= Meteorological history of Hurricane Patricia =

Hurricane Patricia was the most intense tropical cyclone ever recorded in the Western Hemisphere and the second @-@ most intense worldwide in terms of barometric pressure . It also featured the highest one @-@ minute maximum sustained winds ever recorded in a tropical cyclone . Originating from a sprawling disturbance near the Gulf of Tehuantepec in mid @-@ October 2015 , Patricia was first classified a tropical depression on October 20 . Initial development was slow , with only modest strengthening within the first day of its classification . The system later became a tropical storm and was named Patricia , the twenty @-@ fourth named storm of the annual hurricane season . Exceptionally favorable environmental conditions fueled explosive intensification on October 22 . A well @-@ defined eye developed within an intense central dense overcast and Patricia grew from a tropical storm to a Category 5 hurricane in just 24 hours ? a near @-@ record pace . The magnitude of intensification was poorly forecast and both forecast models and meteorologists suffered from record @-@ high prediction errors .

On October 23 , two Hurricane Hunter missions both revealed the storm to have acquired maximum sustained winds of 205 mph (335 km / h) and a pressure of 879 mbar (hPa ; 25 @.@ 96 inHg) . Since the peak intensity was assessed to have occurred between the missions , the National Hurricane Center ultimately estimated Patricia to have acquired winds of 215 mph (345 km / h) and pressure of 872 mbar (hPa ; 25 @.@ 75 inHg) . This ranked it just below Typhoon Tip of 1979 as the most intense tropical cyclone on record . Patricia 's exceptional intensity prompted the retirement of its name in April 2016 . Late on October 23 , Patricia made landfall in a significantly weakened state near Cuixmala , Jalisco . Despite weakening greatly , it was the strongest landfalling hurricane on record along the Pacific coast of Mexico with winds estimated at 150 mph (240 km / h) . Interaction with the mountainous terrain of Mexico induced dramatic weakening , faster than the storm had intensified . Within 24 hours of moving ashore , Patricia degraded into a tropical depression and dissipated soon thereafter late on October 24 .

= = Origins = =

On October 11 , 2015 , an area of disturbed weather traversed Central America and emerged over the eastern Pacific Ocean . The disturbance moved slowly over the next few days , and coalesced into a Central American gyre ? a broad monsoonal circulation . A tropical wave crossed the Caribbean Sea and eventually reached Central America on October 15 ; the two systems merged the following day near the Gulf of Tehuantepec . A concurrent Tehuantepec gap wind event on the western side of the gyre , complimented by anticyclonic flow behind a cold front , enhanced vorticity and spurred the formation of an elongated area of low pressure on October 17 . The broad system spanned several hundred miles from the Yucatán Peninsula into the eastern Pacific . A large , disorganized area of convection ? showers and thunderstorms ? accompanied the system , increasing in coverage substantially throughout the day . A strong pulse in the Madden ? Julian oscillation ? a propagating climate pattern associated with increased tropical cyclogenesis ? may have aided in creating favorable conditions for further development .

Moving south of the Gulf of Tehuantepec on October 18 , the system consolidated and developed a small , defined circulation . Associated convection became more concentrated around its center . Another gap wind event soon impacted the system , temporarily delaying development of the disturbance into a tropical depression . The low soon relocated to the northeast , aligning itself east of the gap wind event which aided in development . A small , well @-@ defined circulation formed by early on October 20 within a broader cyclonic circulation . With increasing deep convection , the system is estimated to have become a tropical depression , assigned the identifier Twenty @-@ E , by 06 : 00 UTC . Upon its designation , the depression was situated roughly 205 mi (335 km) south @-@ southeast of Salina Cruz , Mexico .

= = Rapid intensification = =

Located south of a mid @-@ level ridge and the continuing gap wind event , the nascent depression moved slowly west @-@ southwest on October 20 . Initial environmental conditions were modestly favorable , allowing for steady intensification . The depression achieved tropical storm status by 00 : 00 UTC on October 21 ; the National Hurricane Center (NHC) assigned it the name Patricia accordingly . Throughout much of October 21 , Patricia moved through a region of drier , more stable air and over relatively cool sea surface temperatures . Both of these factors served to delay intensification of the cyclone . The system unraveled substantially , with banding features dissipating and the low @-@ level circulation becoming poorly defined . Once clear of the hindering factors , convection blossomed over Patricia late on October 21 and a central dense overcast formed over the center . Simultaneously , the storm accelerated west @-@ northwest .

Exceptionally favorable atmospheric conditions , consisting of little wind shear , anomalously high sea surface temperatures of 87 to 88 ° F (30 @.@ 5 to 31 ° C) , and high moisture levels yielded an environment highly conducive to rapid intensification . Consequently , Patricia commenced explosive intensification late on October 21 . Patricia reached hurricane strength shortly after 00 : 00 UTC on October 22 , featuring prominent outflow , well @-@ defined banding features , and a developing eye . Upon becoming a hurricane , Patricia was located 230 mi (370 km) south of Acapulco , Mexico . In the following 12 hours , a well @-@ defined 12 mi (19 km) wide eye formed within a ring of intense convection ? with cloud tops of ? 80 to ? 90 ° C (? 112 to ? 130 ° F) ? forming " an almost perfectly symmetric [central dense overcast] " . Data from NOAA Hurricane Hunters investigating the cyclone indicated Patricia to have reached Category 4 status on the Saffir ? Simpson hurricane wind scale by 18 : 00 UTC ; maximum sustained winds were estimated at 130 mph (215 km / h) alongside a barometric pressure of 957 mbar (hPa ; 28 @.@ 26 inHg) at this time .

= = = Forecast errors = = =

The rapid intensification of Patricia was well @-@ anticipated but poorly forecast . Meteorologists at the NHC indicated the possibility of such in the system 's first advisory as a tropical depression . They noted the only inhibiting factor would be how quickly the storm could organize an inner core . Just before the onset of rapid intensification , the agency was unable to utilize the Statistical Hurricane Intensity Prediction Scheme rapid intensification guidance due to technical errors . This likely contributed to even greater errors in the agency 's forecast . Initial forecasts were consistently conservative with intensity and dramatic strengthening was not explicitly shown until rapid intensification was already underway .

At 03 : 00 UTC on October 22 , the NHC forecast Patricia to achieve major hurricane status in 36 hours ; less than 15 hours later , the system exceeded their forecast peak . Strengthening into a Category 5 hurricane was not forecast at all until Patricia had already reached such intensity , although in the intermediate advisory immediately before Patricia 's upgrade to Category 5 , the NHC noted that " Patricia could become a category 5 hurricane overnight " . This trend continued throughout the rapid intensification period , resulting in some of the largest errors on record through 48 hours ; they were the worst @-@ ever for the Eastern Pacific since the NHC took over operations for the basin in 1988 . All forecast models saw enormous errors , most of which performed worse than the official NHC forecasts . No model accurately prognosticated the magnitude nor rate of the intensification . The EMXI ? an output from the European Centre for Medium @-@ Range Weather Forecasts ? saw the largest average error with 98 @.@ 5 mph (158 @.@ 5 km / h) at 48 hours .

= = Peak strength = =

During the overnight hours of October 22 ? 23 , Patricia turned northwest and decelerated slightly as it reached the western edge of the mid @-@ level ridge . Rapid development continued into October 23 , with the hurricane reaching Category 5 status by 00 : 00 UTC , with winds estimated at 175 mph (280 km / h) . Convection cooled even further , with cloud tops colder than ? 130 ° F (? 90 ° C) surrounding an 8 mi (13 km) wide eye by 03 : 00 UTC . In a 24 @-@ hour span , Patricia 's

winds increased by 120 mph (195 km / h) and its central pressure fell by 95 mbar (hPa ; 2 @.@ 81 inHg) . Around 06 : 00 UTC , an Air Force Reserve reconnaissance aircraft measured flight @-@ level winds of 221 mph (356 km / h) and the aircraft 's stepped frequency microwave radiometer (SFMR) observed surface winds of 210 mph (340 km / h) . Furthermore , the final dropsonde observation from that mission at about 06 : 45 UTC indicated a central pressure of 879 mbar (hPa ; 25 @.@ 96 inHg) . Rapid development continued after the aircraft left the hurricane , as the three pressure readings during the mission indicated that the pressure fell at a rate 7 mbar (hPa ; 0 @.@ 21 inHg) per hour . Their findings also revealed an extraordinarily tight pressure gradient of 24 mbar (hPa ; 0 @.@ 71 inHg) per nautical mile , among the steepest gradients on record .

Based on continued improvement of the hurricane 's satellite appearance and the aforementioned pressure drop during the early morning reconnaissance mission , Patricia is assessed to have achieved its peak intensity around 12 : 00 UTC on October 23 ; the storm was situated about 150 mi (240 km) southwest of Manzanillo , Mexico . Maximum winds are estimated at 215 mph (345 km / h) alongside a pressure of 872 mbar (hPa ; 25 @.@ 75 inHg) , making Patricia the second @-@ most intense tropical cyclone ever observed . It is possible that Patricia exceeded the all @-@ time record of 870 mbar (hPa ; 25 @.@ 69 inHg) set by Typhoon Tip in 1979 given the rate of deepening observed during the early morning mission ; due to a lack of direct observation at the time of Patricia 's peak , no concrete determination of such can be made . The violent , compact core of Patricia was roughly 25 mi (40 km) wide with the radius of maximum winds extending only 7 mi (11 km) .

Little change in strength took place for the next six hours ; a shortwave trough crossing the Baja California Peninsula turned Patricia to the northeast and induced acceleration . Another reconnaissance mission around 18 : 00 UTC recorded a central pressure of 879 mbar (hPa ; 25 @.@ 96 inHg) . The aircraft was battered by severe turbulence (the result of updrafts and downdrafts) and the crew experienced maximum g @-@ forces of + 3 @.@ 0 and -1.5 .

= = Landfall and dissipation = =

Late on October 23 , radar imagery depicted the formation of a secondary outer eyewall , indicative of an eyewall replacement cycle . By 20 : 30 UTC , the final pass by reconnaissance , the hurricane 's flight @-@ level winds fell by 60 mph (95 km / h) and its central pressure rose at 8 mbar (hPa ; 0 @.@ 24 inHg) per hour . Coinciding with the eyewall replacement cycle was an increase in southwesterly wind shear , a factor that further accelerated Patricia 's degradation . The hurricane 's eye soon became cloud @-@ filled and rapid weakening ensued at an unprecedented pace .

At 23 : 00 UTC , the cyclone made landfall at Cuixmala in the municipality of La Huerta , Jalisco ? about 55 mi (85 km) west @-@ northwest of Manzanillo ? with winds of 150 mph (240 km / h) and an estimated pressure of 932 mbar (hPa ; 27 @.@ 49 inHg) . This made Patricia the strongest hurricane to strike Mexico 's Pacific coast , exceeding an unnamed storm in 1959 and Madeline in 1976 (the latter of which has not been reanalyzed) . An automated station in Cuixmala measured a pressure of 934 @.@ 2 mbar (hpa ; 27 @.@ 54 inHg) . Storm chasers in Emiliano Zapata , just inside the eye of Patricia , measured a pressure of 937 @.@ 8 mbar (hPa ; 27 @.@ 70 inHg) . Their observations also indicated a pressure gradient of 11 mbar (hPa ; 0 @.@ 32 inHg) per nautical mile . Operationally , Patricia was thought to have made landfall as a Category 5 hurricane with winds of 165 mph (270 km / h) and a pressure of 920 mbar (hPa ; 27 @.@ 17 inHg) .

Patricia 's winds at landfall are relatively uncertain , and the 150 mph (240 km / h) value is based upon the Knaff @-@ Zehr @-@ Courtney pressure @-@ wind relationship and an extrapolation of a 54 mbar (hPa ; 1 @.@ 59 inHg) filling using the Dvorak Technique . An additional equation stemming from work by Willoughby (1993) yielded a landfall intensity of 147 mph (237 km / h) . A NOAA automated weather station at the Chamela @-@ Cuixmala Biosphere Reserve , at an elevation of 280 ft (85 m) , recorded sustained winds of 185 mph (298 km / h) and a maximum gust of 211 mph (340 km / h) . Further raw data from this station indicated unrealistically high sustained winds of 266 mph (428 km / h) and a maximum gust of 1 @,@ 138 mph (1 @,@ 831 km / h) . Based on the station 's distance from Patricia 's eye , outside the radius of maximum winds

, the observations from this station are considered unreliable . The highest reliably measured winds of 98 mph (158 km / h) occurred in Pista between 22 : 30 and 23 : 00 UTC on October 23 before the anemometer failed .

Even faster weakening ensued through October 24 as the hurricane traversed the Sierra Madre mountains ; its eye disappeared from satellite imagery within hours of moving ashore . The system weakened below hurricane strength by 03 : 00 UTC as it passed west of Guadalajara . Patricia accelerated inland between a trough over Northwestern Mexico and the ridge over the Gulf of Mexico . Convection dramatically decreased in organization and the low- and mid- to upper @-@ level circulation centers of the cyclone soon decoupled . The system degraded into a tropical depression by 12 : 00 UTC as little organized convection remained , and the storm dissipated shortly thereafter over central Mexico . Unimpeded by the mountains of Mexico , the mid- to upper @-@ level circulation of Patricia , accompanied by considerable moisture , continued northeast and interacted with a cold front over the western Gulf of Mexico . The new system produced flooding rains across large areas of Arkansas , Louisiana , Mississippi , and Texas .

= = Records = =

With maximum sustained winds of 215 mph (345 km / h) and a minimum pressure of 872 mbar (hPa ; 25 @.@ 75 inHg) , Hurricane Patricia is the second @-@ most intense tropical cyclone ever observed , just shy of Typhoon Tip in 1979 which had a minimum pressure of 870 mbar (hPa ; 25 @.@ 69 inHg) . It is also the strongest tropical cyclone ever recorded in the Western Hemisphere . It exceeded the previous sustained wind record of 190 mph (305 km / h) set by Hurricane Allen in 1980 and the pressure record of 882 mbar (hPa ; 26 @.@ 05 inHg) set by Hurricane Wilma in 2005 , both in the Atlantic basin . In the Eastern Pacific basin , north of the equator and east of the International Dateline , the previous basin record @-@ holder was Hurricane Linda in 1997 with winds of 185 mph (295 km / h) and a pressure of 902 mbar (hPa ; 26 @.@ 64 inHg) . Reconnaissance also found a pressure gradient of 24 mbar (hPa ; 0 @.@ 71 inHg) per nautical mile early on October 23 , among the steepest gradients ever observed in a tropical cyclone .

On a global scale , Patricia 's one @-@ minute maximum sustained winds rank as the highest ever reliably observed or estimated globally in a tropical cyclone , surpassing Typhoon Haiyan of 2013 , although the intensity of Haiyan was only estimated via satellite imagery (T8.0 , the highest rating on the Dvorak scale) . Since no aircraft reconnaissance was available during Haiyan , the record is uncertain and comparing the intensities of the two storms is problematic . According to the World Meteorological Organization , Typhoon Nancy of 1961 produced the highest sustained winds on record at 215 mph (345 km / h) ; however , it is widely accepted that Western Pacific reconnaissance during the 1940s to 1960s overestimated cyclone intensity and Nancy 's record is considered questionable . The most powerful wind gust produced by a tropical cyclone , as well as the highest non @-@ tornadic winds ever recorded , is still retained by Cyclone Olivia in 1996 : 253 mph (407 km / h) was observed on Barrow Island , Western Australia .

The magnitude of Patricia 's rapid intensification is among the fastest ever observed . In a 24 @-@ hour period , 06 : 00 ? 06 : 00 UTC October 22 ? 23 , its maximum sustained winds increased from 85 mph (140 km / h) to 205 mph (335 km / h) . This represents a record increase of 120 mph (195 km / h) . During the same period , Patricia 's central pressure fell by 95 mbar (hPa ; 2 @.@ 81 inHg) . This fell just short of the world @-@ record intensification set by Typhoon Forrest in 1983 , which featured a pressure drop of 100 mbar (hPa ; 2 @.@ 95 inHg) in just under 24 hours . With a pressure of 932 mbar (hPa ; 27 @.@ 52 inHg) , Patricia is the strongest landfalling Pacific hurricane on record . The previous record was 941 mbar (hPa ; 27 @.@ 73 inHg) set by Hurricane Odile in 2014 . Similarly , the hurricane featured the fastest weakening while still over water in NHC 's area of responsibility , with a pressure rise of 54 mbar (hPa ; 1 @.@ 59 inHg) in the five hours before it made landfall . Furthermore , a dropsonde observed a 700 mbar height temperature of 32 @.@ 2 ° C (90 @.@ 0 ° F) in the eye of Patricia . This is the warmest temperature ever observed in a tropical cyclone 's eye worldwide .