B. Tech (Environmental Studies and Disaster Management)

CHM 1012

Study material

Cyclone

Disaster -

Any occurrence that causes
damage, ecological disruption,
loss of human life,
deterioration of health and health services
on a scale, sufficient to warrant an extraordinary response from outside the affected community or area.(WHO)

A disaster can be defined as an occurrence either nature or man made that causes human suffering and creates human needs that victim cannot alleviate without assistance.
(American Red Cross)

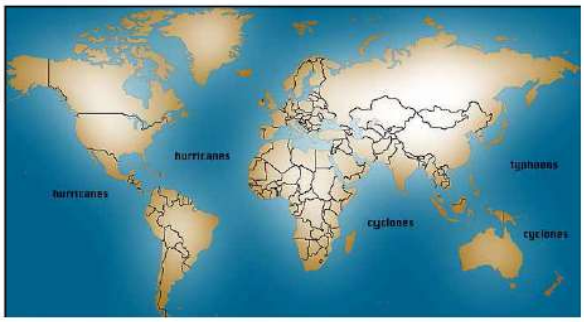
- "Cyclone" is an intense whirl in the atmosphere with very strong winds circulating around it in anti-clockwise direction in the Northern Hemisphere and in clockwise direction in the Southern Hemisphere.
- Word "Cyclone" is derived from the Greek, word "Cyclos" meaning the coils of a snake.

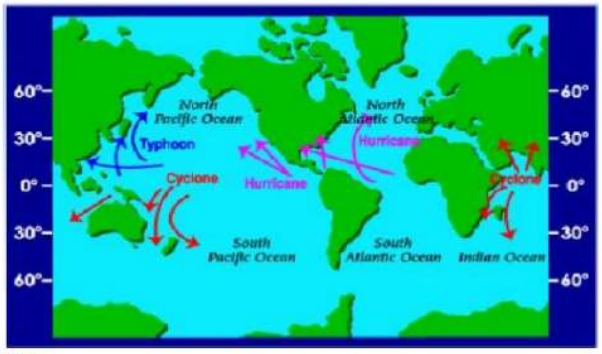
- Cyclones are intense low pressure areas - from the centre of which pressure increases outwards.
- The amount of the pressure drop in the centre and the rate at which it increases outwards gives the intensity of the cyclones and the strength of winds.

- **Cyclone** refers to any inner spinning storm that rotates around a low-pressure center. The low-pressure center is also referred to as the 'eye' of the storm.

Classification of cyclone

- Cyclones are classified as: (i) extra tropical cyclones (also called temperate cyclones); and (ii) tropical cyclones.
- Extra tropical cyclones occur in temperate zones and high latitude regions, though they are known to originate in the polar regions.





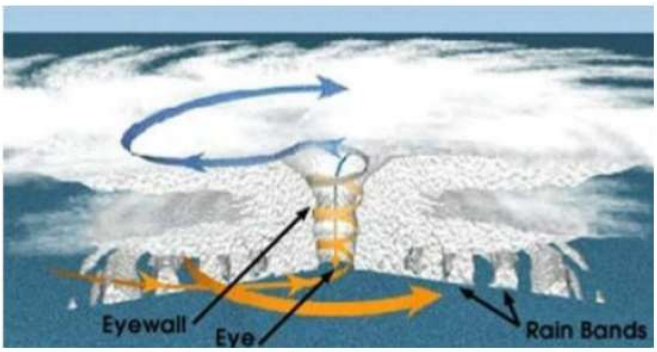
- Hurricanes – tropical cyclones in the Atlantic and Eastern Pacific Oceans
- Typhoons – tropical cyclones in waste Pacific Ocean and north of equator
- Cyclones – tropical cyclones in the Indian Ocean

Initial Development of Cyclone

- A warm sea (temperature in excess of 26 degrees Celsius to a depth of 60 m) with abundant and turbulent transfer of water vapour to the overlying atmosphere by evaporation.
- Atmospheric instability encourages formation of massive vertical cumulus clouds due to convection with condensation of rising air above ocean surface.

- Evaporation increases rapidly as temperature increases.
- Evaporation= energy in the form of latent heat that fuels the cyclone.

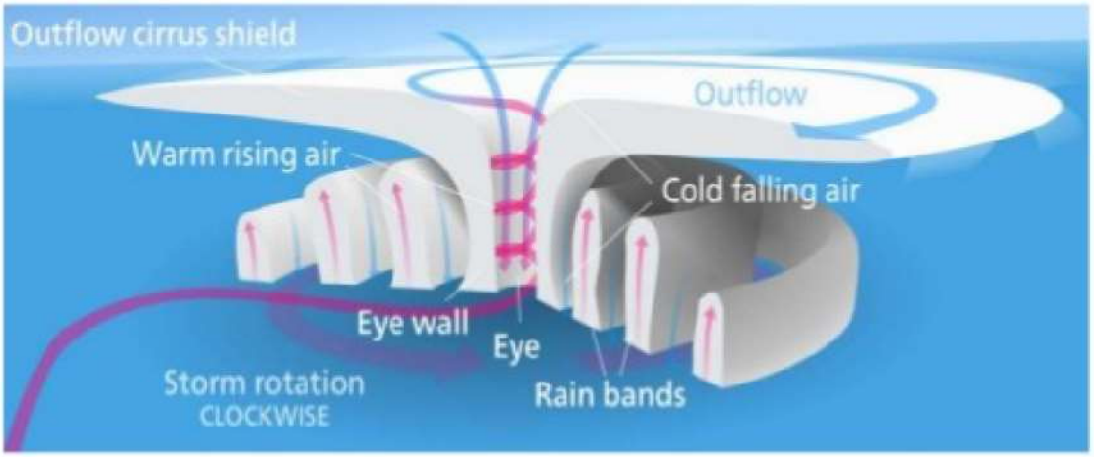
Low pressure center and numerous thunderstorms that produce strong winds and heavy rains.



Formation process

- Surface water evaporates and is convected upward
- Air rises and diverges; some air is forced towards the eye center, where it sinks
- Compressional heating in the eye creates the warm core and clear conditions
- Divergence aloft and warmer results in lower surface pressure
- Increased surface pressure gradient yields increased surface winds
- Evaporation increases and the cycle strengthens

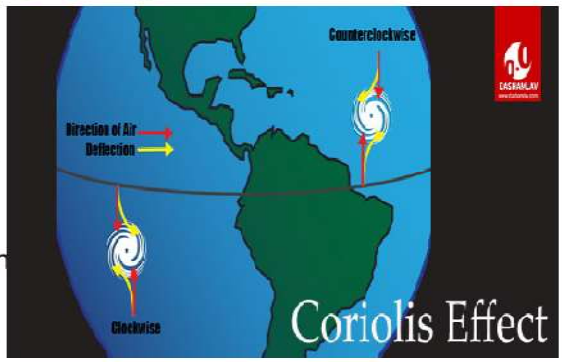
Tropical cyclone structure



- **Eye:** A region 30-65 km in diameter found at the center where skies are often clear, winds are light, and the storm's lowest pressure readings are obtained.
- **Eye Wall:** A ring of cumulonimbus clouds that swirl around the eye. The heaviest precipitation and strongest winds are found here.
- **Spiral Rainbands:** Bands of heavy convective showers that spiral inward toward the storm's center. Thunderstorms are observed here.

Formation of Cyclone

- A full-grown cyclone is a violent whirl in the atmosphere 150 to 1000 km across, 10 to 15 km high.
- The central calm region of the storm is called the "Eye". The diameter of the eye varies between 30 and 50 km and is a region free of clouds and has light winds.
- Around this calm and clear eye, there is the "Wall Cloud Region" of the storm about 50 km in extent, where the winds, thick clouds with torrential rain, thunder and lightning prevail.
- Away from the "Wall Cloud Region", the wind speed gradually decreases.



- Have warm central cores
- Derived energy from Warm Ocean water and latent heat
- Most have warm ocean water greater than 26C
- Coriolis force

Coriolis force is an inertial or fictitious force[1] that acts on objects that are in motion within a frame of reference that rotates with respect to an inertial frame. In a reference frame with clockwise rotation, the force acts to the left of the motion of the object. In one with anticlockwise (or counterclockwise) rotation, the force acts to the right. Deflection of an object due to the Coriolis force is called the **Coriolis effect**

Formation of Cyclone

- This low pressure creates violent storms that are characterized by winds over 100 km/h and heavy rainfall.
- They have caused the loss of life on a number of occasions due to there intensity.
  1. Warm Ocean waters at least **26.5°C** to provide the heat.
  2. Availability of moisture. Moisture is necessary for providing latent heat of condensation.
  3. Coriolis force to provide the rotation. (they do not form within 5° of the equator due to the negligible CF there).

Tornadoes:

- A **tornado** is a violent, dangerous, rotating column of air that is in contact with both the surface of the earth and a cumulonimbus cloud or in rare cases, the base of a cumulus cloud.
- They are often referred to as a **twister** or a **cyclone,** although the word cyclone is used to name any closed low pressure circulation.
- Tornadoes come in the term of a visible condensation funnel, whose narrow end touches the earth and is often encircled by a cloud of debris and dust.

Criteria followed classify cyclones

- As adopted by Meteorological Department of India

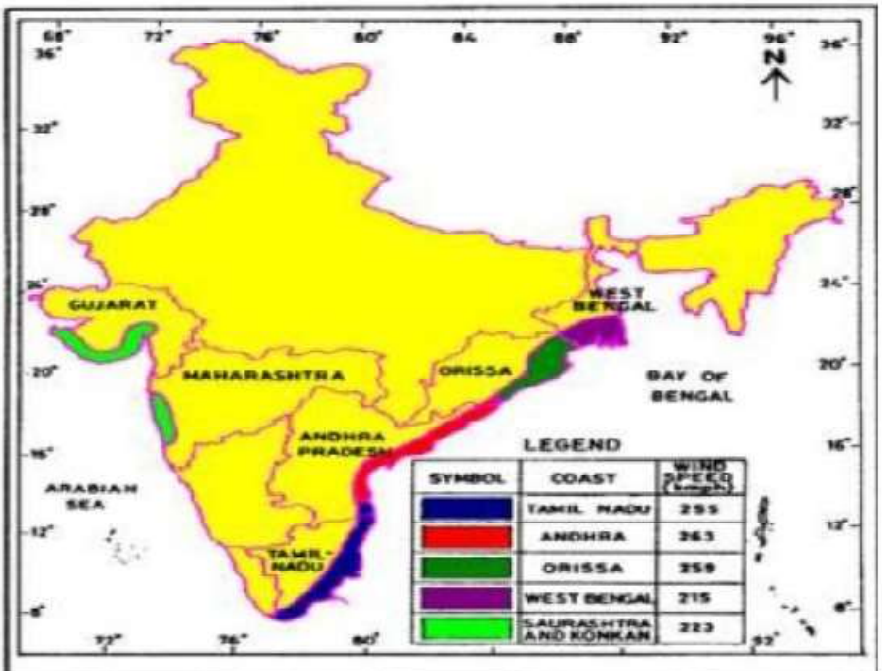
Type of Disturbances	Wind Speed in Km/h	Wind Speed in Knots
Low Pressure	Less than 31	Less than 17
Depression	31-49	17-27
Deep Depression	49-61	27-33
Cyclonic Storm	61-88	33-47
Severe Cyclonic Storm	88-117	47-63
Super Cyclone	More than 221	More than 120

1 Knot= 1.85km/h

1 knot - 1.85 km per hour

Cyclones are classified into five different levels on the basis of wind speed. They are further divided into the following categories according to their damage capacity.

Cyclone Category	Wind Speed in Km/h	Damage Capacity
01	120-150	Minimal
02	150-180	Moderate
03	180-210	Extensive
04	210-250	Extreme
05	250 and above	Catastrophic



CYCLONIC WIND SPEED MAP OF COASTAL INDIA

Cyclone map of India:

- Vulnerability to storm surges is not uniform along Indian coasts.
- **East coast of India** are most vulnerable to high surges
  I. North Odisha and West Bengal coasts.
  II. Andhra Pradesh coast between Ongole and Machilipatnam.
  III. Tamil Nadu coast, south of Nagapatnam.
- The **West coast of India** is less vulnerable to storm surges
  I. Maharashtra coast, north of Harnai and adjoining south Gujarat coast and the coastal belt around the Gulf of Bombay.
  II. The coastal belt around the Gulf of Kutch.

Effect of Cyclone:

- Consequent strong winds. These in turn generate storm surges.
- Abnormal rise of sea level near the coast caused by a severe tropical cyclone.
- Very strong winds may damage installations, dwellings, communication systems, trees etc. resulting in loss of life and property.
- Heavy rains due to cyclones may cause river floods.
- Death
- Disability
- Increase in communicable disease
- Psychological problems
- Food shortage
- Socio-economic losses
- Shortage of drugs and medical supplies.

Cyclone disaster prevention and Mitigation

- A Cyclone Forecast - and Warning Service.
- Rapid dissemination of warnings to the Government Agencies, Marine interests like the Ports, Fisheries and Shipping and to General Public.
- Organisations to construct Cyclone Shelters in the cyclone-prone areas and ready machinery for evacuation of people to safer areas.
- Community preparedness at all levels to meet the exigencies.

Four Stage Warning

Four stages of warning

STAGE	STAGE OF WARNING	TIME
First Stage	*PRE CYCLONE WATCH*	*Before 72hrs*
Second Stage	*"CYCLONE ALERT"*	*Before 48hrs*
Third Stage	*CYCLONE WARNING*	*Before 24hrs*
Fourth Stage	*POST LANDFALL OUTLOOK*	*Before 12hrs*

Before cyclone season

- Check the house; secure loose tiles, carry out repair works for doors and windows
- Remove dead woods or dying trees close to the house; anchor removable objects like lumber piles, loose tin sheds, loose bricks, garbage cans, sign-boards etc. which can fly in strong winds
- Keep some wooden boards ready so that glass windows can be boarded if needed
- Demolish condemned buildings
- Keep some dry non-perishable food always ready for emergency use

When evacuation instructed

- Pack essentials for yourself and your family to last you a few days, including medicines, special foods for babies and children or elders.
- Head for the proper shelter or evacuation points indicated for your area.
- Do not worry about your property
- At the shelter follow instructions of the person in charge.
- Remain in the shelter until you have been informed to leave

When cyclone start

- Switch off electrical mains in your house.
- Remain calm.
- Believe in the official information when a cyclone alert is on for your area, continue normal working but stay alert to the radio warnings.
- Remember that a cyclone alert means that the danger is within 24 hours. Stay alert.
- If your house is securely built on high ground take shelter in the safer part of the house. However, if asked to evacuate do not hesitate to leave the place.
- Provide strong suitable support for outside doors.
- Keep torches handy
  - Be sure that a window and door can be opened only on the side opposite to the one facing the wind.
  - If the centre of the cyclone is passing directly over your house there will be a lull in the wind and rain lasting for half and hour or so. During this time do not go out; because immediately after that very strong winds will blow from the opposite direction.

- Small and loose things, which can fly in strong winds, should be stored safely in a room.
- Leave early before your way to high ground or shelter gets flooded
- When your area is under cyclone warning get away from low-lying beaches or other low-lying areas close to the coast
- If you are to evacuate the house move your valuable articles to upper floors to minimize flood damage.
- Get extra food, which can be eaten without cooking. Store extra drinking water in suitably covered vessels.
- Make provision for children and adults requiring special diets.

When evacuation is instructed

- Pack essentials for youeself and your family to last you a few days, including medicines, special foods for babies, children or elders.
- Head for the proper shelter or evacuation points indicated for your area.
- Do not worry about your property
- At the shelter follow instructions of the person in charge
- Remain n the shelter until you have been informed to leave.

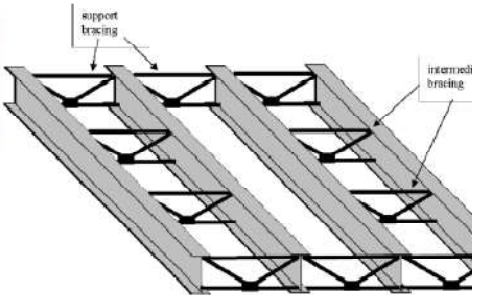
❑If you are in car-menain in the car,stop driving.
❑ move away from electric poles,trees,etc.
❑Close doors & windows switch off electric appliances and stay in home.
❑Keep a note of all the warnings given by the Meteorological Department.
❑Keep emergency phone numbers of police, ambulance and fire brigade handy.
❑Move people and valuable items to a safe place.

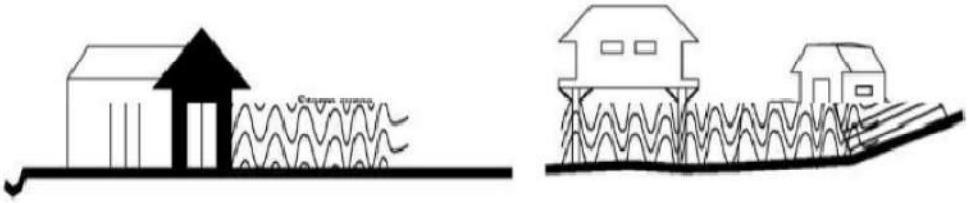
❑**POST CYCLONE MEASURES**

- You should remain in the shelter until informed that you can return to your home.
- Strictly avoid any loose and dangling wires from the lamp posts
- If you are to drive, drive carefully.
- Clear debris from your premises immediately.
- Report the correct loss to appropriate authorities.

When choosing a site for your house, consider the following

- In cyclonic regions close to the coast, a site above the likely inundation level should be chosen. In case of non availability of high level natural ground, construction should be done on stilts with no masonry or cross bracings up to maximum surge level, or on raised earthen mounds to avoid flooding/inundation but knee bracing may be used.





Shielding from high wind by permeable barriers such as strong trees

In hilly regions,

- construction along ridges should be avoided since they experience an increase of wind velocity
- whereas valley experiences lower speeds in general

Ridge ;an elongated region of high barometric pressure.

Cyclone Operation in India:

- Mereorological Department, by providing cyclone Surveilance Radars at Calcuta in the east coast and at Goa, Bombay in the west Coast.
- Satellite picture receiving equipments at Delhi, Bombay, Madras are receiving satellite pictures of the cyclones from the polar-orbiting Satellites of the USA and USSR Since April 1982.
- A.V.H.R.R. (Advance very high resolution Radio-meter) Indian Geo Stationary Satellite INSAT-LB has become operational since October 1983. Monitoring of the cyclone by taking hourly pictures has helped the forecaster to improve his skill in issuing the timely warnings to the public.
- **Some Indian Associations:**
- Area Cyclone Warming Centres (ACWC)

- Cyclone Warning Centre (CWC)
- Numerical Weather Prediction (NWP)
- Northen Hemispheric Analysis Centre (NHAC)
- Cyclone Warning Research Centre (CWRC)
- Regional Specialized Meteorological Centre (RSMC)

Disaster management structure:

E.g. : Indian Meteorological department (IMD) plays a key role in forewarning the disaster of cyclone-storms by detection tracing. It has 5 centers in Kolkata, Bhubaneswar, Vishakhapatnam, Chennai and Mumbai. In addition there are 31 special observation posts setup along the coast of India.

The International Agencies which provides humanitarian assistance to the disaster strike areas are United Nation agencies.

- Office for the co-ordination of Humanitatian affair (OCHA)
- World Health Organization (WHO)
- United Nations Children's Fund (UNICEF)
- World Food Program (WFP)
- Food and Agricultural Organisation (FAO)

E.g. Non Governmental Organizations

- Co-operative for Assistance and Relief Everywhere (CARE)
- International committee of Red Cross

Disaster management structure:

NDMA Apex Body with Prime Minister as Chairperson.

National Executive Committee- Secretaries of 14 Mnistries and Chief of Integrated Defence Staff.

- Armed Forces
- Central Para Military Forces
- State Police Forces and Fire Services
- Civil Defence and Home Guards
- State Disaster Response Force (SDRF)
- National Cadet Corps (NCC)

- National Service Scheme (NSS)
- Nehru Yuva Kendra Sangathan (NYKS)

General management in India

- An artificially created reservoir behind a dam across a river
- Channelization of river.
- Artificially raised embankments that reduce spilling
- Channel and drainage improvement works, which artificially reduce the flood water level

Integrated Disaster Management

Disaster Mitigation:

- It is the effort to reduce loss of life and property by lessening the impact of disasters.
- Mitigation is taking action now- before the next disaster.
- To reduce human and financial consequences later (analyzing risk, reducing risk, ensuring against risk).

E.g. improving structural qualities of schools, houses and such other buildings so that medical causalities can be minimized.

Similarly ensuring the safety of health facilities and public health services including water supply and sewerage system to reduce the cost of rehabilitation and reconstruction.

The end