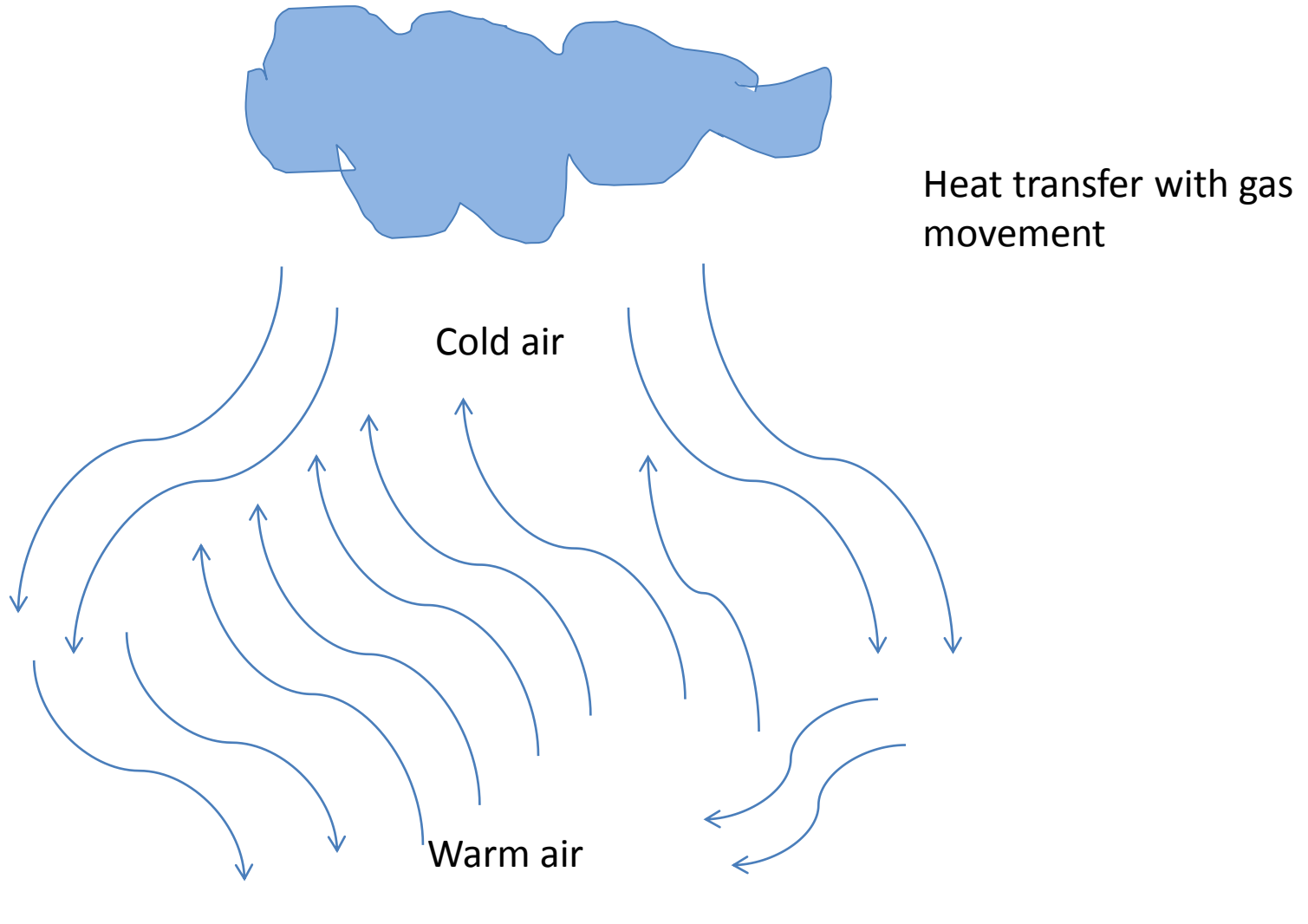# Precipitation

Hydrology 604212

Lifting mechanisms

- Since:
- $\rho_d > \rho_a$
- As temperature increases saturated vapor pressure increases
- From precipitable water calculation we established that moist air is near the surface
- Then the moist air mass should be lifted to the upper atmosphere in order for precipitation to occur

Lifting mechanisms

- Three main mechanisms
    1. Convective
    2. Orographic
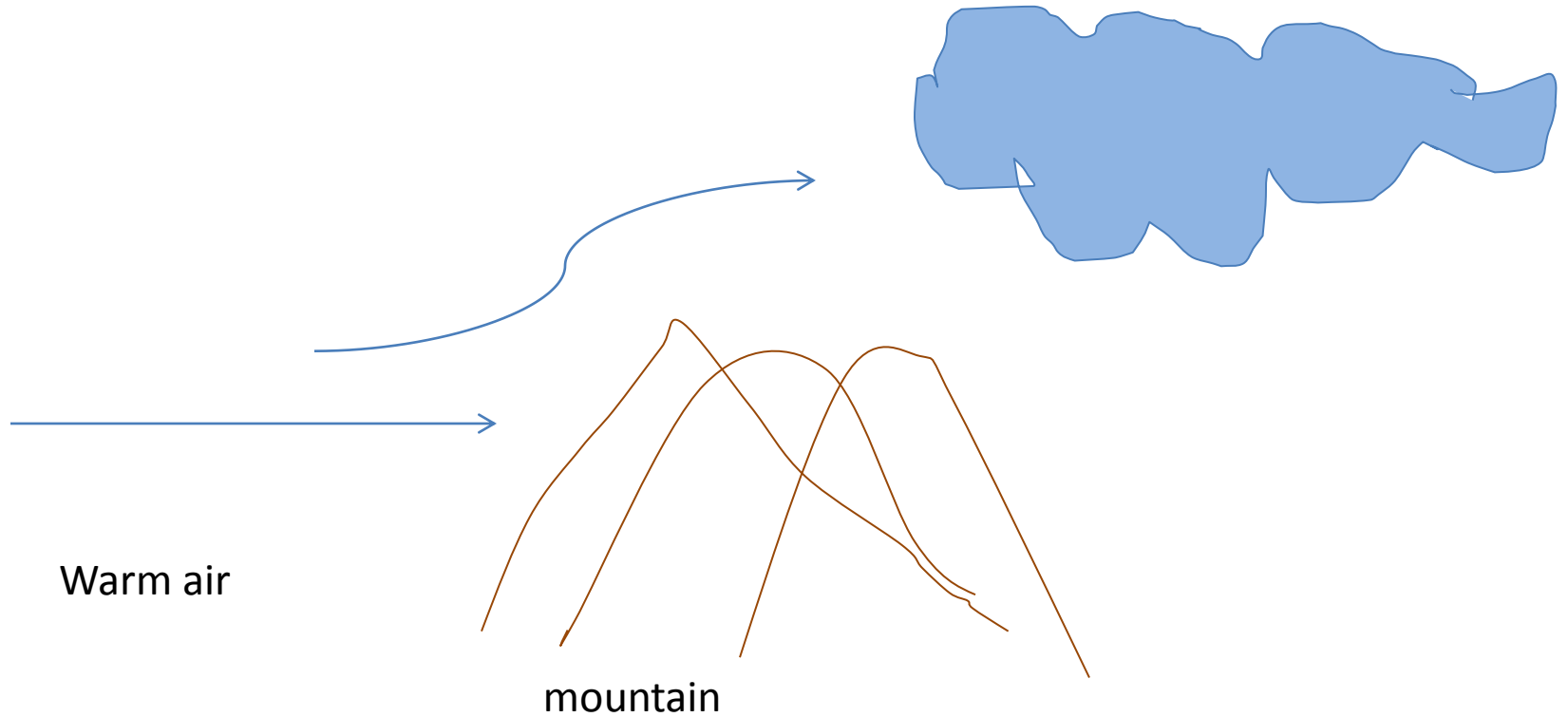   3. Frontal
        a. cold front
        b. warm front

Convective (thunderstorm)

Heat transfer with gas movement

Cold air

Warm air

Characteristics of Convective precipitation

- Intense
- Short duration
- Localized
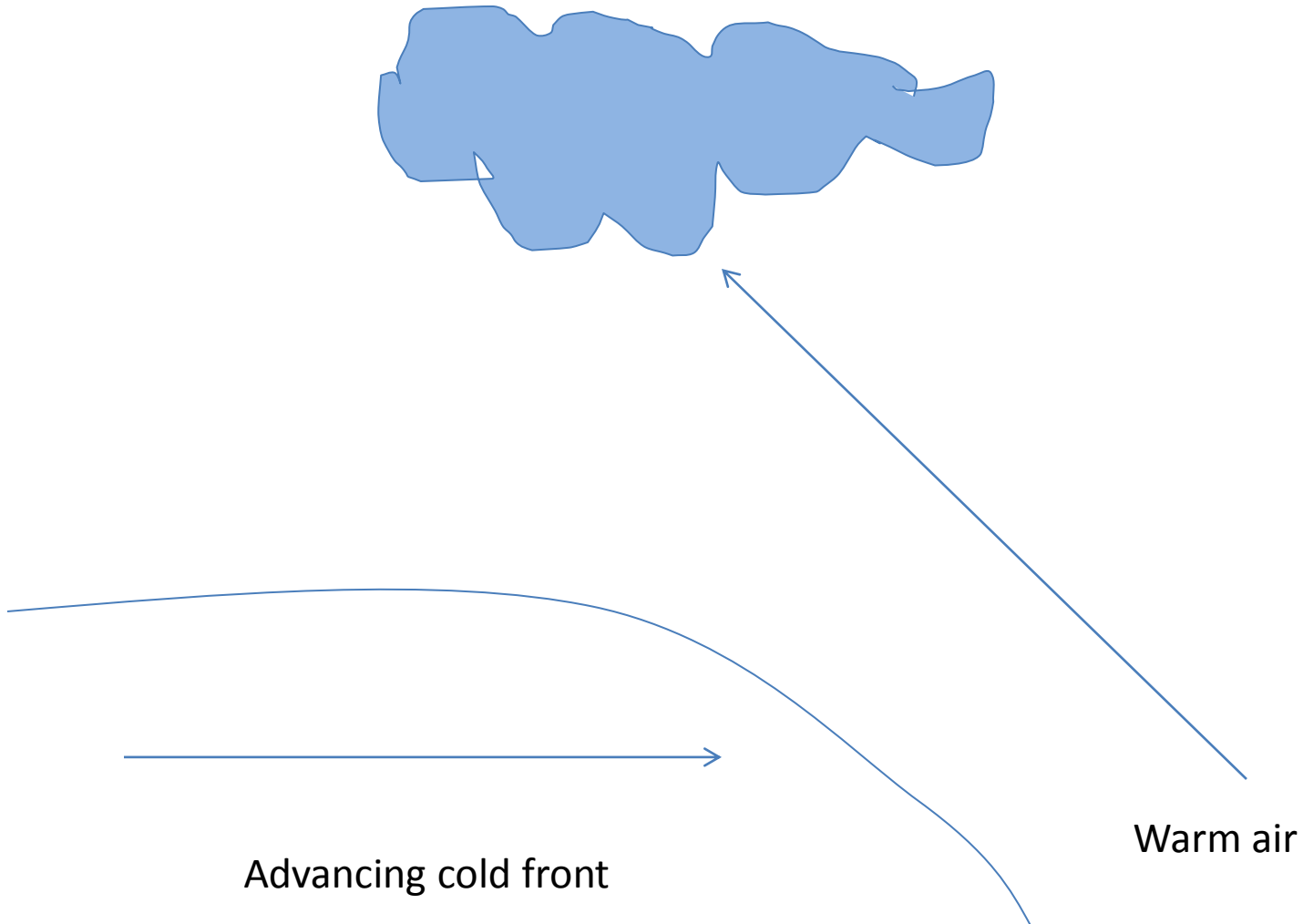- Occur during warmer months
- Occur in warm regions

Orographic lifting

Warm air

mountain

Characteristics of Orographic precipitation

- Intense
- Diminishes as moist air travels away form the mountain
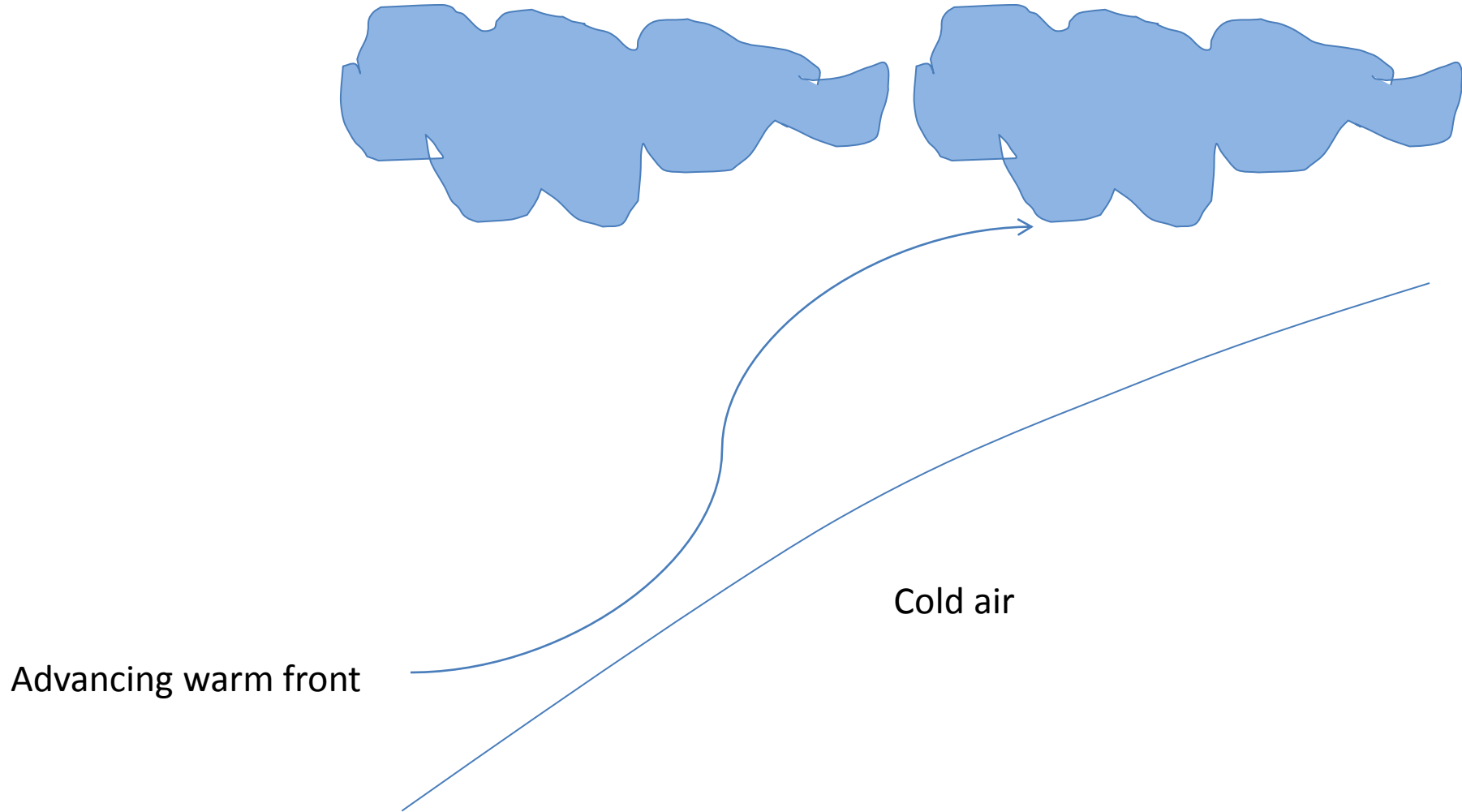
Frontal lifting – cold front

Advancing cold front

Warm air

Characteristics of precipitation resulting from cold front

- Intense
- Short duration
- Localized

Frontal lifting – warm front

Cold air

Advancing warm front

Characteristics of precipitation resulting from warm front

- Less intense than precipitation resulting from cold fronts or convective precipitation
- Covers more areas than the other types of precipitation

Rainfall variability

- Rainfall varies in space (spatially) and time (temporally).

- Spatial ➔ different depths at different location ➔ Areal average
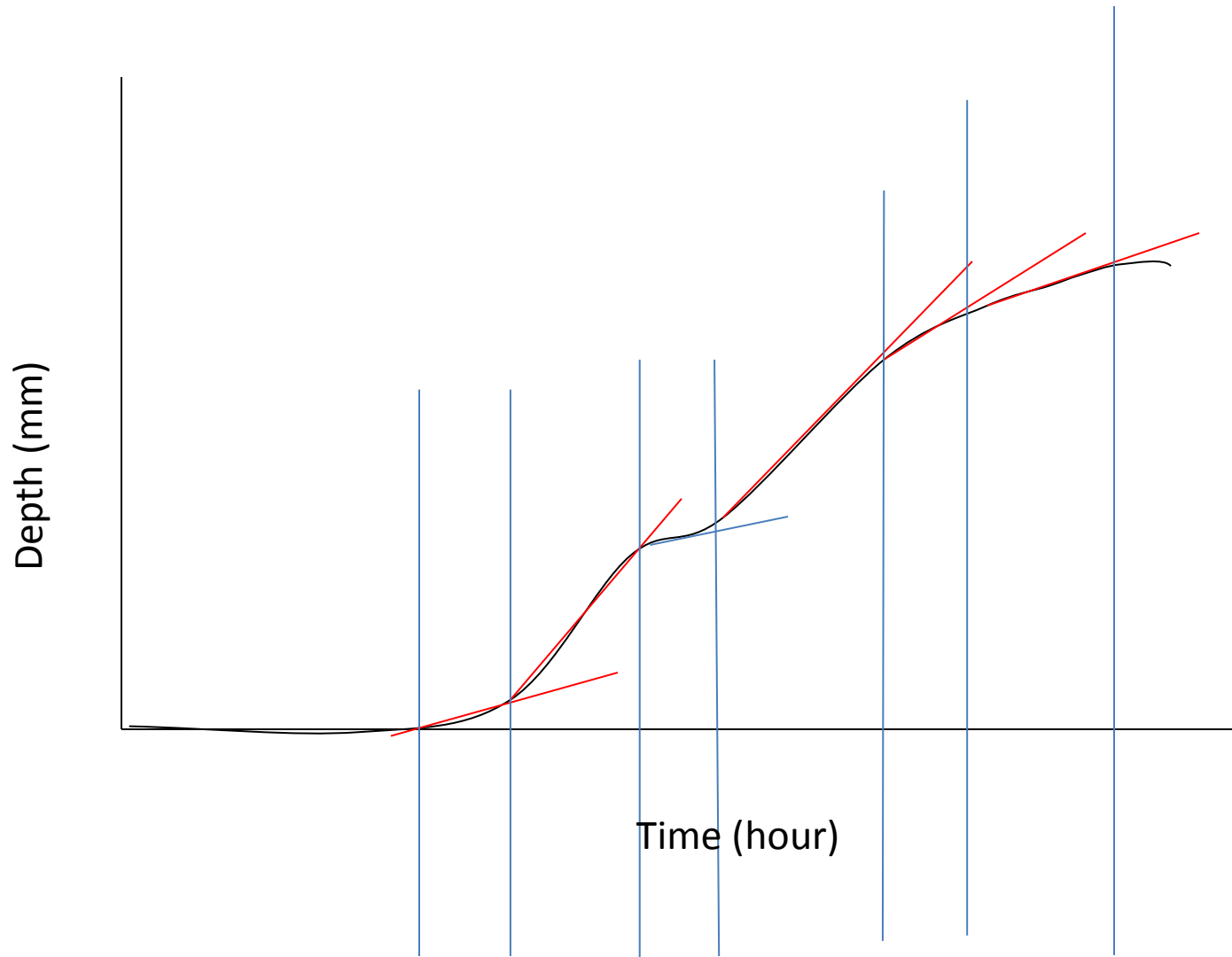- Temporal ➔ rainfall intensity is not constant

Measurements

- Gages
  - Non- recording gage
  - Recording gage
    - Float
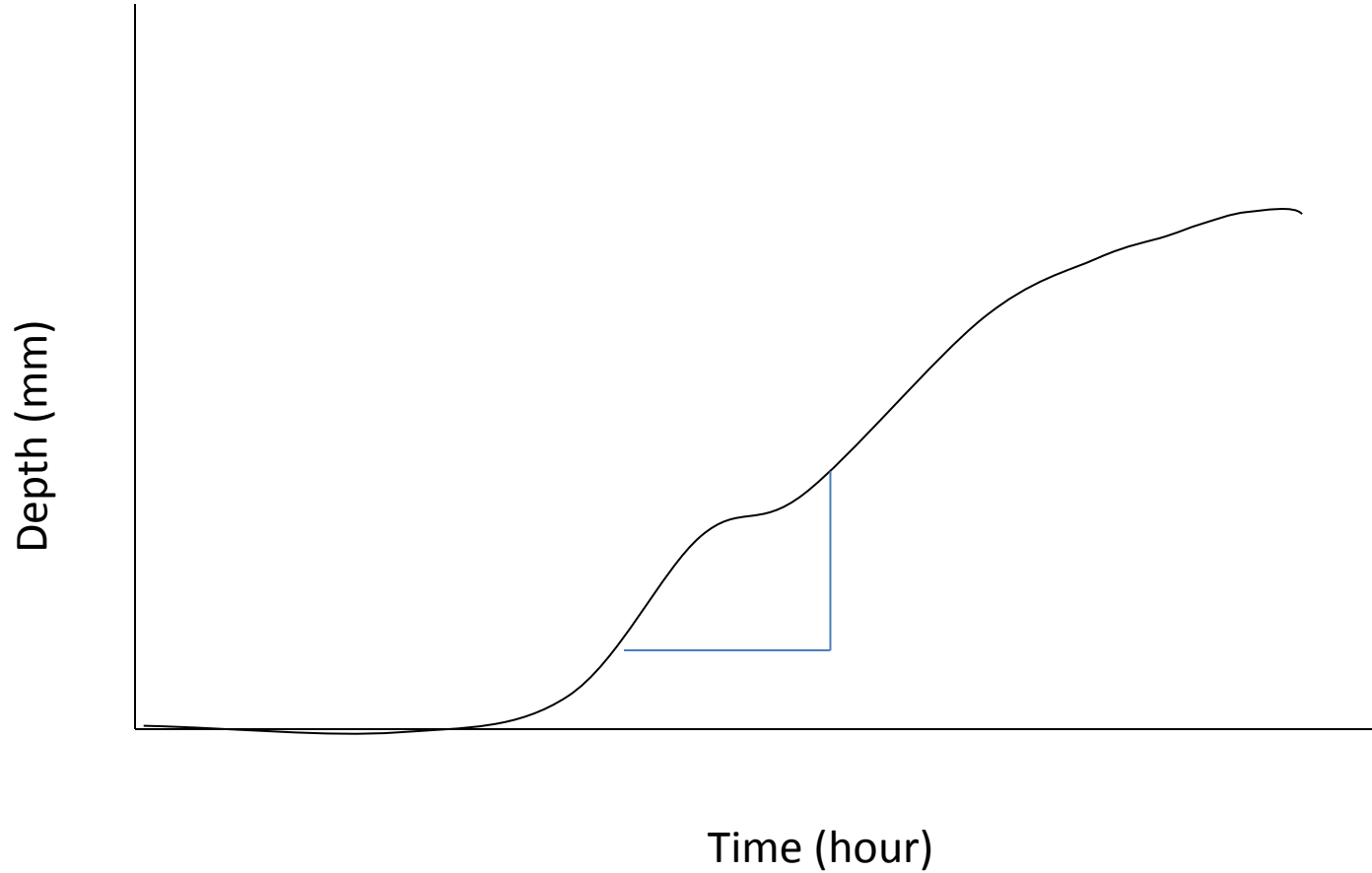   - Balance
    - Tipping bucket
- Rader

How to plot rainfall

- Hyetograph is a histogram of rainfall depth as a function of time.

- Rainfall mass curve is a plot of cumulative rainfall as a function of time
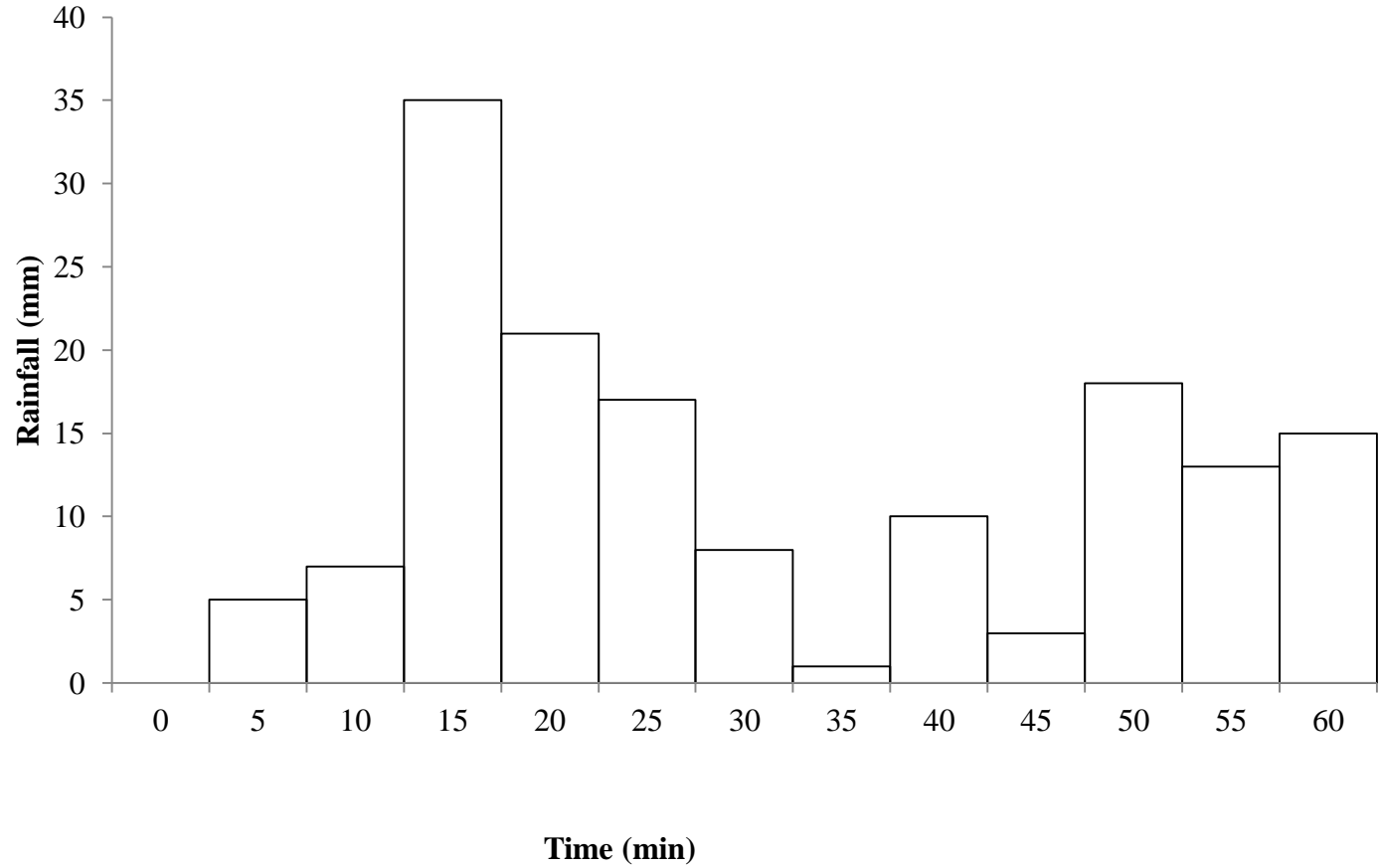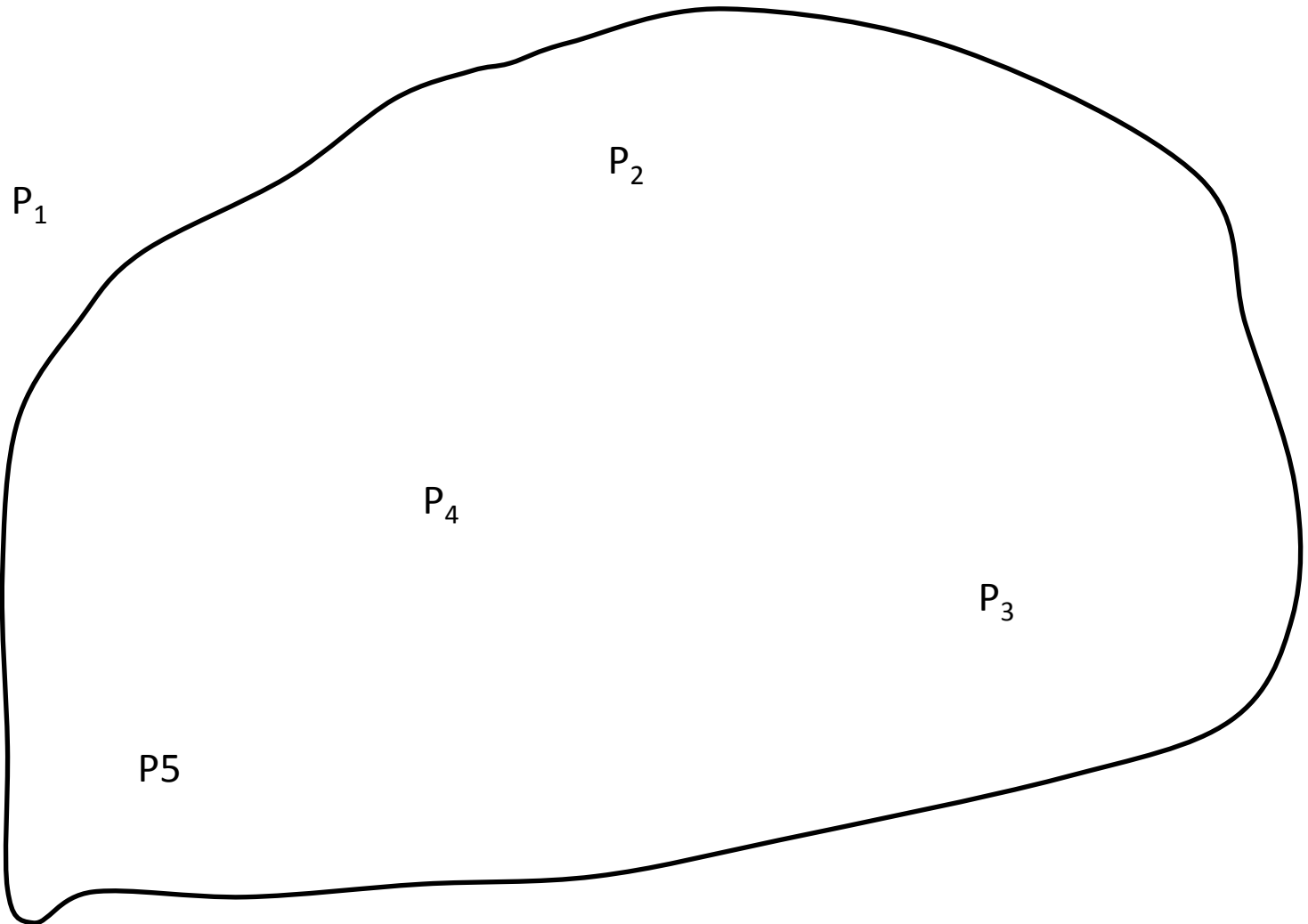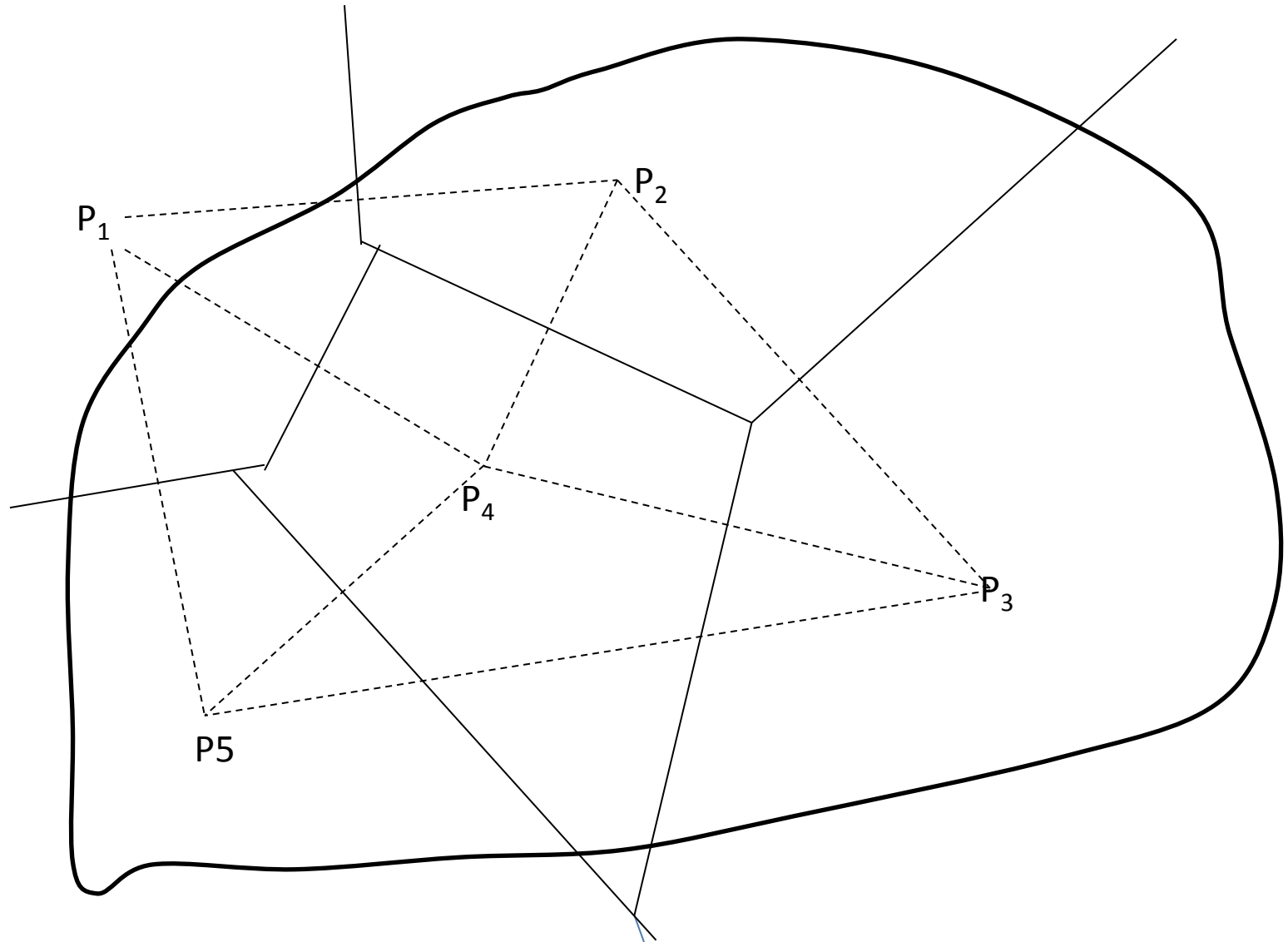
Rainfall intensity

Rainfall intensity
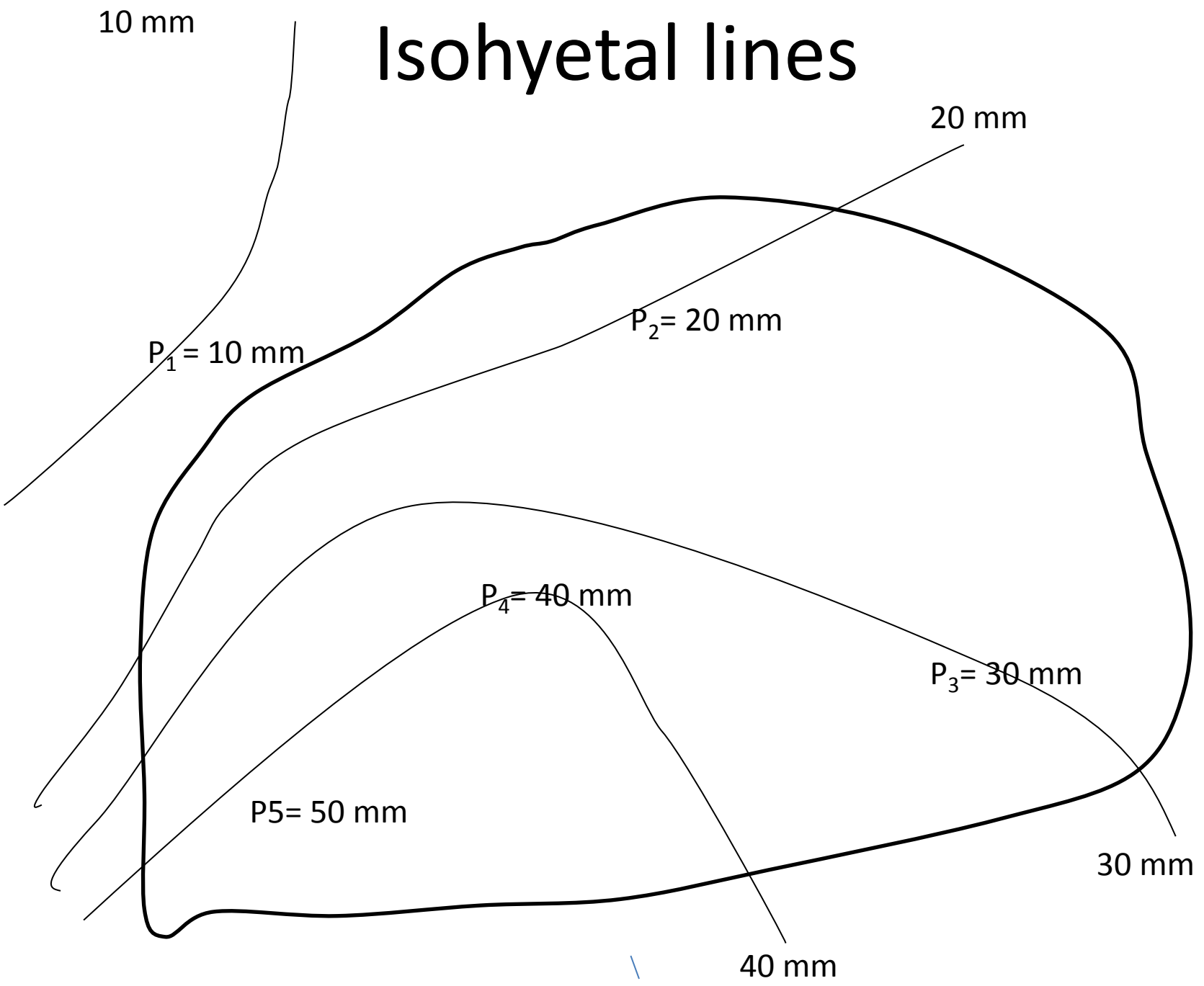
Hyetograph

Precipitation

Thiessen polygons

Thiessen polygons

- Each polygon is represented by one rainfall gage
- Determine the area for each polygon
- Then:
- $\bar{P} = \sum_{n=1}^{N} A_n \times P_n$

Isohyetal lines

10 mm

20 mm

P_1 = 10 mm

P_2= 20 mm

P_4= 40 mm

P_3= 30 mm

P5= 50 mm

30 mm

40 mm

Isohyetal lines

- Determine the area enclosed between any two Isohyetal lines

- The corresponding rainfall is the average of the two rainfall depths of the Isohyetal lines

- Multiply the area with average rainfall to get the volume between any two isohyetal lines

- Sum all the volumes and divide by the total area of the watershed.

Missing values – Inverse distance squared method

23 mm

P_1

15 mm

P_2

P_3 P_4 = ?

11 mm
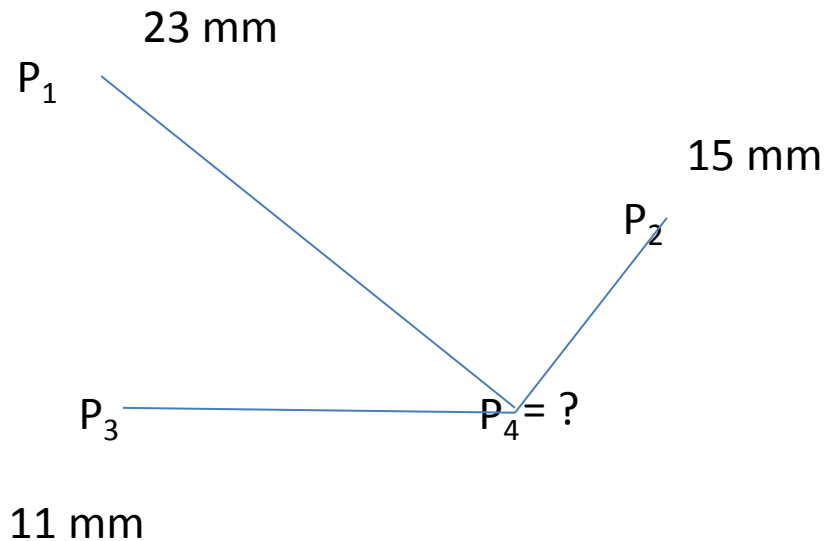
P	D	$1/D^2$	W	WxP
23	2.8	0.13	0.13	3.02
15	1.3	0.59	0.61	9.16
11	2.0	0.25	0.26	2.8
Sum		0.97	1.00	**15.02**