

## Week 1

Hydrology and Hydrogeology are earth sciences. It encompasses the occurrence, distribution, movement, and properties of the waters of the earth and their environmental relations.

### Hydrologic Cycle

The hydrologic cycle is a global-scale process that continuously circles water in gas, liquid, and solid phases among the atmosphere, continents, and oceans. Solar energy and gravity along with other forces drive the hydrologic cycles. Components of the hydrologic cycle include precipitation, evaporation, transpiration, infiltration, surface runoff, ground-water flow, baseflow, river flow, ocean circulation, and global air circulation.

### Water Budgets

$$\text{input} - \text{output} = \text{change} \in \text{storage}$$

A water budget within a system can be described as a form of mass conservation:

interconnections and components of the global hydrologic cycles: atmosphere, surface, soil, ground water, lithosphere, streams, and oceans.

interconnections and components of the basin hydrologic cycles: surface, soil, ground water, and streams.

### Major Hydrologic Processes

#### Precipitation

Precipitation is the primary input parameter of the hydrologic cycle.

1. Convective
2. Orographic
3. Cyclonic

#### ***Characteristics of rainfall events***

1. Intensity (mm/hour)
2. Rainfall duration
3. Temporal distribution of rainfall
4. Spatial distribution
5. Frequency of storms events

### Evaporation

Evaporation is the change of the state of water from liquid to vapor as a result of heat addition.

Evaporation from a body of water occurs only if the surrounding air is not completely saturated with water vapor, that is, if the relative humidity is less than 100 percent.

### **Transpiration**

1. Transpiration is the transfer of soil moisture from the soil to the atmosphere by the action of vegetation. Plants transpire water vapor through their foliage.

2. Transpiration has minimal effect on individual storms and is usually only taken into account in long-term hydrologic budgets.

3. Evaporation and transpiration are commonly lumped in one variable called evapotranspiration.

4. Evapotranspiration can be measured by means of lysimeters. A lysimeter is a tank of soil which vegetation is planted. The setup in the tank resembles the surrounding ground cover. ET is calculated based on the water balance amount input and output components (precipitation, drainage, changes in soil moisture).

### **Interception**

1. A portion of the rainfall is intercepted by plant foliage, buildings, and other objects. This water is not available for runoff.

2. Interception typically removes about 0.55 mm during a single storm event. Values as high as 1.5 mm have been reported.

3. The amount of precipitation captured by vegetation and trees is determined by comparing the precipitation in gages beneath the vegetation with that recorded nearby under the open sky.

### **Streamflow**

A streamflow hydrograph describes the discharge (or flow rate) of the river over time at a location. It consists of surface runoff and ground-water baseflow.

### **Overland flow**

The runoff from rainfall partitioning flows on the ground.

### **Unsaturated Flow**

The moisture in the unsaturated zone from rainfall-induced infiltration moves in response to the hydraulic gradient.

### **Groundwater Flow**

The water in the saturated zone flows in response to the hydraulic gradient (pressure and gravitation).

### **Contaminant Transport and Geochemical Reactions**

Sediments and chemical species travel along with the water flow in the surface and subsurface. Geochemical reactions occur on the water flow paths (e.g., water-rock or water sediments interaction, mixing of water from different sources).

### **Introduction to Numerical Modeling and Prediction**

1. Hydrological simulation
2. Conceptualization, mathematical models, and model development
3. Data preparation
4. Model calibration
5. Prediction

### **Introduction to Fortran Programming**

1. Source code
2. Compile program and generate executable file
3. Process input files and run the program
4. Process output files