

= 1998 North Indian Ocean cyclone season =

The 1998 North Indian Ocean cyclone season was an active season in annual cycle of tropical cyclone formation . The season has no official bounds but cyclones tend to form between April and December . These dates conventionally delimit the period of each year when most tropical cyclones form in the northern Indian Ocean . There are two main seas in the North Indian Ocean ? the Bay of Bengal to the east of the Indian subcontinent and the Arabian Sea to the west of India . The official Regional Specialized Meteorological Centre in this basin is the India Meteorological Department ( IMD ) , while the Joint Typhoon Warning Center releases unofficial advisories . An average of four to six storms form in the North Indian Ocean every season with peaks in May and November . Cyclones occurring between the meridians 45 ° E and 100 ° E are included in the season by the IMD .

With eleven depressions and eight tropical cyclones , this was one of the most active seasons in the ocean along with 1987 , 1996 , and 2005 . The season caused a large loss of life , most of which was from one storm . Over 10 @, @ 000 people were killed in India when Tropical Cyclone 03A brought a 4 @. @ 9 @- @ metre ( 16 ft ) storm surge to the Kathiawar Peninsula , inundating numerous salt mines . Total damages from the storm amounted to Rs . 120 billion ( US \$ 3 billion ) . Tropical Cyclone 01B killed at least 26 people and left at least 4 @, @ 000 fishermen missing in eastern Bangladesh on May 20 . A short lived depression in mid @- @ October killed 122 people after triggering severe flooding in Andhra Pradesh . In November , Tropical Cyclone 06B killed six people and caused property damage worth BTN 880 million ( US \$ 20 @. @ 7 million ) in eastern India . An additional 40 people were killed and 100 fishermen were listed as missing after Tropical Cyclone 07B affected Bangladesh .

= = Season summary = =

The first storm of the season developed on May 18 out of an area of low pressure over the Bay of Bengal . It reached its peak intensity with winds of 130 km / h ( 70 mph ) before making landfall near Chittagong , Bangladesh . The storm dissipated shortly after . Later that month , a short @- @ lived storm developed over the Arabian Sea and dissipated the next day without impacting land . The most intense storm of the season formed in early June off the southwestern coast of India . It slowly traveled towards the west , remaining relatively weak before turning towards the north and intensifying . The storm reached its peak intensity with winds of 195 km / h ( 120 mph ) shortly before making landfall near Porbandar in the Indian state of Gujarat . The cyclone rapidly dissipated on the same day .

After three months of inactivity , five storms developed in late September and October . Two of them strengthened into tropical storms , neither of which impacted land . In early November , the sixth tropical cyclone of the season developed in the Bay of Bengal . The storm quickly developed and reached its peak intensity upon landfall with winds of 155 km / h ( 100 mph ) . The storm rapidly dissipated the same day it made landfall . Shortly after 06B dissipated , the remnants of Tropical Storm Chip triggered the development of a new cyclone over the Bay of Bengal . The storm tracked along the edge of a subtropical ridge , reaching its peak intensity over open waters with winds of 140 km / h ( 80 mph ) . The cyclone entered an area of higher wind shear shortly after and rapidly weakened before making landfall . Then it dissipated in Bangladesh . The final cyclone of the season developed in the Arabian Sea during mid @- @ December . It reached its peak intensity with winds of 120 km / h ( 75 mph ) before weakening due to strong wind shear . It made landfall in Oman on December 17 as a minimal tropical storm shortly before dissipating .

= = Storms = =

= = = Severe Cyclonic Storm BOB 01 ( 01B ) = = =

The first cyclone in the region developed as a tropical disturbance on May 13 over the southern Bay of Bengal to the southeast of Sri Lanka . With little development , the disturbance initially traveled towards the north @-@ northeast before turning west . On May 16 , the system slowed down near the southeastern coast of India and began to turn towards the northeast once more . At 0700 UTC on May 17 , the Joint Typhoon Warning Center ( JTWC ) issued a Tropical Cyclone Formation Alert ( TCFA ) . Shortly after , the India Meteorological Department ( IMD ) declared that the disturbance developed into Depression BOB 01 . A second TCFA was issued later that day as a new circulation associated with the system developed further towards the northeast . At 0600 UTC on May 18 , the first advisory on Tropical Cyclone 01B was issued by the JTWC . At the time of the advisory , winds were estimated at 55 km / h ( 35 mph ) . The IMD also upgraded BOB 01 to a deep depression at this time .

Continuing on a northeasterly track , BOB 01 gradually intensified as it neared Bangladesh . About 12 hours after being designated a cyclone , it strengthened to the equivalent of a tropical storm . The winds had reached 65 km / h ( 40 mph ) . At that time , it was located 555 km ( 345 mi ) south @-@ southeast of Chittagong . Early on May 20 , BOB 01 reached its peak intensity as a severe cyclonic storm with winds of 110 km / h ( 70 mph ) and a barometric pressure of 972 mbar ( hPa ) . The JTWC assessed the storm to have peaked with winds of 130 km / h ( 80 mph ) , equivalent to a Category 1 hurricane on the Saffir ? Simpson Hurricane Scale . An eye developed and the system made landfall several hours later near Chittagong . After making landfall , the storm quickly weakened , dissipating later that day .

Ahead of the storm , officials in Bangladesh relocated an estimated 650 @,@ 000 people , resulting in a lower loss of life . But BOB 01 adversely affected low @-@ lying areas , destroying 6 @,@ 000 homes and damaging another 9 @,@ 945 . It produced a storm surge of 1 @.@ 8 to 3 m ( 6 to 10 ft ) , inundating coastal towns . A total of 1 @,@ 876 hectares ( 4 @,@ 635 acres ) of salt fields and 25 hectares ( 61 acres ) of shrimp farms were damaged . At least 35 people were killed by the storm and 504 others were injured . Five of the fatalities occurred in Chittagong and another five on an island in the Cox 's Bazar District . Sixteen more of the fatalities occurred when three fishing vessels sank near Chittagong . Additionally , an estimated 4 @,@ 000 fishermen were listed as missing at sea . A total of 108 @,@ 440 people were affected in Bangladesh . An oil tanker anchored near Chittagong was tossed by rough seas into another vessel and sustained significant damage . Large quantities of crude oil spilled into the water due to a hole in the hull of the ship . Both of the ships involved in the incident were owned by the Bangladesh Shipping Corporation . Following the impacts of the storm , the United Nations Educational , Scientific and Cultural Organization provided \$ 40 @,@ 000 in immediate funds for rehabilitation efforts . The Government of Germany also provided \$ 270 @,@ 166 to the affected population . The International Federation of Red Cross and Red Crescent Societies donated about \$ 1 @.@ 2 million to Bangladesh .

= = = Depression ARB 01 ( 02A ) = = =

On May 27 , an area of low pressure developed over the central Arabian Sea . Early the next day , the JTWC issued their first advisory on Tropical Cyclone 02A while the system was located about 740 km ( 460 mi ) south of Masirah Island . The IMD only briefly monitored the system as a weak depression , designating it as ARB 01 . Upon being classified a tropical cyclone , 02A reached its peak intensity . The speed of its winds was 65 km / h ( 40 mph ) . Soon , it began to dissipate due to increasing vertical wind shear . The center of circulation quickly became devoid of convection . The storm weakened below tropical storm intensity later that day before dissipating on May 29 over open waters .

= = = Extremely Severe Cyclonic Storm ARB 02 ( 03A ) = = =

On June 1 , an area of low pressure developed over the Laccadive Islands . Two days later , the JTWC issued a TCFA for the system as it became better organized . Early on June 4 , the JTWC issued its first advisory on Tropical Cyclone 03A . Around the same time , the IMD began monitoring

the system as Depression ARB 02 . Shortly after , the depression was upgraded to a deep depression and further strengthened into a cyclonic storm the following day . The small storm moved slowly towards the west and weakened as wind shear began to increase . The storm weakened below tropical storm intensity later that day and the initial final advisory was issued . However , the system redeveloped and advisories resumed the next day . The storm gradually intensified as it moved towards the northwest . Dvorak satellite intensity estimates on June 6 reached T4.0 , corresponding to an intensity of 120 km / h ( 75 mph ) . The IMD also marked the increase in intensity , upgrading ARB 02 to a severe cyclonic storm . Around this time , the storm began to turn towards the north and accelerate due to an approaching mid @-@ level trough . As the storm neared the Indian coastline , an eye developed and the storm strengthened into the equivalent of a major hurricane with winds reaching 185 km / h ( 115 mph ) . The IMD assessed the storm to be a very severe cyclonic storm at this time , with winds up to 165 km / h ( 105 mph ) and a barometric pressure of 958 mbar ( hPa ) . After slightly weakening early on June 9 , 03A re @-@ strengthened , attaining its peak intensity with winds of 195 km / h ( 120 mph ) . Then it made landfall near Porbandar in the Indian state of Gujarat between 0100 and 0200 UTC . The storm weakened following landfall and the JTWC issued their final advisory later that day . The IMD continued to monitor ARB 02 until June 10 , by which time it had weakened to a depression before dissipating .

Tropical Cyclone 03A brought a large storm surge of 4 @. @ 9 m ( 16 ft ) which devastated coastal communities and salt mines . An estimated 10 @, @ 000 people were killed by the storm , many of whom were salt mine workers who did not own a radio and received little or no warning of the cyclone . The large loss of life was partially attributed to contractors who wanted to continue making profits and did not inform their workers of the approaching storm . Also , the region had witnessed only 17 cyclones since 1890 , all of which were weaker than 03A . As a result , its vulnerability was miscalculated by the local population and the disaster management administration . Power supply to numerous residences was lost due to the storms high winds . A microwave tower in Porbandar collapsed , causing widespread disruption in telecommunication . Hundreds of other power transmission towers also fell , causing an estimated loss of Rs 10 billion for the Gujarat Electricity Board . At least 893 people were injured by the storm and over 11 @, @ 000 animals were killed . Over 162 @, @ 000 structures were damaged or destroyed throughout the affected area and damages amounted to Rs . 120 billion ( US \$ 3 billion ) . Over the next one month , insurance companies had lost approximately Rs . 13 billion ( US \$ 266 @. @ 5 million ) . The remnants of the storm produced heavy rains over Pakistan which electrocuted 12 people . In the wake of the storm , the United States Government provided US \$ 25 @, @ 000 for rehabilitation of the affected population . The Government of Denmark also contributed \$ 72 @, @ 992 in funds for relief efforts . The Gujarat government deployed approximately 330 medical teams to the affected areas . Local aid , amounting to Rs 1 billion ( US \$ 20 @. @ 5 million ) was provided to assist victims .

= = = Deep Depression BOB 02 = = =

On June 13 , the IMD began monitoring a depression over the central Bay of Bengal . Tracking towards the west , the depression intensified into a deep depression , peaking with winds of 55 km / h ( 35 mph ) and a minimum pressure of 992 mbar ( hPa ) . Around 1500 UTC on June 14 , the deep depression made landfall near Visakhapatnam . Shortly thereafter , it weakened to a depression and dissipated early the following day .

= = = Depression ARB 03 ( 04A ) = = =

In late September , an area of low pressure developed over the Arabian Sea within an east @-@ west oriented surface trough while located about 740 km ( 460 mi ) west of Mumbai , India . The system gradually intensified as it moved slowly towards the west . Early on September 30 , the JTWC issued its first advisory on Tropical Cyclone 04A . Its winds peaked at 65 km / h ( 40 mph ) . Located within an area of moderate wind shear , the storm quickly weakened and dissipated early on October 1 .

== Deep Depression ARB 04 ==

On October 8 , the IMD began monitoring a tropical depression located about 835 km ( 520 mi ) southwest of Mumbai . The depression was briefly classified as a deep depression with winds of 55 km / h ( 35 mph ) and a minimum pressure of 998 mbar ( hPa ) as it moved towards the west @-@ northwest . Shortly after reaching its peak intensity , the depression weakened . The last advisory was issued the next day while the storm was over open waters .

== Deep Depression BOB 03 ==

On October 13 , the IMD began monitoring a tropical depression off the eastern coast of India . The depression remained relatively weak , with winds peaking at 45 km / h ( 30 mph ) before the storm made landfall near Narsapur in the Andhra Pradesh early on October 14 . The depression dissipated shortly after landfall . Heavy rains produced by the depression damaged croplands and property . Twenty @-@ four @-@ hour rainfall totals reached 110 mm ( 4 @. @ 3 in ) in localized areas , triggering flash floods in areas severely impacted by another system a week earlier . In Hyderabad , schools and government offices were closed . During the morning of October 14 , overflow from a dam inundated the Srisailem power house , forcing officials to shut down the plant . Numerous highways were also closed due to flowing water . The following day , the water level of the dam continued to rise , leading to the evacuation of nearly 53 @, @ 000 residents in the area . Throughout Andhra Pradesh , flooding from the depression resulted in 122 fatalities .

== Cyclonic Storm ARB 05 ( 05A ) ==

The IMD began monitoring an area of low pressure over the Laccadive Islands on October 10 . The low traveled towards the northwest with little development . On October 15 , the JTWC issued a TCFA as the system became better organized . Although wind shear increased , the first advisory was issued the next day . With minimal convection , the storm never intensified past 65 km / h ( 40 mph ) . The system traveled towards the northeast and weakened due to strong wind shear . On October 17 , the storm fell below tropical storm status and made landfall on the Kathiawar Peninsula , near the same area where 03A made landfall in early June . The storm dissipated shortly after landfall .

As the storm neared land , officials in Gujarat evacuated hundreds of residents from coastal areas . Due to the low @-@ intensity of the storm , no damage was reported on land and only light rain fell . However , offshore , more than 250 people were reported as missing when contact was lost with numerous fishing vessels . One @-@ hundred @-@ twenty people on twelve ships from Satpathy village were among the missing . One of the ships capsized ; however , the crew of 12 swam to shore . One boat from Vasai carrying 20 people was also missing . Ten fishermen from Colaba were reported as missing , three of which later swam to shore . The Indian Coast Guard immediately dispatched search and rescue ships and naval helicopters to find the missing people .

== Deep Depression BOB 04 ==

Early on October 28 , the IMD began monitoring a tropical depression located about 555 km ( 345 mi ) south @-@ southeast of Visakhapatnam in the Andhra Pradesh . The depression strengthened to a deep depression later that day with winds peaking at 55 km / h ( 35 mph ) before undergoing a weakening trend . The depression dissipated the next day near the Andhra Pradesh coastline . The outer bands of the depression produced light rainfall over the coast of Andhra Pradesh .

== Very Severe Cyclonic Storm BOB 05 ( 06B ) ==

On November 10 , an area of low pressure developed over the Bay of Bengal within a monsoonal

trough . Moving towards the northwest , the low gradually developed and the JTWC issued a TCFA early on November 13 . The next day , the first advisory on Tropical Cyclone 06B was issued . A brief period of rapid development took place as the storm strengthened just below Category 1 status . Shortly before making landfall near Visakhapatnam , 06B reached its peak intensity with winds of 155 km / h ( 100 mph ) . At this time , the IMD classified the cyclone as a Very Severe Cyclonic Storm and reported that it had a 60 km ( 37 mi ) wide eye . Rapid weakening followed shortly after landfall and the storm dissipated early on November 16 .

Major crop losses , property damage , and six fatalities were reported from the affected areas . Four of the fatalities were in Visakhapatnam and the other two were in east Godavari . Hundreds of trees and power lines had fallen . At least 116 @, @ 000 acres ( 470 km<sup>2</sup> ) of cropland and more than 2 @, @ 000 homes were damaged . Waves produced by the storm at Visakhapatnam were recorded up to 5 @. @ 74 m ( 18 @. @ 8 ft ) . The storm dropped rainfall in excess of 100 mm ( 3 @. @ 9 in ) throughout the region . Damages from the storm were estimated at BTN 880 million ( US \$ 20 @. @ 7 million ) .

= = = Very Severe Cyclonic Storm BOB 06 ( 07B ) = = =

Tropical Storm Chip dissipated over Vietnam on November 15 , 1998 . The remnants of Chip crossed the Malay Peninsula on November 17 and entered the Bay of Bengal . The system moved along the edge of a subtropical ridge within an area of strong wind shear . After turning towards the northwest , the low entered an area of lower wind shear and began to become better organized . Between November 18 and 20 , the JTWC issued three TCFA's before issuing first advisory on Tropical Cyclone 07B early on November 20 . While recurving towards the northeast , 07B reached its peak intensity on November 22 with winds of 140 km / h ( 85 mph ) . Shortly after reaching peak intensity , the cyclone entered an area of strong wind shear which caused convection associated with the storm to become dislocated from the center . This caused 07B to rapidly weaken before making landfall to the west of Chittagong , Bangladesh . It dissipated on November 23 .

Tropical Cyclone 07B produced a storm surge of 1 @. @ 2 to 2 @. @ 4 m ( 4 to 8 ft ) which inundated coastal areas of Bangladesh , killing 40 people and leaving at least 103 others missing . Winds gusting up to 80 km / h ( 47 mph ) and heavy rains impacted a large area of the country . A large area of rice paddies was lost due to flooding and numerous homes were buried in mud . A total of 5 @, @ 780 families were left homeless . About 8 @, @ 755 homes sustained severe damage and an estimated 300 @, @ 000 people were affected by 07B .

= = = Severe Cyclonic Storm ARB 06 ( 08A ) = = =

On December 7 , a broad area of low pressure developed near southern India within an area of moderate wind shear . On December 11 , the JTWC issued a TCFA for the system as it drifted towards the northwest over the Arabian Sea . Two days later , the first advisory on Tropical Cyclone 08A was issued . The large cyclone slowly organized and intensified as it turned towards the north . By December 15 , the storm reached its peak intensity with winds of 120 km / h ( 75 mph ) . Then , it turned towards the west into an area of higher wind shear . The cyclone gradually weakened as it traveled towards Oman . It made landfall in the country on December 17 with winds of 65 km / h ( 40 mph ) and dissipated later that day . Although it made landfall as a tropical storm , no known damage was reported . The remnants of the storm sank a ship , killing 18 fishermen .

= = Season effects = =

This is a table of the storms in 1998 and their landfall ( s ) , if any . Deaths in parentheses are additional and indirect ( an example of an indirect death would be a traffic accident ) , but are still storm @-@ related .