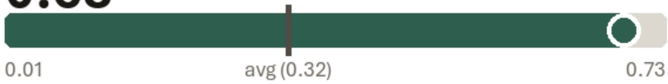
Tiger Wash Groundwater Basin Profile

ARIZONA TRI-UNIVERSITY
RECHARGE AND WATER RELIABILITY PROJECT

Basin Summary Statistics

Size[1]: 74 square miles
Elevation[2]: Range: 1,944-4,964 ft; Median: 2,284 ft
Top 3 land cover types by area[3]: Shrub/Scrub (99.6%), Developed – Open Space (0.40%), Developed – Low Intensity (0.03%)
Major surface watershed(s)[4]: Tiger Wash
Groundwater subbasins[1]: None
Groundwater-derived streamflow fraction[5]:

0.68 (Very High)



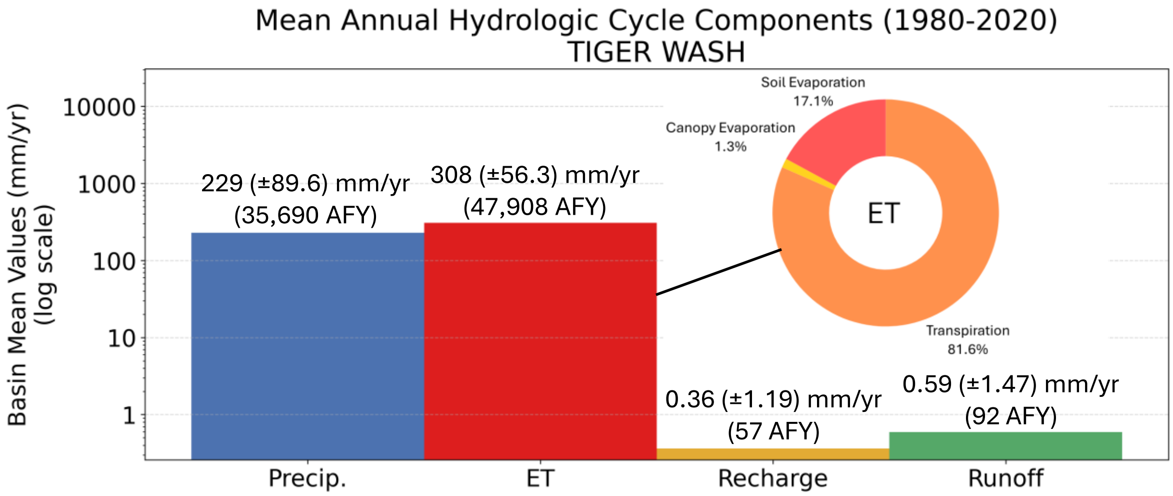


Figure 1 (above). Bar chart showing Noah-MP modeling results of the historical mean annual hydrologic cycle components (precipitation [P], evapotranspiration [ET], natural recharge, and runoff) in the basin from 1980-2020.[6] ET is partitioned into soil evaporation, canopy evaporation, and transpiration.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

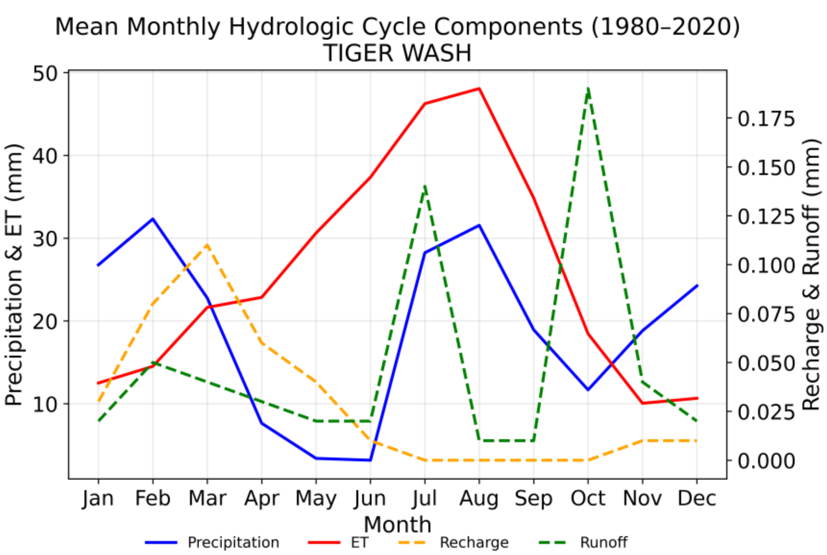


Figure 2. Graph showing monthly mean precipitation, ET, recharge, and runoff for the groundwater basin (1980-2020) from Noah-MP modeling results.[6]

On annual timescales, evapotranspiration (ET) exceeds precipitation (P) across the basin, resulting in near zero basin-wide annual averages for natural recharge (0.36 mm) and runoff (0.59 mm). The greatest atmospheric losses occur during the summer months, and ET is greater than P from March through mid-October. Transpiration makes up the majority (81.6%) of total ET in the basin, while soil evaporation comprises 17.1% and canopy evaporation accounts for the remainder (1.3%).

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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.

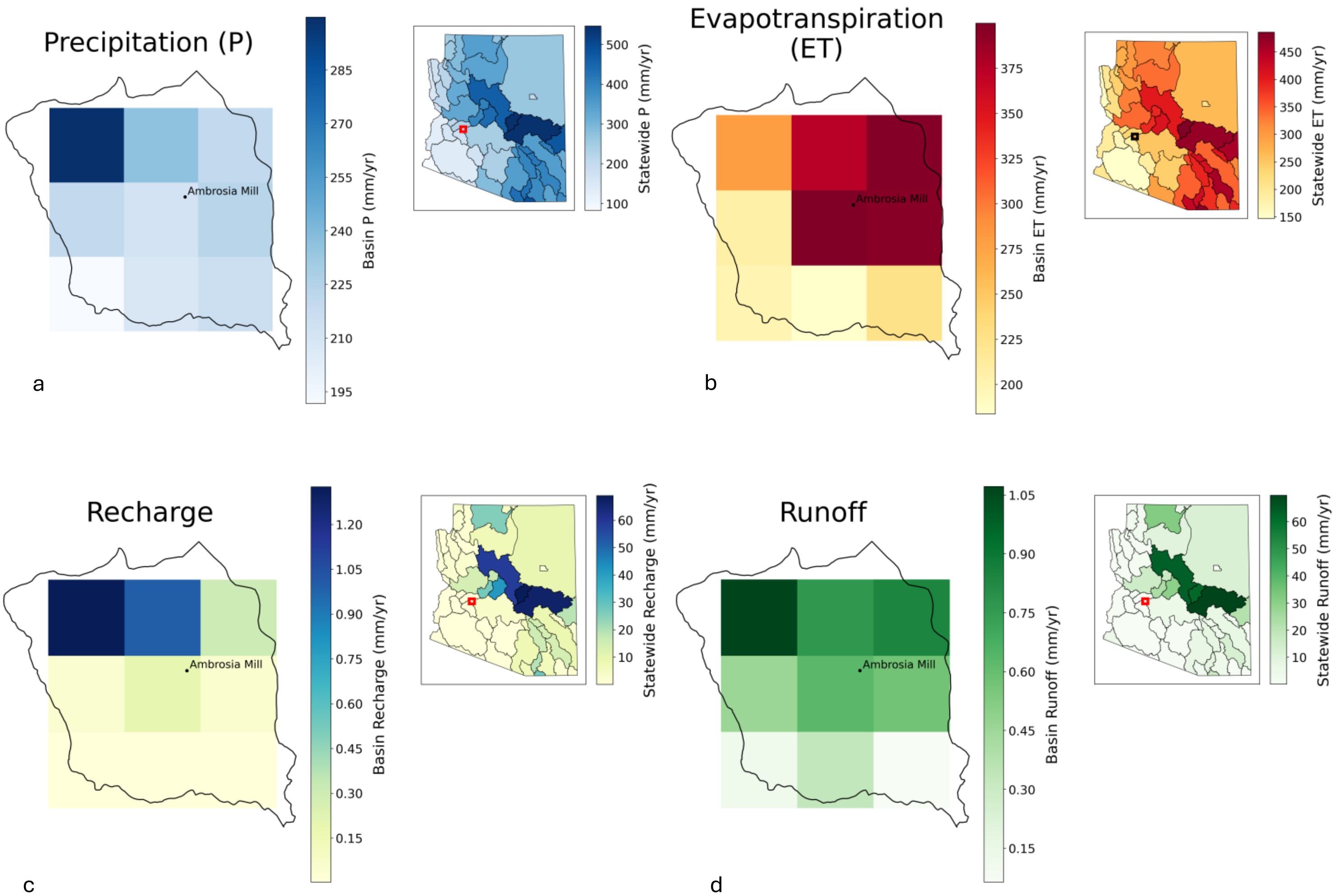
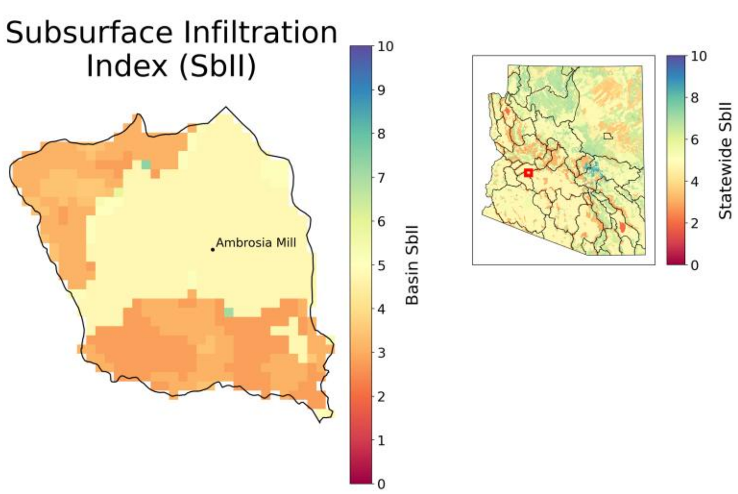


Figure 4 (below). Subsurface infiltration index (SbII) showing infiltration potential of the subsurface across the groundwater basin on a scale of 1-10 based on geologic features.[9]



Precipitation (P) in the Tiger Wash basin is greatest in the Harquahala Mountains Wilderness, where P can exceed 300 mm/yr. ET is generally higher in the eastern portion of the basin (~400 mm/yr). Natural recharge and runoff are both minimal across the basin due to low water availability. Infiltration potential is low in the Harquahala Mountains and in the south of the basin due to the granitic geology of these areas. Infiltration potential is moderate in the alluvial areas around Tiger Wash.

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

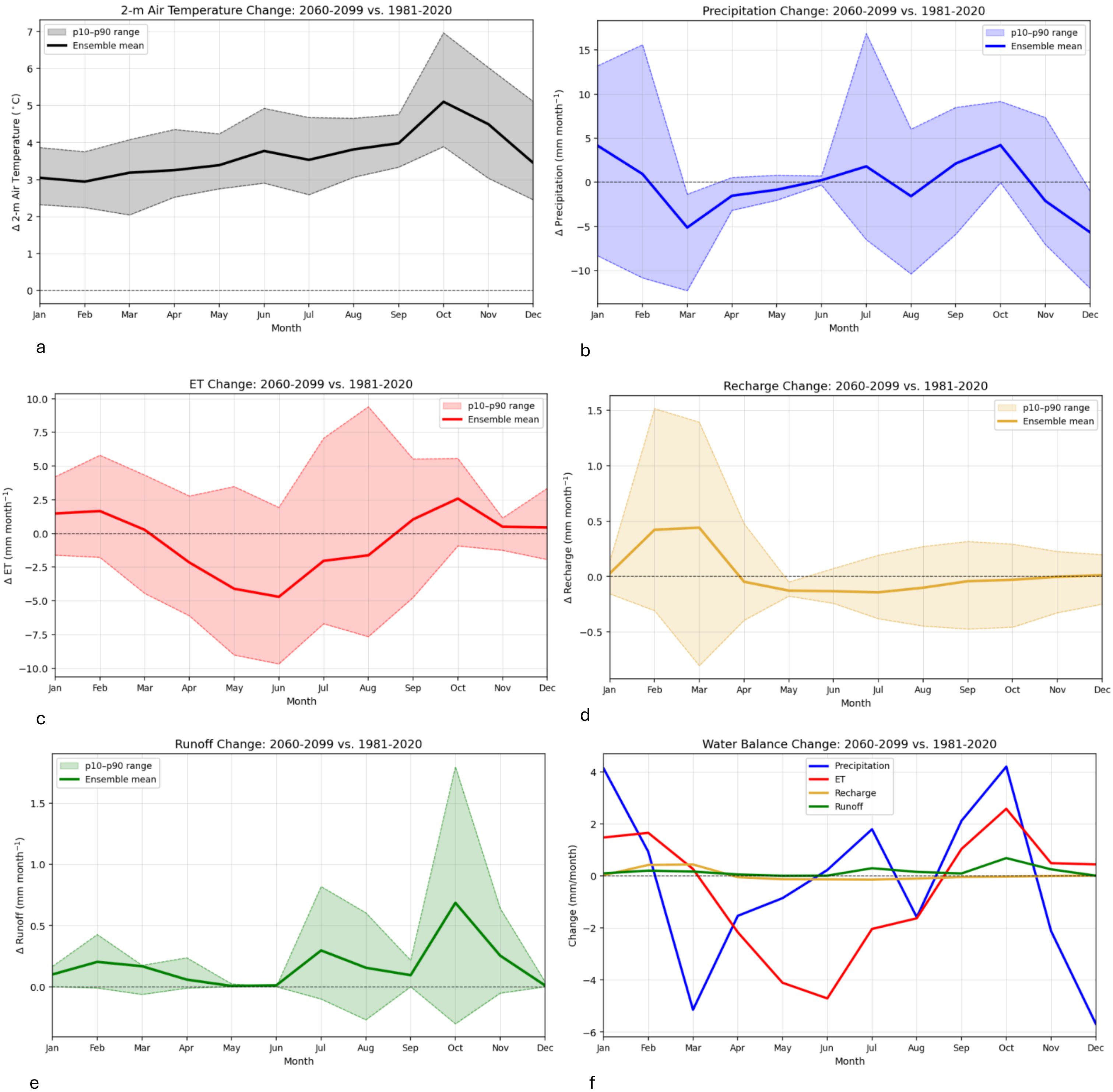

Figure 5. Plots (a)-(e) show projected changes in (a) temperature, (b) precipitation, (c) evapotranspiration (ET), (d) natural recharge, and (e) runoff statewide, comparing end of the 21st century to the historical record from 1981-2020 under the IPCC Scenario SSP3-7.0.[10] Plot (f) shows the change 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 Tiger Wash basin show drier springs (20-26% drier March through May), and a drier August (4%), November (12%), and December (22%). September and October are projected to be 11-26% (2.1-4.2 mm/month) 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. The months with the highest natural recharge (February-March) are projected to have increases of 0.41-0.43 mm/month by the end of the century; however, from May through December, recharge is projected to be negative (-0.04 to -0.33 mm/month).* While remaining below 1.0 mm/month, runoff is projected to increase for most months of the year, particularly January-March (0.10-0.21 mm/month) and July-November (0.10-0.68 mm/month). 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 18% (2.6 mm) increase in evapotranspiration (ET) in October compared to the baseline period, while less water availability April to August leads to projected declines in ET (4-18%, or -1.5 to -4.8 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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