CYCLONES In [meteorology](https://en.wikipedia.org/wiki/Meteorology), a **cyclone** is a large scale [air mass](https://en.wikipedia.org/wiki/Air_mass) that rotates around a strong center of low [atmospheric pressure](https://en.wikipedia.org/wiki/Atmospheric_pressure). Cyclones are characterized by inward [spiraling](https://en.wikipedia.org/wiki/Spiral) [winds](https://en.wikipedia.org/wiki/Wind) that rotate about a zone of [low pressure](https://en.wikipedia.org/wiki/Low-pressure_area). The largest low-pressure systems are [polar vortices](https://en.wikipedia.org/wiki/Polar_vortex) and [extratropical cyclones](https://en.wikipedia.org/wiki/Extratropical_cyclone%22%20%5Co%20%22Extratropical%20cyclone) of the largest scale (the [synoptic scale](https://en.wikipedia.org/wiki/Synoptic_scale)). Warm-core cyclones such as [tropical cyclones](https://en.wikipedia.org/wiki/Tropical_cyclone) and [subtropical cyclones](https://en.wikipedia.org/wiki/Subtropical_cyclone) also lie within the synoptic scale. [Mesocyclones](https://en.wikipedia.org/wiki/Mesocyclone%22%20%5Co%20%22Mesocyclone), [tornadoes](https://en.wikipedia.org/wiki/Tornado), and [dust devils](https://en.wikipedia.org/wiki/Dust_devil) lie within smaller [mesoscale](https://en.wikipedia.org/wiki/Mesoscale_meteorology%22%20%5Co%20%22Mesoscale%20meteorology). Upper level cyclones can exist without the presence of a surface low, and can pinch off from the base of the [tropical upper tropospheric trough](https://en.wikipedia.org/wiki/Tropical_upper_tropospheric_trough) during the summer months in the [Northern Hemisphere](https://en.wikipedia.org/wiki/Northern_Hemisphere).

 Cyclones have also been seen on extraterrestrial planets, such as [Mars](https://en.wikipedia.org/wiki/Mars), [Jupiter](https://en.wikipedia.org/wiki/Jupiter), and [Neptune](https://en.wikipedia.org/wiki/Neptune).

 [Cyclogenesis](https://en.wikipedia.org/wiki/Cyclogenesis) is the process of cyclone formation and intensification.

  [Extratropical cyclones](https://en.wikipedia.org/wiki/Extratropical_cyclones%22%20%5Co%20%22Extratropical%20cyclones) begin as waves in large regions of enhanced mid-latitude temperature contrasts called [baroclinic zones](https://en.wikipedia.org/wiki/Baroclinity%22%20%5Co%20%22Baroclinity). These zones contract and form [weather fronts](https://en.wikipedia.org/wiki/Weather_front) as the cyclonic circulation closes and intensifies. Later in their life cycle, extratropical cyclones [occlude](https://en.wikipedia.org/wiki/Occluded_front) as cold air masses undercut the warmer air and become cold core systems. A cyclone's track is guided over the course of its 2 to 6 day life cycle by the steering flow of the subtropical [jet stream](https://en.wikipedia.org/wiki/Jet_stream).

Extratropical cycloneAn **extratropical cyclone** is a [synoptic scale](https://en.wikipedia.org/wiki/Synoptic_scale_meteorology) of [low-pressure](https://en.wikipedia.org/wiki/Low-pressure_area) weather system that does not have [tropical](https://en.wikipedia.org/wiki/Tropical_cyclone) characteristics, as it is connected with [fronts](https://en.wikipedia.org/wiki/Surface_weather_analysis) and horizontal [gradients](https://en.wikipedia.org/wiki/Gradients) (rather than vertical) in [temperature](https://en.wikipedia.org/wiki/Temperature) and [dew point](https://en.wikipedia.org/wiki/Dew_point) otherwise known as "baroclinic zones".

"Extratropical" is applied to cyclones outside the tropics, in the middle latitudes. These systems may also be described as "mid-latitude cyclones" due to their area of formation, or "post-tropical cyclones" when a tropical cyclone has moved ([extratropical transition](https://en.wikipedia.org/wiki/Extratropical_cyclone%22%20%5Cl%20%22Extratropical_transition%22%20%5Co%20%22Extratropical%20cyclone)) beyond the tropics. They are often described as "depressions" or "lows" by weather forecasters and the general public. These are the everyday phenomena that, along with [anti-cyclones](https://en.wikipedia.org/wiki/Anti-cyclone), drive weather over much of the Earth. Although extratropical cyclones are almost always classified as [baroclinic](https://en.wikipedia.org/wiki/Baroclinic%22%20%5Co%20%22Baroclinic) since they form along zones of temperature and dewpoint gradient within the [westerlies](https://en.wikipedia.org/wiki/Westerlies%22%20%5Co%20%22Westerlies), they can sometimes become [barotropic](https://en.wikipedia.org/wiki/Barotropic%22%20%5Co%20%22Barotropic) late in their life cycle when the temperature distribution around the cyclone becomes fairly uniform with radius.

[Subtropical cyclone](https://en.wikipedia.org/wiki/Subtropical_cyclone) A **subtropical cyclone** is a [weather](https://en.wikipedia.org/wiki/Weather) system that has some characteristics of a [tropical cyclone](https://en.wikipedia.org/wiki/Tropical_cyclone) and some characteristics of an [extratropical cyclone](https://en.wikipedia.org/wiki/Extratropical_cyclone%22%20%5Co%20%22Extratropical%20cyclone). They can form between the equator and the 50th parallel. As early as the 1950s, meteorologists were unclear whether they should be characterized as tropical cyclones or extratropical cyclones, and used terms such as quasi-tropical and semi-tropical to describe the cyclone hybrids. By 1972, the [National Hurricane Center](https://en.wikipedia.org/wiki/National_Hurricane_Center) officially recognized this cyclone category. Subtropical cyclones began to receive names off the [official tropical cyclone list](https://en.wikipedia.org/wiki/Tropical_cyclone_naming) in the Atlantic Basin in 2002. They have broad wind patterns with maximum sustained winds located farther from the center than typical tropical cyclones, and exist in areas of weak to moderate temperature gradient.

Since they form from extratropical cyclones, which have colder temperatures aloft than normally found in the tropics, the sea surface temperatures required is around 23 degrees Celsius (73 °F) for their formation, which is three degrees Celsius (5 °F) lower than for tropical cyclones. This means that subtropical cyclones are more likely to form outside the traditional bounds of the hurricane season. Although subtropical storms rarely have hurricane-force winds, they may become tropical in nature as their cores warm.

**Tropical Cyclone**

A **tropical cyclone** is a [storm system](https://en.wikipedia.org/wiki/Storm) characterized by a [low-pressure](https://en.wikipedia.org/wiki/Low-pressure_system) center and numerous [thunderstorms](https://en.wikipedia.org/wiki/Thunderstorm) that produce strong winds and [flooding](https://en.wikipedia.org/wiki/Flood) [rain](https://en.wikipedia.org/wiki/Rain). A tropical cyclone feeds on heat released when moist [air](https://en.wikipedia.org/wiki/Air) rises, resulting in [condensation](https://en.wikipedia.org/wiki/Condensation) of [water vapour](https://en.wikipedia.org/wiki/Water_vapour) contained in the moist air. They are fueled by a different heat mechanism than other cyclonic windstorms such as [nor'easters](https://en.wikipedia.org/wiki/Nor%27easter), [European windstorms](https://en.wikipedia.org/wiki/European_windstorm), and [polar lows](https://en.wikipedia.org/wiki/Polar_low), leading to their classification as "warm core" storm systems.

 The term "tropical" refers to both the geographic origin of these systems, which form almost exclusively in [tropical](https://en.wikipedia.org/wiki/Tropics) regions of the globe, and their dependence on [Maritime Tropical air masses](https://en.wikipedia.org/wiki/Air_mass#Classification_and_notation) for their formation. The term "cyclone" refers to the storms' cyclonic nature, with [counter clockwise](https://en.wikipedia.org/wiki/Clockwise_and_counterclockwise) rotation in the [Northern Hemisphere](https://en.wikipedia.org/wiki/Northern_Hemisphere) and clockwise rotation in the [Southern Hemisphere](https://en.wikipedia.org/wiki/Southern_Hemisphere). Depending on their location and strength, tropical cyclones are referred to by other names, such as hurricane, [typhoon](https://en.wikipedia.org/wiki/Typhoon), tropical storm, cyclonic storm, tropical depression, or simply as a cyclone.

 While tropical cyclones can produce extremely powerful winds and torrential [rain](https://en.wikipedia.org/wiki/Rain), they are also able to produce high waves and a damaging [storm surge](https://en.wikipedia.org/wiki/Storm_surge). Their winds increase the wave size, and in so doing they draw more heat and moisture into their system, thereby increasing their strength. They develop over large bodies of warm water, and hence lose their strength if they move over land. This is the reason coastal regions can receive significant damage from a tropical cyclone, while inland regions are relatively safe from strong winds. Heavy rains, however, can produce significant flooding inland. Storm surges are rises in sea level caused by the reduced pressure of the core that in effect "sucks" the water upward and from winds that in effect "pile" the water up. Storm surges can produce extensive coastal [flooding](https://en.wikipedia.org/wiki/Flood) up to 40 kilometres (25 mi) from the coastline. Although their effects on human populations can be devastating, tropical cyclones can also relieve [drought](https://en.wikipedia.org/wiki/Drought) conditions. They also carry heat and energy away from the tropics and transport it toward [temperate](https://en.wikipedia.org/wiki/Temperate) [latitudes](https://en.wikipedia.org/wiki/Latitudes), which makes them an important part of the global [atmospheric circulation](https://en.wikipedia.org/wiki/Atmospheric_circulation) mechanism. As a result, tropical cyclones help to maintain equilibrium in the Earth's [troposphere](https://en.wikipedia.org/wiki/Troposphere).

 Many tropical cyclones [develop](https://en.wikipedia.org/wiki/Tropical_cyclogenesis) when the atmospheric conditions around a weak disturbance in the atmosphere are favorable. Others form when [other types of cyclones](https://en.wikipedia.org/wiki/Cyclone#Related_cyclone_types) acquire tropical characteristics. Tropical systems are then moved by [steering winds](https://en.wikipedia.org/wiki/Cyclone#Steering_winds) in the [troposphere](https://en.wikipedia.org/wiki/Troposphere); if the conditions remain favorable, the tropical disturbance intensifies, and can even develop an [eye](https://en.wikipedia.org/wiki/Eye_%28cyclone%29). On the other end of the spectrum, if the conditions around the system deteriorate or the tropical cyclone makes landfall, the system weakens and eventually dissipates. A tropical cyclone can become extratropical as it moves toward higher latitudes if its energy source changes from heat released by condensation to differences in temperature between air masses. A tropical cyclone is usually not considered to become subtropical during its extratropical transition.

 Effects Cyclones are among the most dangerous and most destructive natural disasters that can occur. They have been responsible for about 1.9 million deaths worldwide over the last two centuries, and it is estimated that 10,000 people are killed each year by these storms. Cyclones tend to do the most damage in coastal areas, where they have been known to alter the landscape and remove forest canopy.

**#** Strong WindsThe most prevalent and perhaps best understood effect of cyclones is strong wind. In fact, these strong winds tend to affect the other destructive agents of cyclones. Low-level winds will typically be stronger on the right side of a cyclone in the Northern Hemisphere, but the wind strength tends to be highly variable no matter where a cyclone hits. The strong winds of cyclones can cause damage over an area of 25 km in smaller systems and up to 500 km in larger systems. Winds have been known to destroy smaller buildings and knock out power for thousands of people.

## # Tornadoes Tornadoes do not normally occur in the same tropical regions that cyclones usually affect, rather tornadoes generally come from the storms in coastal regions and on islands. They may be far more common than people once believed. Cyclone-spawned tornadoes are often not reported in regions such as the Caribbean, but some damage patterns suggest that they occur frequently. Tornadoes can attain wind speeds of up to 480 kph and can stretch more than 3 km. Cyclone tornadoes tend to occur in the outer edge of the eyewall cloud, in the right-front quadrant of the storm system.

## # Rainfall and Flooding The thunderstorms produced in a cyclone system produce intense rainfall -- causing massive flooding, mudslides and landslides. This flooding tends to be more severe and destructive inland due to poor preparedness. Although this rainfall can be very destructive and cost millions of dollars in damage, rain in smaller cyclone systems can actually be beneficial when it provides much needed rainfall to drier areas.

## # Storm Surges A storm surge is an abnormal rise in water that occurs during a cyclone. Potentially disastrous surges occur in coastal areas with low-lying terrain that enables inundation. The storm surge is typically the most damaging effect of cyclones, historically resulting in 90 percent of tropical cyclone deaths. When combined with strong winds, storm surges can produce massive waves that can cause inland flooding and destruction.

Mitigation As the tropical cyclones are caused by atmospheric disturbances around a low-pressure area distinguished by swift and often destructive air circulation, these are usually accompanied by violent storms and bad weather. The World Meteorological Organisation uses the term 'Tropical Cyclone’ to cover weather systems in which winds exceed ‘Gale Force’ (minimum of 63 kmph). In addition to strong winds and rain, tropical cyclones are capable of generating high waves, damaging storm surge. They typically weaken rapidly over land, where they are cut off from their primary energy source. For this reason, coastal regions are particularly vulnerable to damage from a tropical cyclone as compared to inland regions. Heavy rains can cause significant flooding inland and storm surges can produce extensive coastal flooding up to 40 kms from the coastline. Their effects on human populations are often devastating.

\*Structural measures refer to any physical (natural or artificial) construction to reduce or avoid possible impacts of hazards. Structural measures can range from engineering structures that are added to the landscape to protect from hazards.

\*Non-structural measures refer to policies, regulations and plans that promote good coastal management practices to minimize risks from coastal hazards.

\*Education and outreach campaigns that increase the public’s awareness of risks, vulnerability and preparedness responses can be considered as non-structural measures.

\*“Protection” involves the use of natural or artificial measures to protect landward development. Traditionally, protection against coastal erosion, flooding, storm surge and tsunami inundation has been approached through mitigation by hard structural response. Examples of common protection measures include constructing groynes, seawalls, offshore breakwaters.

 Selection of specific measures will depend on a wide variety of factors including: the hazard(s) being addressed; the geographical scope and level of development of the area to be managed; priorities identified through the vulnerability and risk analyses; the timeframe that is being addressed; the existing and potential capacity of the community (e.g., funds, expertise, administrative capacity); and the political, legal and socioeconomic context.

\* Construction of cyclone shelter A large number of people in the coastal area do not have access to safe shelters, which could withstand the fury of cyclone. So studies along the entire coastline needs to be conducted to find out villages, where people do not have access to safe shelters within a range of 1.5 km and without having to cross a natural barrier. Cyclone shelters may be constructed in such places to ensure physical safety of people those who have no access to safe shelters. Livestock need to be provided with shelter to ensure their sustenance during a disaster. Therefore, the cyclone shelters should be designed for multi-purpose use such as school building, community center, or any other public utility buildings so as to ensure that these building are used and maintained during normal times. Cyclone shelter management and maintenance committees may be constituted for upkeep of these shelters. A corpus fund may be placed with the committee for routine maintenance of the buildings. The committees may be encouraged to generate funds by collecting fees from people for using the buildings for social / cultural functions. Designing and building of robust cyclone proof shelters, which have storage and resting areas sufficiently high above the ground using corrosion resistant and durable materials need to be addressed.

\*Rain water harvesting technique could be adopted so as to make drinking water available to people in the cyclone shelter at the time of cyclone / 27 storm-surge.

\*Construction / renovation of canals and embankments for improved drainage. An alternative to road communication could be a coastal canal system. A canal network in the coast would also be an effective tool of water management. Besides improvement to minor drains in the coastal areas may be considered for effective drainage of water, which may include repair and reconstruction of damaged and other vulnerable flood embankments. Saline embankments protect people, live stocks and agricultural fields from saline water inundation / storm surge. Hence, there is a need to protect vulnerable areas by renovating the existing embankments and creating new ones.

\*Shelter belt plantation Shelterbelts are barriers of trees that are planted to reduce wind velocities and prevent wind erosion. In coastal areas shelterbelt plantation of Casuarinas is one of the most suitable and effective alternative to minimize the impact of wind velocity and saline ingress. They also provide direct benefits to provide shelter to livestock. Main objective of windbreaks and shelterbelts is to protect the human habitations and agricultural crops. A barrier should be established perpendicular to the direction of the prevailing wind for maximum effect. The trees selected for such salt-breaks must have some degree of salt tolerance. Species that has been used successfully tried in India include Casuarina equisetifolia.

