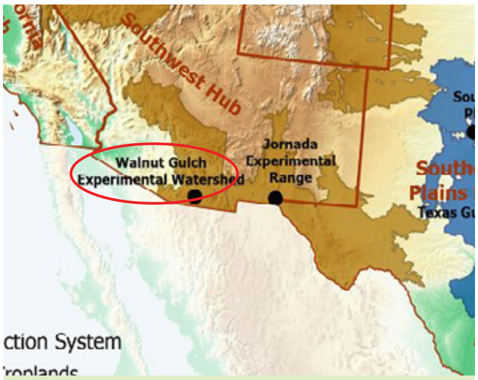
WALNUT GULCH EXPERIMENTAL WATERSHED (WGEW)



Location and Climate

The Walnut Gulch Experimental Watershed (WGEW) lies in the transition area between the Sonoran and Chihuahuan Deserts and is served by the USDA Southwest Climate Hub. The watershed's climate supports shrubland at the lowest elevations, semi-desert grassland at the upper elevations, and a small area of oak savannah at the highest elevations.

Historic Temperature

Average annual temperature in Walnut Gulch (1981-2010) is 64°F. Mean maximum temperature is highest in June (96°F). Mean minimum temperature is lowest in January (34°F).

Historic Precipitation

The average long-term mean precipitation across the watershed is 31 cm, although there is a precipitation gradient with elevation. Localized convective storms with moisture from the Gulf of Mexico occur primarily in July-September and provide more than 60% of total annual precipitation.

Growing Season

The effective growing season, when both precipitation and temperature are favorable, is normally July through September, although grasses greenup and annuals are produced in the spring.

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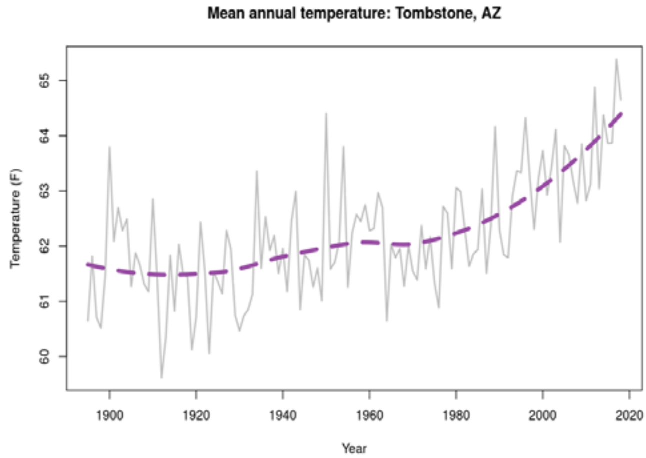
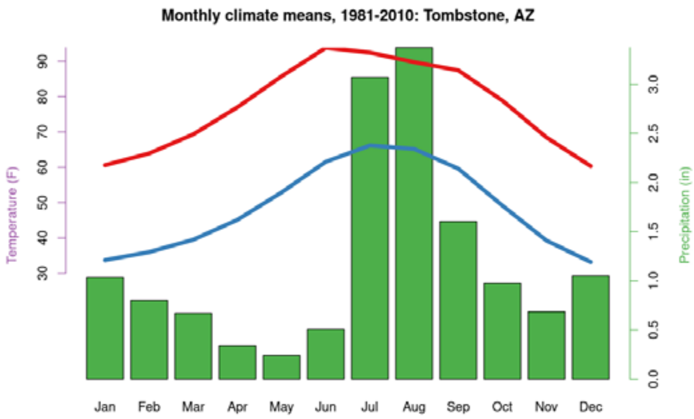
LTAR Network and USDA Climate Hubs are working to develop knowledge and technology for sound resource management **via research and collaboration with stakeholders.** The goal is to ensure **sustained crop and livestock production and ecosystem services** from agroecosystems, and to forecast and verify the effects of environmental changes, public policies, and emerging technologies.



Average annual temperature variability as compared to mean temperature trend (1895-2018) (credit: Sarah Goslee).



Maximum and Minimum temperature and mean precipitation 1981 -2010 (credit: Sarah Goslee.

Measuring Weather and Climate

A dense network of 97 weighing rain gauges captures the spatial distribution of precipitation, as these storms produce almost all of the runoff. Precipitation during the rest of the year generally arrives as long duration, low intensity frontal storms from the Pacific Ocean. Occasionally, remnants of hurricanes formed off Mexico in the Pacific arrive as tropical storms in Sept-Oct.

Impacts to Agriculture

Producers are challenged by drought and increasing aridity. Localized overgrazing can accelerate grass and soil losses primarily by water erosion. A long drought culminated in the 2006 conversion at higher elevations of the native perennial midgrass community to an invasive midgrass species, Lehmann lovegrass. Shrub dominance is progressing, with some ranchers responding by herbicide treatments on the limy soils at the lower end of the watershed. Drought is a constant consideration in ranch decision making.

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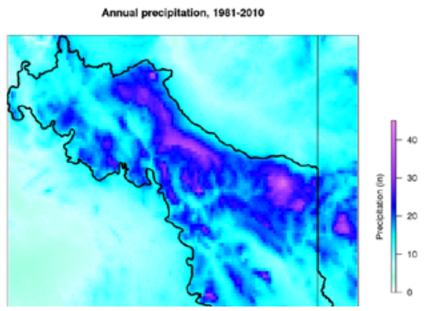
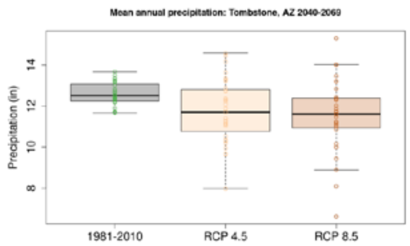
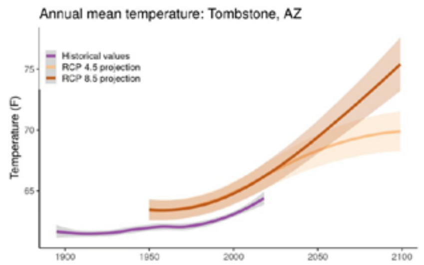


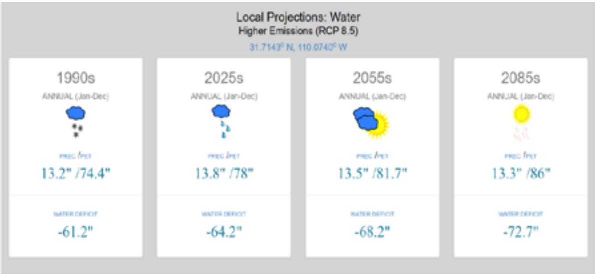
Annual Precipitation (mm), 1981-2010 (credit: Sarah Goslee).



Projection of annual precipitation 2040-2069 at WGEW (credit: Climate Toolbox). Annual precipitation is projected to become more variable, with a slight decrease in mean precipitation.



Mean temperature projections (credit: Climate Toolbox). Average and extreme temperatures are projected to increase at WGEW.



Future climate projections dashboard (Water Deficit) for WGEW (credit: Climate Toolbox). Available water in the region will likely decline as increased temperatures lead to increased evaporation and evapotranspiration.

Climate and Climate Change

The Walnut Gulch Experimental Watershed has the densest rain gauge network of any semiarid watershed in the world with almost 1 rain gauge per 1.5 km2 in addition to a network of flumes and other measurement devices. Unlike most rain gauges, the WGEW gauges operate at a minute timestep to estimate the rainfall intensity that drives runoff and erosion. With this unique dataset, we have found an increasing trend in storm intensity over time. Another study at 10 rural sites near Walnut Gulch in southeastern Arizona (Goodrich et al. 2011) found an increasing trend in temperature of roughly half a degree (F) per decade for the period 1961-2009).

To manage land sustainably, consider weather and climate.

Water Resources

- Water scarcity in the Colorado Basin is expected to increase as the river is overallocated, and the declining amount of snow falling at higher elevations is resulting in declines in Lakes Mead and Powell. Irrigated agriculture in Arizona will be most affected, as will municipal supplies, but ranchers rely on local sources.
- Research from WGEW has confirmed that although there is little to no recharge on the uplands, percolation in ephemeral channels can be a significant source of recharge in wet years (Goodrich).
- Further, an urban development can generate 27 times as much runoff as undisturbed grassland to serve as "new water" (Kennedy).
- Only 1 to 2% of the precipitation falling on Walnut Gulch leaves the watershed as runoff past the outlet flume. Most of the rest returned to the atmosphere as either evaporation from the soil or transpiration through plants. Often these processes are lumped in the term "evapotranspiration." Recent experimentation with new instrumentation, eddy flux towers, has allowed a much better understanding of the interrelationships of the water, carbon, and energy cycles on rangeland.
- Soil moisture is a critical limiting factor on rangelands across the West. The network of instrumentation across Walnut Gulch has allowed it to be a key field validation site for satellite estimates of both soil moisture and surface heat.

Decision Support

- The Rangeland Hydrology and Erosion Model, RHEM, developed in conjunction with the NRCS, is a hillslope erosion model that is the standard for rangeland erosion prediction. https://apps.tucson.ars.ag.gov/rhem/
- The Automated Geospatial Watershed Assessment (AGWA) tool, developed with many partners, is a GIS interface around a detailed watershed model to assess the impact of land surface change on runoff and erosion across small watersheds. https://www.tucson.ars.ag.gov/agwa/

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