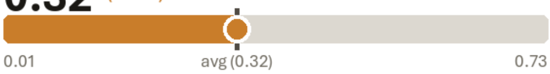
Gila Bend
Groundwater Basin Profile

ARIZONA TRI-UNIVERSITY
RECHARGE AND WATER RELIABILITY PROJECT

Basin Summary Statistics

Size[1]: 1,284 square miles
Elevation[2]: Range: 535-3,914 ft; Median: 1,102 ft
Top 3 land cover types by area[3]: Shrub/Scrub (86%), Cultivated Crops (7.0%), Grassland Herbaceous (2.6%)
Major surface watershed(s)[4]: Lower Gila – Painted Rock Reservoir
Groundwater subbasins[1]: None
Groundwater-derived streamflow fraction[5]:

0.32 (Low)



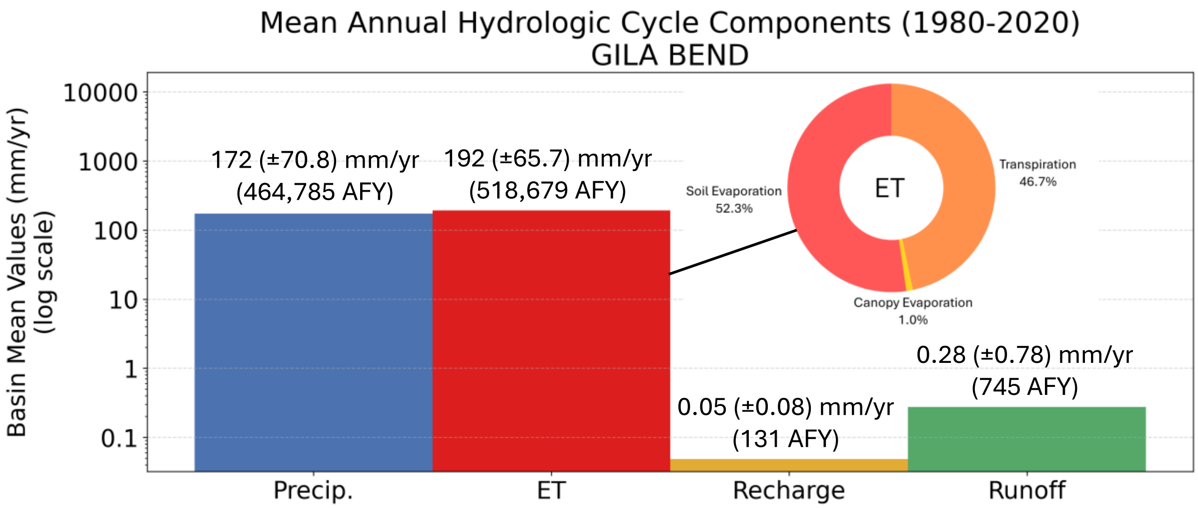


Figure 1 (above). Bar chart showing Noah-MP modeling results of the historical mean annual hydrologic cycle components (precipitation [P], evapotranspiration [ET], natural recharge, and runoff) in the basin from 1980-2020.[6] ET is partitioned into soil evaporation, canopy evaporation, and transpiration.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

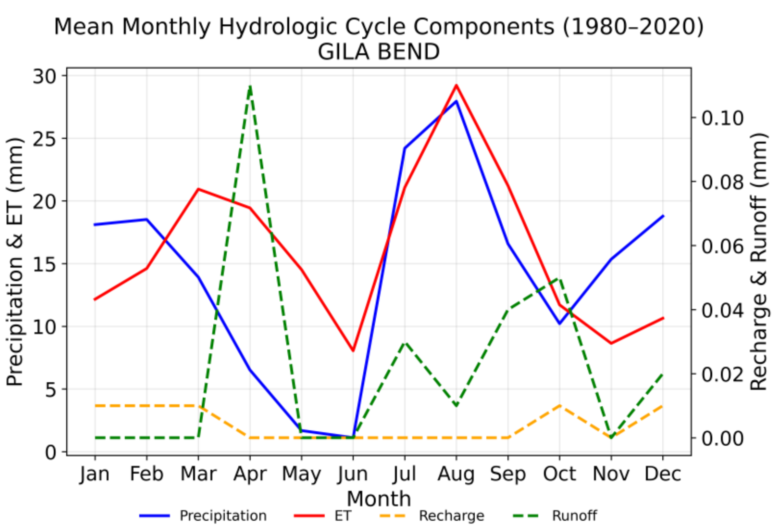


Figure 2. Graph showing monthly mean precipitation, ET, recharge, and runoff for the groundwater basin (1980-2020) from Noah-MP modeling results.[6]

On annual timescales, evapotranspiration (ET) is greater than precipitation (P) on average across the basin, resulting in near zero averages for natural recharge (0.05 mm) and runoff (0.28 mm). P in the Gila Bend basin is affected by the North American Monsoon during the summer months and large frontal systems in the winter. 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 52.3% of total ET in the basin, while transpiration comprises 46.7% and canopy evaporation accounts for the remainder (1.0%).

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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.

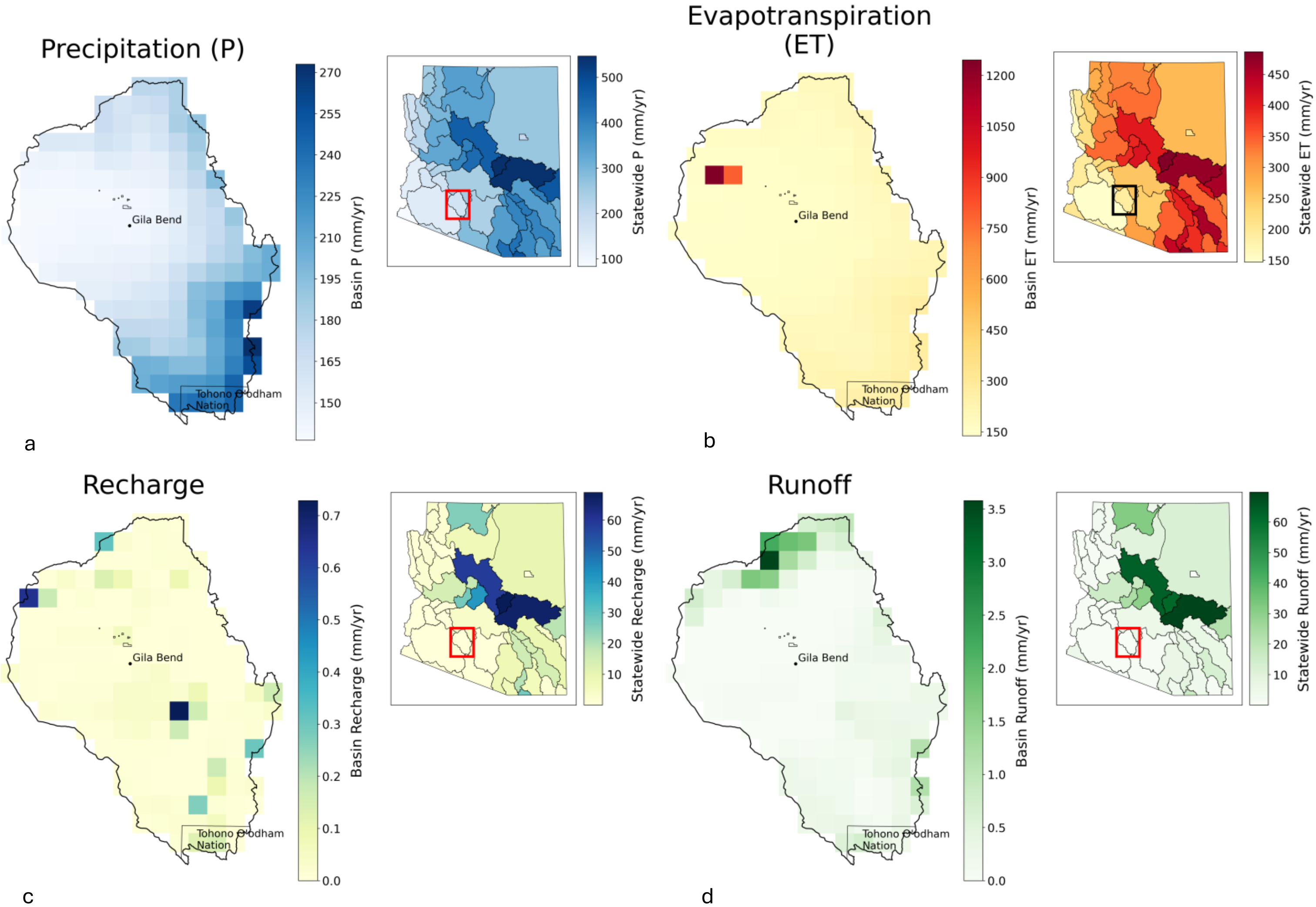
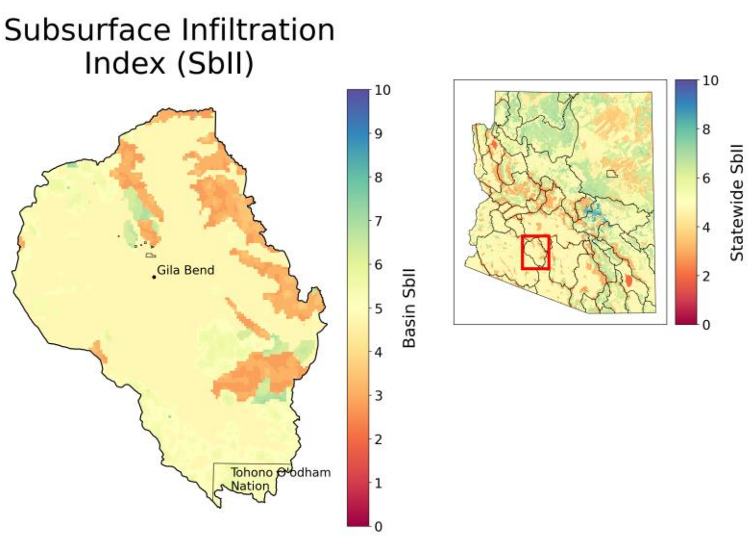


Figure 4 (below). Subsurface infiltration index (SbII) showing infiltration potential of the subsurface across the groundwater basin on a scale of 1-10 based on geologic features.[9]



Precipitation in the Gila Bend basin is highest in the Sauceda Mountains to the south and the Sand Tank Mountains to the southeast. These regions receive over 250 mm/yr of precipitation on average. Evapotranspiration (ET) is highest (~1,000 mm/yr) over the Painted Rock Reservoir northwest of Gila Bend. ET averages ~260 mm/yr in the mountainous regions of the basin. Natural recharge and runoff are near zero across the basin, with slightly higher runoff values (2-3 mm/yr) in the Woolsey Peak Wilderness to the north. Subsurface infiltration potential is generally low to moderate across the basin, with pockets of higher infiltration potential due to karst-type geology north of Gila Bend and in the southeast portion of the basin near the Sand Tank Mountains.

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

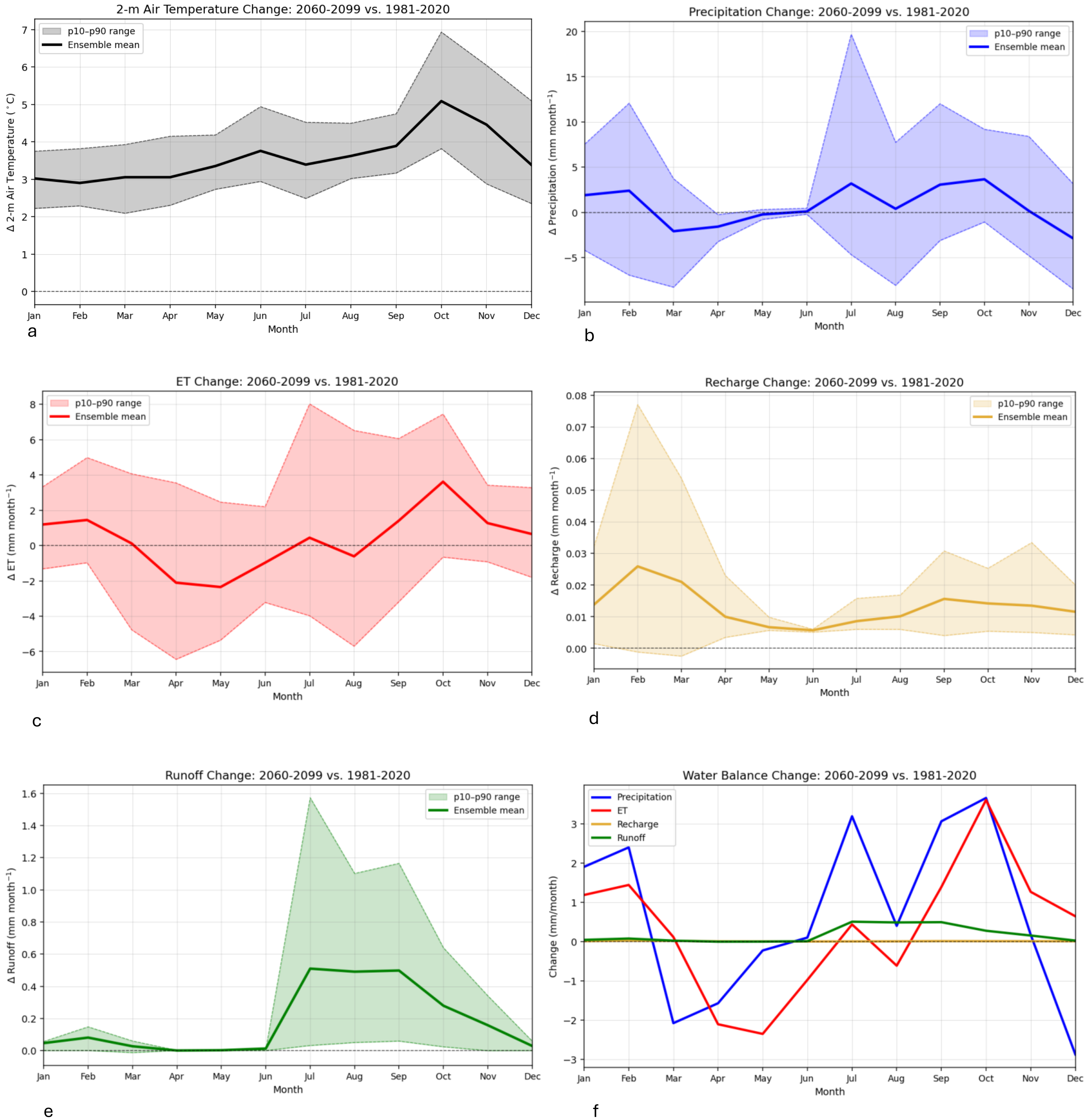

Figure 5. Plots (a)-(e) show projected changes in (a) temperature, (b) precipitation, (c) evapotranspiration (ET), (d) natural recharge, and (e) runoff statewide, comparing end of the 21^{st} century to the historical record from 1981-2020 under the IPCC Scenario SSP3-7.0.[10] Plot (f) shows the change 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 $10\text{-}90^{th}$ percentile shaded to show model projection uncertainty.

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Climate change projections across the Gila Bend basin show drier springs (13-33% drier March through May) and a drier December (14%). January-February (11-12%), July (13%) and September-October (18-32%) are projected to be wetter on average. This increase in precipitation in September and October (3.0-3.8 mm/month) 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 mm/month) throughout the year.* While remaining below 0.6 mm/month, runoff is projected to increase by 0.16-0.51 mm/month from July to November by the end of the century. Projected increases in temperature range from approximately 2.9 °C in February to 5.1 °C in October. Higher temperatures and greater water availability from precipitation lead to a projected 30% (3.6 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 (12-20% or -2.2 to -2.4 mm/month) during those 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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