

What is Hydroclimate?

Hydroclimate is the scientific field that brings together hydrology and climate, including the impacts that water and its processes have on Earth's climate, and the impacts of climate patterns and change on the global hydrological (or water) cycle. From small to large scales, the hydrological cycle plays a vital role in Earth's ecosystem as well as the weather that we experience. The hydrological cycle involves processes where liquid water evaporates into water vapor, condenses to form clouds, and precipitates back to Earth in the form of rain and snow. Also, the hydrological cycle involves factors such as water storage through snow, ground, and vegetation. Ocean currents and large-scale dynamics transport energy across the planet and regulate global climate patterns. Hydroclimate phenomena such as drought, flooding, and precipitation can have societal impacts such as crop damage and loss of life.

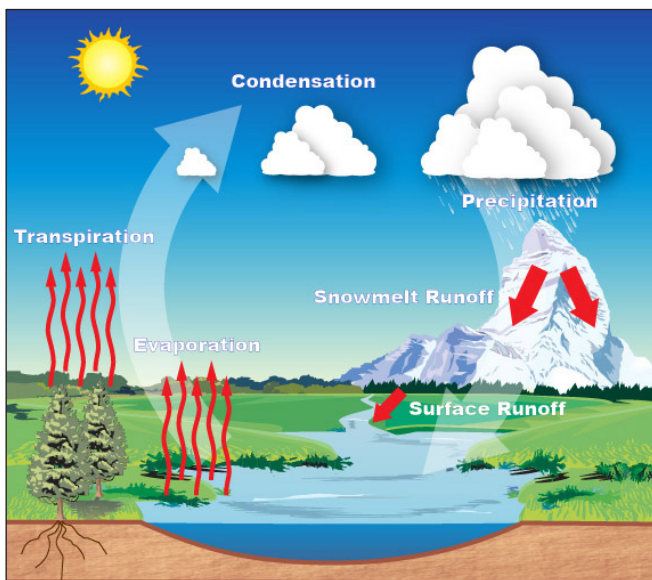
The Hydrological Cycle

The five principal components of the hydrological cycle - evaporation, transpiration, condensation, precipitation, and runoff - each play a major role in sustaining global life. Components of the hydrological cycle take place at different timescales. Processes such as evaporation, transpiration, and condensation are constantly occurring at the surface and atmosphere, and only require several days for evaporated water to fall back to the Earth as precipitation. In contrast, oceanic currents, snowpack and groundwater change on timescales of months to years to centuries.

Evaporation is the change of state of water from a liquid to a gas, which requires energy through the sun, the atmosphere, earth, or objects created by humans. Similarly, transpiration is the evaporation of water from plants through stomata, which are small openings found on the underside of leaves that are connected to vascular plant tissues. Both of these steps are key to the creation of clouds, as they transfer water from the ground to the atmosphere.

Precipitation occurs after condensation, when atmospheric water vapor created through evaporation and transpiration undergoes a phase change. Precipitation is the primary way the Earth's surface receives freshwater. Falling in the form of rain, hail, snow, or sleet precipitation replenishes groundwater and reservoirs to allow crops to grow.

Rivers and lakes can be formed as a result of runoff, which is a process that occurs when the ground is saturated and cannot absorb more water. In mountainous areas, snowmelt can be the primary source of runoff during the spring and summer months. Many reservoirs rely on heavy winter snows to produce spring runoff to replenish their water supplies. The evaporation of this runoff water begins the hydrological cycle again.



The ocean influences weather and climate by storing solar radiation, distributing heat and moisture around the globe, and driving weather systems. It plays a large role in the hydrological cycle: ocean currents act much like a conveyor belt, transporting warm water and precipitation from the equator toward the poles and cold water from the poles back to the tropics. Thus, ocean currents regulate global climate, helping to evenly distribute the solar radiation reaching Earth's surface.

Hydroclimate Events and Extremes

Defined as a deficiency in precipitation, drought impacts the same sectors of society that rely on the hydrological cycle, including agriculture, health, and our supplies of energy and drinking water. Drought can occur in all climate zones and last from months to years. For example, the 2011-2017 California drought caused billions of dollars in damage, largely due to agricultural losses and efforts employed to combat the event. Because of the interplay between physical changes, such as lake levels and soil moisture, and human factors, such as transportation and impacts to our food supply chain, droughts are complex events that can have widespread impacts.



Folsom Lake - July 20, 2011

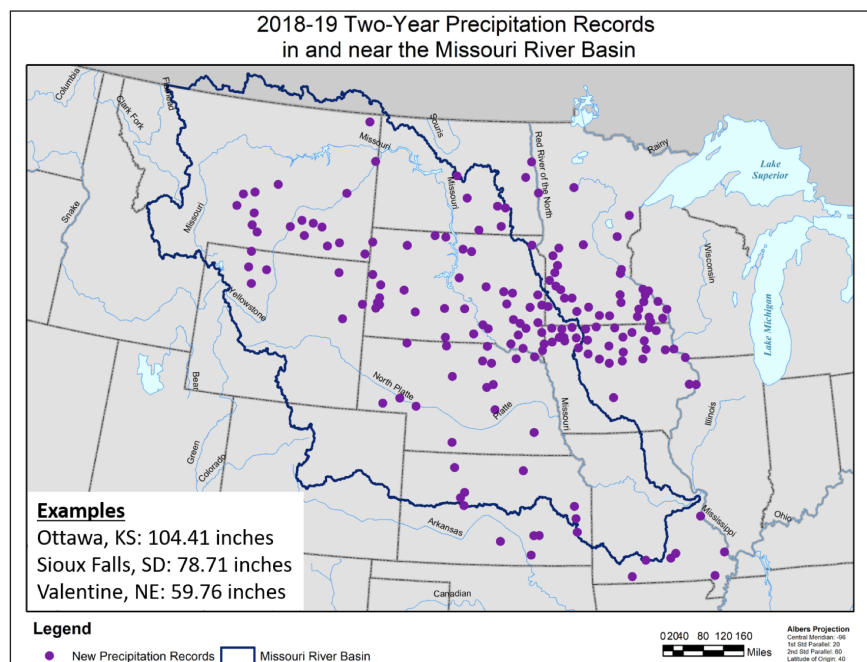


Folsom Lake - January 16, 2014

Anomalously wet events are another type of disruption to the hydrological cycle. 2019 was one of the wettest years on record for the majority of the Missouri River Basin. Excessive rainfall led to massive delays in crop planting, with nearly 20 million acres of land being left unplanted.

Disruptions in the hydrological cycle will continue to cause anomalously wet or dry periods across the U.S. as our climate shifts. Water monitoring systems are necessary to prepare for and mitigate risk arising from these climatic events. The National Weather Service (NWS) provides information to the government and public regarding hydroclimate. Precipitation forecasts are available on the NWS Weather Prediction Center's

website, while observed and forecast river conditions are available on the NWS Advanced Hydrologic Prediction Service (AHPS) website. The NWS, National Integrated Drought Information System (NIDIS), National Drought Mitigation Center (NDMC), and other partners play key roles in drought monitoring, forecasting, and research. Understanding and collecting data helps to be better prepared for hydroclimate events and mitigate their societal impacts.



Increasing global temperatures can disrupt the hydrological cycle since its processes are strongly dependent on temperature. Higher temperatures mean that the atmosphere can hold larger amounts of water, potentially leading to more intense precipitation events. Rising temperatures may cause some regions to become more arid or experience more frequent droughts. Greater evaporation can lead to harder, less absorbent soils, which can in turn mean that less water is absorbed by vegetation and thus to more runoff during precipitation events. Changes in sea surface temperatures and to the pace of ocean circulation are affecting regional and global weather patterns.