Detrital Valley Groundwater Basin Profile

Basin Summary Statistics

Size[1]: 892 square miles
Elevation[2]: Range: 1,081-7,126 ft; Median: 2,866 ft
Top 3 land cover types by area[3]: Shrub/Scrub (93%), Open Water (2.8%), Barren Land (1.6%)
Major surface watershed(s)[4]: Detrital Wash, Lake Mead
Groundwater subbasins[1]: None
Groundwater-derived streamflow fraction[5]:

0.58 (High)

0.01 avg (0.32) 0.73

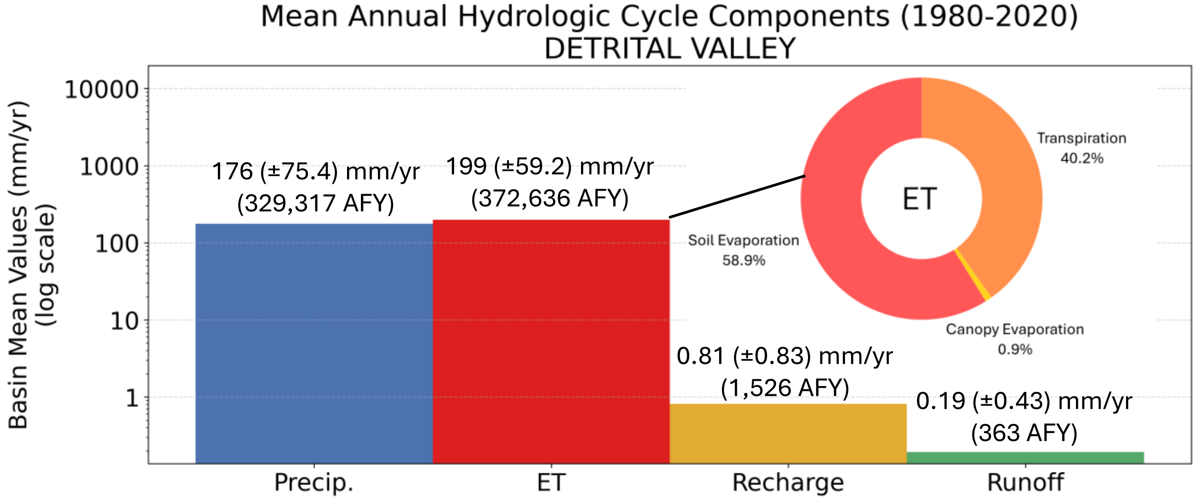

Figure 1 (above). Bar chart showing Noah-MP modeling results of the historical mean annual hydrologic cycle components (precipitation [P], evapotranspiration [ET], natural recharge, and runoff) in the basin from 1980-2020.[6] ET is partitioned into soil evaporation, canopy evaporation, and transpiration.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

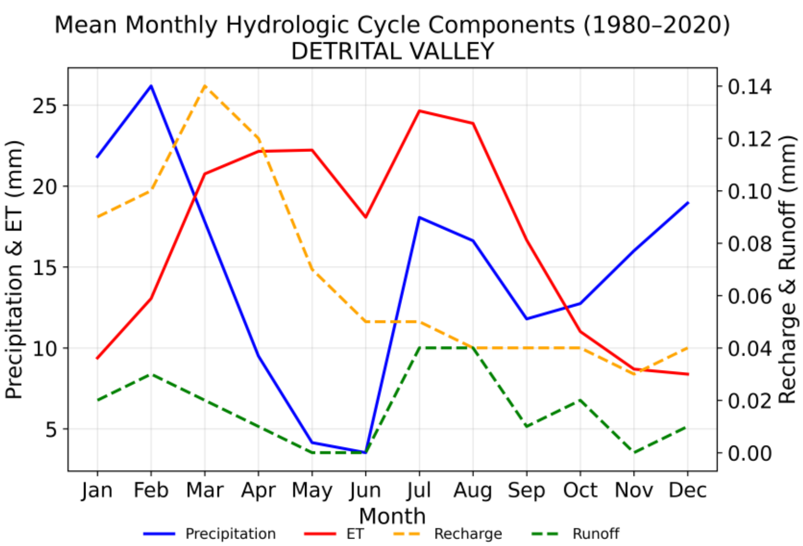

Figure 2. Graph showing monthly mean precipitation, ET, recharge, and runoff for the groundwater basin (1980-2020) from Noah-MP modeling results.[6]

Precipitation (P) in the Detrital Valley basin is affected by the North American Monsoon during the summer months and large frontal systems during the winter. On annual timescales, evapotranspiration (ET) is greater than P, with the greatest atmospheric losses occurring during the summer months. ET exceeds P from mid-February through mid-September. Soil evaporation makes up 58.9% of total ET in the basin, while transpiration comprises 40.2% and canopy evaporation accounts for the remainder (0.9%). Natural recharge (0.81 mm/yr) and runoff (0.19 mm/yr) are near zero on average across the basin.

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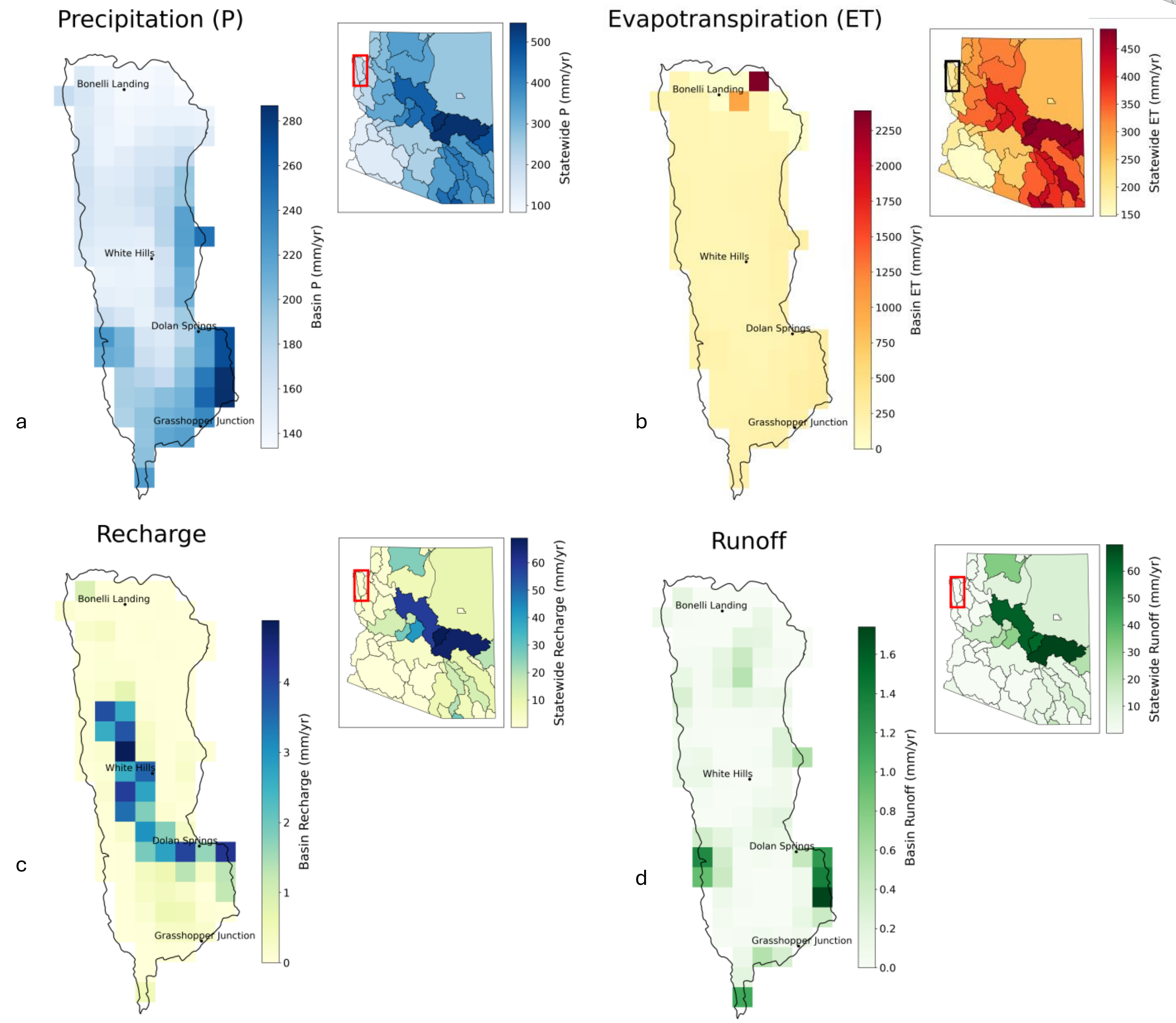
Figure 3 (below). Gridded depiction of mean annual water fluxes across the groundwater basin from Noah-MP modeling (1980-2020): (a) precipitation, (b) evapotranspiration, (c) recharge, (d) runoff.[6] Major cities/towns[7] and Native American Reservation boundaries[8] are shown (as applicable) to help orient the reader.



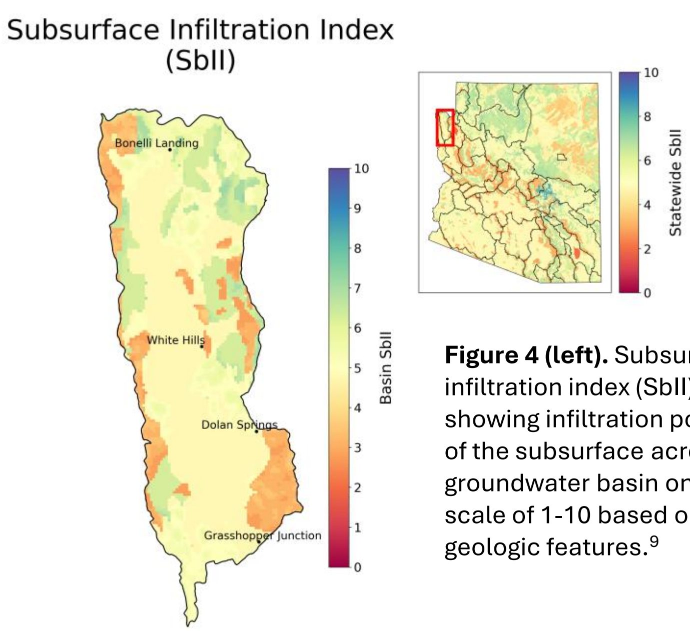


Figure 4 (left). Subsurface infiltration index (SbII) showing infiltration potential of the subsurface across the groundwater basin on a scale of 1-10 based on geologic features.[9]

Precipitation (P) in the Detrital Valley basin is greatest at higher elevations to the southeast in the Mount Tipton Wilderness, where P exceeds 260 mm/yr on average. ET is highest over Lake Mead, where it exceeds 1,000 mm/yr on average. The greatest natural recharge (4 mm/yr) occurs along Detrital Wash. Surface runoff is minimal across the basin, with slightly higher values in the Mount Tipton Wilderness to the southeast. Overall, the basin has moderate infiltration potential with pockets of higher potential. Areas with higher potential result from the presence of moderately consolidated conglomerate that contains limestone, particularly in the northern portion of the basin.

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

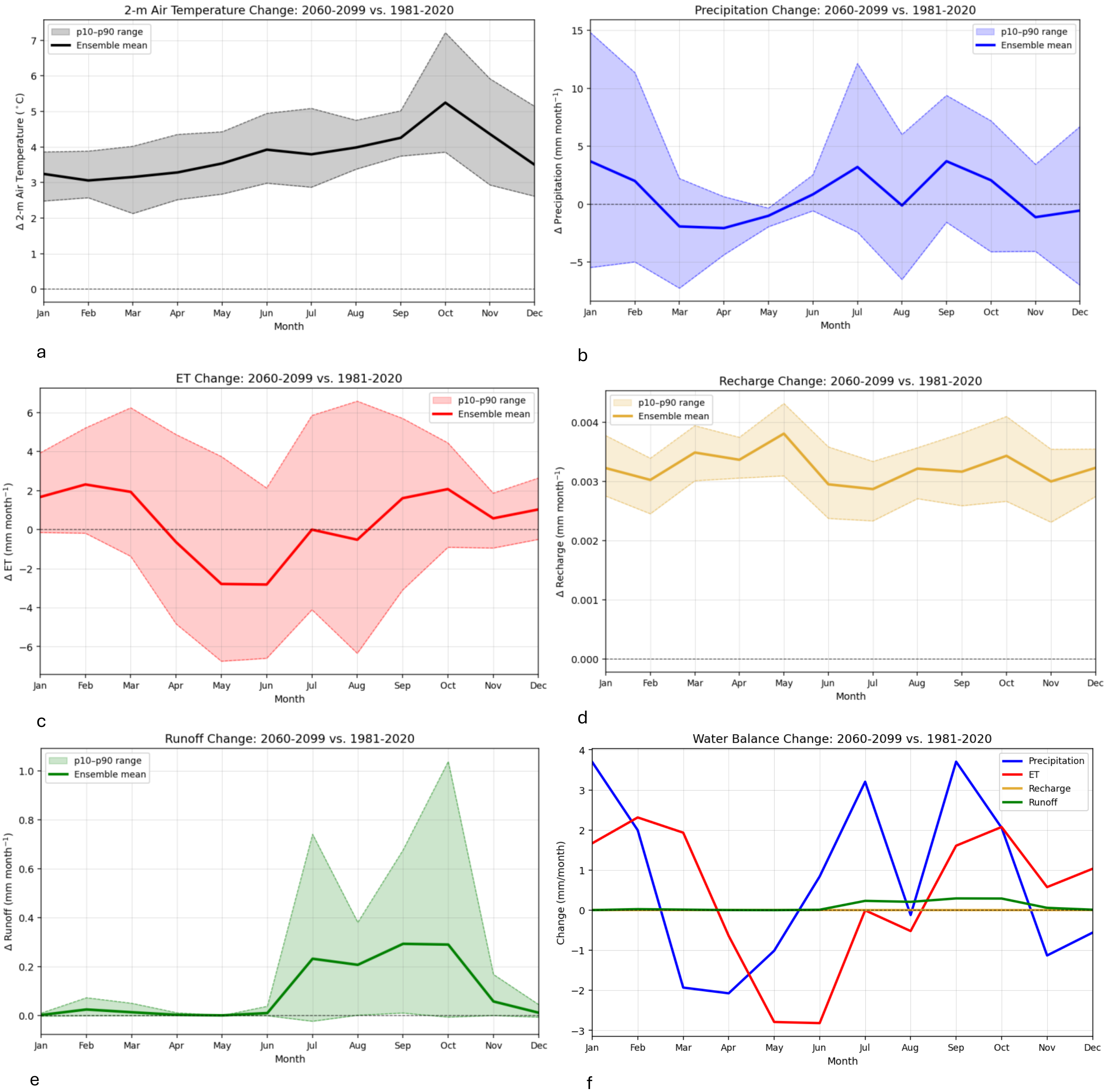

Figure 5. Plots (a)-(e) show projected changes in (a) temperature, (b) precipitation, (c) evapotranspiration (ET), (d) natural recharge, and (e) runoff statewide, comparing end of the 21st century to the historical record from 1981-2020 under the IPCC Scenario SSP3-7.0.[10] Plot (f) shows the change 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 Detrital Valley basin show drier springs (10-24% drier March through May) and a drier November (7%). September and October are projected to be 17-30% (2.1-3.7 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. Natural recharge is projected to remain near zero and slightly negative (approximately -0.005 mm/month) throughout the year.* While runoff is projected to remain near zero for most of the year, minor increases of 0.21-0.30 mm/month are projected for July-October. Projected increases in temperature range from approximately 3.1 °C in February to 5.3 °C in October. Higher temperatures and greater water availability from precipitation lead to a projected 21% (2.1 mm) increase in evapotranspiration (ET) in October and a 18-19% (1.7-2.3 mm) increase in January-February compared to the baseline period.

*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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