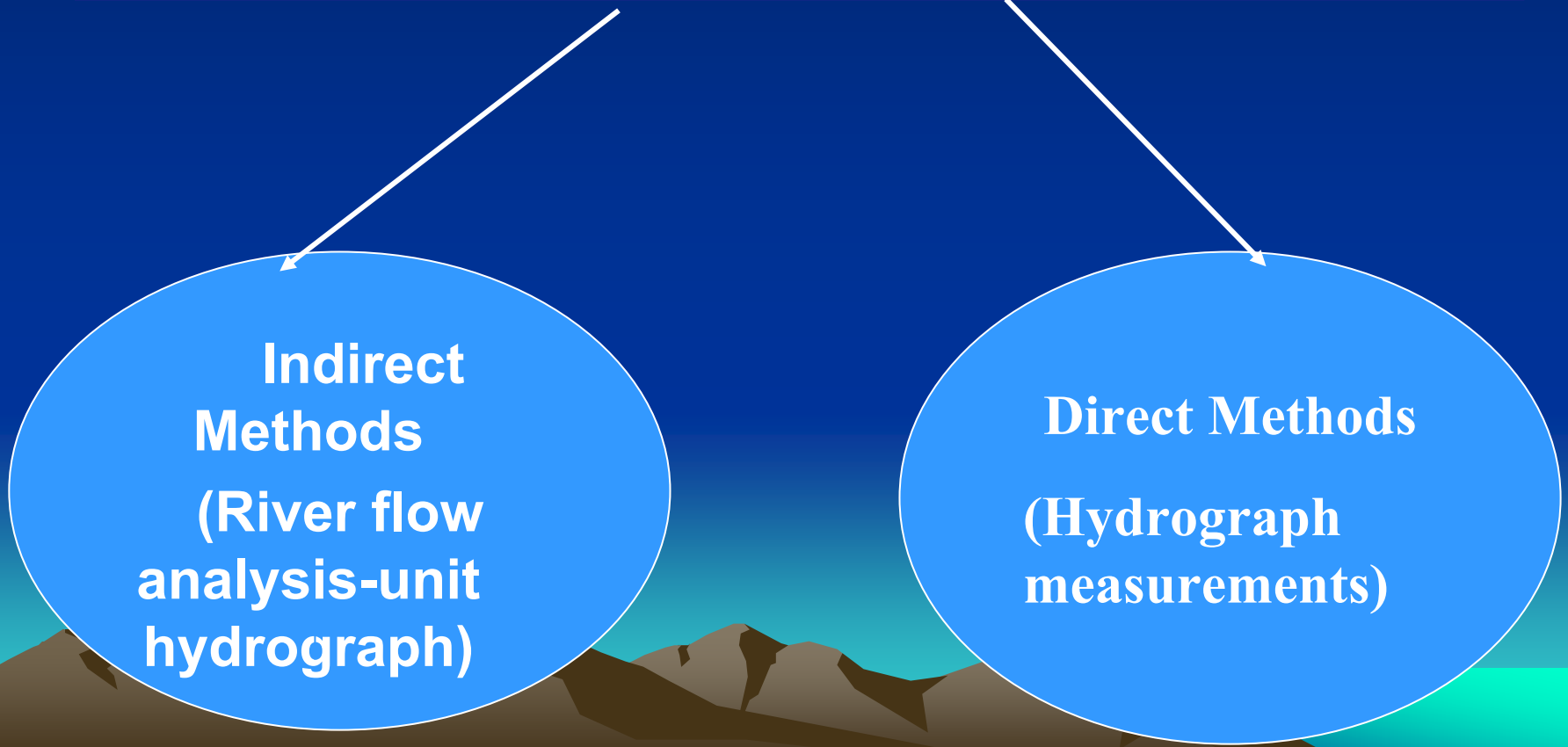
Rainfall runoff relationship

Catchment Yield estimation



Rainfall runoff relationship

- Rainfall is the primary source of water for runoff generation over the land surface.
- Type of Runoff
  - surface runoff
  - subsurface runoff
  - Base flow

Rainfall runoff relationship

- Surface the runoff: it is that portion of rainfall, which enters the stream immediately after the rainfall.
- Subsurface runoff: that part of rainfall, which first leaches into the soil and moves laterally without joining the water table, to the streams, rivers, sea or wadis.
- Base flow: it is delayed flow, defined as that part of rainfall, which after falling on the ground surface, infiltrate into the soil and meets to the water table.

Total Runoff= surface runoff + base flow (including subsurface runoff)

Rainfall runoff relationship

- **Factors affecting runoff:** The runoff rate and its volume from an area, mainly influenced by following two factors:
  - climatic factors,
  - physiographic factors.

Rainfall runoff relationship

Factors affecting runoff
Climatic factors

- climatic factors:
  - type of precipitation
  - rainfall intensity
  - form of precipitation
  - duration of rainfall
  - rainfall distribution
  - direction of the prevailing wind

Rainfall runoff relationship

Factors affecting runoff

Climatic factors

- **Type of precipitation**
  - a precipitation which occurs in form of rainfall, starts immediately in form of surface flow over the land surface, while a precipitation which take place in form of snow or hails, the flow of water on ground surface will not take place immediately, but after melting of the same.

Rainfall runoff relationship

Factors affecting runoff

Climatic factors

- **Rainfall intensity**
  - if rainfall intensity greater than infiltration rate of the soil, the surface runoff takes place very shortly, while in case of low intensity rainfall, there is fund a reverse trend to the same. Thus, high intensities rainfall yield higher runoff.

Rainfall runoff relationship

Factors affecting runoff

Climatic factors

- **Duration of rainfall**
  - rainfall duration is directly related to the volume of runoff, due to the fact, that infiltration rate of the soil goes on decreasing with the duration of rainfall, till it attains a constant rate.

Rainfall runoff relationship

Factors affecting runoff

Climatic factors

- **Rainfall distribution**
  - Runoff from a watershed depends very much on the distribution of rainfall, the rainfall distribution for this propose can be expressed by the term of distribution coefficient, which my be defined as the ratio of max. rainfall at appoint to the mean rainfall of the watershed. The greater value of the distribution coeff., grater the peak runoff.

Rainfall runoff relationship

Factors affecting runoff

Climatic factors

- **direction of the prevailing wind**
  - if the direction of the prevailing wind is same, as the drainage system then it has a great influence on the resulting peak flow and also on duration of surface flow, to reach the outlet. A storm moving in the direction of stream slope, produces a higher peak in shorter period of time, than the storm moving in opposite direction

Rainfall runoff relationship

Factors affecting runoff

- **Physiographic factors:** the different characteristics of watershed and channel, which affect the runoff, are listed below:
  - size of watershed
  - shape of watershed
  - slope of watershed
  - orientation of watershed
  - land use
  - soil moisture
  - soil type
  - topographic characteristic
  - drainage density

Rainfall runoff relationship

- **Method of runoff computation**
  - rational method
  - SCS method
  - cook's method

Runoff Hydrograph

- Hydrograph is a graphical or tabular representation of instantaneous runoff/discharge rate against time.
- A hydrograph represents the total runoff (direct + base flow), occurring at a given time. It also shows the time distribution of total runoff at a certain point of measurements. All hydrographs have three characteristics region viz. rising limb, crest segment or peak point and falling limb.

Runoff Hydrograph

- **Components of Hydrograph**
  - Rising limb
  - Crest segment
  - Falling limb

Runoff Hydrograph

- **Factors affecting the shape of hydrograph:**
- ***Climatic factor***
- ***Physiographic factors***

Factors affecting the shape of hydrograph

Climatic factor

- type of precipitation,
- intensity of rainfall,
- duration of rainfall,
- direction of rainfall,
- Others

Runoff Hydrograph
Factors affecting the shape of hydrograph

Physiographic factors

- Basin characteristics (shape, size, slope, nature of the valley, elevation, land use pattern, soil characteristics of the basin)
- Channel characteristics (cross section of the channel, roughness of the channel, storage capacity, drainage density)

Runoff Hydrograph

- Base flow separation from hydrograph
- straight line method
- Method 11
- Method 111

Runoff Hydrograph (Unit Hydrograph)

- **Computation of runoff using unit hydrograph**
  - **If two identical rainfalls regarding their characteristics, take place on a drainage basin having the same conditions prior to the rainfall, the runoff hydrographs from the two storms would be expected to be the same.**
  - **Sherman, 1932 investigate the unit hydrograph theory, which is widely used for computing the flood or runoff volume for various purposes. Unit hydrograph is defined as the direct runoff hydrograph, produced by a rain of a unit duration, resulting the effective rainfall depth as 1 cm which is uniformly distributed, over the entire watershed area.**

Theoretical eq. for runoff est. for Yemen

- المعادلات النظرية لاحتساب الجريان السطحي (لليمن):

- **Jac A.M. van der Gun and others 1995.**

  R. O.= 0.055*P (mm).

  P= precipitation (mm)

- **Arnon 1972**

  R. O.= 0.6*P*S (mm).

  S=Slop

- **Runoff Coefficient Method**

  V=103C.P.A (m3).

  C=Runoff Coefficient

- **Flood Estimation**

  Q=C.I.A/3.6 (m3/s).

  I=Rainfall Intensity (mm/hr)

- **SCS Curve Number Method**

  F/S = Q/Pe

  F=Actual water retention (Pe-Q)
  S=Potential Maximum Retention
  Q=Actual Runoff

- Pe=Potential runoff