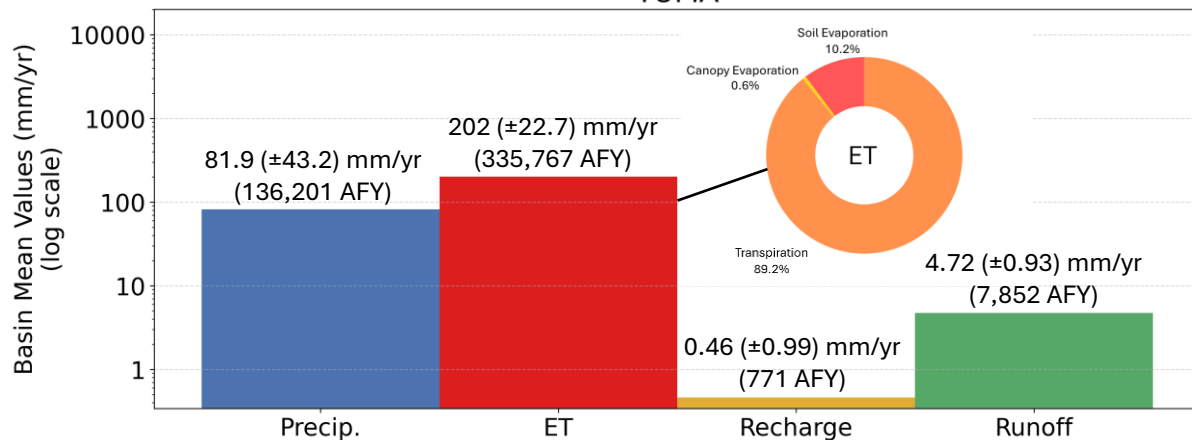


Figure 1 (above). Bar chart showing Noah-MP modeling results of the historical mean annual hydrologic cycle components (precipitation [P], evapotranspiration [ET], natural recharge, and runoff) in the basin from 1980-2020.⁶ ET is partitioned into soil evaporation, canopy evaporation, and transpiration.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

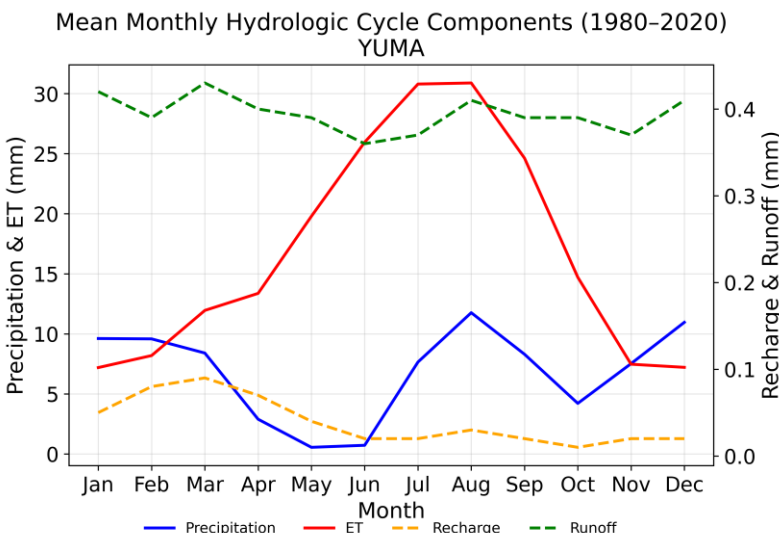


Figure 2. Graph showing monthly mean precipitation, ET, recharge, and runoff for the groundwater basin (1980-2020) from Noah-MP modeling results.⁶

On annual timescales, evapotranspiration (ET) exceeds precipitation (P) on average across the Yuma basin, yielding near zero annual values for natural recharge (0.46 mm) and runoff (4.72 mm). Seasonally, ET is greater P for most months of the year, with the exception of the cooler months from mid-November through mid-February. Due to large areas of cultivated crops, transpiration makes up the vast majority (89.2%) of total ET in the basin, while soil evaporation comprises 10.2% and canopy evaporation accounts for the remainder (0.6%). Any ephemeral streamflow in the basin is derived almost entirely from surface runoff; groundwater is estimated to supply only 2% of total streamflow in the Yuma 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.

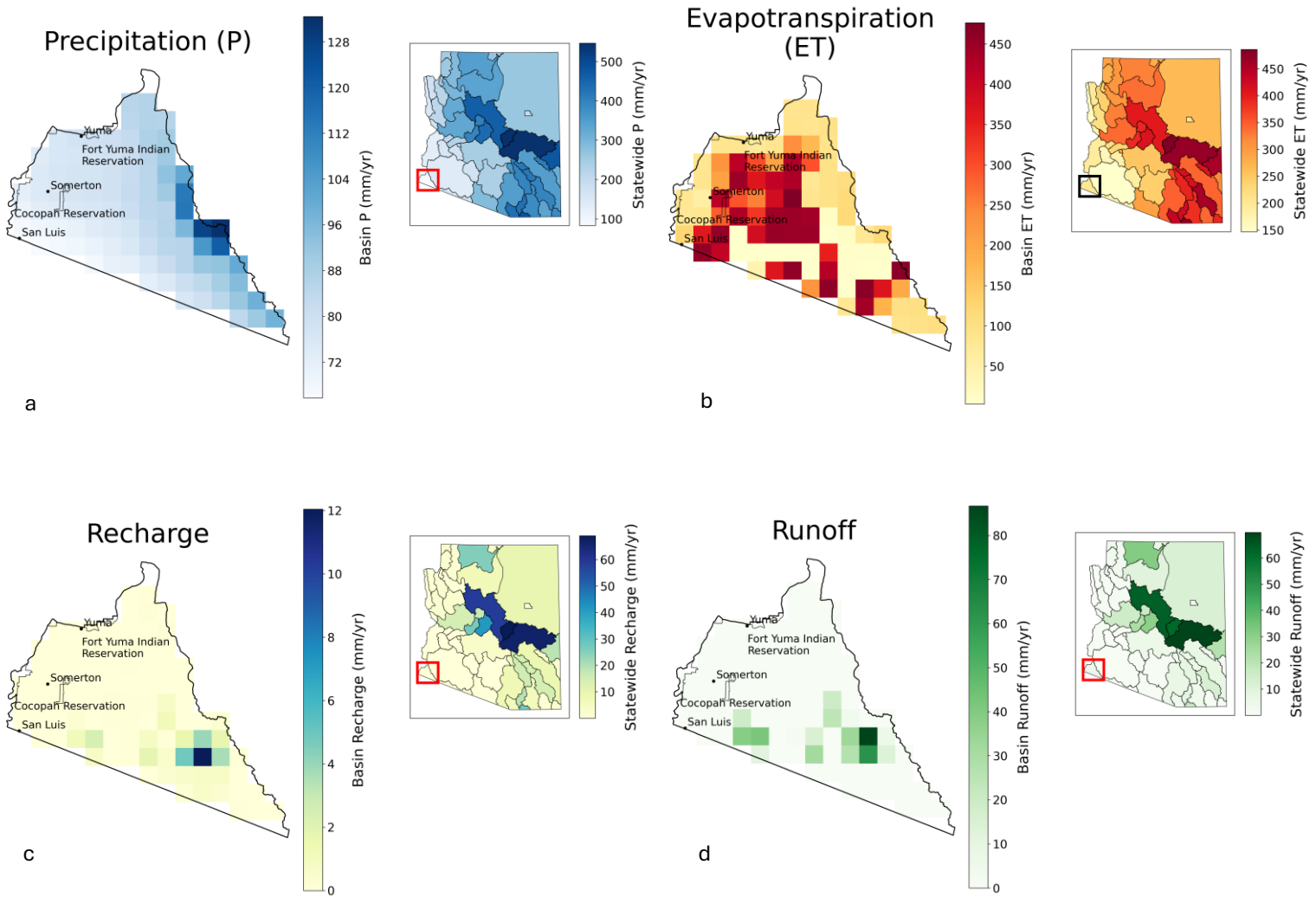
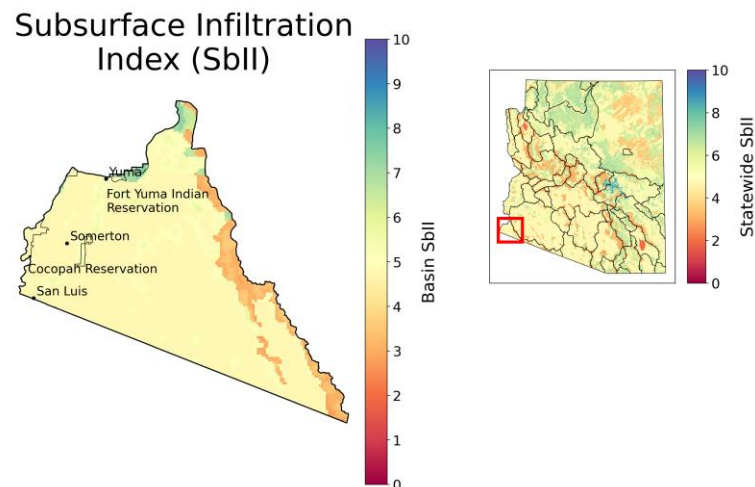


Figure 4 (below). Subsurface infiltration index (SbII) showing infiltration potential of the subsurface across the groundwater basin on a scale of 1-10 based on geologic features.⁹



Precipitation in the Yuma basin is highest in the Gila Mountains to the southeast, which receive over 120 mm/yr on average. Evapotranspiration (ET) is highest (over 400 mm/yr) over cultivated croplands and in the Yuma Desert. Natural recharge and runoff are generally minimal across the basin; however, both are highest in the southern foothills of the Gila Mountains. In this region, recharge can exceed 10 mm/yr and runoff exceeds 60 mm/yr. Subsurface infiltration potential is low to moderate across the basin; however, the sand and gravel alluvium of the Colorado River channel and floodplain provide higher infiltration potential than elsewhere in the basin.



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

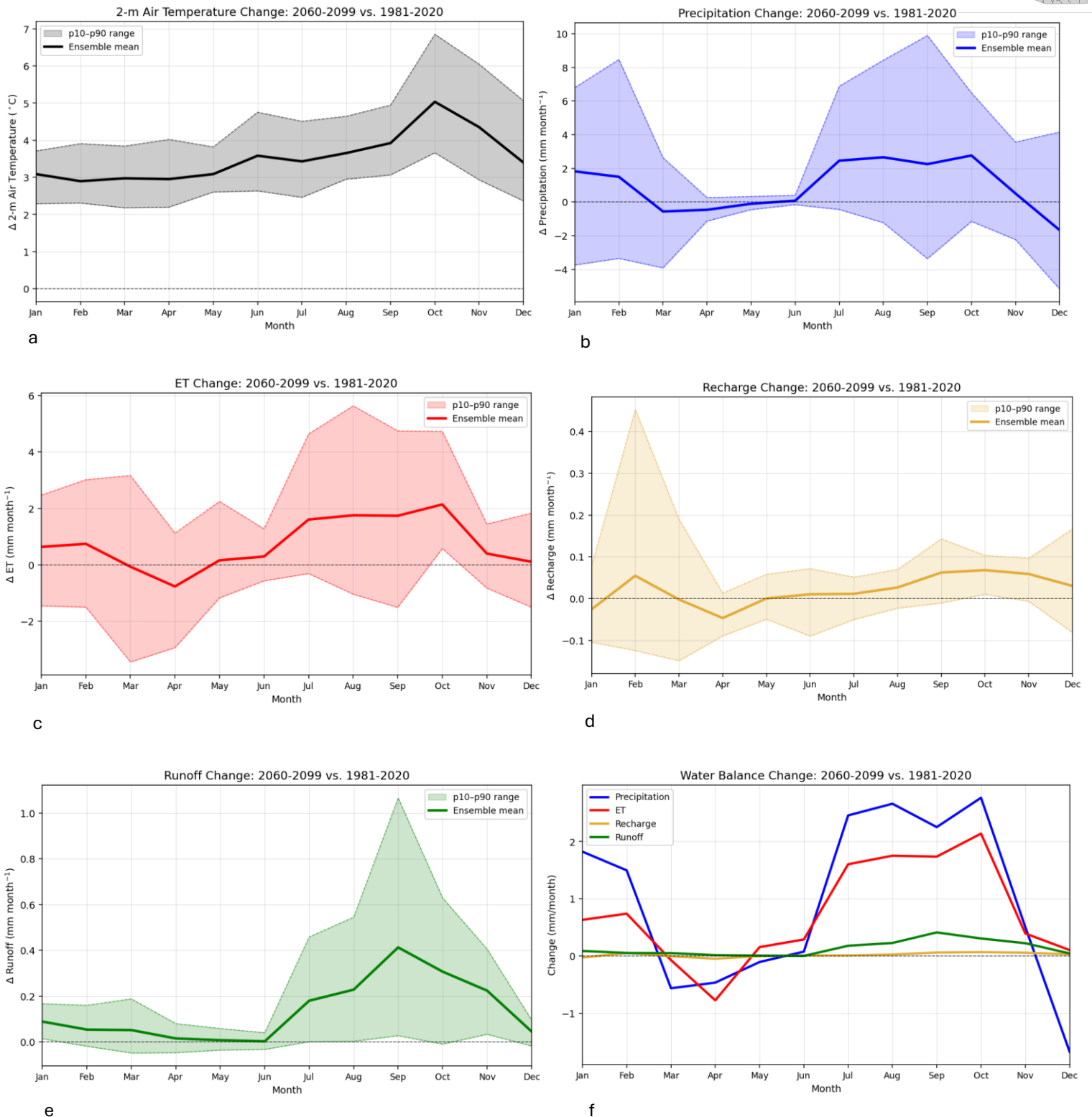


Figure 5. Plots (a)-(e) show projected changes in (a) temperature, (b) precipitation, (c) evapotranspiration (ET), (d) natural recharge, and (e) runoff statewide, comparing end of the 21st century to the historical record from 1981-2020 under the IPCC Scenario SSP3-7.0.¹⁰ Plot (f) shows the change in 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 Yuma basin show drier springs (6-21% drier March through May) and a drier December (13%). January-February (15-20%) and June-October (21-59%) are projected to be wetter on average by the end of the century. The increase in precipitation in September-October (2.4-2.9 mm/month) is consistent with a projected increase in extreme events associated with hurricane and tropical cyclone activity. Natural recharge is projected to remain near zero, with slightly negative projections (-0.07 to -0.08 mm/month) in May and June.* While runoff is projected to remain below 0.7 mm/month, minor increases of 0.17-0.42 mm/month are projected for July-November. Projected increases in temperature range from approximately 2.9 °C in February to 5.1 °C in October. Evapotranspiration (ET) is projected to generally track with precipitation throughout the year, showing increases of 19-42% (0.31-2.2 mm/month) from June through October due to high temperatures and greater water availability.

*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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