ES 10 February 25 2002 **Inez Fung**
The Water Cycle

Topics:

1. Inventory (in kg) and fluxes (in kg/year) of water.
2. Residence (replacement) times of water – 10 days in atmosphere, 2 weeks in rivers and streams, 39,000 years for the oceans. Evaporation and precipitation do not balance over the land or over the ocean. . The atmosphere and rivers, even though they hold very little water, are very important for water transporters. This transport is necessary for the water balance of the ocean and land.
3. If precipitation and runoff were turned off, the oceans would empty in >3000 years. Without the atmospheric transport, precipitation over land would be smaller by 1/3. A very different biosphere would have resulted on land. Without the river input, the oceans would get saltier. Mediterranean is an evaporative basin.
4. In the atmosphere, water (as vapor or clouds) influences the energy budget.
5. In the oceans, different patterns of precipitation and evaporation create variations in salinity (and densities) in the world ocean. These density variations are one cause of the ocean currents (recall the thermohaline circulation).
6. Ice. About 75% of the freshwater on earth is stored as ice in glaciers. The amount is equivalent to 90 years of precipitation over whole globe. Glacial melt in the spring and summer is the principal source of water for some areas.
7. Surface water, rivers and glaciers sculpt the surface, and transport the sediments downstream.
8. Ground water. Very little ground water flows to the oceans. Ground water forms as rainwater infiltrates soil, and sinks into cracks and crevices of bedrock. When sufficient ground water collects above an impermeable bedrock, an acquifer is formed.

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.

[a]As liquid volume equivalent of water vapor.

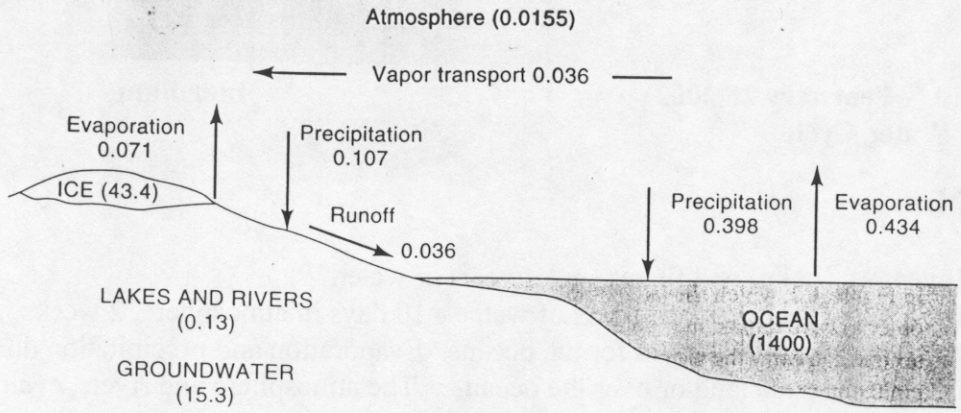

Figure 1.1 The hydrologic cycle. Numbers in parentheses represent inventories (in 10^6 km^3 = 10^{18} kg) for each reservoir. Fluxes are in 10^6 km^3/yr (10^{18} kg/yr). (Data from Table 1.1 and NRC 1986.)

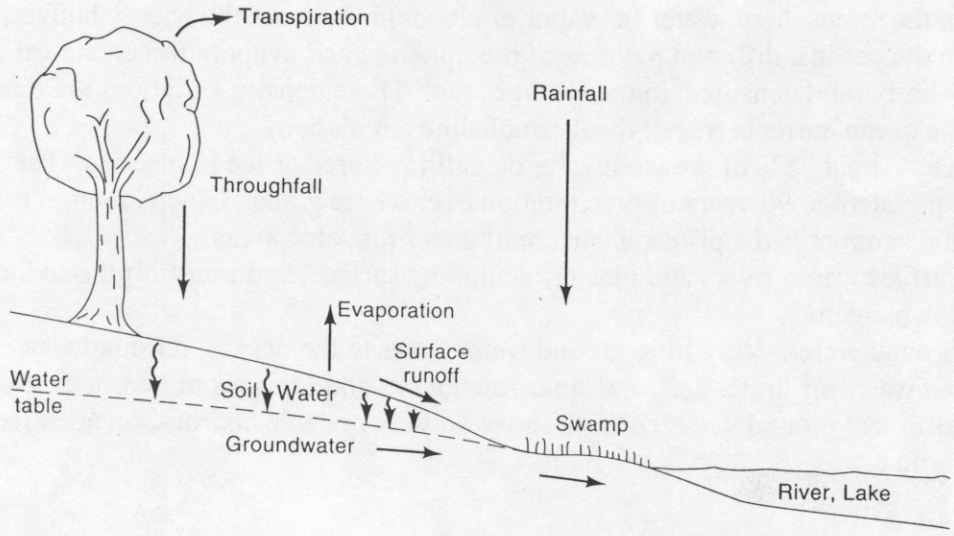

Figure 4.1. Pathways of water near the land surface.