Climate Change And Its Implications (CCI)

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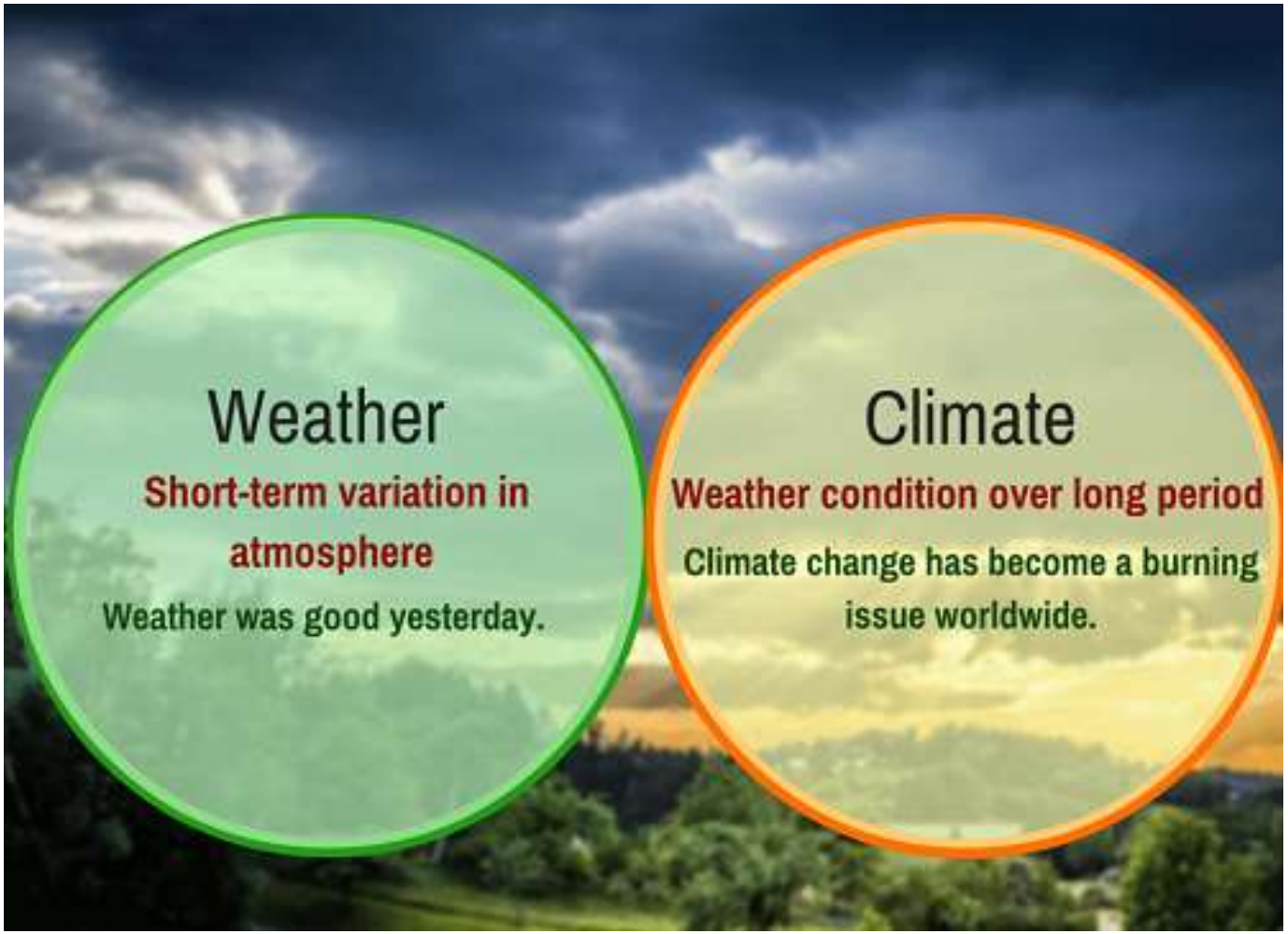
Lecture-3

Lecture-1&2

- Earth’s atmosphere
- Oceans
- Cryosphere
- Biosphere
- Earth’s crust and mantle

Class outline

- Introduction to weather & climate
- Weather parameters
- Measurements and analysis of weather parameters -interpretation


Weather
Short-term variation in atmosphere
Weather was good yesterday.
Climate
Weather condition over long period
Climate change has become a burning issue worldwide.

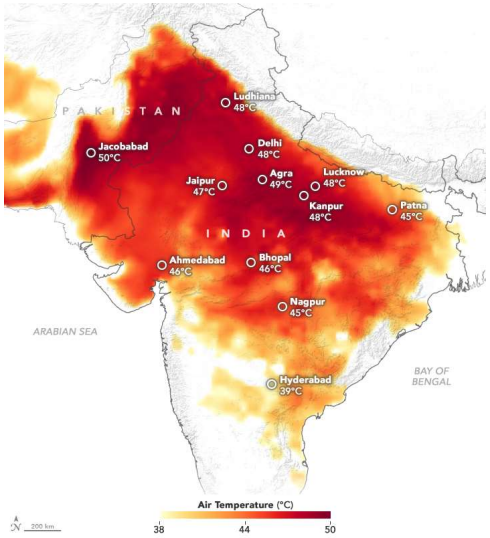
Weather & Climate

- Weather is the state of the atmosphere experienced at a given time
- It is defined by variables such as temperature, wind, rainfall, pressure, and other dynamical variables –Meteorology

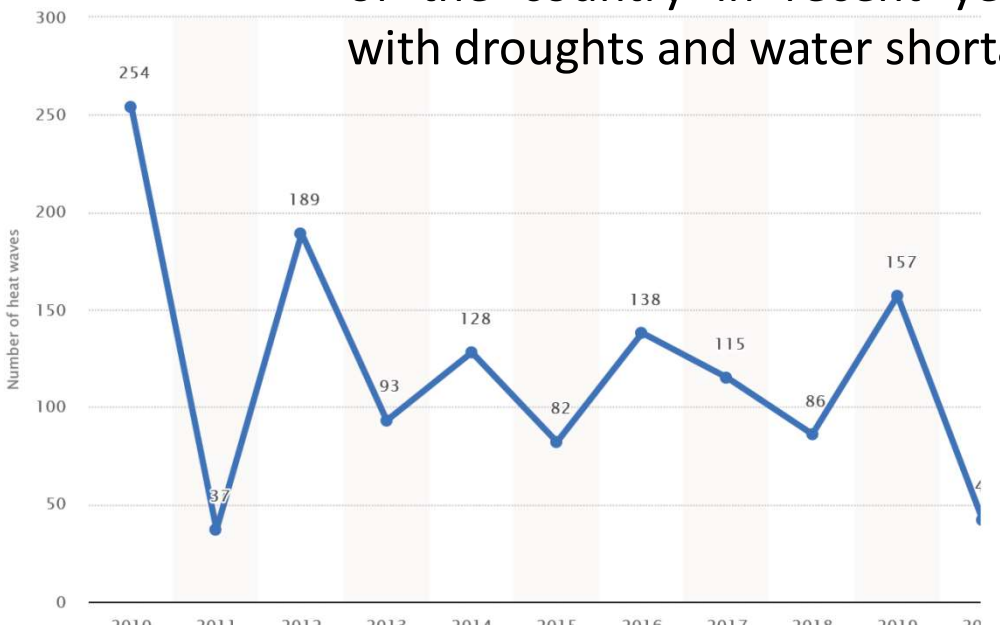
- Climate is the averages of weather elements obtained from their time series for a location or any region
- Climate refers to the monthly, seasonal or annual mean distributions of temperature, rainfall or any other weather parameter
- Any change in the incoming and outgoing radiations would affect its climate

Where do we use weather information?

Heat waves

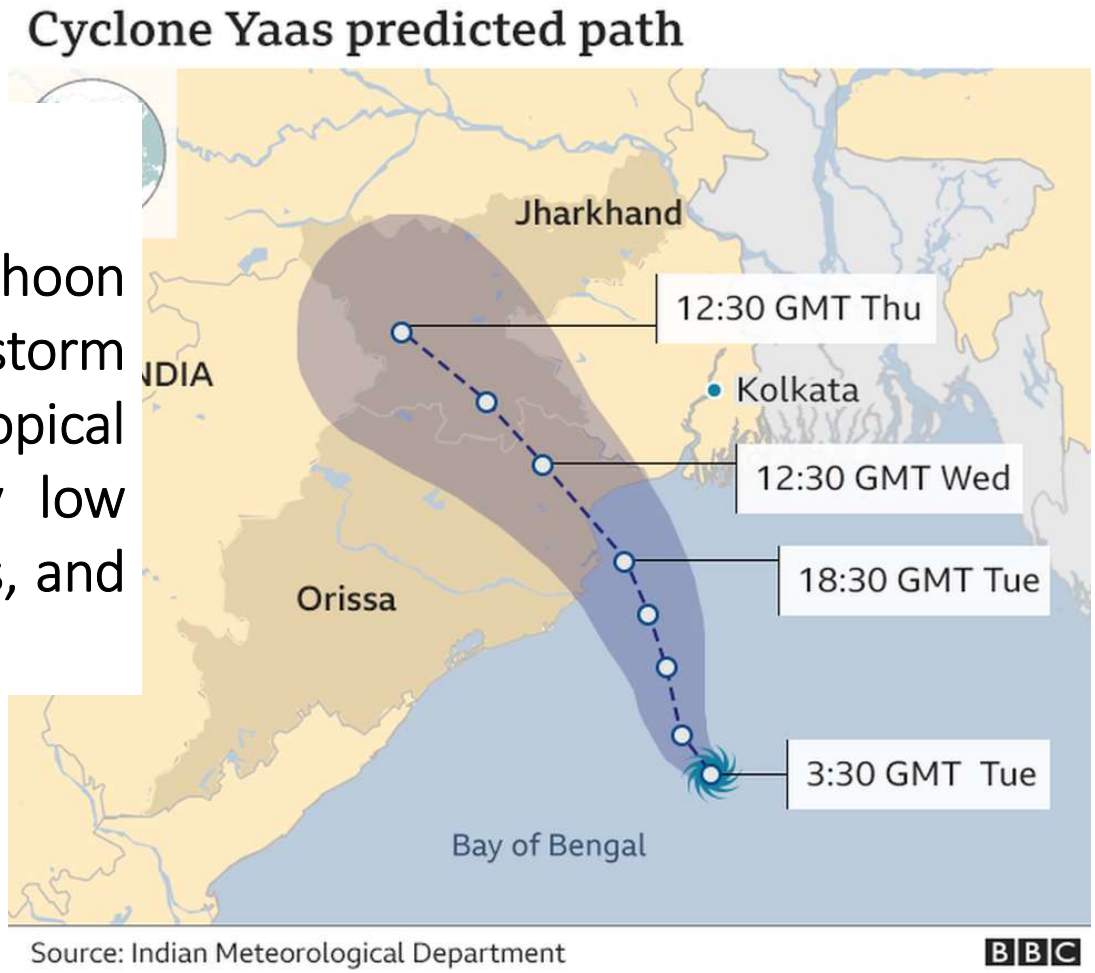


- Heat wave is considered if maximum temperature of a station reaches at least 40^0C or more for Plains and at least 30^0C or more for Hilly regions.
- About 42 heat wave days are reported in India in 2020
- These are more intense in northern regions of the country in recent years, coinciding with droughts and water shortage



Tropical cyclones

- Tropical cyclone, also called typhoon or hurricane, an intense circular storm that originates over warm tropical oceans and is characterized by low atmospheric pressure, high winds, and heavy rain



Extreme rainfall

Tornadoes

- A tornado is a narrow, violently rotating column of air that extends from a thunderstorm to the ground


USAF
DELTA

Weather Parameters

Temperature

- Maximum and minimum temperatures (most important for agriculture)
- Average temperature
- Diurnal temperature (Tmax-Tmin)

Measurements: Thermometers

Stevenson's screen

Satellite measurements

- Satellite measures the atmosphere in radiance (W/m^2), and then using mathematical and statistical equations, temperature is derived from this

INSAT-3D is a meteorological, data relay and satellite aided search and rescue satellite developed by the Indian Space Research Organisation (in 2013)

Precipitation

Hail

Sleet

Rain

Glaze

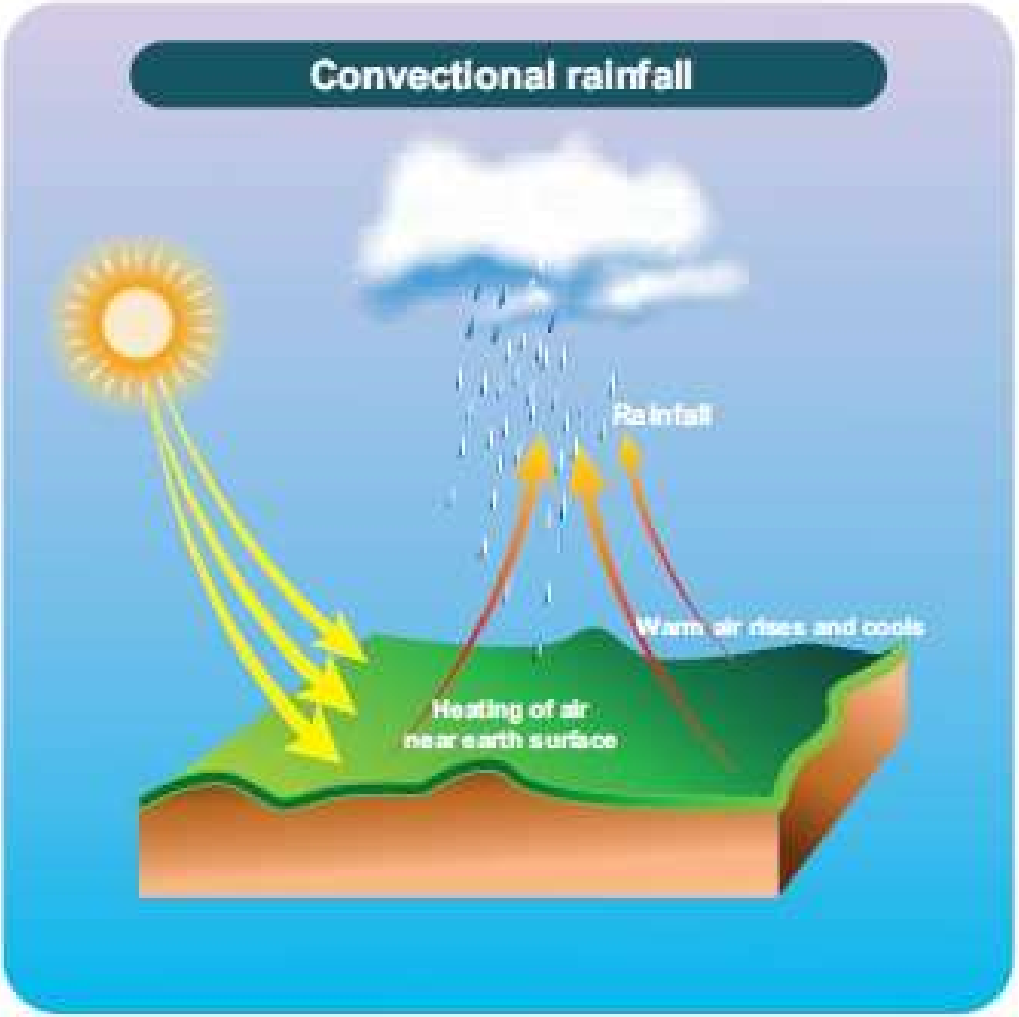
Snow

Forms of precipitation

- Rain – It is the main form of precipitation with water drop size >0.5 mm
- Snow – Ice crystals, which combines to form flakes
- Drizzle-Fine sprinkle of numerous water droplets of size <0.5 mm
- Glaze- when rain or drizzle comes in contact with cold ground at 0°C, the water drops freeze to form an ice coating called freezing rain
- Sleet – frozen raindrops forms when rain falls through air at subfreezing temperature
- Hail – precipitation in the form of ice crystals of size >8 mm

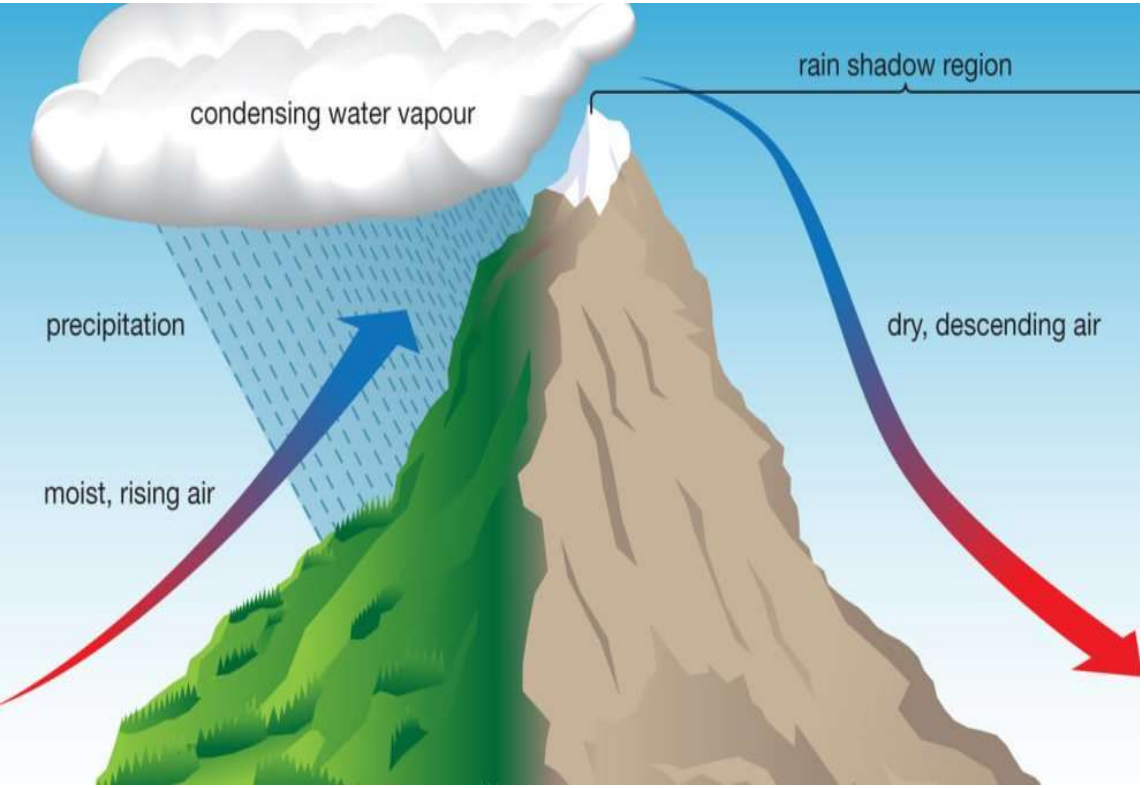
Weather systems for precipitation

Convective precipitation



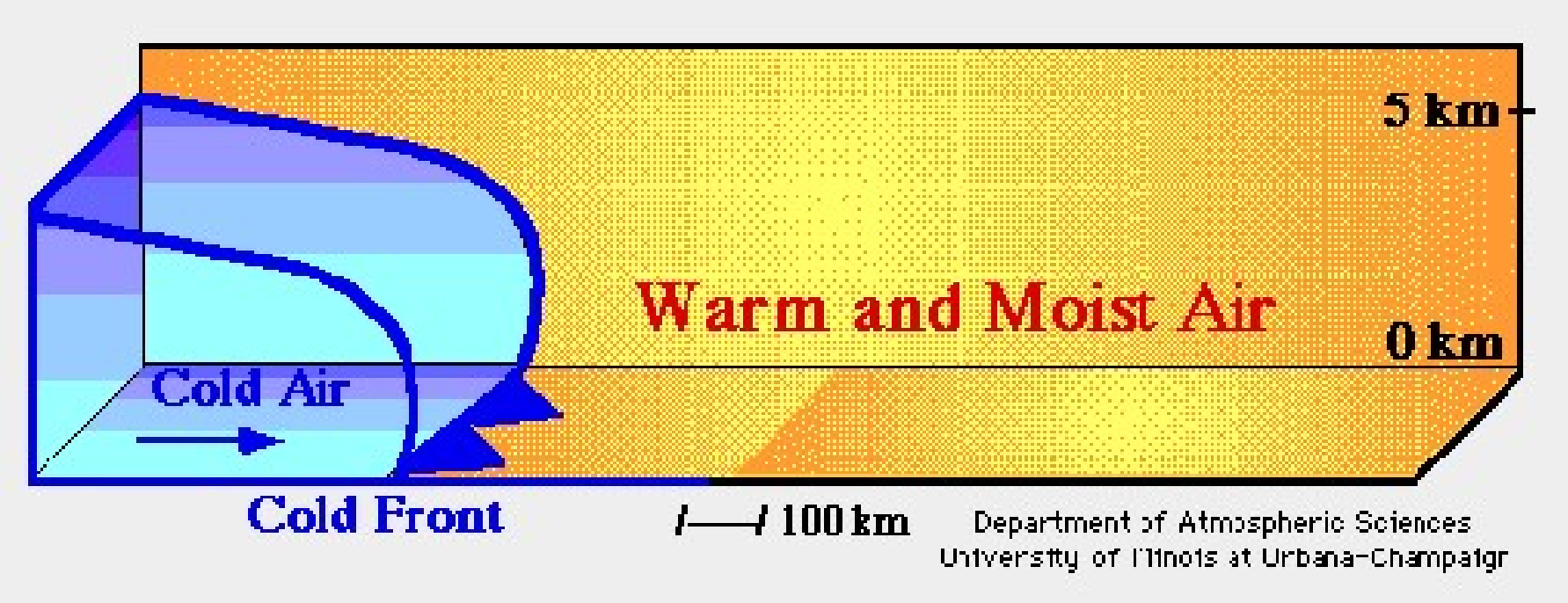
- On a hot day the ground surface becomes heated, as does the air in contact with it
- This causes the air to rise, expand, and cool dynamically, causing condensation and precipitation

Orographic precipitation



- Lifting an air mass occurs when air flows up and over a topographic feature such as a mountain barrier
- Orographic barriers often supply the lift to set off precipitation
- For this reason, precipitation is heavier on windward slopes, with rain shadows (areas of lighter precipitation) on leeward slopes
- Orographic precipitation is associated with low intensity with relatively long durations

<u>Precipitation along cold front</u>: A cold front is defined as the transition zone where a cold air mass is replacing a warmer air mass



Characteristics of precipitation in India

1) **South-West Monsoon (June-September)**

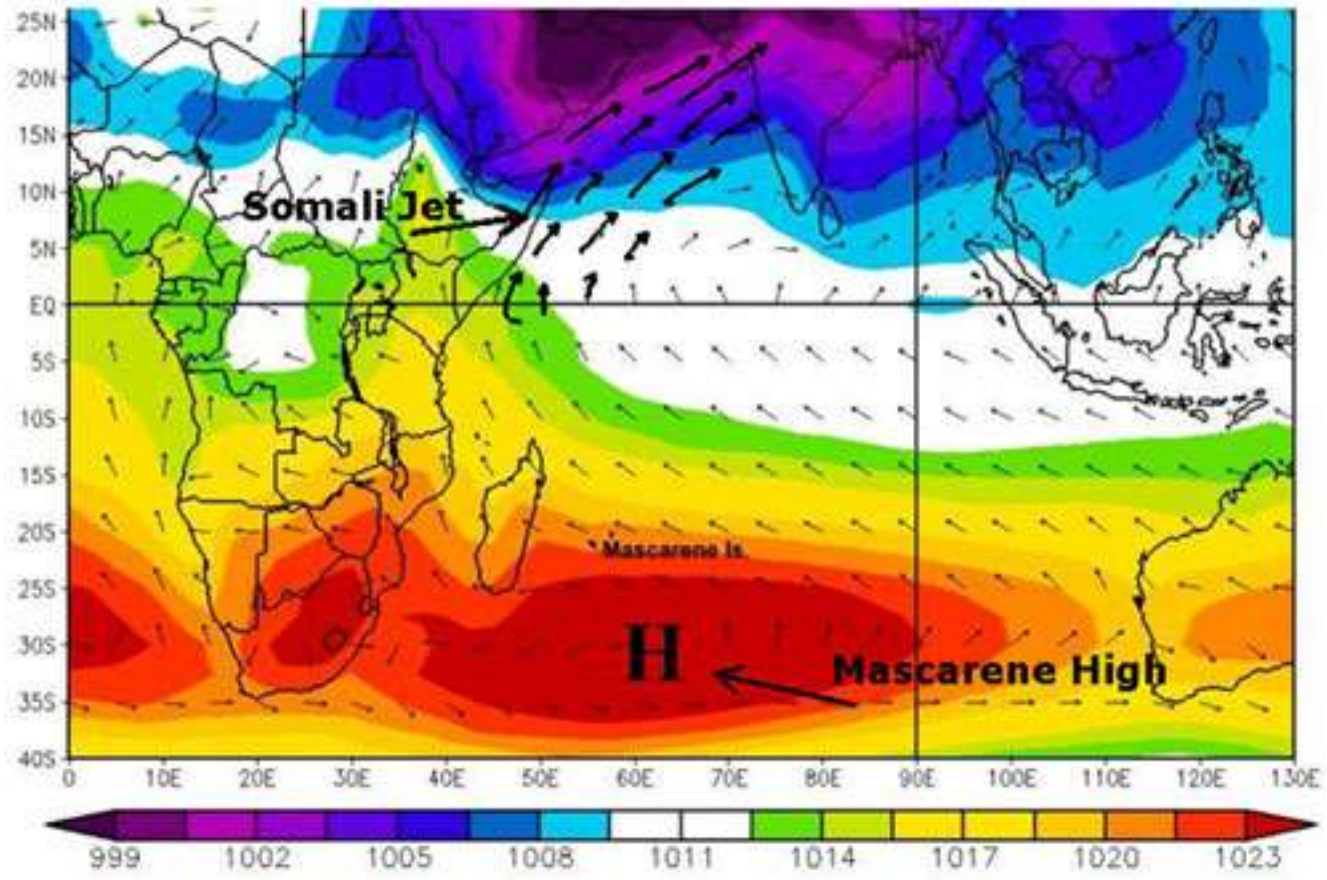
- It originates in Indian ocean
- Receives 75% of annual rainfall
- Starts from Kerala, and extends towards all states except Tamil Nadu and Jammu & Kashmir

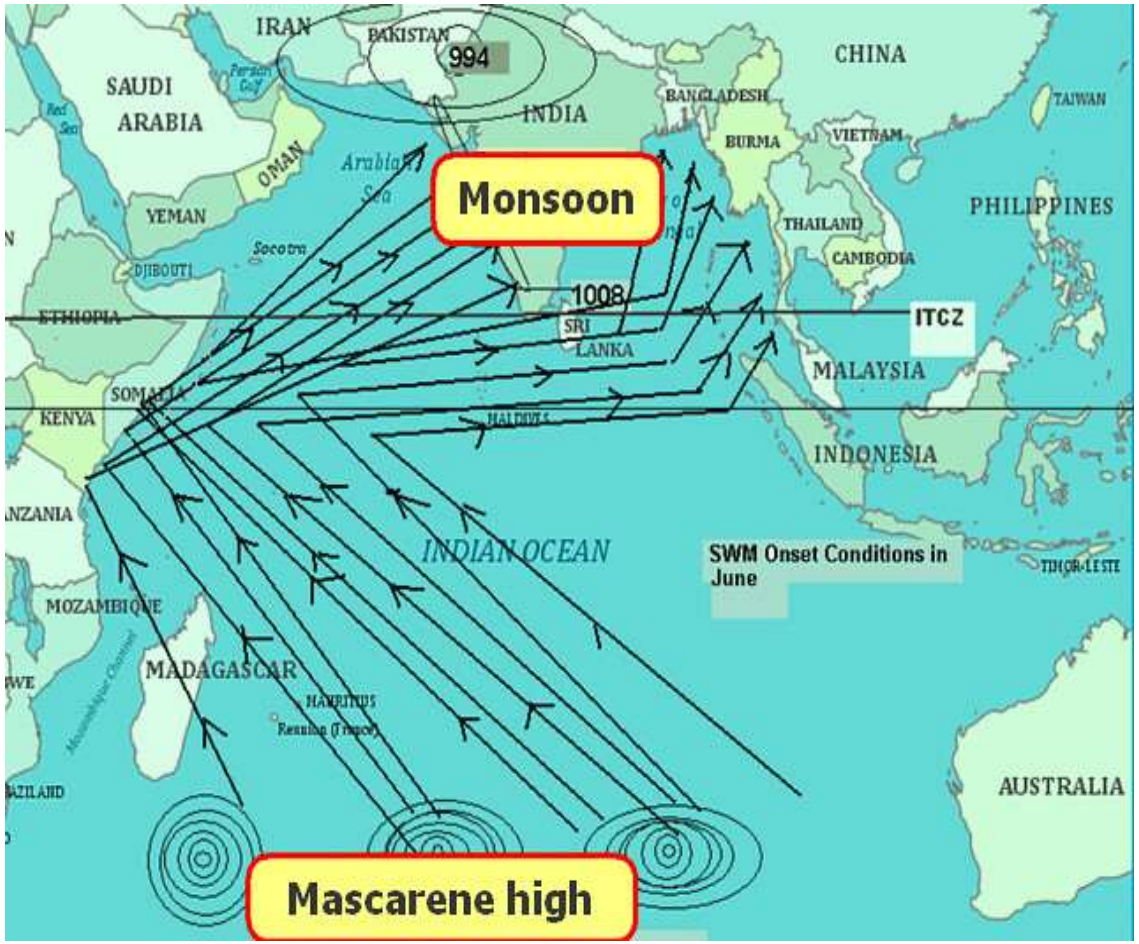
2) Post-Monsoon or NE Monsoon (October-November)

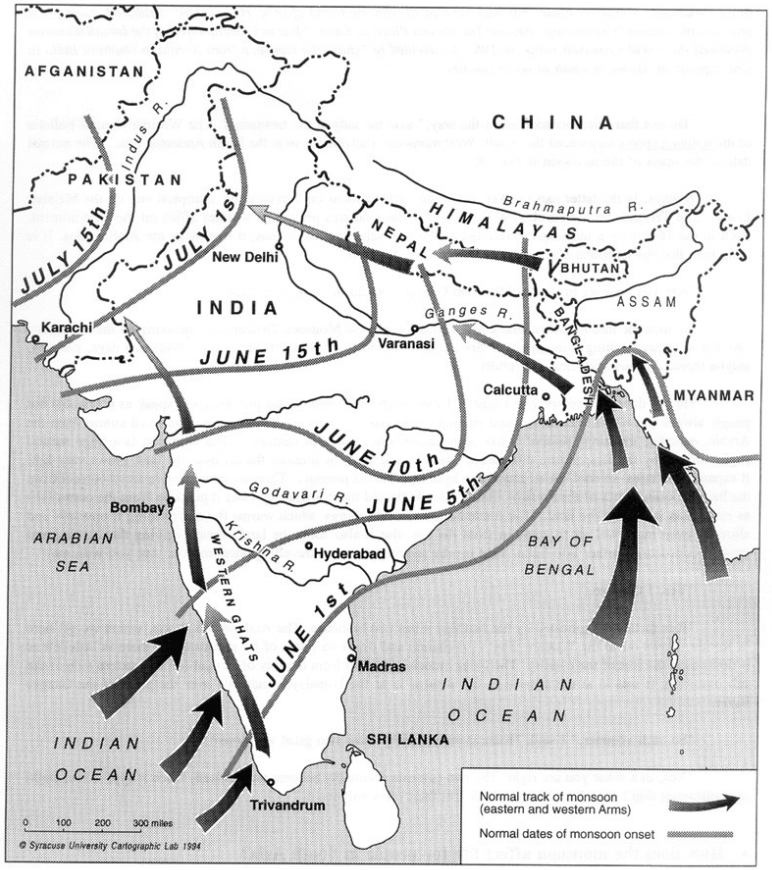
- It mainly strikes the east coast of Southern Peninsula (Tamil Nadu)

3) Pre-Monsoon (March-May)

Indian monsoon and its friends







ITCZ-Inter Tropical Convergence Zone: The region that circles the Earth, near the equator, where the trade winds of the Northern and Southern Hemispheres come together

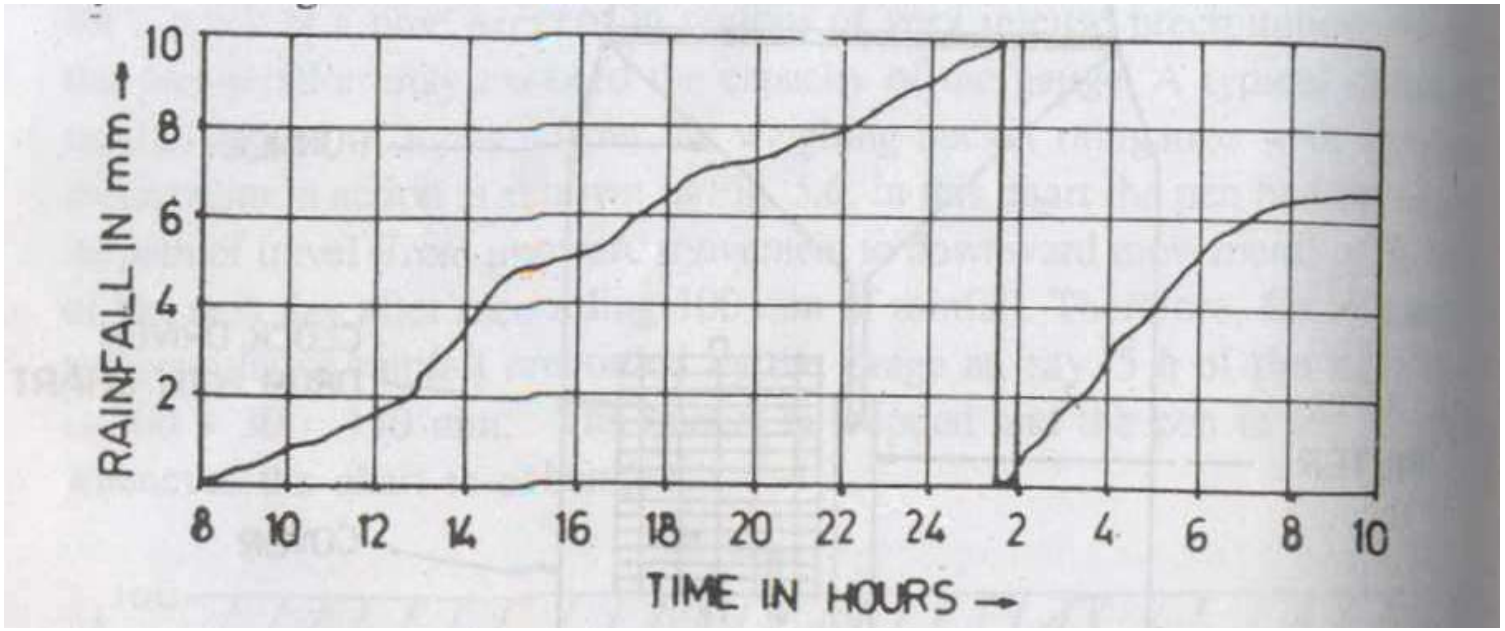
- The **Mascarene High** (MH) is a semi-permanent subtropical high-pressure zone in the South Indian Ocean
- A trough extends from this low over Pakistan (994 hPa) to Head Bay with strong pressure gradient to the south. This trough is often referred to as the ‘monsoon trough’.


INDIA
BLANK MAP
North East
Trade winds
Arabian Sea
Bay of Bengal
INDIAN OCEAN

Measurement of rainfall

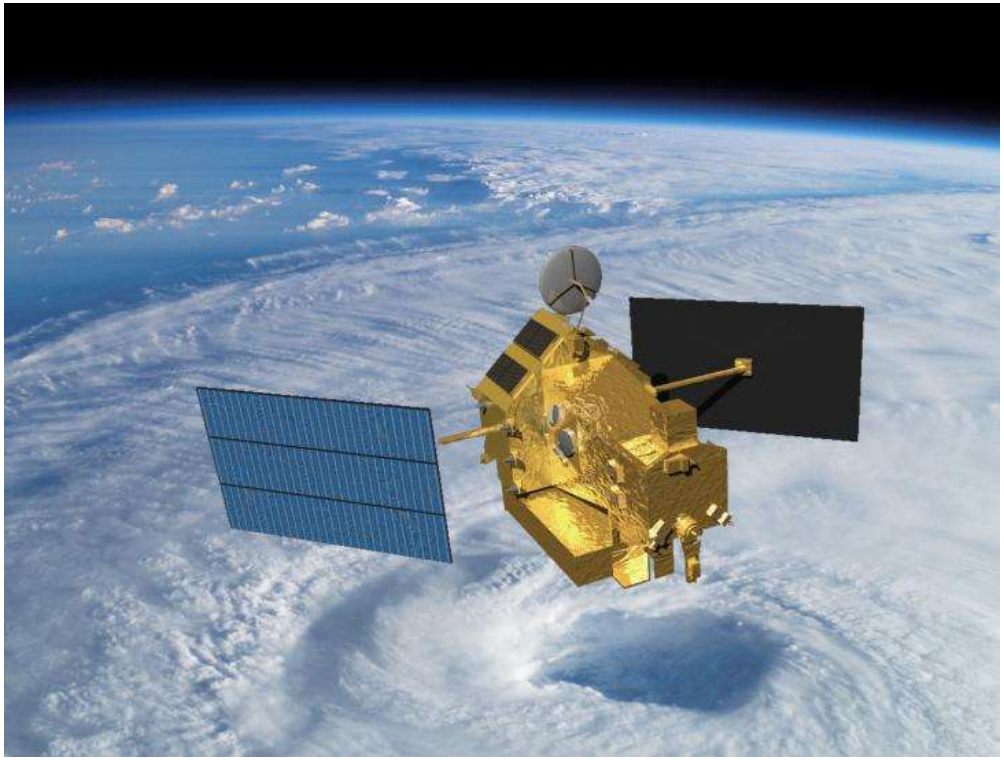
- Rainfall is expressed in terms of depth (mm)
- Rainfall is measured using rain gauges: Recording & non-recording gauges
- Radar/satellite measurement

Rain gauges



Rain gauge chart

Tropical Rainfall Measuring Mission (TRMM)-1997



- A joint space mission between NASA and the Japan Aerospace Exploration Agency JAXA designed to monitor and study tropical rainfall

Solar radiation

Meaurement (W/m^2)

- **<u>Pyranometer</u>**: It is designed to measure the solar radiation flux density (W/m^2) from the hemisphere above within a wavelength range 0.3 µm to 3 µm

- **Satellite**

Meteorological observatories

IMD (Indian Meteorological Department)

http://weather.uwyo.edu/upperair/sounding.html- University of Wyoming

https://power.larc.nasa.gov/data-access-viewer/- NASA Power data