

= Effects of tropical cyclones =

The main effects of tropical cyclones include heavy rain , strong wind , large storm surges at landfall , and tornadoes . The destruction from a tropical cyclone depends mainly on its intensity , its size , and its location . Tropical cyclones act to remove forest canopy as well as change the landscape near coastal areas , by moving and reshaping sand dunes and causing extensive erosion along the coast . Even well inland , heavy rainfall can lead to mudslides and landslides in mountainous areas . Their effects can be sensed over time by studying the concentration of the Oxygen @-@ 18 isotope within caves within the vicinity of cyclones ' paths being very hazardous to people 's life .

After the cyclone has passed , devastation often continues . Standing water can cause the spread of disease , and transportation or communication infrastructure may have been destroyed , hampering clean @-@ up and rescue efforts . Nearly two million people have died globally due to tropical cyclones . Despite their devastating effects , tropical cyclones are also beneficial , by potentially bringing rain to dry areas and moving heat from the tropics poleward . Out at sea , ships take advantage of their known characteristics by navigating through their weaker , western half .

When a cyclone hits it causes PST hazards . PST is an acronym standing for Primary , Secondary and Tertiary . A primary hazard involves destructive winds , debris and storm surge . Secondary hazard is flooding , fires and of course fresh water flooding . Finally Tertiary hazards involves food prices that go majorly up and other long term hazards like water poisoning .

= = At sea = =

A mature tropical cyclone can release heat at a rate upwards of 6×10^{14} watts . Tropical cyclones on the open sea cause large waves , heavy rain , and high winds , disrupting international shipping and , at times , causing shipwrecks . Generally , after its passage , a tropical cyclone stirs up ocean water , lowering sea surface temperatures behind it . This cool wake can cause the region to be less favorable for a subsequent tropical cyclone . On rare occasions , tropical cyclones may actually do the opposite . 2005 's Hurricane Dennis blew warm water behind it , contributing to the unprecedented intensity of Hurricane Emily , which followed it closely . Hurricanes help to maintain the global heat balance by moving warm , moist tropical air to the mid @-@ latitudes and polar regions . Were it not for the movement of heat poleward (through other means as well as hurricanes) , the tropical regions would be unbearably hot .

= = = North American colonization = = =

Shipwrecks are common with the passage of strong tropical cyclones . Such shipwrecks can change the course of history , as well as influence art and literature . A hurricane led to a victory of the Spanish over the French for control of Fort Caroline , and ultimately the Atlantic coast of North America , in 1565 . The Sea Venture was wrecked near Bermuda in 1609 which led to the colonization of Bermuda and provided the inspiration for Shakespeare 's The Tempest .

= = = Shipping = = =

Mariners have a way to safely navigate around tropical cyclones . They split tropical cyclones in two , based on their direction of motion , and maneuver to avoid the right segment of the cyclone in the Northern Hemisphere (the left in the Southern Hemisphere) . Sailors term the right side the dangerous semicircle since the heaviest rain and strongest winds and seas were located in this half of the storm , as the cyclone 's translation speed and its rotational wind are additive . The other half of the tropical cyclone is called the navigable semicircle since weather conditions are lessened (subtractive) in this portion of the storm (but are still potentially quite hazardous) . The rules of thumb for ship travel when a tropical cyclone is in their vicinity are to avoid them if at all possible and do not cross their forecast path (crossing the T) . Those traveling through the dangerous semicircle are advised to keep to the true wind on the starboard bow and make as much headway as possible .

Ships moving through the navigable semicircle are advised to keep the true wind on the starboard quarter while making as much headway as possible .

= = Upon landfall = =

The most significant effects of a tropical cyclone occur when they cross coastlines , making landfall .

= = = Strong winds = = =

Strong winds can damage or destroy vehicles , buildings , bridges , personal property and other outside objects , turning loose debris into deadly flying projectiles . In the United States , major hurricanes comprise just 21 % of all land falling tropical cyclones , but account for 83 % of all damage . Tropical cyclones often knock out power to tens or hundreds of thousands of people , preventing vital communication and hampering rescue efforts . Tropical cyclones often destroy key bridges , overpasses , and roads , complicating efforts to transport food , clean water , and medicine to the areas that need it . Furthermore , the damage caused by tropical cyclones to buildings and dwellings can result in economic damage to a region , and to a diaspora of the population of the region .

= = = Storm surge = = =

The storm surge , or the increase in sea level due to the cyclone , is typically the worst effect from landfalling tropical cyclones , historically resulting in 90 % of tropical cyclone deaths . The relatively quick surge in sea level can move miles / kilometers inland , flooding homes and cutting off escape routes . The storm surges and winds of hurricanes may be destructive to human @-@ made structures , but they also stir up the waters of coastal estuaries , which are typically important fish breeding locales .

= = = Heavy rainfall = = =

The thunderstorm activity in a tropical cyclone produces intense rainfall , potentially resulting in flooding , mudslides , and landslides . Inland areas are particularly vulnerable to freshwater flooding , due to residents not preparing adequately . Heavy inland rainfall eventually flows into coastal estuaries , damaging marine life in coastal estuaries . The wet environment in the aftermath of a tropical cyclone , combined with the destruction of sanitation facilities and a warm tropical climate , can induce epidemics of disease which claim lives long after the storm passes . Infections of cuts and bruises can be greatly amplified by wading in sewage @-@ polluted water . Large areas of standing water caused by flooding also contribute to mosquito @-@ borne illnesses . Furthermore , crowded evacuees in shelters increase the risk of disease propagation .

Although cyclones take an enormous toll in lives and personal property , they may be important factors in the precipitation regimes of places they affect and bring much @-@ needed precipitation to otherwise dry regions . Hurricanes in the eastern north Pacific often supply moisture to the Southwestern United States and parts of Mexico . Japan receives over half of its rainfall from typhoons . Hurricane Camille averted drought conditions and ended water deficits along much of its path , though it also killed 259 people and caused \$ 9 @. @ 14 billion (2005 USD) in damage .

On the other hand , the occurrence of tropical cyclones can cause tremendous variability in rainfall over the areas they affect : indeed cyclones are the primary cause of the most extreme rainfall variability in the world , observed in places such as Onslow and Port Hedland in subtropical Australia where the annual rainfall can range from practically nothing with no cyclones to over 1 @, @ 000 millimetres (39 in) if cyclones are abundant .

= = = Tornadoes = = =

The broad rotation of a land falling tropical cyclone often spawns tornadoes , particularly in their right front quadrant . While these tornadoes are normally not as strong as their non @-@ tropical counterparts , heavy damage or loss of life can still occur . Tornadoes can also be spawned as a result of eyewall mesovortices , which persist until landfall .

= = Deaths = =

During the last two centuries , tropical cyclones have been responsible for the deaths of about 1 @. @ 9 million people worldwide . It is estimated that 10 @, @ 000 people per year perish due to tropical cyclones . The deadliest tropical cyclone was the 1970 Bhola cyclone , which had a death toll of anywhere from 300 @, @ 000 to 500 @, @ 000 lives .

= = = United States = = =

Before Hurricane Katrina , the average death rate for tropical cyclones in the United States was decreasing . The main cause of storm @-@ related fatalities was shifting away from storm surge and towards freshwater flooding . However , the median death rate per storm had increased through 1979 , with a lull during the 1980 @-@ 1995 period . This was due to greater numbers of people moving to the coastal margins and into harm 's way . Despite advances in warning strategies and reduction in track forecast error , this increase in fatalities is expected to continue for as long as people migrate towards the shore .

= = Reconstruction and repopulation = =

While tropical cyclones may well seriously damage settlement , total destruction encourages rebuilding . For example , the destruction wrought by Hurricane Camille on the Gulf coast spurred redevelopment , greatly increasing local property values . Research indicates that the typical hurricane strike raises real house prices for a number of years , with a maximum effect of between 3 percent to 4 percent three years after occurrence . However , disaster response officials point out that redevelopment encourages more people to live in clearly dangerous areas subject to future deadly storms . Hurricane Katrina is the most obvious example , as it devastated the region that had been revitalized after Hurricane Camille . Many former residents and businesses do relocate to inland areas away from the threat of future hurricanes as well .

In isolated areas with small populations , tropical cyclones may cause enough casualties to contribute to the founder 's effect as survivors repopulate their place . For example , around 1775 , a typhoon hit Pingelap Atoll , and in combination with a subsequent famine , reduced the island 's population to a low level . Several generations after the disaster , as many as 10 % of Pingelapese have a genetic form of color @-@ blindness called achromatopsia . This is due to one of the survivors of the depopulation brought on by the typhoon having a mutated gene , which the population bottleneck caused to be at a higher @-@ than @-@ usual level in succeeding generations .

= = Effects on natural resources = =

= = = Geomorphology = = =

Tropical cyclones reshape the geology near the coast by eroding sand from the beach as well as offshore , rearranging coral , and changing dune configuration onshore . Their rain water gets absorbed into stalagmites within caves , creating a record of past tropical cyclone impacts .

= = = Coastal ridges = = =

Waves and storm surges accompanying tropical cyclones erode undersea sands , erode shell deposits , break off corals from near shore reefs in their paths , and carry all this detritus landwards in a rolling wave of material that is deposited onshore , above highest astronomical tide as a ridge of sand , shell and coral . For example , each severe tropical cyclone (i.e. Category 4 @-@ 5 on the Saffir @-@ Simpson scale) crossing northeast Australia 's tropical coastline since the last significant change in sea levels (about 5000 years ago) has ' emplaced ' such ridges within the coastal landscape forming , in some places , series of ridges and a geomorphological record of highest magnitude cyclones hitting the coast over 3000 ? 5000 years .

Eyewitness accounts verify ridges of this kind are formed by severe tropical cyclones and two clear examples cited are the 18 kilometres (11 mi) long , 35 metres (115 ft) wide , 3 @.@ 5 metres (11 ft) high coral shingle ridge deposited on Funafuti Atoll (Central South Pacific) by Cyclone Bebe in October 1972 , and the large coral shingle ridge deposited on Jaluit Atoll (Marshall Islands) by Typhoon Ophelia in January 1958 . In tropical northeast Australia , an intense tropical cyclone hit in March 1918 (crossing over the town of Innisfail) , at which time there were eyewitness accounts of a 4 @.@ 5 metres (15 ft) to 5 @.@ 1 metres (17 ft) high ridge of pumice being deposited by that cyclone 's surge as it crossed the coast .) .

= = = Limestone cave stalagmites = = =

When tropical cyclones cross land , thin layers of calcium carbonate of unusually ' light ' Oxygen isotope (Oxygen @-@ 18) composition are deposited onto stalagmites in limestone caves up to 300 kilometres (190 mi) from the cyclone 's path .

As the cloud tops of tropical cyclones are high and cold , and their air is humid - their rainwater is ' lighter ' . In other words , the rainfall contains significantly higher quantities of unevaporated Oxygen @-@ 18 than other tropical rainfall . The isotopically lighter rainwater soaks into the ground , percolates down into caves , and , within a couple of weeks , Oxygen @-@ 18 transfers from the water into calcium carbonate , before being deposited in thin layers or ' rings ' within stalagmites . A succession of such events created within stalagmites maintain a record of cyclones tracking within a 300 kilometres (190 mi) radius of caves going back centuries , millennia , or even millions of years .

At Actun Tunichil Muknal cave in central Belize , researchers drilling stalagmites with a computer-controlled dental drill accurately identified and verified evidence of isotopically light rainfall for 11 tropical cyclones occurring over a 23 year period (1978 ? 2001) .

At the Chillagoe limestone caves in northeast Australia (130 kilometres (81 mi) inland from Cairns) researchers identified and matched evidence of isotopically light rainfall with 100 years of cyclone records , and from this have created a record of tropical cyclones from 2004 back to 1200 A.D. (an 800 year record) .

= = = Landscapes = = =

Severe tropical cyclones defoliate tropical forest canopy trees , remove vines and epiphytes from the trees , break tree crown stems , and cause tree falls . The degree of damage they do along their paths , at a landscape level (i.e. > 10 kilometres (6 @.@ 2 mi)) , can be catastrophic yet variable and patchy . Trees break at 42 m / s , regardless of size and type . Stripping trees and scattering forest debris also provides fuel for wildfires , such as a blaze that lasted three months in 1989 and burned 460 square miles (1 @.@ 200 km²) of forest that had been stripped by Hurricane Gilbert .

Wind velocity gradients or horizontal wind shear (size of cyclone , the intensity of cyclone , proximity to the cyclone , and local scale cyclonic convection effects) .

Degree of exposure (windward exposure , leeward acceleration , or local topographic sheltering / shading) ; and

Ecosystem species composition and forest structure

Assessments of cyclone damage done to tropical rainforest landscapes in northeast Australia ,

have produced the following typology for describing and ' mapping ' the variable impacts they have along their paths , as follows :

Severe and extensive closest to the centre of cyclone : impact appears to be multidirectional and is evidenced by crowns of most trees having been broken , smashed or windthrown

Severe and localised closer to the cyclone centre than its edge : direction of the destructive winds is clearly identifiable , and severe canopy disruption is limited to the windward aspect of these forested areas

Moderate canopy disturbance closer to cyclone edge than its centre : most of the tree stems are still standing , with only some treefalls , and most of the damage is the defoliation of the canopy and branch breakage ;

Slight canopy disturbance closest to cyclone edge : occasional stem fall or branch breakage , with most of the damage consisting of loss of foliage on the forest edges only , subsequently followed by leaf damage and heavy leaf litter falls .