Section 5.0
Climate and Precipitation

Summary

Climate is fundamental to the character of the hydrologic cycle which is fundamental to the functioning of the South Arkansas River watershed. Climate in the South Arkansas River watershed is dominated by the interaction between the Sawatch Mountains and prevailing westerly weather pattern. The high peaks collect most of the precipitation as snow in winter and create a semi-arid climate on the leeward (east) side where the watershed is located. Drought conditions in the watershed have increased in recent years, but are not as severe as some that have occurred in the last 1,000 years. Climate predictions do not indicate any consistent long-term trends in annual precipitation but, by the mid-21st century, the snowpack above 8,200 feet is expected to decline, snowmelt is projected to shift 2-4 weeks earlier in the spring, and late-summer flows may be reduced. Drought and changes in runoff, coupled with water diversions, will likely adversely impact the watershed, the river, and streamside habitats.

This section reviews the climate of the Southern Rocky Mountain region in general and the South Arkansas River watershed specifically. The impact of climate on watershed processes is then examined. The section concludes with a discussion of the potential impacts of climate change on the South Arkansas River watershed.

Introduction

Climate refers to meteorological conditions that prevail in a region, including seasonal temperature variations, wind, evaporation, and the timing and intensity of precipitation. Climate also influences a region's characteristic vegetation, the rate of groundwater recharge, the rate of erosion, and the rate at which local geology weathers to soil. Climate is fundamental to watershed processes because climate drives the hydrologic cycle. The hydrologic cycle refers to the circulation of water from the earth's surface—land, rivers, lakes, and oceans—into the atmosphere, then back to the surface as snow and rain (Figure 5-1). The cycle is continuous and involves evaporation, movement of water by plants from soils to the air ("transpiration"), short- and long-term storage of water in soils and groundwater, and runoff into rivers, lakes, and oceans (Dunne and Leopold 1978).

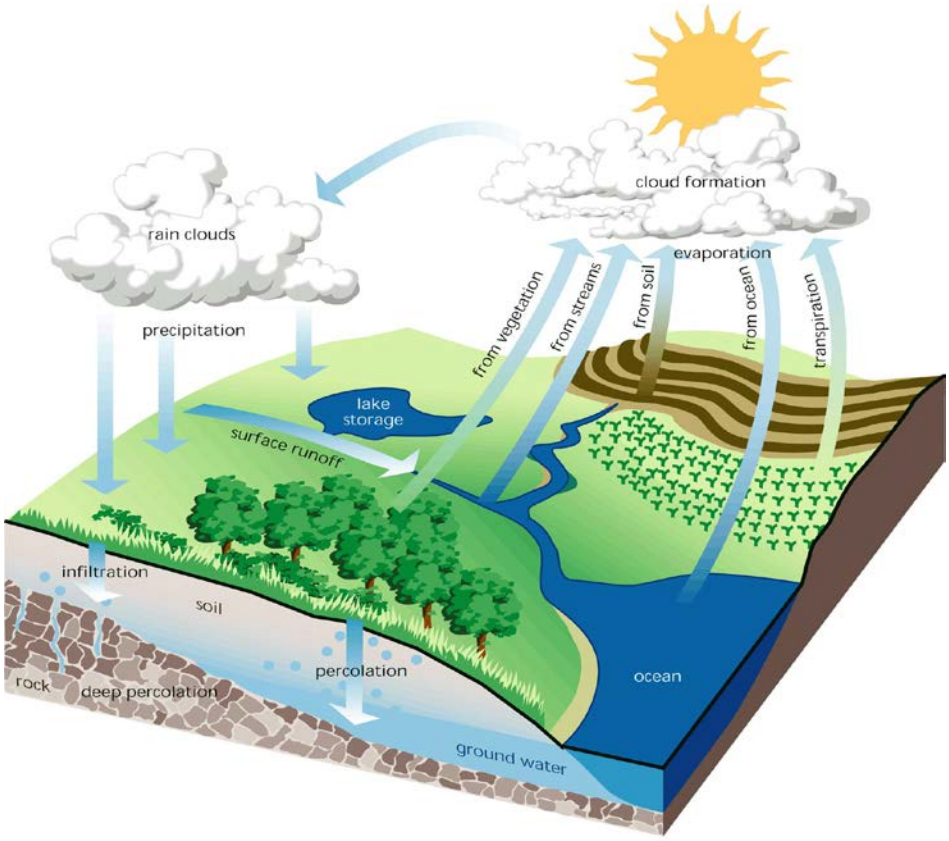

Figure 5-1. Components of the hydrologic cycle
(FISRWG 2001)

Climate in the Southern Rocky Mountains and the South Arkansas River Watershed

The South Arkansas River watershed is located in the Southern Rocky Mountains where the climate is variously described as “continental” (CNHP 2006) and as a “temperate semi-arid steppe regime” (Bailey 1995). The characteristics of the climate in the watershed are summarized below (Bailey 1995; Chapman et al. 2006; USFS 2013b).

- Climate is influenced by the prevailing west winds and the general north-south orientation of the mountain ranges. East slopes are much drier than west slopes.
- Intense convective thunderstorms may occur, producing localized flooding (CNHP 2009a, Mutel and Emerick 1984).
- At lower elevations, evaporation generally exceeds precipitation. However, as elevation climbs, these condition are reversed—temperatures generally decrease and precipitation increases. These trends are modified locally due to slope aspect and topography (CNHP 2006).
- Average annual temperatures range from 35^{o} to 45^{o}F in most of the region, reaching 50^{o}F in the lower valleys. In Salida, average temperatures range from 28^{o}F in December-January to 65^{o}F in July and August (WRCC 2013).

- At the base of the Sawatch Mountains, annual precipitation ranges from 10 to 20 inches of rainfall. Average annual precipitation in Salida is 11 inches. At higher elevations, annual precipitation increases to 40 inches, most of this as snow during the winter (Figure 5-2; WRCC 2013).

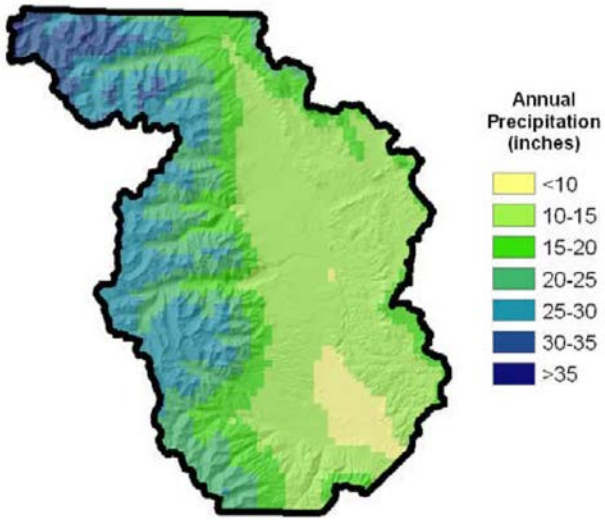

Figure 5-2. Precipitation zones in the South Arkansas River watershed (CNHP 2009a)

Climate Change—Colorado

The Colorado Water Conservation Board commissioned a study on the potential impact of climate change on Colorado water resources (CWCB 2008). The report noted that, although many studies include information about Colorado, few studies focus on the state. The CWCB study reviewed those studies specific to Colorado and developed additional information for the state. Major findings are presented below.

- The frequency and severity of drought conditions in Colorado during the 20th century have not been as severe as climatic indicators over the last 1,000 years.
- Over the past 30 years, the average annual temperature in Colorado has increased about 2°F. Climate modeling projects that temperatures will increase an additional 2.5°F by 2025, and 4°F by 2050. These projected increases in temperatures are likely to exacerbate drought impacts.
- "No consistent long-term [statewide] trends in annual precipitation have been detected in Colorado…Variability [in precipitation data] is high, which makes detection of trends difficult" (CWCB 2008).
- Increases in precipitation falling as rain rather than snow have been noted for the western U.S., but such changes for Colorado are "smaller and not as significant."
- No significant trends in the frequency and intensity of extreme precipitation events have been detected for Colorado.
- "Changes in the quantity and quality of water may occur due to warming even in the absence of precipitation changes" (CWCB 2008).
- By the mid-21st century, Colorado's snowpack above 8,200 feet is projected to decline 10–20%.
- The timing of spring runoff is projected to shift 2 to 4 weeks earlier, and late-summer flows may be reduced regardless of changes in precipitation.
- Collectively, the report "suggest a reduction in total water supply…(and) a decline in runoff for most of Colorado's river basins by the mid-21st century" (CWCB

2008). However, the report indicated that runoff projections specific to the Arkansas River basin are lacking. Climate change projections were used in the estimates of water supply and demand for the CWCB's Arkansas River basin report (CWCB 2011a).

Additional conclusions from other climate change research that may bear on the South Arkansas River watershed are summarized below.

- Projected changes in climate may alter the timing, intensity, frequency, and extent of natural disturbance cycles, such as those caused by drought, fire, and insect outbreaks. Interactions among different types of disturbance may also change (Dale et al. 2001).
- Climate change has been implicated in shifts in plant communities, insects, and birds both northward and to higher elevations (Parmesan 2006).
- Climate change has also been implicated in the earlier flowering of plants and changes in the emergence of pollinating insects. One potential adverse impact of these two changes is a mismatch in timing between plants and pollinators (Inouye 2008). However, the phenomena and potential consequences have not been extensively explored (Hegland et al. 2009).

Climate and Precipitation— Impacts and Issues in the South Arkansas River and Watershed

For the South Arkansas River and watershed, the most important statement regarding climate and precipitation is that current drought conditions are not as severe as some that the area has experienced during the last 1,000 years. However, the river and watershed currently exhibit impacts from recent drought conditions. Coupled with water diversions, still more severe drought and changes in the timing of runoff will likely further impact the watershed, the river, and streamside habitats.

Potential impacts of changing precipitation and watershed and stream hydrology are explored in more detail in the following sections.

- Section 6.0, Hydrology and Flow Regime
- Section 7.0, Vegetation
- Section 8.0, Wildlife, Fish, and Aquatic Invertebrates
- Section 9.0, Water Quality
- Section10.0, Channel and Floodplain Processes

Restoration goals and recommendations for the South Arkansas River and watershed are discussed in Section 11.0, Establishing Watershed and Riparian Restoration Goals.

A lot of people like snow. I find it to be an unnecessary freezing of water.

Carl Reiner