= Hurricane Epsilon =

Hurricane Epsilon was the final of fifteen hurricanes within the record @-@ breaking 2005 Atlantic hurricane season . Originating from a cold front beneath an upper @-@ level low , Epsilon formed on November 29 about 915 mi (1470 km) east of Bermuda . Initially , the National Hurricane Center (NHC) forecast the storm to transition into an extratropical cyclone within five days , due to conditions unfavorable for significant intensification . Epsilon continually defied forecasts , at first due to an unexpected loop to the southwest , and later due to retaining its strength despite cold waters and strong wind shear .

On December 1 , Epsilon began a northeast motion due to an approaching trough , and the next day it attained hurricane status . After turning to the east , it developed characteristics of an annular hurricane , meaning it had a circular eye , a ring of convection , and had few fluctuations in its intensity . On December 5 Epsilon attained peak winds of 85 mph (140 km / h) , and the next day it turned to the south and southwest . Late on December 7 , the winds dropped below hurricane status for the first time in five days , making Epsilon the longest @-@ lasting December hurricane on record . Stronger wind shear caused rapid weakening , and the storm could no longer be classified as a tropical cyclone late on December 8 . The next day the remnant circulation of Epsilon dissipated .

= = Formation and naming = =

On November 27 , a surface storm with gale @-@ force winds developed beneath an upper @-@ level low pressure area , about 1150 mi (1850 km) east of Bermuda . At the time , a cold front extended eastward from the surface storm toward the eastern Atlantic Ocean , north of Tropical Storm Delta . By that time , tropical cyclone forecast models anticipated the possible development of a subtropical cyclone , and although they were inconsistent , National Hurricane Center (NHC) specialist Eric Blake stated , " blocking at high latitudes seems to favor another subtropical cyclone effort . " The blocking referred to a ridge stretching across the northern Atlantic . The surface storm gradually separated from the frontal zone , but initially its convection , or thunderstorm activity , was sparse and poorly organized .

The NHC introduced the system in its tropical weather outlook on November 28 , with the possibility of subtropical or tropical development noted . It moved slowly westward , becoming better organized , and by late that day resembled a subtropical cyclone ; however , as it was still connected to the cold front , it could not have been classified as such . Early on November 29 , an area of deep convection developed and organized over the surface center when it was about 915 mi (1470 km) east of Bermuda . The NHC accordingly assessed the system as developing into a tropical storm , designating it with the Greek letter Epsilon .

= = Tropical storm intensity = =

Operationally , the NHC did not initiate advisories until 1500 UTC on November 29 , about nine hours after it actually developed . By that time , the convection had wrapped into a ring 45 mi (72 km) in diameter . In the first advisory on Epsilon , the NHC forecast steady strengthening to near hurricane status due to marginally favorable conditions , followed by extratropical transition within five days ; an alternate possibility was Epsilon being absorbed by a larger extratropical storm . The storm moved westward after its development with a persistent ridge to its north . Initially , Epsilon was embedded beneath an upper @-@ level low that provided an area of low wind shear and instability . An eye @-@ like feature briefly developed in the center of the convection , although the thunderstorms waned late on November 28 due to restricted inflow . However , banding features and outflow improved at the same time .

By November 30 , the NHC anticipated extratropical transition to occur within two days , although some strengthening was still expected . That day , there was an increase in convection over the center and the development of a ragged eye @-@ feature . The winds briefly increased to 65 mph (

105 km / h) , although the intensity of the thunderstorms diminished . Initially Epsilon was predicted to continue westward and eventually turn to the north and northeast . Instead , it turned toward the southwest and executed a cyclonic loop ; the unexpected motion caused larger than normal errors in the extended track forecast . As it moved to the south , the storm crossed over an area of warmer water temperatures , and the NHC remarked that " just a modest increase in convection [would be] needed to make Epsilon a hurricane . " At the time , forecasters assessed the winds in Epsilon to be around 70 mph (115 km / h) , although in a post @-@ season re @-@ analysis it was found to have been 10 mph (15 km / h) weaker . Late on November 30 , Epsilon made its closest approach to Bermuda , passing about 645 miles (1045 km) east @-@ southeast of the island .

Tropical Storm Epsilon began its motion to the east and northeast on December 1 , due to an approaching trough . Its structure became that of a " shallow hybrid @-@ type tropical cyclone " , and an eye @-@ feature again developed within the convection . At the time , the NHC and several computer models anticipated extratropical transition within 36 hours as it accelerated northeastward near the Azores . However , four computer models predicted an alternate scenario , and forecaster Stacy Stewart stated such transition would only occur " barring any southward motion over warmer water that would prolong both the lifetime of Epsilon and the 2005 Atlantic hurricane season . " As it continued northeastward , the storm separated from upper @-@ level low it was previously beneath . After a decrease in convection , the thunderstorm activity again increased over the center , and there were more banding features . Despite moving over slightly cooler water temperatures , Epsilon attained hurricane status late on December 2 , following the development of a well @-@ defined eye 29 miles (46 km) in diameter .

= = Peak strength and hurricane status = =

A few hours after reaching hurricane status , the NHC thought Epsilon reached peak winds , as the storm was about to move over cooler water temperatures . Additionally , the hurricane was expected to stall near the Azores , in contrast to the original forecast of continued acceleration to the northeast . On December 3 it turned due eastward , still maintaining an eye , modest amounts of convection , and outflow . Despite moving into an area of cooler waters and generally unfavorable atmospheric conditions , Epsilon retained its hurricane status ; the only entity supporting its intensity was its warm upper @-@ level temperature . By late on December 3 , its presentation was described as " remarkably well @-@ organized for a hurricane at high latitude in December ... embedded in a strong upper @-@ level westerly wind environment and moving over [70 ? 72 ° F (21 ? 22 ° C)] water . "

As it continued eastward , Epsilon developed characteristics of an annular hurricane ; such cyclones , more often found in the deep tropics with greater intensity , have circular eyes , surrounded by a nearly uniform ring of convection and a general lack of thunderstorms outside the ring . For several days , the intensity fluctuated in a narrow range , and although Epsilon was briefly downgraded to tropical storm status on December 4 , the NHC assessed it as remaining a hurricane . After it was thought to have weakened , the eye became more symmetric as the ring of convection became stronger . The hurricane remained difficult to forecast , as NHC forecaster Lixion Avila remarked , " There are no clear reasons ... and I am not going to make one up ... to explain the recent strengthening of Epsilon . "

By late on December 4 , the NHC was no longer anticipating extratropical transition , after a front passed north of the storm and there was no interaction . At 0600 UTC on December 5 , the hurricane 's appearance generated 4 @.@ 7 on the Dvorak technique , a system used to estimate intensity from satellite imagery . This was the highest rating during Epsilon 's duration , and suggested winds of 85 mph (140 km / h) , which was its peak intensity . Around that time , the hurricane began a turn to the east @-@ southeast , as the ridge to its north built behind the passage of a cold front . Despite the cold water temperatures and unfavorable strong upper @-@ level winds , Epsilon maintained its intensity , and the Geophysical Fluid Dynamics Laboratory (GFDL) model predicted it would remain a hurricane for nearly three days .

= = Weakening and dissipation = =

On December 6 the hurricane turned to the south and southwest . As it did so , Epsilon passed beneath a mid @-@ level trough that sheltered it from the wind shear . After weakening during the evening , the convection redeveloped around the large and distinct eye in the daytime , a process Epsilon had done repeatedly in its duration . However , late on December 7 , an approaching trough began increasing wind shear over the system , displacing the convection from the center and causing the eye to dissipate . After maintaining hurricane status for five days , Epsilon weakened to tropical storm status about 920 mi (1480 km) southwest of the Azores .

Once weakened to a tropical storm , Epsilon began rapidly deteriorating . On December 8 , it was downgraded to a tropical depression as the convection had totally dissipated . The NHC issued their final advisory on Epsilon at 1500 UTC that day , after the cyclone consisted of a tight swirl of low clouds with no convection . On issuing the last advisory , Lixion Avila remarked , " I hope this is the end of the long lasting 2005 hurricane season . " There was ultimately one more tropical storm ? Zeta .

Late on December 8 , Epsilon transitioned into a remnant low pressure area . The remnant circulation elongated in advance of a frontal zone , and it dissipated late on December 9 . The front absorbed the remnants the next day .

= = Naming and records = =

After completing the list of 21 tropical cyclone names for the first time ever , the NHC began naming storms with the Greek alphabet . Epsilon was the fifth name of the list , and ultimately there was one additional storm , making the 2005 season the most active on record with 27 named storms . Since Epsilon stayed well out to sea and never approached land , no warnings or watches were issued . No ships reported tropical storm force winds from Epsilon and there were no damages or fatalities .

When Tropical Storm Epsilon persisted until December 1 , it extended the 2005 Atlantic hurricane season beyond the normal boundaries of June 1 to November 30 . Although such off @-@ season Atlantic storms are unusual , a similar event occurred just one year prior with Tropical Storm Otto .

Epsilon is just one of four tropical cyclones to ever attain hurricane status in December , along with a hurricane in 1887 , Alice in 1954 , and Lili in 1984 . The cyclone maintained hurricane status for five days , longer than any other Atlantic hurricane in December .