Hydroinformatics

Measurement, Sampling and Data Collection of Hydro climatological Data

Hydroclimatic Data

- Hydrological Data
  - Rainfall
  - Streamflow
  - Soil Moisture
  - Ground Water Depth
- Water Quality Data
  - Physical, Chemical and Biological parameters, pollution data
- Climate Data
  - Air temperature, wind speed, humidity, etc.

More about Hydroclimatic Data

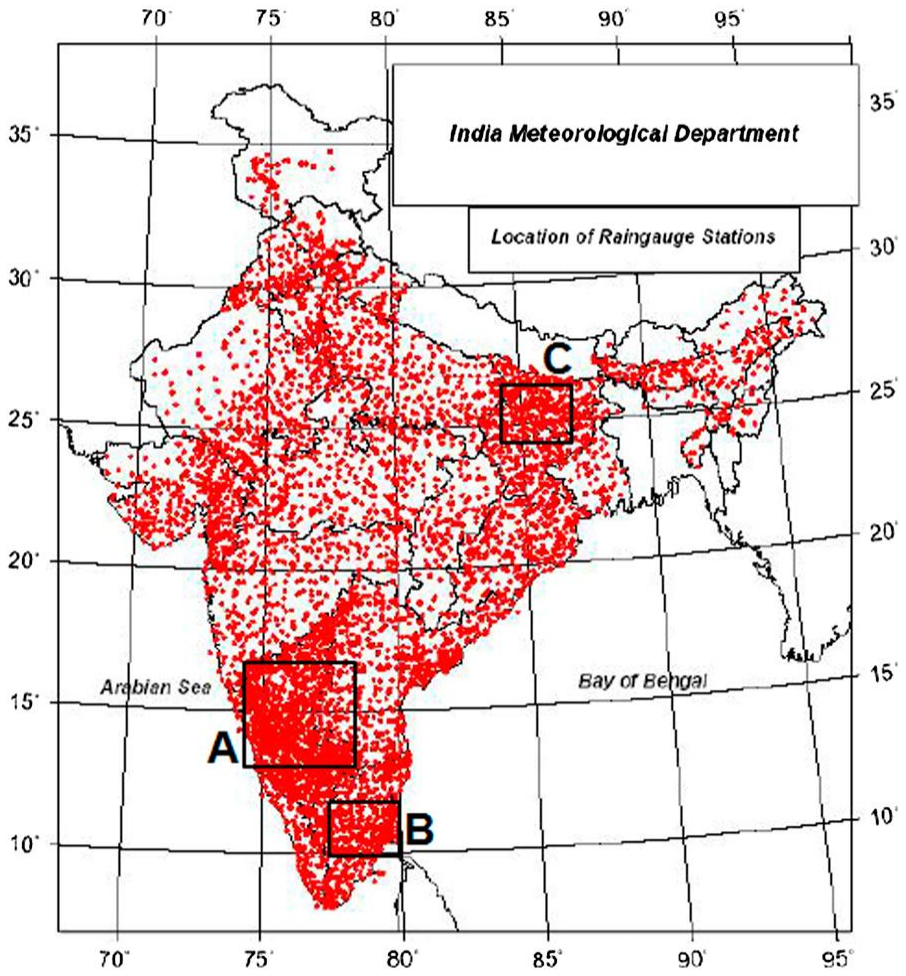
- Types of data
  - Spatial resolution
  - Temporal variability
- Dimension of data
  - 1D, 2D, 3D, 4D
- Point and gridded data
- Vector, Raster and Image data

Hydroclimatic Data Storage

- Meteorological, hydrological, climatological, experiment and simulation data sets
- Data storage file formats and standards
- Web based data and access using web services
- Integration of data (e.g. hydro-climate)
- Various forms of data (e.g. grd, NetCDF)
  - Scalar data values on a regular rectangular grid, either in (x, y) or (longitude, latitude) space.
  - NetCDF (Network Common Data Form) for array-oriented scientifics geo-gridded data sets

Rainfall Data

- Rainfall data is highly important data for irrigation, hydrologic, water resources management.
- Rainfall is recorded as observational data through rainfall station networks.
- Rainfall records are often incomplete because of missing rainfall data in the measured period or insufficient stations in the study region.
- Climate model data sets are widely used for assessing the responses of climate systems under global warming and climate change.
- **Climate models provide rainfall data at a spatial resolution** (above km) that is too coarse to be directly used in local or regional studies.
- Finer resolution rainfall data can be estimated through spatial interpolation techniques



Location of IMD rain gauges used for the preparation of the gridded dataset (Rajeevan and Bhate 2009). Boxes A, B, and C are the subregions having dense networks of rain gauges

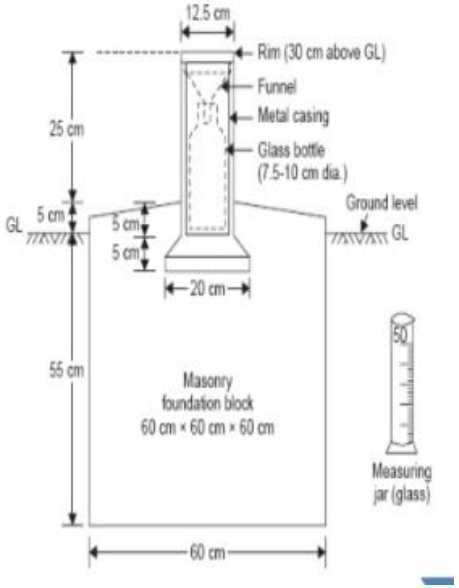
Rainfall/Precipitation

- Represents all forms of water that may reach the earth from the atmosphere
- Forms: Rainfall, snowfall, hail, frost, and dew
- General form: Rainfall
- Study of Precipitation – Hydrometerology
- Rain: Form of precipitation, with water drop size > 0.5 mm

Type	Intensity
Light Rain	Trace to 2.5 mm/h
Moderate Rain	2.5 mm/h to 7.5 mm/h
Heavy Rain	> 7.5 mm/h

Rain gauges

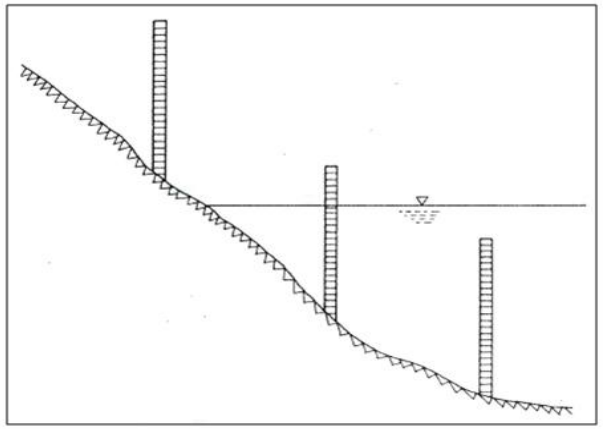
Symon's gauge

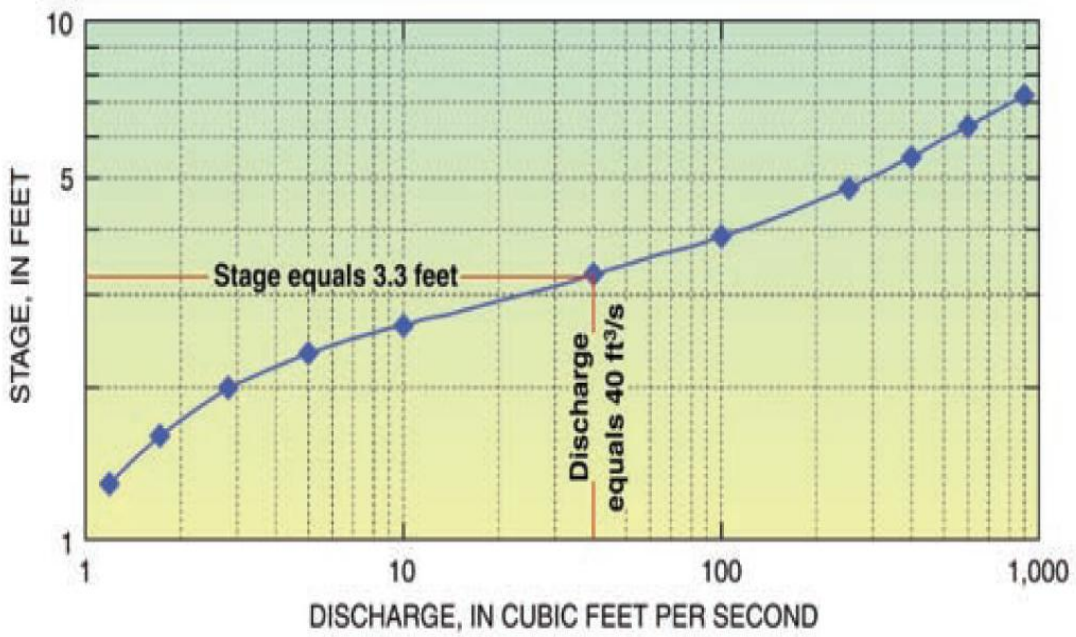


- Rainfall is measured everyday at 8.30 AM and is recorded as the rainfall of that day
- Receiving bottle normally can hold up to 10 cm, in case of heavy rainfall, measurement must be done more frequently and entered.
- Total rainfall of a particular day: sum of past 24 hrs
- Rain gauges can be used to measure the snowfall. The funnel and receiving bottle are removed and snow is allowed to collect in the outer metal container. The melted snow and the resulting depth is measured.

Streamflow/Runoff

- The first step in calculating streamflow involves measuring stage, which is the height of the water surface at a particular point in a stream or river. Stage is sometimes known as gauge height.
- Stream flow is measured in units of discharge (m^3/s)
- discharge is estimated by using the previously determined stage-discharge relationship





More on Streamflow

- The stage-discharge relation depends on the shape, size, slope, and roughness of the channel at each gage and is different for every stream gage.

- A rating curve often changes after a flood when the physical force of high-water movement can change the dimensions of the streambed or stream channel.
- To keep the rating curve accurate and up-to-date, hydrologic technicians visit each stream gage about once every 6 weeks to measure the flow directly and also measure high flows when they happen.

Manning's Equation

$$V = \frac{R^{2/3} S^{1/2}}{n}$$

Where

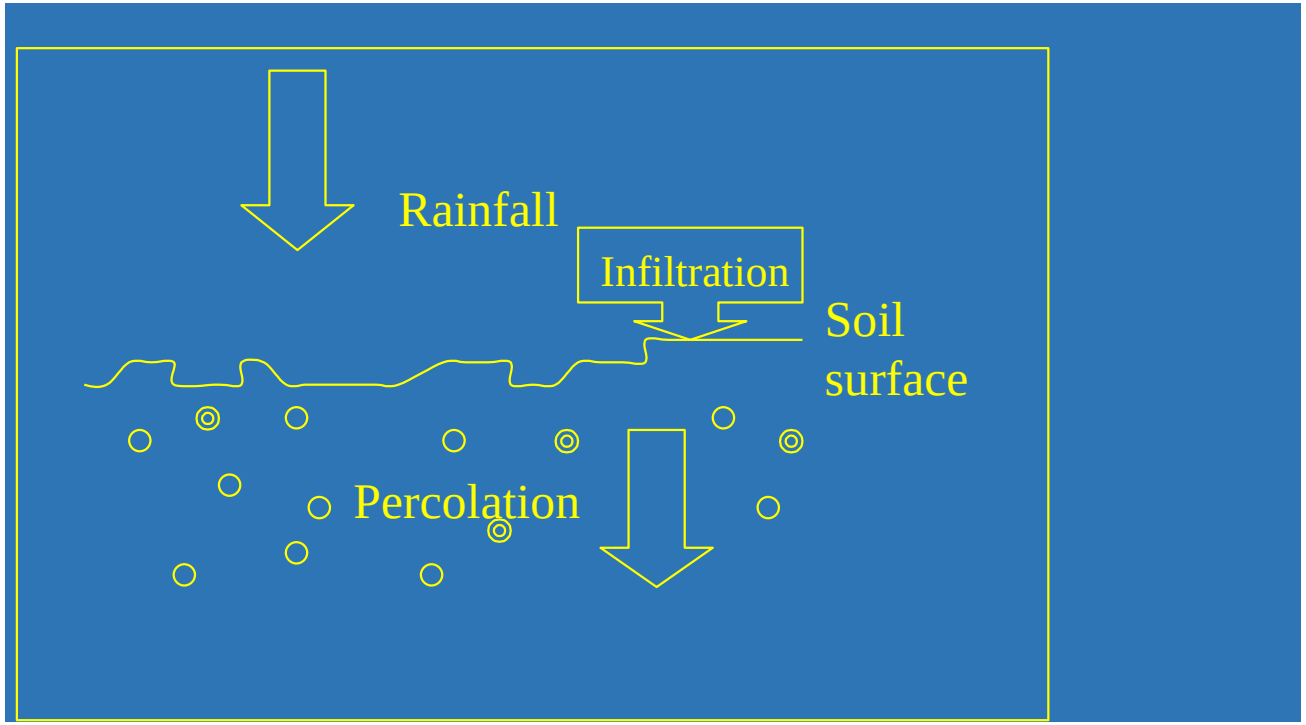
v = average flow velocity
r = hydraulic radius
s = channel slope (unitless)
n = Manning roughness coefficient

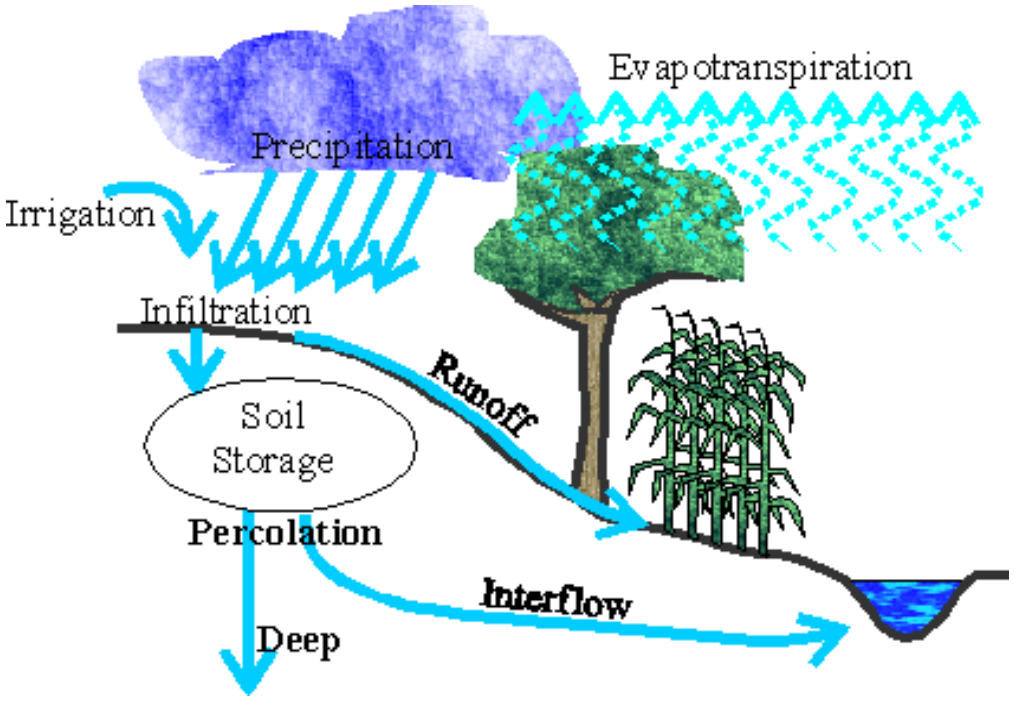
R = A/P

A = Area

P = Wetted Perimeter

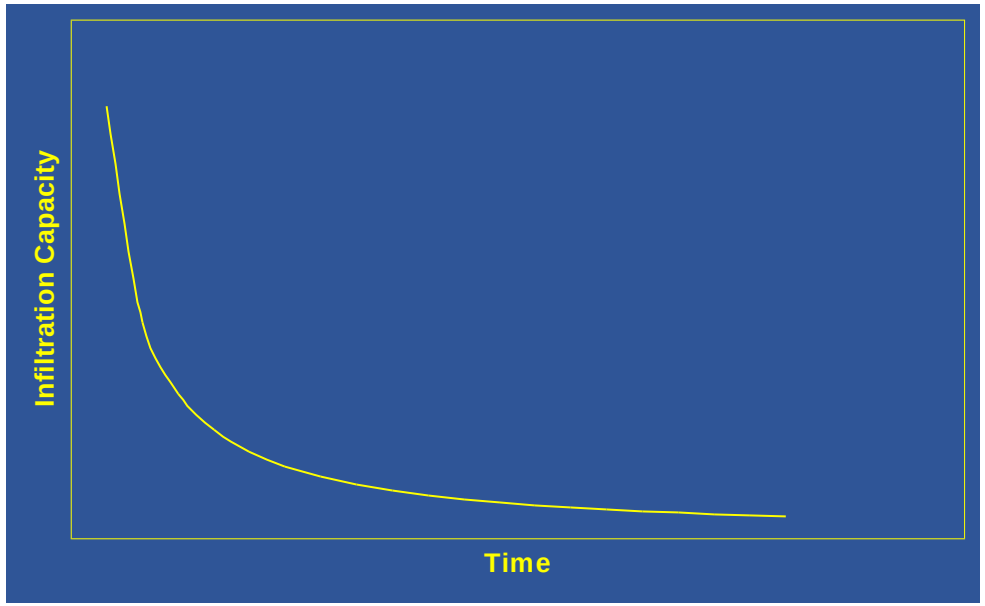
Infiltration





Infiltrometers

- ✓ Volume of water added during different time intervals will be noted
- ✓ A plot of infiltration capacity vs time can be obtained (cm/hr)
- ✓ Experiment will be continued till a uniform rate of infiltration is obtained (take 2-3 hrs)



Pan Evaporimeters

- From open water bodies will be measured.
- Evaporation of water from small pans filled with water is measured
- Assumption: evaporation from lake and pan are closely related
- Measurement must take account of evaporation losses and also gains due to rainfall

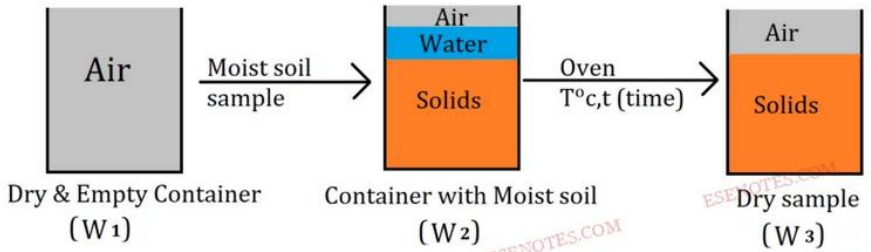
Fig. 5.1 U.S. Weather Bureau class A land pan.

SOIL MOISTURE MEASUREMENT

Oven drying method

Soil sample is collected in a moisture can and wet weight of the sample is recorded. The soil sample is dried in hot air oven at 105 °C until constant weight is obtained and dry weight of the sample is recorded.

$$\text{Moisture content (on weight basis)} = \frac{\text{Wet weight-Dry weight X 100}}{\text{Dry weight}}$$



Weight of air is neglected.

Weight of water = W_2-W_3.

Weight of solids = W_3-W_1.

$$w = \frac{Weight\ of\ water(Ww)}{Weight\ of\ solids\ (Ws)} = \frac{W2-W3}{W3-W1} \times 100$$

Basic Questions

- Why estimate?
- Why not just measure the value at all locations?

- Predictions are required because time and money are limiting.
- There is an infinite number of potential sampling locations for any continuous variable in any study area, and it is impossible to measure at all locations.
- While there is a finite number of discrete objects in all studies, there are usually too many to measure them all.
- Besides cost, some areas may be difficult or impossible to visit or it may be unsafe to collect data in a desired location.
- For example, it may be too dangerous to collect soil samples in part of a region because lions may eat the sampling crew, or elephants trample them.

Hydroclimatic DATA Availability

- Observed/Predictand Data
  - Source: IMD, CWC etc.

- Observed Climate Data/Predictors Data
  - Source: NCEP/NCAR Reanalysis data

- GCM Current and Future Predictors Climate Data
  - Source: Different GCMs – About 23 Climate Modeling Centres
    - ✓EX: Beijing Climate Center, Canadian Centre for Climate Modelling and Analysis, Meteorological Research Institute, NASA/GISS (Goddard Institute for Space Studies) USA

IIIT, HYDERABAD

Data Required

- Drought - Rainfall, Stream flow, Evapotranspiration, Soil moisture, etc.
- Flood: Rainfall, stream flow, water inundation depth
- Proxy data to validate Drought or flood ?

Class Task

- Collect Proxy data to represent or validate droughts and floods
- Deadline: Thursday (9th)
- Mode of Submission: Data collected, Explanation and presentation, supporting files