

Topics:

1. What drives the water cycle?
2. Inventory of water on Earth
3. Concept of residence (replacement) time, back-of-the-envelope calculations
4. Residence times for water in the various reservoirs – 11 days in atmosphere, 17 days in rivers and streams, 3200 years in ocean. Although they are relatively small reservoirs, the atmosphere and rivers are important for water transporter – water balance on land and in the oceans depend on this transport.
5. Water's effect on the energy balance – clouds in the atmosphere, balance between sensible and latent heat
6. In the oceans, different patterns of precipitation and evaporation create variations in salinity (and density). Runoff can also affect salinity. Density variations are one cause of ocean currents.
7. Ice contains about 75% of the freshwater on earth in the form of glaciers. The ice/glacial “reservoir” is equivalent to about 90 years of global precipitation. Glacial and snow melt in spring and summer is the principal source of water for some areas
8. Surface water, rivers, and glaciers sculpt the surface, and transport sediments downstream
9. Groundwater – created very slowly, and moves very slowly. Forms when rainwater infiltrates soil, follows path of least resistance through the ground. Aquifer (underground lake) can form when water collects above impermeable soil or bedrock.
10. Water balance calculation: $P + R_{in} - ET - R_{out} = \Delta S$

Conversion factors interest for water:

1 acre-foot = 325,851 gallons = 1234 cubic meters (m^3)

1 gallon = 3.785 liters = 0.003785 m^3

Density of water = $1000 \text{ kg}/m^3 = 62.4 \text{ lb}/ft^3$

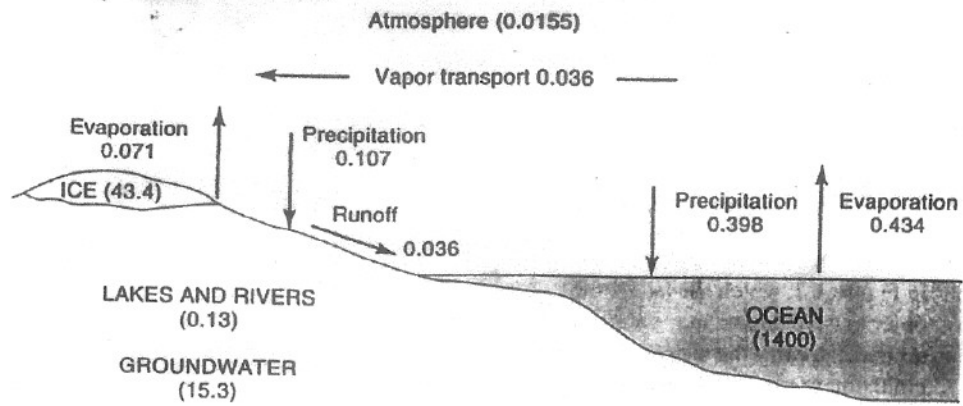


Figure 1.1 The hydrologic cycle. Numbers in parentheses represent inventories (in $10^6 \text{ km}^3 = 10^{18} \text{ kg}$) for each reservoir. Fluxes are in $10^6 \text{ km}^3/\text{yr}$ (10^{18} kg/yr). (Data from Table 1.1 and NRC 1986.)

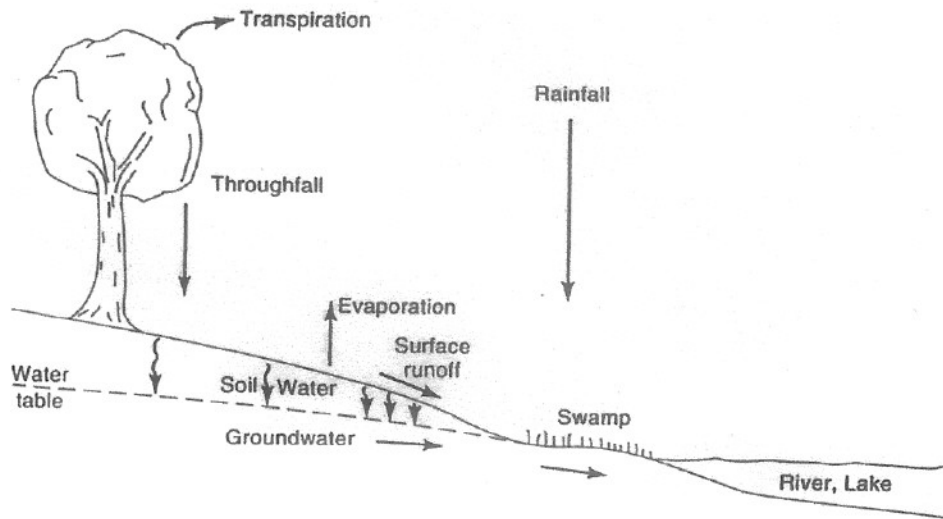


Figure 4.1. Pathways of water near the land surface.

TABLE 1.1 Inventory of Water at the Earth's Surface

Reservoir	Volume 10^6 km^3 (10^{18} kg)	Percent of Total
Oceans	1400.	95.96
Mixed layer	50.	
Thermocline	460.	
Abyssal	890.	
Ice caps and glaciers	43.4	2.97
Groundwater	15.3	1.05
Lakes	0.125	0.009
Rivers	0.0017	0.0001
Soil Moisture	0.065	0.0045
Atmosphere total ^a	0.0155	0.001
Terrestrial	0.0045	
Oceanic	0.0110	
Biosphere	0.002	0.0001
Approximate total	1459.	

Sources: NRC 1986; Berner and Berner 1987.

^aAs liquid volume equivalent of water vapor.