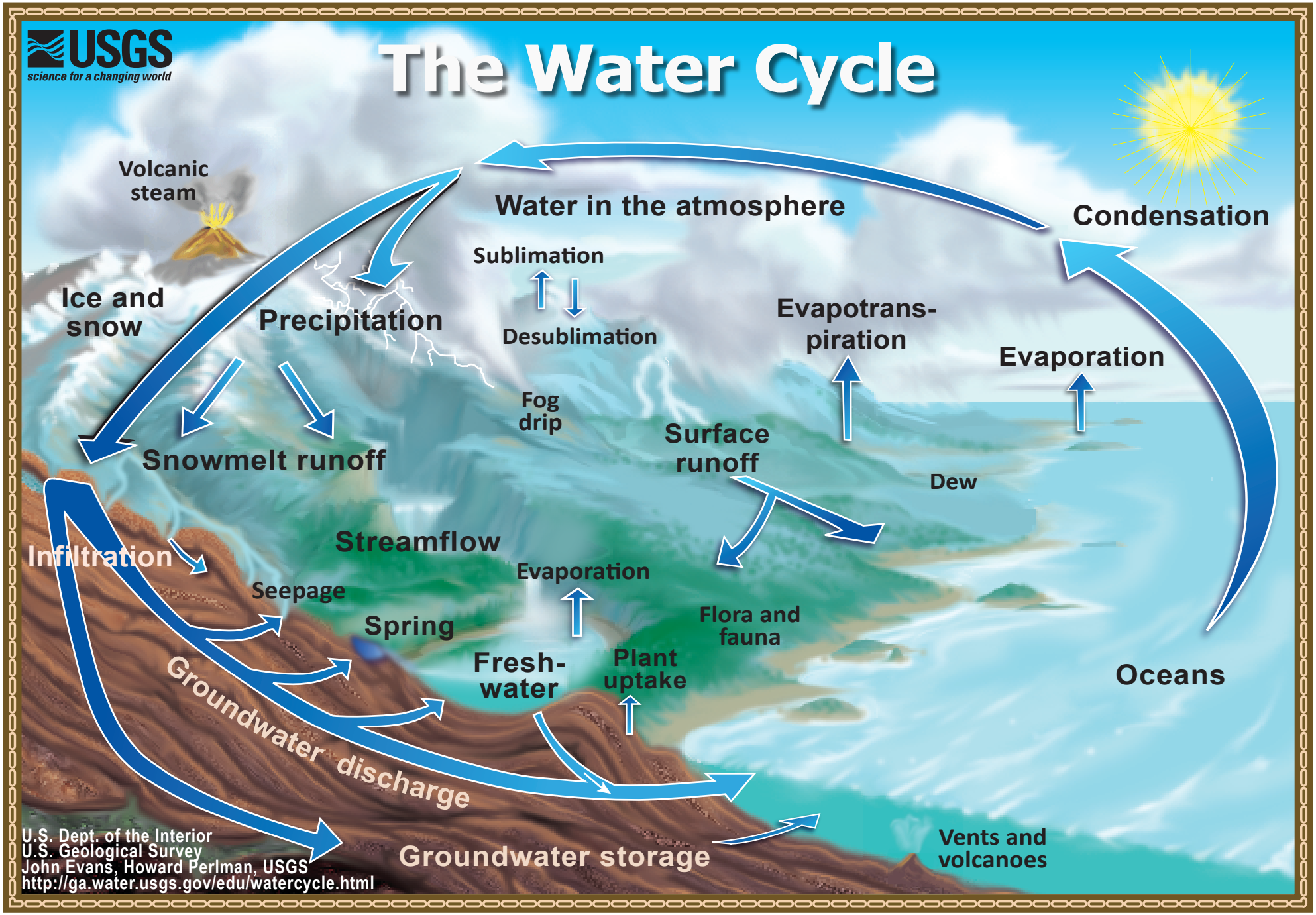

USGS
science for a changing world
The Water Cycle
Volcanic steam
Water in the atmosphere
Condensation
Sublimation
Desublimation
Ice and snow
Precipitation
Evapotrans-piration
Evaporation
Fog drip
Surface runoff
Dew
Snowmelt runoff
Infiltration
Streamflow
Evaporation
Seepage
Spring
Flora and fauna
Fresh-water
Plant uptake
Oceans
Groundwater discharge
Groundwater storage
Vents and volcanoes
U.S. Dept. of the Interior
U.S. Geological Survey
John Evans, Howard Perlman, USGS
http://ga.water.usgs.gov/edu/watercycle.html

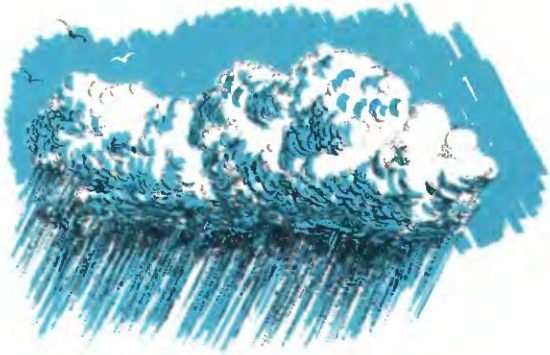


Introduction

?Do forests reduce floods?
?Where does my well water come from?
?What is the temperature of the water that will be found in a well on my farm?
?Will salt or fresh water be found if I drill a well?
?Is the water table falling in my State?

These and similar problems are discussed in this book. The section on "The supply of water" concerns the occurrence of water in Alabama, and some aspects of climate and land which affect the supply of water. The section "The use of water" is about the use of water in Alabama, and problems associated with water supply and flood control. The "Tomorrow's water" section discusses opportunities for further development.

The three authors are a geologist, an engineer, and a chemist of the U.S. Geological Survey. Together, they have devoted half a century to the technical and scientific study of water resources. Their work in Alabama has been supported cooperatively by the U.S. Geological Survey, the Geological Survey of Alabama, and several Federal, State, and local agencies.



THE SUPPLY OF WATER

The Water Cycle

Our water comes from the ocean, as shown on figure 1, and returns to the ocean in a never-ending cycle. Water evaporates from the ocean and becomes vapor in the air. Carried overland by winds, it condenses and falls as rain or snow, part of which is absorbed by soil, part evaporated, and part used by trees and plants. The remainder returns to the ocean through streams that drain the land. During its journey, water modifies the face of the earth by erosion and other processes. The cycle moves at a varying pace (sometimes there is drought, occasionally flood), but move it does and thus replenishes the supply for land and people.

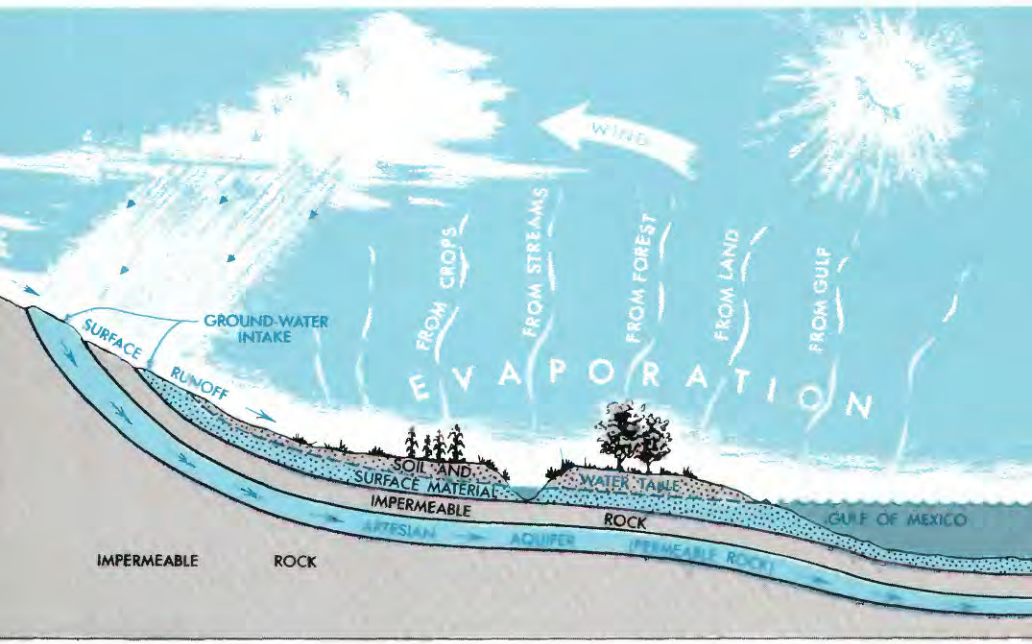


FIGURE 1.—Water, a renewable resource. Moisture from the Gulf of Mexico is carried by winds over the land and falls as rain. Part is absorbed by the ground, part is used by vegetation, part again evaporates, and part runs back to the Gulf in streams.

The total amount of water in and on the earth changes but little, if at all. Some is in the oceans, rivers, and lakes; some is in openings in soil and rock; some is frozen in polar icecaps and in glaciers; some is in the tissues of plants and animals; and some is held as vapor in the atmosphere. Most of the vapor that condenses into rain is evaporated from the sea. If the polar icecaps melted, the sea would rise and cover sections of Alabama, as it did many times long ago in the geologic past.

Most rain that falls on Alabama is moisture that evaporated earlier from the Gulf of Mexico. The nearness of the Gulf is thus a major reason for plentiful rainfall in Alabama. Rains come at intervals as the air moves back and forth and as contact between warm air with colder air causes the moist air to release part of its water as rain. Climatic forces change with the seasons, but the directions and velocity of the winds do not vary greatly from season to season; thus, there are no major seasonal differences in the amount of rainfall in Alabama (fig. 2). There is, however, a seasonal difference in the type of rainstorms: the more intense rains usually occur during warmer months.

General or average conditions obscure variations. Variations of weather must be considered because they can be very great and extremes are important in relation to water supply. Long-time trends in climate may exist, but there is little evidence of any significant trend in Alabama within recent decades or even centuries. We are, however, interested in those changes that occur from year to year and during periods of a few years.

Rainfall at Tuscaloosa in most years differs greatly from the long-time average (fig. 3). During some periods, series of wet years or of dry years tend to occur together. At other times wet years and dry years occur entirely independently of each other. Evidently lack of repeated order or pattern in annual rainfall is a characteristic of weather.

An even greater range in variability is evident if single months are studied instead of years. At Montgomery, for example, rainfall was less than 0.01 inch in October 1904, but more than 20 inches in November 1948. In some years when total annual rainfall is near normal, seasonal amounts may be abnormally high or low.

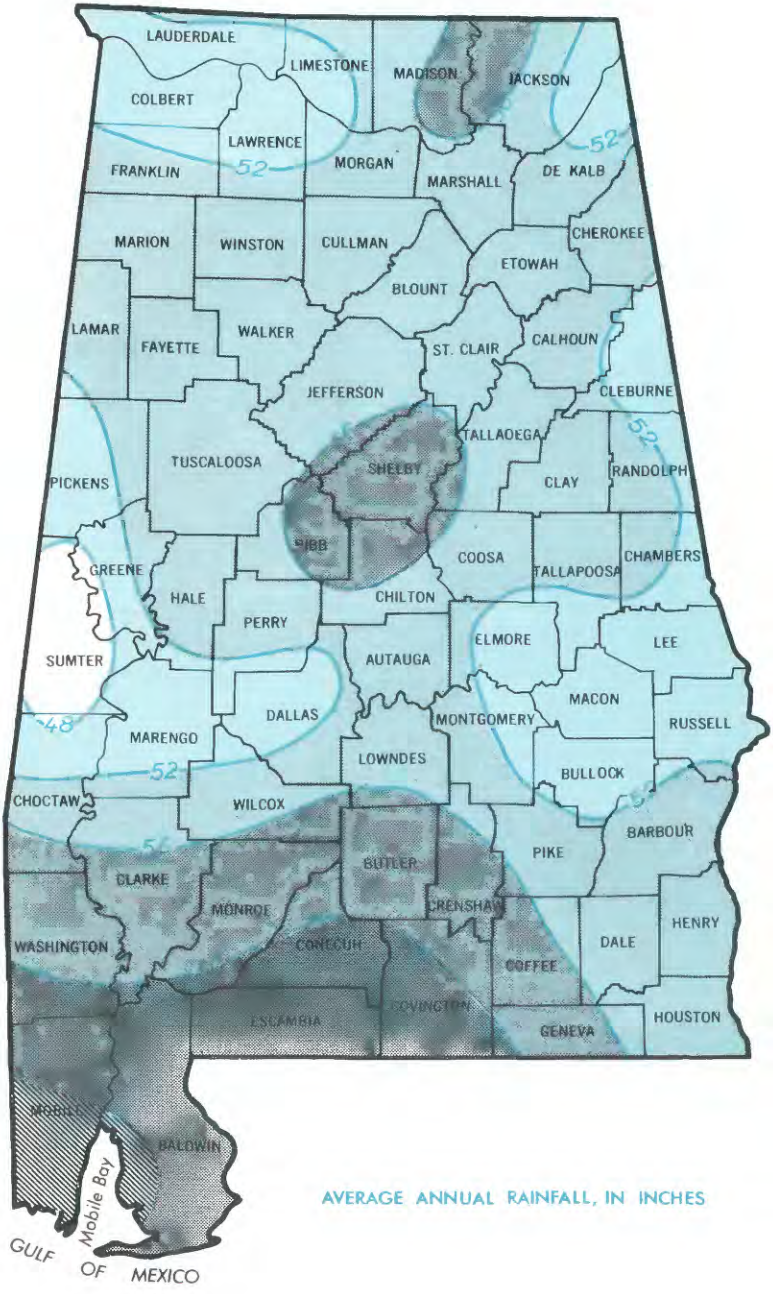


FIGURE 2.—Average annual rainfall in Alabama.

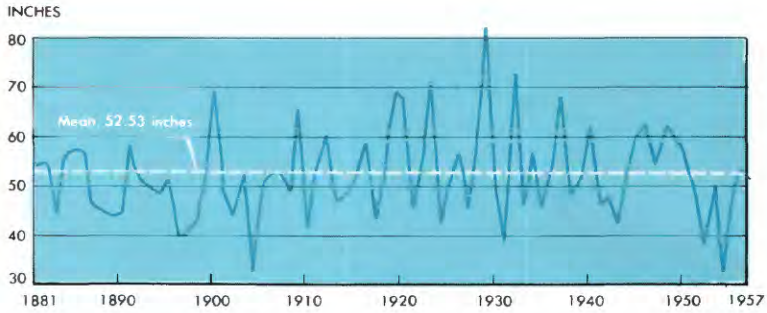


FIGURE 3.—Annual rainfall at Tuscaloosa.

If we consider individual storms, extreme variations are evident: First, the amount of rain can vary from a mere trace to a great deal; about 30 inches fell at Elba in the great storm of 1929. Second, the area covered by a storm may be very small or it may be many thousands of square miles.

About 15,000 cubic miles of water evaporates each year from the lakes and land surfaces of the continents. Water evaporates

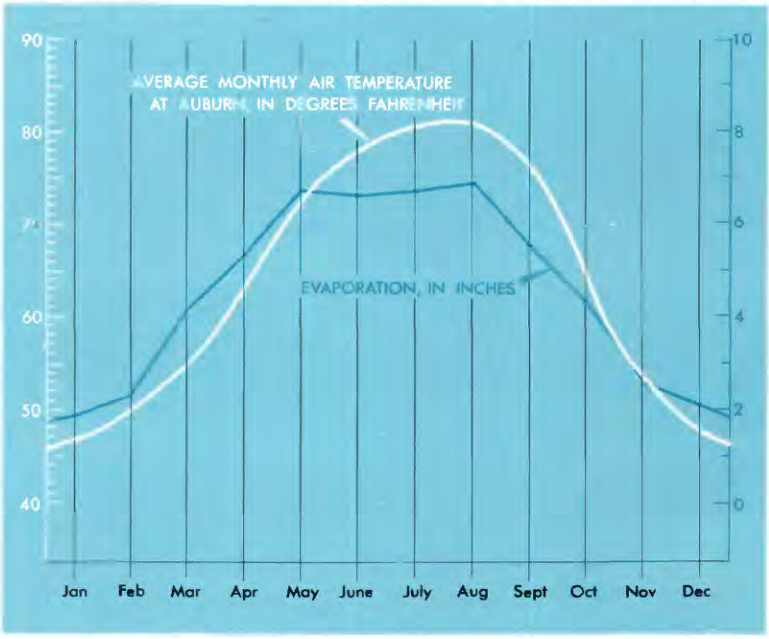


FIGURE 4.—Monthly evaporation from a pan at Lake Martin and air temperature at Auburn.