GEO335
HYDROGEOLOGY

Components of the hydrologic cycle

Condensation

Evaporation

Transpiration– Growing plants are continuously pumping water from the ground into the atmosphere through this process.

Evapotranspiration- under field conditions it is not possible to separate evaporation from transpiration. Therefore, the total water loss (through free-water evaporation, plant transpiration or soil moisture) from a basin

PRECIPITATION

Relative humidity is a ratio of the air's actual water-vapor content compared with the amount of water vapor required for saturation at that temperature (and pressure).

Two ways to change relative humidity:

Addition and removal of water vapor

Temperature

When water vapor is added to a parcel of air, its relative humidity increases until saturation occurs (100% relative humidity). If even more moisture added to this parcel of saturated air, relative humidity do not exceed 100%, excess water vapor condenses to form liquid water.

When the relative humidity reaches 100%, the air is saturated.

In nature, moisture is added to the air mainly via evaporation from the oceans.

Precipitation is one of the main components of hydrologic cycle. There are several variations like rain, snow, hail (dolu), drizzle (çiselemek), sleet (a mixture of rain and snow)

Several conditions must be met for precipitation to occur:

1) A humid air mass must be cooled to the dew-point temperature
2) Condensation or freezing nuclei must be present
3) Droplets must coalesce to form raindrops
4) The raindrops must be of sufficient size when they leave the clouds. They may grow as large as 6 mm in diameter.

Air masses are cooled by adiabatic expansion occuring during the rise of air in the atm.
Atm. becomes less dense with altitude, so a rising air mass must expand due to the lower pressure.
When the rising air is dry (R.H. <100%) the rate of cooling is 1 °C for every 100m rise in height.
When the air mass reaches the dew point temp., further lifting and cooling will cause condensation.

Adiabatic temperature changes occur when air is compressed or allowed to expand.
When air is allowed to expand, it cools. When it is compressed it warms.

Adiabatic cooling--- PRIMARY CAUSE OF CONDENSATION AND IS RESPONSIBLE FOR MOST RAINFALL

Three major types of ppt based on mechanisms that cause air to rise:

1) Frontal Ppt or Cyclonic Ppt. Caused by the lifting of air masses by a moving weather front where warmer less dense air is forced over cooler denser air.

Stage 1.
An area of warm air meets an area of cold air.
Stage 2.
The warm air is forced over the cold air (warm air is less dense- it has more energy)
Stage 3.
As the warm air rises it cools
Stage 4.
Clouds form and precipitation occurs

2) Convective Precipitation (tropical regions)
İntense, of shorter duration. Caused by uneven heating of the air at the interface with the ground.

3) Orographic precipitation: caused by mechanical lifting of humid horizontal air currents over mountain ranges

Any open container can be used to catch and measure rainfall. Standard rain gauges or pluviometers are used. The total amount of precipitation is expressed as the depth of precipitation (mm) or the weight (kg/m^2).

A rain gauge that has been borrowed from Turkish State Meteorological Service.

U.S. Standard rain gauge has a diameter of 20.3 cm, Canadian gauge diamater is 9 cm.

Rain gauges should be located in the open areas, away from trees and buildings.

In water-budget studies, it is necessary to know the average depth of precipitation over a drainage basin.
If data are missing at one or more stations ---- PROBLEM

Effective uniform depth (EUD) of precipitation is defined as the depth of water which would result if all of the precipitation received were uniformly distributed over the drainage area.

Methods to calculate EUD of PPT (over a basin)

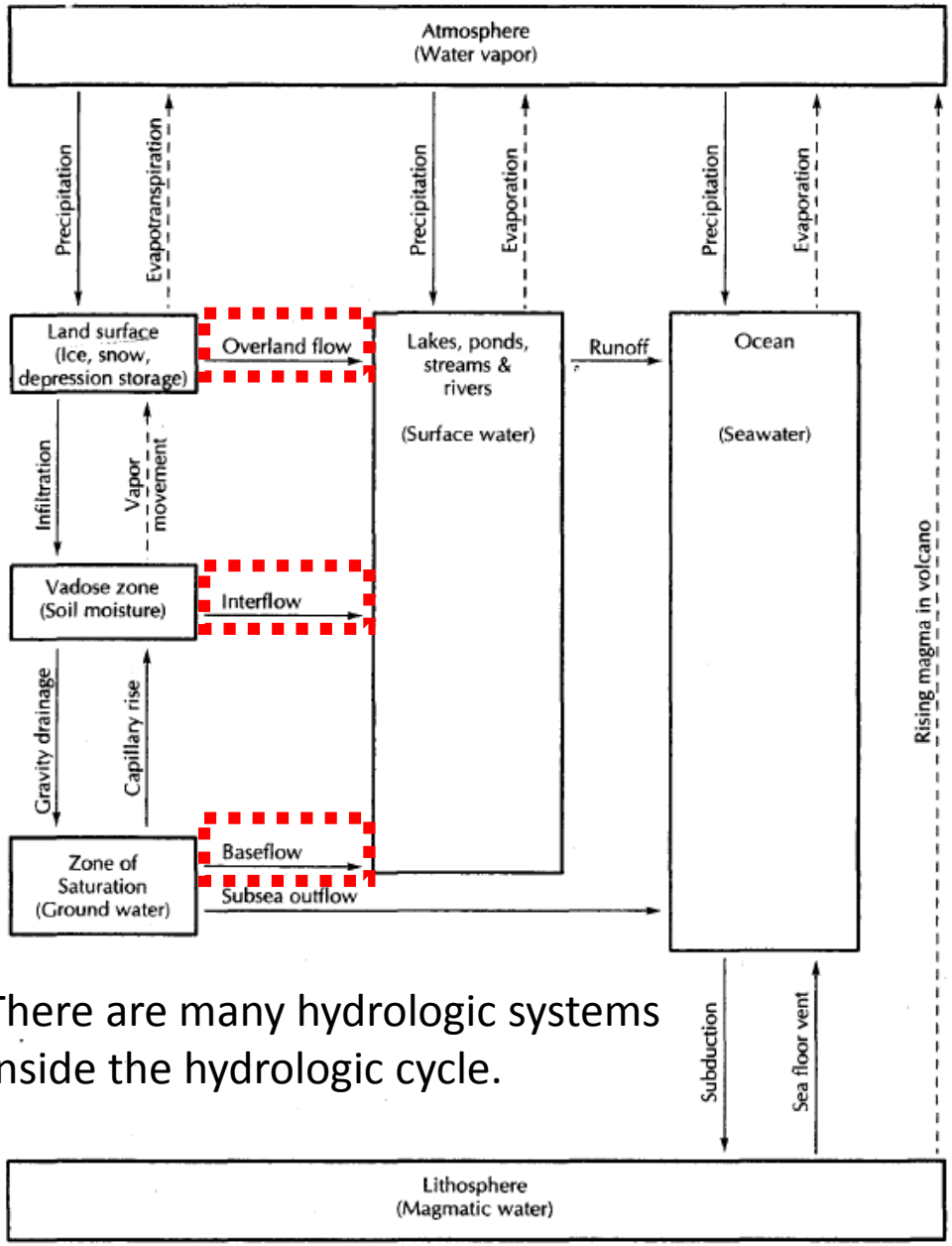
1) Arithmetic mean method: Only the gauges inside the basin boundary is used.

2) Isohyetal method: Draw lines of equal ppt (isohyets) on the drainage basin map. Use linear interpolation.

Isohyets never cross
never split
never meet

3) Thiessen polygons

a) Connect adjacent rain gauges
b) Mark perpendicular bisectors
c) Connect adjacent bisector lines



▲ FIGURE 1.4
Schematic drawing of the hydrologic cycle. Movement of liquid water is shown by a solid line and movement of water vapor is shown by a dashed line.

There are many hydrologic systems inside the hydrologic cycle.

Movement of liquid water →

Movement of water vapor ⇢

Hydrologic equation (law of mass conservation):

Inflow= outflow ± changes in storage