Climate of Utah

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Climate in Utah is greatly influenced by its location within the North American Continent with significant local modifications due to topography. Northern, higher-latitude locations are generally cooler than southern, lower-latitude locations. Likewise, higher-elevation locations are typically cooler and wetter than lower-elevation locations.

The regional wind pattern for a mid-latitude location, such as Utah, is generally from west to east. As a general rule, Pacific storms traveling across the Western United States are very moist. As that air meets the backslope of the western mountain ranges, the air is forced upward due to orographic lifting. The subsequent adiabatic cooling reduces the moisture content of the air mass. As a result, the Sierra Nevada and the Cascade Ranges of California, as well as the Rocky Mountains of Utah, receive a significant amount of precipitation. While comparatively dry, light precipitation conditions are the outcome for most of the other regions of Utah. Moreover, this phenomenon explains, to a large degree, the distribution of settlements and agricultural production in Utah and is a significant driver in the distribution of ecosystems that will be discussed later.

Utah is home to a large variety of terrain. Mountain ranges and high plateaus generally extend in a north-south orientation across much of the state and are most prominently found along the central east-west portion of Utah. These include the Wasatch, Bear River, and Pahvant ranges, and the Oquirrh, Stansbury, Tushar Mountains, and Wasatch, Fish Lake, Markagunt, Paunsaugunt and Aquarius plateaus. The Uinta Mountains span east to west in the northeast corner of Utah and contain the highest elevations in the state. Mid-to-high elevation valleys and basins are found near these mountain ranges. Desert plateaus and slick rock canyons are prevalent in the south and southeast regions, while desert valleys cover much of the western third of the state.

The National Climate Data Center (NCDC) has defined the following seven climate divisions for Utah: Western, Dixie, North Central, South Central, Northern Mountains, Uinta Basin, and Southeast (Figure 5.1). These divisions are organized such that the terrain within each region is similar, and the associated weather stations experience the same general climate conditions. There have been many efforts to partition the state into similar units such as these climate divisions. While these various classifications have different purposes, they invariably have relatively similar results since environments in Utah are regionally driven by climate.

According to the Köppen-Geiger climate classification, much of Utah is classified as a steppe, or semiarid region. Of the seven climate divisions listed above, this climate characterization encompasses the Western, Dixie, Southeast, Uinta Basin, and much of the North and South Central divisions. Steppe regions typically experience hot, dry summers and cold winters with average annual precipitation totals of 5 to 15 inches.

The mountainous areas and higher elevation valleys of Utah include the Northern Mountains and portions of the Uinta Basin, Southeast, and North and South Central divisions. These areas are characterized as Humid Continental with no real dry season and warm-to-hot summers. Winters are severe with cold temperatures and abundant snowfall. Annual precipitation amounts can range from 10 to more than 55 inches (Figure 5.2). High elevation mountain stations like Alta, Utah, for example, normally receive over 500 inches of snowfall that contribute to its average of 58 inches of precipitation (water equivalent) annually. The Uinta Mountains and other mountainous areas with elevations over 11,000 feet are classified as subarctic. Here there is no dry season. Cool summers and severe, cold winters characterize these mountain areas.

Given the different climate zones in Utah, there is some similarity among them as to when the majority of precipitation in a year is received. Generally, the winter months bring the highest amounts of monthly precipitation. This is due to the Polar Jet Stream that moves southward in winter and often places Utah in the path of strong Pacific storm systems moving in from the northwest. The summer months generally bring the driest weather to Utah as the Polar Jet Stream lies further to the north and high pressure prevails over much of the region. Precipitation in the summer months is generally limited to convective thunderstorm activity. Thunderstorms occur more often over the mountains as warm air rises from the surface of multiple sides of a mountain ridge converging at the top of the ridge. Summer precipitation in the eastern portion of Utah increases around the latter part of the summer season as high pressure moves eastward, creating a so-
Figure 5.1. NOAA National Climatic Data Center climate division.
Figure 5.2. Average annual precipitation in Utah.
called monsoonal flow from the south. The monsoonal flow draws moist air from the Gulf of California, the Gulf of Mexico, and the Pacific Ocean into the Intermountain Region, generally affecting mostly the southern and southeastern part of the state with some rainfall activity in the north, depending on the location of the Polar Jet Stream. The moist air combined with afternoon heating brings an increased chance for thunderstorm activity.

The semiarid characteristic of the state is primarily due to the balance between total precipitation (PPT) and the total reference evapotranspiration (RET). The RET is the total amount of water that is evaporated from the ground surface and transpired from plants for a given time period and assumes that available moisture is not limited (Figure 5.3). Therefore, areas where total RET is greater than total PPT are considered dry because more water is extracted than provided, and areas where RET is less than PPT are considered wet. Using this reference, approximately 91 percent of the state experiences dry climatic conditions throughout the year (Figure 5.4). These conditions vary on a monthly basis.

The controlling variable for the calculation of RET is temperature. As with precipitation, temperature varies across Utah primarily as a function of elevation and latitude (Figure 5.5). Northern Utah is typically cooler than southern Utah and higher elevations are generally cooler than lower areas. Therefore, precipitation and temperature working together are the primary drivers of the distribution of vegetation in the state. At local scales, soils and topographic relief also strongly affect plant distributions.

Other climate features of note are inversion conditions that occur during late fall and winter months. These may persist for several weeks. In natural settings, this results in long-lasting fog, while in the inhabited valleys of northwestern Utah, car exhausts and smoke accumulate to form haze in the stagnant air.

Climatologically, winds are generally moderate but from time to time, they reach damaging proportions in the vicinity of canyons along the western edges of the Wasatch Mountains, especially if there is a temperature inversion aloft. Dust storms occur occasionally in spring and mostly in western Utah.
Figure 5.3. Average annual reference evapotranspiration in Utah.
Figure 5.4. Dry and wet climates in Utah.
Figure 5.5. Average annual temperature in Utah.