

Tropical Cyclone Report
Hurricane Noel
(AL162007)
28 October-2 November 2007

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(to include rainfall amount for Camp Perrin, Haiti)

Noel took an erratic track across Hispaniola and Cuba as a tropical storm before becoming a hurricane as it exited the northwestern Bahamas. Torrential rainfall from Noel produced devastating floods and loss of life in the Dominican Republic, Haiti, Jamaica, eastern Cuba and the Bahamas. Noel then evolved into a large and powerful extratropical cyclone that brought hurricane force wind gusts to portions of the northeastern United States and eastern Canada.

a. Synoptic History

The tropical wave that played a role in the development of Noel departed the west coast of Africa early on 16 October. During the next several days, the wave moved westward across the eastern Atlantic without showing any signs of organization. As the tropical wave approached the Lesser Antilles late on 22 October, it began to interact with a surface trough lying just north of the Leeward Islands and an upper-level trough that extended southwestward from the Atlantic into the eastern Caribbean Sea. As the wave interacted with these two features, a broad surface low pressure area formed about 150 n mi east-northeast of the northern Leeward Islands late on 23 October. The new surface low then moved slowly westward and produced disorganized thunderstorm activity during the next couple of days, while strong upper-level westerly winds inhibited further development. The low turned west-southwestward on 25 October, moving over the Virgin Islands and passing near the southeastern coast of Puerto Rico early the next day. On 27 October, the strong upper-level winds began to decrease, allowing convection to develop and remain closer to the low center. An increase in organization that afternoon led to the formation of a tropical depression about 185 n mi south-southeast of Port-Au-Prince, Haiti by 0000 UTC 28 October. The “best track” chart of the tropical cyclone’s path is given in Fig. 1, with a close-up of the tropical cyclone portion of the track shown in Fig. 2. Wind and pressure histories are provided in Figs. 3 and 4, respectively. The best track positions and intensities are listed in Table 1.

After genesis, the depression turned northwestward, around the eastern side of a mid-to upper-level low located to the northwest of the tropical cyclone. Convection continued to increase and banding features became better defined during the early morning hours of 28 October. A ship observation taken to the northeast of the center at 1200 UTC that day suggests that the depression reached tropical storm strength by that time. Thereafter, Noel continued to

strengthen, reaching an intensity of 50 kt six hours later. As Noel continued moving northwestward toward the southern coast of Haiti on 29 October, interaction with the mountainous terrain along the southern coast of the island resulted in the disruption of the low-level circulation. Noel's maximum winds decreased to 45 kt before the center made landfall along the southern coast of Haiti around 0700 UTC near the town of Jacmel, about 25 miles south-southwest of Port-Au-Prince.

During its passage along the west coast of Haiti, the low-level circulation became very difficult to track. Satellite imagery during this time suggests that a mid-level circulation continued moving northward and exited the northern coast of Hispaniola just before 1200 UTC. Shortly thereafter, visible satellite imagery suggests that a new low-level center formed near the northwestern coast of Haiti, southwest of the apparent mid-level center. A reconnaissance mission later that afternoon was unable to fly directly through the low-level center seen in satellite imagery because it was located too close to the complex terrain of eastern Cuba. Wind and pressure data from this mission, however, were consistent with the position estimated from satellite imagery.

The mid-to upper-level low that had been steering Noel northwestward weakened late on 29 October. After this occurred, the tropical storm turned westward to the south of a mid-level ridge over the western Atlantic. During this time, Noel hugged the northern coast of eastern Cuba and regained an intensity of 50 kt. Surface data and radar observations from Holguin, Cuba indicate the center of Noel passed near or just north of Cabo Lucrecia and made landfall around 0600 UTC near Guardalavaca, Cuba. A few hours later, the center passed near La Jiquima, where a minimum pressure of 997.9 mb was recorded. Noel's center spent a little more than 30 hours over Cuba. While over the island, the maximum winds decreased, but ship and surface observations show that Noel remained a minimal tropical storm. For the first 18 h over Cuba, Noel moved a little south of due west. Thereafter, the tropical storm turned northwestward, then north-northwestward and re-emerged over the Atlantic waters along the north-central coast of Cuba near Cayo Coco, shortly after 1200 UTC 31 October.

Once over water, the tropical storm regained strength and meandered just off the north coast of Cuba. During this time, the low-level center was displaced to the southwest of the convective activity due to southwesterly wind shear. Early on 1 November, Noel turned north-northeastward ahead of a mid-latitude trough that was moving across the Gulf of Mexico. At this time, a very strong burst of deep convection developed just northeast of the center. Aircraft data indicate that the minimum pressure began to fall but that the maximum winds did not initially increase. The center of Noel moved across Andros Island in the northwest Bahamas shortly after 1200 UTC 1 November with maximum winds of 50 kt, and six hours later passed very near Nassau with winds of 55 kt. Despite the southwesterly shear, Noel continued to intensify over the northwestern Bahamas and shortly after passing between Eleuthera and Abaco Islands, it attained hurricane strength. Noel reached a peak intensity of 70 kt and accelerated northeastward ahead of the mid-latitude trough. Shortly thereafter, the satellite appearance of Noel began to deteriorate as the inner-core convection weakened. By 0000 UTC 3 November, Noel lacked the deep convection required to consider it a tropical cyclone and the system became extratropical, while centered about 240 n mi southeast of Cape Hatteras, North Carolina.

The extratropical low grew into a very large and powerful cyclone as it moved north-northeastward off the east coast of the United States. The cyclone intensified a little, reaching a peak intensity of 75 kt at 1200 UTC 3 November. Late that day, the low weakened slightly as it passed about 75 n mi east-southeast of Nantucket Island, Massachusetts. Shortly after 0600 UTC 4 November, the center of the low made landfall near Chebogue Point, Nova Scotia, just south of Yarmouth with maximum winds of 65 kt. The cyclone weakened after landfall in eastern Canada and exited the coast of Labrador about 18 h later. The low continued northeastward and merged with another extratropical cyclone over Greenland by 0600 UTC 6 November.

b. Meteorological Statistics

Observations in Noel (Figs. 3 and 4) include satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB) and the Satellite Analysis Branch (SAB). Microwave satellite imagery from NOAA polar-orbiting satellites, the NASA Tropical Rainfall Measuring Mission (TRMM), the NASA Aqua, the NASA QuikSCAT, the Department of Defense WindSat, and Defense Meteorological Satellite Program (DMSP) satellites were also useful in tracking Noel. Ten reconnaissance missions by the U.S. Air Force Reserve and one by the NOAA WP-3D aircraft were flown into Noel. The NOAA G-IV aircraft conducted two synoptic surveillance missions. Observations from these missions include flight-level winds, dropwindsonde observations, and surface wind estimates from the Stepped-Frequency Microwave Radiometer (SFMR). Radar imagery and surface observations from Cuba were extremely useful in tracking Noel's passage over that country. One NOAA WP-3D flight was flown after Noel was no longer a tropical cyclone. This flight was flown in support of an experimental unmanned Aerosonde mission that was conducted on 3 November.

The 50 kt estimated intensity of Noel when it was centered south of Hispaniola is based on a blend of an SFMR surface wind estimate of 53 kt and peak flight-level wind of 58 kt adjusted to the surface using a standard adjustment factor. The highest wind gust recorded on the island of Hispaniola was 60 kt at Barahona, Dominican Republic at 0815 UTC 29 October (Table 2). Noel's re-strengthening to 50 kt prior to landfall in eastern Cuba is supported by an SFMR surface wind estimate of 52 kt. A wind gust to 113 kt was reported at Gran Piedra, Cuba. This observing site, however, is at an elevation of about 4000 ft and this wind measurement is clearly not representative of conditions near sea level. Table 2 shows that most of the official observing sites in eastern Cuba reported maximum wind gusts between 30 and 40 kt.

The 70 kt peak intensity of Noel is based on several peak SFMR surface wind estimates of around 70 kt on 2 November. A maximum flight-level wind of 89 kt was observed at 0216 UTC 2 November, which would typically correspond to an 80 kt maximum surface wind using a standard 90% adjustment of the 700 mb wind. SFMR and dropwindsonde data, however, during this flight suggest that the standard 90% adjustment was likely not valid for Noel at this time. The highest SFMR wind during the mission was 70 kt and a dropwindsonde at 0520 UTC provided a surface wind estimate of 70 kt (derived from the mean wind over the lowest 150 m of the sounding). A subsequent reconnaissance mission between 1200 and 1800 UTC 2 November recorded a maximum flight-level wind of 90 kt at 700 mb, but again the highest surface wind estimate from the SFMR during this flight was 70 kt.

Reconnaissance data from a NOAA WP-3D mission early on 3 November suggest that Noel maintained a shallow warm core at the time the cyclone is analyzed as extratropical in the best track. While the presence of the warm core is noted, this does not mean that Noel remained a tropical cyclone during this time. Inner-core convection significantly decreased after 1200 UTC 2 November, and Noel no longer met the convective requirement of a tropical cyclone by 0000 UTC 3 November (Fig. 5). The shallow warm core associated with Noel at this time was likely the residual warm core of the tropical cyclone. The 75 kt peak intensity of the extratropical cyclone is based on QuikSCAT data from 1024 UTC 3 November.

Ship reports of winds of tropical storm force directly associated with Noel are given in Table 3.

Noel produced several days of torrential rainfall across Hispaniola and Cuba. The maximum rainfall report received from Haiti was 25.78 in from Camp Perrin, located near Cayes along the southwestern coast of Hispaniola. The total from this gauge, which is maintained by the Organization for the Rehabilitation of the Environment (ORE), includes rainfall during the 5 day period between 6 am (local time) 28 October and 6 am 2 November. Rainfall reports received from the Dominican Republic include accumulations between 25-31 October, a period that includes the effects of the precursor low of Noel. The reports indicate that the heaviest rains fell between 28-31 October. Several locations in the Dominican Republic reported total accumulations between 15 and 25 in with a maximum of 35.63 in (905 mm) at Angelina. The rainfall totals, however, from several of the locations that received greater than 20 in, including Angelina, are incomplete. These sites received rainfall that was not recorded because the gauges reached their maximum capacity during some of the 24 h periods between measurements. In some cases, this occurred on several consecutive days during Noel's passage. For example, at Angelina the rain gauge reached its capacity of 300 mm (11.81 in) on two consecutive days. At Rancho Arriba (total rainfall 31.98 in), the rain gauge reached its capacity of 170 mm (6.69 in) on 4 consecutive days (28-31 October). It is possible that the maximum rainfall in the Dominican Republic from Noel and its incipient low may have approached 40 in.

Reports show that rainfall accumulations of 5 to 12 in were common across eastern Cuba. In the Province of Holguin, 12.20 in fell at Loynaz Hechavarria during the 24-h period ending at 1200 UTC 31 October. In the Bahamas, 29.43 in was recorded on Long Island during the 79 h period between 0200 UTC 30 October and 0900 UTC 2 November. The precursor low also produced significant rainfall across Puerto Rico and the Virgin Islands, with a maximum amount of 17.23 in at Gate Tower, Puerto Rico.

The combination of Noel over the northern Caribbean and strong high pressure over the eastern United States produced a tight pressure gradient over the western Atlantic and Florida between 29-31 October. This pressure gradient resulted in an extended period of gale force winds along the east coast of the Florida Peninsula that were not directly associated with the circulation of Noel. The highest sustained wind measured over land in south Florida during this period was 37 kt, with a gust to 47 kt at Miami Beach

The post-Noel extratropical cyclone produced very strong winds along coastal sections of the United States from the Carolinas northward as it passed offshore. The strongest winds were observed in eastern Massachusetts, where a sustained wind of 51 kt with a gust to 63 kt was measured on Nantucket Island. The highest wind gust reported in mainland Massachusetts was 77 kt at Barnstable. In eastern Maine, wind gusts as high as 57 kt were recorded. In eastern Canada, the low brought hurricane force wind gusts to portions of Nova Scotia and Newfoundland. The highest sustained wind in Canada was 61 kt at McNab's Island in Halifax Harbor. Maximum wind gusts were 97 kt at Wreckhouse, Newfoundland and 79 kt at Grand Etang, Nova Scotia. A wind gust to 73 kt was also experienced near Halifax. The extratropical cyclone produced a wide-swath of 2 to 4 inches of precipitation that extended from coastal sections of Massachusetts northward across Maine, Nova Scotia, New Brunswick and eastern Quebec. The highest precipitation total in the United States was 5.03 in at Cutler Rainwise, Maine and the highest in Canada was 5.28 in at Cap D'Espoir, in southeastern Quebec. The extratropical cyclone also produced significant snowfall across northern Maine, northwestern New Brunswick, southeastern Quebec and Labrador.

c. Casualty and Damage Statistics

Torrential rains from Noel produced widespread damage and loss of life in the Dominican Republic, Haiti, Jamaica, eastern Cuba, and the Bahamas. As of this writing, Noel is estimated to have caused a total of 163 deaths, while 59 remained missing. On 16 November, the United Nations Office for the Coordination of Humanitarian Affairs listed the death toll in the Dominican Republic at 87, while 42 people remained missing. The exact number of deaths in Haiti has been somewhat difficult to determine, as counts have ranged from 57 to 103. Media reports from Reuters on 8 November stated that authorities have confirmed 57 fatalities. A report from the USAID Fact Sheet #3 on 8 November lists 103 casualties in Haiti with 20 persons missing. This report, however, appears to include deaths that may have occurred during "continuous rains over the past six weeks" before Noel's passage. A report from the International Federation of Red Cross and Red Crescent Societies on 14 December states that the Haitian Direction of the Civil Protection (Direction de las Protection Civile- DPC) confirmed 73 deaths, while 17 people remained missing. For the purpose of establishing a final death toll in Haiti for Noel, this report uses the count of 73 fatalities, since that count is from a Haitian governmental agency and it appears to only include the deaths directly attributed to the tropical cyclone. Reports indicate that Noel was responsible for one death in the Bahamas, one death in Jamaica, and one death in Cuba. The reports show that nearly all of the fatalities were the result of floods and mudslides. In the Dominican Republic and Haiti, there were several reports of villages being swept away by flood waters. In Cuba, a man died attempting to cross a swollen river, and in Jamaica the death was the consequence of a tree falling on a house due to a landslide.

Reports show that 78,000 people in the Dominican Republic remained in emergency shelters over two weeks after the passage of Noel. The cyclone is estimated to have damaged nearly 15,000 homes with a little more than 6,000 homes destroyed. Mudslides and floods also washed away several bridges that left numerous towns and villages isolated for many days. The government of the Dominican Republic reported that crop losses totaled \$77.7 million (United

States dollars) in that country. In Haiti, government reports note that nearly 18,000 homes were damaged and almost 4,000 homes were destroyed, while countless crops were ruined due to floods.

Reuters reported that 80,000 residents in Cuba were evacuated from flooding produced by Noel. Twenty-two thousand houses were damaged or destroyed and over 8,000 miles (13,000 km) of roads were damaged. Other infrastructures including railroad lines, drainage systems, bridges and power lines were also damaged. Agricultural losses accounted for \$305 million of the \$500 million (United States dollars) in financial losses in Cuba as reported by the Granma International Newspaper on 8 November. Officials reported that Cuba lost 10% of its coffee crop and that nearly 125,000 acres of sugar cane fields were flooded or damaged, which accounts for about half of the Cuban sugar output. Damage to homes amounted to \$128 million, and \$33 million in damages were estimated for the collapse of power and communication lines. The Cuban Meteorological Service stated that rains from Noel produced the worst flooding in Cuba since Hurricane Flora in 1963.

Media reports from the Bahamas show that severe flooding occurred on Cat Island, Exuma, and Long Island with water inundating several homes. The one death reported in the Bahamas was a drowning that was blamed on the flooding in Exuma.

As a tropical cyclone, Noel was not directly responsible for any damage in the United States. The extratropical cyclone produced strong winds that downed trees and power lines in the northeastern United States and eastern Canada. Media reports indicate 190,000 homes and businesses in eastern Canada and about 80,000 homes in the northeastern United States lost electricity. Coastal floods and significant wave action washed out sections of coastal roads in Nova Scotia and many roads were littered with large rocks and boulders that washed ashore during the storm. Several waterfront buildings also suffered damage and some docks were destroyed.

The gale force winds created by the combination of Noel and a strong high over the eastern United States generated very large waves that pounded the east coast of Florida for several days. This wave action produced significant beach erosion along the Atlantic Coast of Florida prior to Noel's center passing offshore. It is difficult to determine the monetary impact of the beach erosion in Florida, but media reports estimate the cost at \$3-4 million for the Palm Beach area beaches alone. Additional beach erosion was reported along the Atlantic coast from the Carolinas northward as Noel passed east of the United States.

d. Forecast and Warning Critique

The tropical wave that played a role in the development of Noel was introduced into the Tropical Weather Outlook (TWO) at 0930 UTC 23 October. Subsequent Outlooks issued over the next couple of days correctly predicted that upper-level winds would remain unfavorable for significant development during that time. The Outlook issued at 1530 UTC 25 October was the first to indicate that upper-level winds "could become more favorable" for development. The

Outlook issued six hours later was the first to explicitly mention the possibility of tropical depression formation, which was a little more than 48 hours prior to genesis.

Verification of official and guidance model track forecasts is given in Table 4. Average official track errors for Noel (with the number of cases in parenthesis) were 51 (22), 78 (20), 97 (18), 120 (16), 180 (12), 97 (8), and 184 (4) n mi for the 12, 24, 36, 48, 72, 96, and 120 h forecasts, respectively. Noel's erratic track across the northern Caribbean proved to be difficult to predict. Despite official track errors through 72 h that were larger than the 5-yr (2002-2006) mean, the official forecasts beat most of the individual track models for this period. The only track models that consistently beat the official forecast for this period were the deep-layer Beta and Advection model (BAMD), the CONU and GUNA model consensuses, and the Florida State Super Ensemble (FSSE). The official track errors at 96 and 120 were much lower than the 5-yr means and were only bettered by the CONU and GUNA model consensuses at 120 h.

Average official intensity errors (Table 5) were 8, 10, 12, 12, 14, 16, 20 kt for the 12, 24, 36, 48, 72, 96, and 120 h forecasts, respectively. The official intensity errors are close to the 5-yr means through 36 h and are slightly below the 5-yr means at 48 h and beyond. The NHC intensity forecasts were out-performed by the consensus of the DSHP, GHMI, HWFI models (ICON) at all forecast times, except 48 and 72 h. Most of the intensity guidance had errors lower than the official forecasts at 96 and 120 h. Because of expected strong wind shear, the official intensity forecasts issued on 31 October and 1 November, did not predict that Noel would strengthen into a hurricane before becoming an extratropical cyclone, which Noel did despite the strong shear.

Table 6 is a summary of coastal watches and warnings issued in association with Noel.

e. Acknowledgements

The Meteorological Services of the Dominican Republic, Cuba, and the Bahamas provided most of the surface and rainfall data shown in the report. Chris Fogarty of the Canadian Hurricane Center furnished surface data for the extratropical portion of Noel. The National Data Buoy Center and National Weather Service Offices in Miami, Florida; Taunton, Massachusetts; and Caribou, Maine also supplied surface data and storm summaries. David Roth of the Hydrometeorological Prediction Center contributed additional rainfall information.

Table 1. Best track for Hurricane Noel, 28 October- 2 November 2007.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
24 / 0000	18.0	60.2	1010	20	low
24 / 0600	18.0	60.7	1009	25	“
24 / 1200	18.1	61.2	1009	25	“
24 / 1800	18.4	61.7	1009	25	“
25 / 0000	18.8	62.3	1009	25	“
25 / 0600	19.1	62.9	1007	25	“
25 / 1200	19.2	63.5	1007	25	“
25 / 1800	19.1	64.1	1006	25	“
26 / 0000	18.8	64.8	1005	25	“
26 / 0600	18.0	65.7	1005	25	“
26 / 1200	17.2	66.7	1004	25	“
26 / 1800	16.5	67.7	1004	25	“
27 / 0000	16.1	68.5	1004	25	“
27 / 0600	15.7	69.3	1004	25	“
27 / 1200	15.3	70.1	1004	25	“
27 / 1800	15.4	71.0	1004	25	“
28 / 0000	15.7	71.2	1003	30	tropical depression
28 / 0600	16.0	71.4	1002	30	“
28 / 1200	16.3	71.6	999	40	tropical storm
28 / 1800	16.6	71.8	996	50	“
29 / 0000	17.1	72.1	999	50	“
29 / 0600	18.0	72.4	1002	45	“
29 / 1200	19.2	72.9	1002	40	“
29 / 1800	20.2	73.6	1001	45	“
30 / 0000	21.0	74.6	999	45	“
30 / 0600	21.1	75.8	997	50	“
30 / 1200	20.8	76.8	999	40	“
30 / 1800	20.8	77.4	1000	35	“
31 / 0000	21.2	77.8	1000	35	“
31 / 0600	21.8	78.1	1000	35	“
31 / 1200	22.5	78.3	995	45	“
31 / 1800	22.6	78.8	995	45	“
01 / 0000	22.9	78.6	995	50	“
01 / 0600	23.4	78.3	993	50	“
01 / 1200	23.9	78.0	993	50	“
01 / 1800	25.1	77.3	992	55	“
02 / 0000	26.4	76.5	981	70	hurricane
02 / 0600	27.7	75.6	981	70	“
02 / 1200	28.7	74.4	981	70	“
02 / 1800	30.3	73.3	980	70	“

03 / 0000	32.3	72.4	980	70	extratropical
03 / 0600	34.3	71.7	980	70	“
03 / 1200	36.4	70.9	974	75	“
03 / 1800	38.8	69.7	970	75	“
04 / 0000	41.1	68.2	968	70	“
04 / 0600	43.6	66.2	965	65	“
04 / 1200	47.5	64.3	966	60	“
04 / 1800	51.2	62.2	966	60	“
05 / 0000	54.8	59.6	967	60	“
05 / 0600	57.9	57.6	967	55	“
05 / 1200	60.4	55.4	968	55	“
05 / 1800	62.3	53.3	974	55	“
06 / 0000	64.2	50.4	983	45	“
06 / 0600					dissipated
02 / 1800	30.3	73.3	980	70	Maximum wind and minimum pressure
29 / 0700	18.1	72.5	1002	45	Landfall near Jacmel, Haiti
30 / 0600	21.1	75.8	997	50	Landfall near Guardalavaca, Cuba
01 / 1315	24.1	77.9	993	50	Landfall Andros Island, Bahamas
01 / 1745	25.0	77.4	992	55	Landfall, New Providence Island, Nassau Bahamas

Table 2. Selected surface observations for Hurricane Noel, 28 October-2 November 2007.

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) ^c	Storm tide (ft) ^d	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) ^a	Sustained (kt) ^b	Gust (kt)			
Dominican Republic^e								
Punta Cana	28/2200	1006.0	28/2300		35			
Las Americas			29/1700		35			9.83 ^f
Santiago	29/0600	1006.0	29/1300		35			9.07
Barhona (78482)			29/0815		60			
Jarabacoa								7.44
Altamira								5.61
Luperon								6.77
La Union (Airport)								8.93
Gaspar Hdez								11.46 ^f
Rio San Juan								11.59
Cabrera								8.85
Nagua								7.99
Joaquin Balaguer Airport								22.63
Yamasa								11.35
Monte Plata								10.71
Bayaguana								7.76
Santo Domingo								14.60
S.G. Boya								10.59
Hato Mayor								4.82
Los Llanos								8.67
La Romana								7.45
Higuey								7.93
San Rafael Del Yuma								4.87
Moca								14.41
Salcedo								11.37
La Vega								14.70
Pimentel								13.19 ^f
Angelina								35.63 ^f
Villa Riva								10.83

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) ^c	Storm tide (ft) ^d	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) ^a	Sustained (kt) ^b	Gust (kt)			
Cotui								28.23 ^f
Bonao								16.46 ^f
Juma Bonao								18.60
Limon del Yuna								9.29
Sabana Mar								5.57
San Cristobal								13.28 ^f
Azua								21.22 ^f
Rancho Arriba								31.98 ^f
Villa Altigracia								20.32
Bani								17.91 ^f
San Jose Ocoa								19.53
Bohechio								14.21 ^f
Constanza								12.46
Padre Las Casas								16.54 ^f
San Juan de la Maguana								11.85
Barahona								25.57
Polo								27.85 ^f
Oviedo								13.41
Neyba								12.82
Duverge								7.49
Las Matas de Farfan								4.62
El Cercado								7.04
Sanchez								6.20
Arroyo Barril								6.03
Samana								4.15
Catey Airport								8.64
Haiti								
Camp Perrin								25.78 ^g
Cayes								11.61 ^h
Foret des Pins								15.98 ^h
Nazon, Centreville								5.63 ^h

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) ^c	Storm tide (ft) ^d	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) ^a	Sustained (kt) ^b	Gust (kt)			
Port-Au-Prince (Airport)								3.94 ^h
Saint-Louis du Nord								6.69 ^h
Cuba								
La Jiquima (78362)	30/0900	997.9	29/1633		31			5.71
Cabo Lucrecia (78365)	30/0600	1000.3	29/2130		38			3.82
Guaro (78370)	30/0900	1001.5	29/1145		27			2.39
Pinares de Mayari (78371)	30/0600	1002.7	30/1430		17			6.00
Holguin (78372)	30/0900	1001.3	30/2058		25			3.46
Velasco (78378)	30/0900	999.9	30/0610		30			3.30
Las Tunas (78357)	30/1300	1001.9	1/1840		32			4.75
Puerto Padre (78358)	30/0920	1000.8	30/1002		37			8.76
Florida (78350)	31/0015	1000.5	29/1710		40			0.54
Santa Cruz del Sur (78351)	30/2115	1001.7	29/1915		34			0.85
Esmeralda (78352)	31/0130	1000.4	30/1515		31			0.78
Nuevitas (78353)	30/1700	1002.6	31/1915		40			9.49
Guaimaro (78354)	30/1900	1001.0	31/0315		42			9.02
Camaguey (78355)	30/2230	1001.7	31/2020		28			3.14
Cayo Coco (78339)	31/2058	997.8	31/2144		34			1.64
Jucaro (78345)	31/2000	1000.0	31/1758		24			0.19
Ciego de Avila (78346)	31/0900	1000.4	31/1850		25			0.78
Falla (78347)	31/0900	999.8	31/1900		26			1.22
Gran Piedra (78366)			30/0010		113 ⁱ			6.74
Universidad (78364)			30/1648		54			3.32
Mansanillo (78359)								3.21
Cabo Cruz (78360)								9.08
Contramaestre (78363)								4.19
Artemisa (78319)								11.41
Guantanamo (78334)								9.30
Guantanamo (78356)								10.15
Guantanamo (78368)								7.77
Punta de Maisi (78369)								3.69

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) ^c	Storm tide (ft) ^d	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) ^a	Sustained (kt) ^b	Gust (kt)			
Guantanamo (MUGM)	30/0855	1004.4	31/2155		46			
Santiago De Cuba (MUCU)			30/2355		40			
Bahamas								
Georgetown (MYEG)	01/1716	998.6	01/1601	31	42			
Nassau (MYNN)	01/1700	993.0	01/0100	30	36			4.60
Exuma								13.62
Long Island								29.43
Freeport (MYGF)	01/2200	1001.4						
Congo Town (78084) (Andros Island)	01/2100	993.6						
Rock Sound (78080) (Eleuthera)	01/2000	994.3	01/1900	35				
Deadman's Cay (78094) (Long Island)	012004	1000.6						
Moss Town (78091) (Exuma)	01/1904	998.6	01/1404	31				
South Bimini (78069) (Bimini)	01/2000	1000.0						
Nassau (Weather Underground)	01/1914	989.7	01/0030	30	40			
Buoy/CMAN								
41046- E. of Bahamas (24.0°N 71.0°W)	02/0642	1007.0	02/0616	31 ^j	35			
41047- NE. of Bahamas (27.5°N 71.5°W)	02/1211	1001.0	02/1353	54 ^j	62			

^a Date/time is for sustained wind when both sustained and gust are listed.

^b Except as noted, sustained wind averaging periods for C-MAN and land-based ASOS reports are 2 min; buoy averaging periods are 8 min.

^c Storm surge is water height above normal astronomical tide level.

^d Storm tide is water height above National Geodetic Vertical Datum (1929 mean sea level).

^e Rainfall totals from the Dominican Republic are accumulations between 25-31 October. The totals include rainfall from Noel and its incipient low.

^f Incomplete.

^g Rainfall total between 6 am 28 October and 6 am 2 November.

^h Rainfall total between 28-30 October.

ⁱ Elevated location.

^j 1-min average.

Table 3. Selected ship reports with winds of at least 34 kt that are directly associated with Noel, 28 October-2 November 2007.

Date/Time (UTC)	Ship call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
29 / 0600	PDKK	17.4	69.5	170 / 37	1005.5
29 / 1500	KS004	21.6	70.6	160 / 35	1011.6
29 / 1500	ZCDP8	21.4	70.4	120 / 38	1009.0
29 / 1800	VQHO7	17.7	70.1	140 / 35	1009.6
29 / 1800	ZCDP8	21.0	69.6	150 / 40	1010.1
29 / 1800	C6FN5	21.1	69.6	130 / 37	1007.0
29 / 2100	WDB3258	21.0	75.3	040 / 34	1008.0
30 / 0000	WDB3258	21.0	74.8		1002.0
30 / 1000	WZJC	21.3	75.1	120 / 37	1003.5
01 / 0600	H3GQ	25.5	79.5	050 / 37	1004.0
02 / 0000	A8MH9	25.8	72.2	130 / 39	1005.7
02 / 0600	A8MH9	24.3	72.4	150 / 37	1004.0
02 / 1800	DEDI	30.2	76.1	020 / 35	1001.0
02 / 1900	P3ZY6	31.0	75.9	030 / 41	1001.0

Table 4. Track forecast evaluation (heterogeneous sample) for Hurricane Noel, 28 October-2 November. Forecast errors (n mi) are followed by the number of forecasts in parentheses. Errors smaller than the NHC official forecast are shown in bold-face type. Verification includes the depression stage, but does not include the extratropical stage.

Forecast Technique	Forecast Period (h)						
	12	24	36	48	72	96	120
CLP5	64 (22)	132 (20)	187 (18)	233 (16)	293 (12)	160 (8)	255 (4)
GFNI	55 (19)	88 (17)	98 (15)	98 (12)	176 (7)	220 (5)	
GFDI	46 (22)	86 (20)	115 (18)	169 (16)	326 (12)	455 (8)	494 (4)
HWFI	45 (21)	74 (19)	103 (17)	144 (15)	233 (11)	198 (7)	281 (3)
GFSI	55 (21)	90 (18)	130 (16)	126 (12)	229 (7)	178 (4)	416 (1)
AEMI	61 (21)	85 (17)	112 (15)	164 (13)	263 (9)	403 (4)	704 (3)
NGPI	59 (20)	95 (18)	127 (16)	179 (14)	288 (8)	351 (5)	253 (2)
UKMI	56 (21)	87 (19)	101 (17)	100 (15)	101 (11)	202 (7)	322 (3)
BAMD	45 (22)	64 (20)	85 (18)	106 (16)	161 (12)	221 (8)	215 (4)
BAMM	57 (22)	96 (20)	126 (18)	147 (16)	172 (12)	147 (8)	323 (4)
BAMS	81 (22)	143 (20)	195 (18)	237 (16)	296 (12)	318 (8)	490 (4)
CONU	48 (22)	74 (20)	87 (18)	93 (16)	154 (12)	140 (8)	139 (4)
GUNA	44 (19)	63 (17)	74 (15)	98 (12)	156 (6)	132 (4)	127 (1)
FSSE	42 (19)	56 (17)	76 (15)	97 (13)	188 (9)	128 (5)	272 (1)
OFCL	51 (22)	78 (20)	97 (18)	120 (16)	180 (12)	97 (8)	184 (4)
NHC Official (2002-2006 mean)	35 (1852)	61 (1686)	86 (1519)	112 (1362)	162 (1100)	221 (885)	290 (723)

Table 5. Intensity forecast evaluation (heterogeneous sample) for Hurricane Noel, 28 October-2 November 2007. Forecast errors (kt) are followed by the number of forecasts in parentheses. Errors smaller than the NHC official forecast are shown in bold-face type. Verification includes the depression stage, but does not include the extratropical stage.

Forecast Technique	Forecast Period (h)						
	12	24	36	48	72	96	120
SHF5	9.1 (22)	10.6 (20)	10.9 (18)	13.8 (16)	10.8 (12)	10.3 (8)	12.3 (4)
GHMI	8.0 (22)	10.6 (20)	15.9 (18)	19.8 (16)	20.8 (12)	13.3 (8)	8.0 (4)
HWFI	8.3 (21)	9.1 (19)	12.2 (17)	15.3 (15)	12.8 (11)	19.4 (7)	8.3 (3)
SHIP	8.2 (22)	10.3 (20)	13.2 (18)	18.4 (16)	20.4 (12)	19.4 (8)	8.8 (4)
DSHP	7.5 (22)	9.6 (20)	10.5 (18)	14.1 (16)	16.1 (12)	13.1 (8)	26.5 (4)
FSSE	8.4 (19)	10.9 (17)	13.3 (15)	11.5 (13)	14.9 (9)	24.2 (5)	34.0 (1)
ICON	7.1 (22)	8.5 (20)	11.2 (18)	15.1 (16)	15.0 (12)	12.1 (8)	9.3 (4)
OFCL	8.0 (22)	10.3 (20)	11.7 (18)	12.2 (16)	13.8 (12)	15.6 (8)	20.0 (4)
NHC Official (2002-2006 mean)	6.4 (1852)	9.8 (1686)	12.0 (1519)	14.1 (1362)	18.3 (1100)	19.8 (885)	21.8 (723)

Table 6. Tropical Cyclone watch and warning summary for Hurricane Noel, 28 October-2 November 2007.

Date/Time (UTC)	Action	Location
28/ 0300	Tropical Storm Warning issued	Southwestern peninsula of Haiti from Haiti-Dominican Republic border to Port-Au-Prince
28/ 0300	Tropical Storm Watch issued	Cuban Provinces of Granma... Santiago De Cuba...and Guantanamo.
28/ 1200	Tropical Storm Watch issued	Jamaica
28/ 2100	Tropical Storm Warning extended	extended northward to include entire coast of Haiti
28/ 2100	Tropical Storm Watch replaced with Tropical Storm Warning and a Hurricane Watch	Cuban Provinces of Granma...Santiago De Cuba...Guantanamo...and Holguin
29/ 0900	Tropical Storm Warning issued	Southeastern Bahamas...including the Turks and Caicos Islands
29/ 0900	Tropical Storm Watch issued	Central Bahamas
29/ 1500	Tropical Storm Watch replaced with Tropical Storm Warning	Central Bahamas
29/ 1500	Hurricane Watch discontinued	all
29/ 1500	Tropical Storm Warning discontinued	Jamaica and the Cuban Provinces of Granma and Santiago
29/ 1800	Tropical Storm Warning discontinued	South of Gonaives, Haiti
29/ 2100	Tropical Storm Warning extended	Cuban Provinces of Camaguey and Las Tunas
29/ 2100	Tropical Storm Watch issued	Northwestern Bahamas
30/ 0300	Tropical Storm Warning extended	Cuban Province of Ciego de Avila
30/ 0300	Tropical Storm Warning discontinued	Remainder of Haiti
30/ 0600	Tropical Storm Warning discontinued	Turks and Caicos
30/ 0900	Tropical Storm Warning and Hurricane Watch issued	Northwestern Bahamas
30/ 1200	Tropical Storm Warning discontinued	Southeastern Bahamas
30/ 1500	Hurricane Watch discontinued	Northwestern Bahamas
30/ 2100	Tropical Storm Warning extended	Cuban Province of Sancti Spiritus

31/ 1500	Tropical Storm Warning discontinued	Cuban Province of Sancti Spiritus and Guantanamo
31/ 2100	Tropical Storm Watch issued	Florida east coast from Ocean Reef to Jupiter Inlet
01/ 0300	Hurricane Watch issued	Northwestern Bahamas
01/ 0900	Tropical Storm Watch replaced with Tropical Storm Warning	Ocean Reef to Deerfield Beach
01/ 0900	Tropical Storm Warning discontinued	Remainder of Cuba
01/ 1500	Tropical Storm Watch discontinued	Deerfield Beach to Jupiter Inlet
01/ 1800	Tropical Storm Warning discontinued	Ocean Reef to Deerfield Beach
02/ 0300	Tropical Storm Warning discontinued	Central and Northwest Bahamas
02/ 0300	Hurricane Watch discontinued	Northwest Bahamas

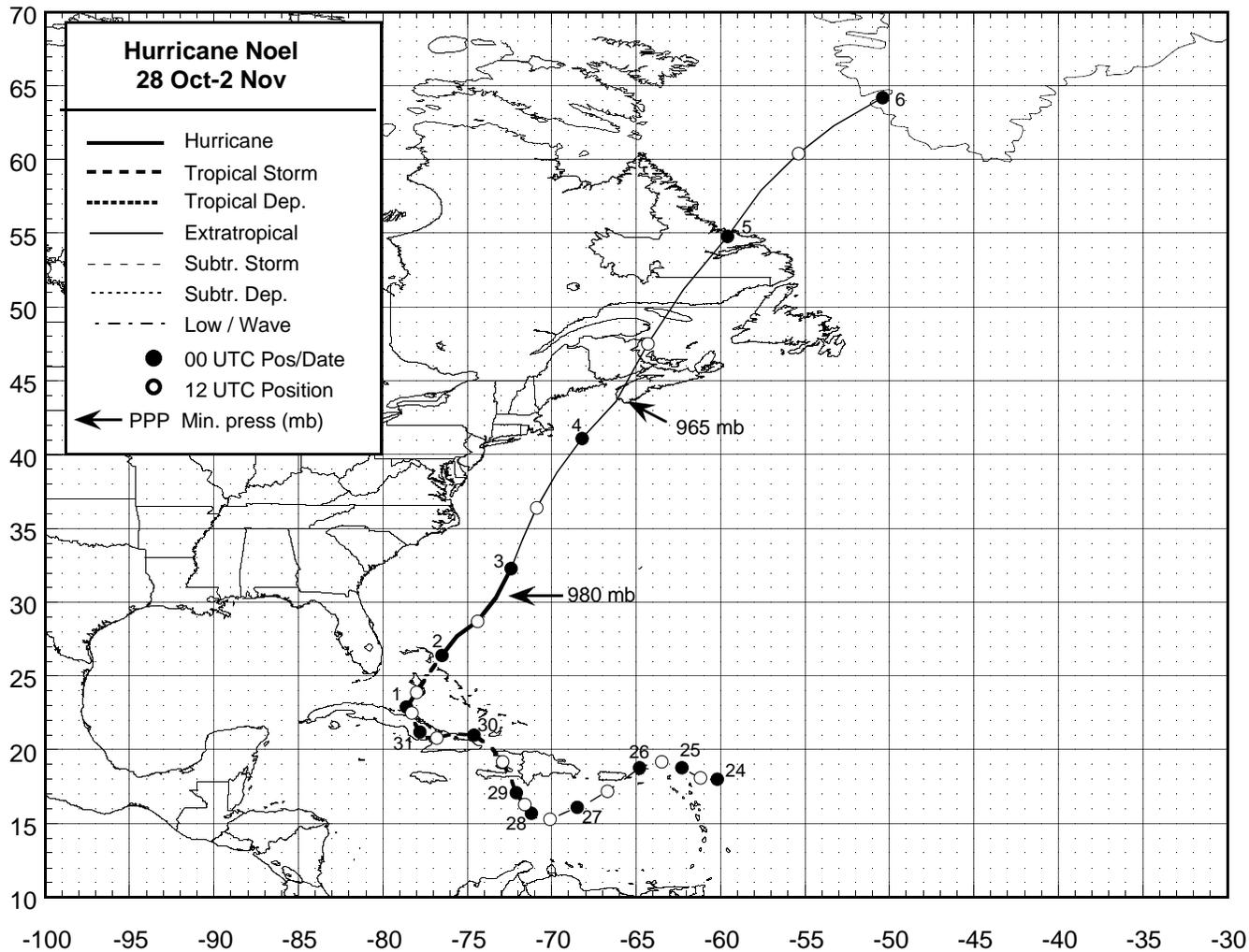


Figure 1. Best track positions for Hurricane Noel, 28 October-2 November 2007. Track during the extratropical stage is partially based on analyses from the Canadian Hurricane Center and the Ocean Prediction Center. The 965 mb minimum pressure shown on the map represents the lowest minimum pressure during the extratropical phase.

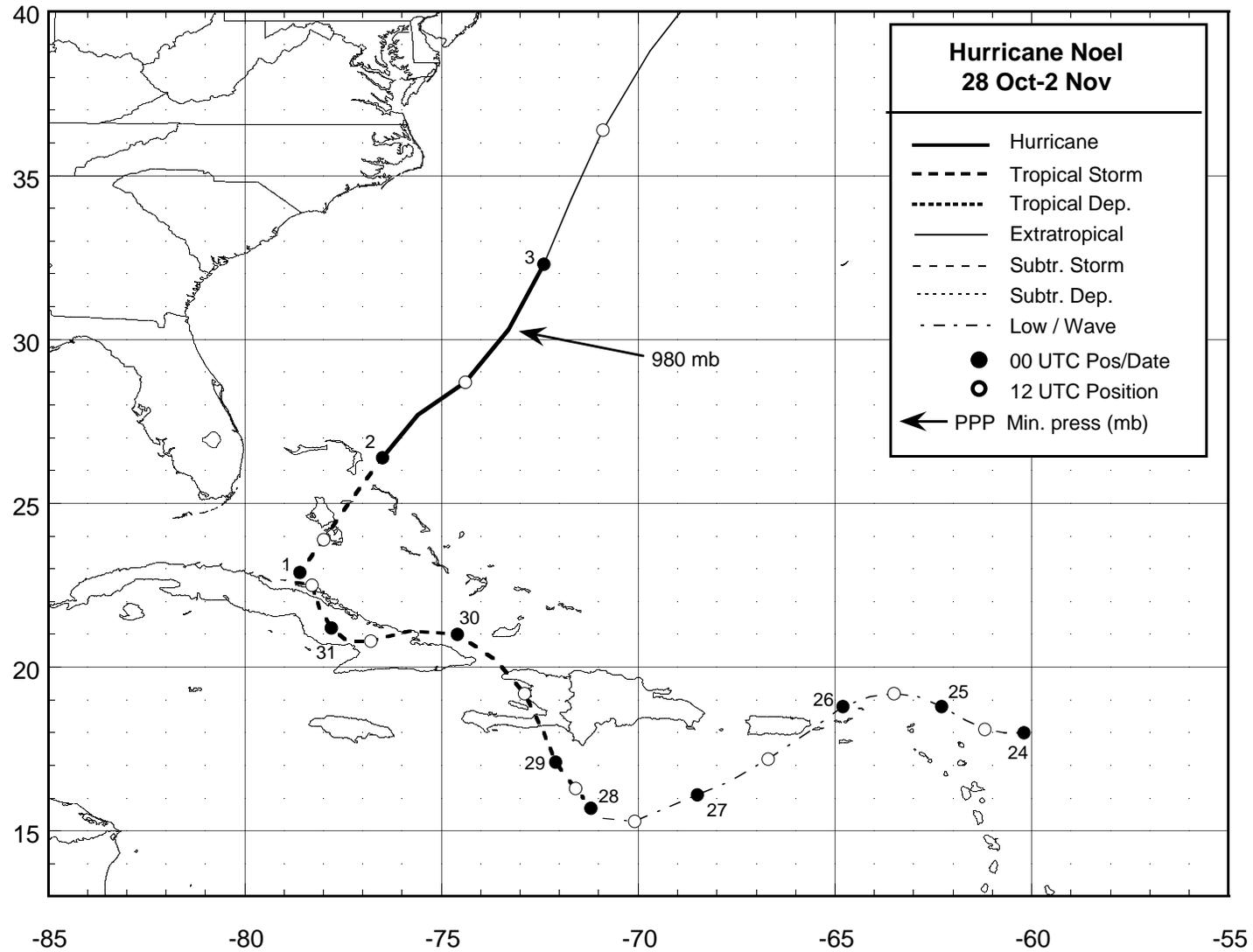


Figure 2. Close-up of the best track positions for Hurricane Noel, 28 October-2 November 2007.

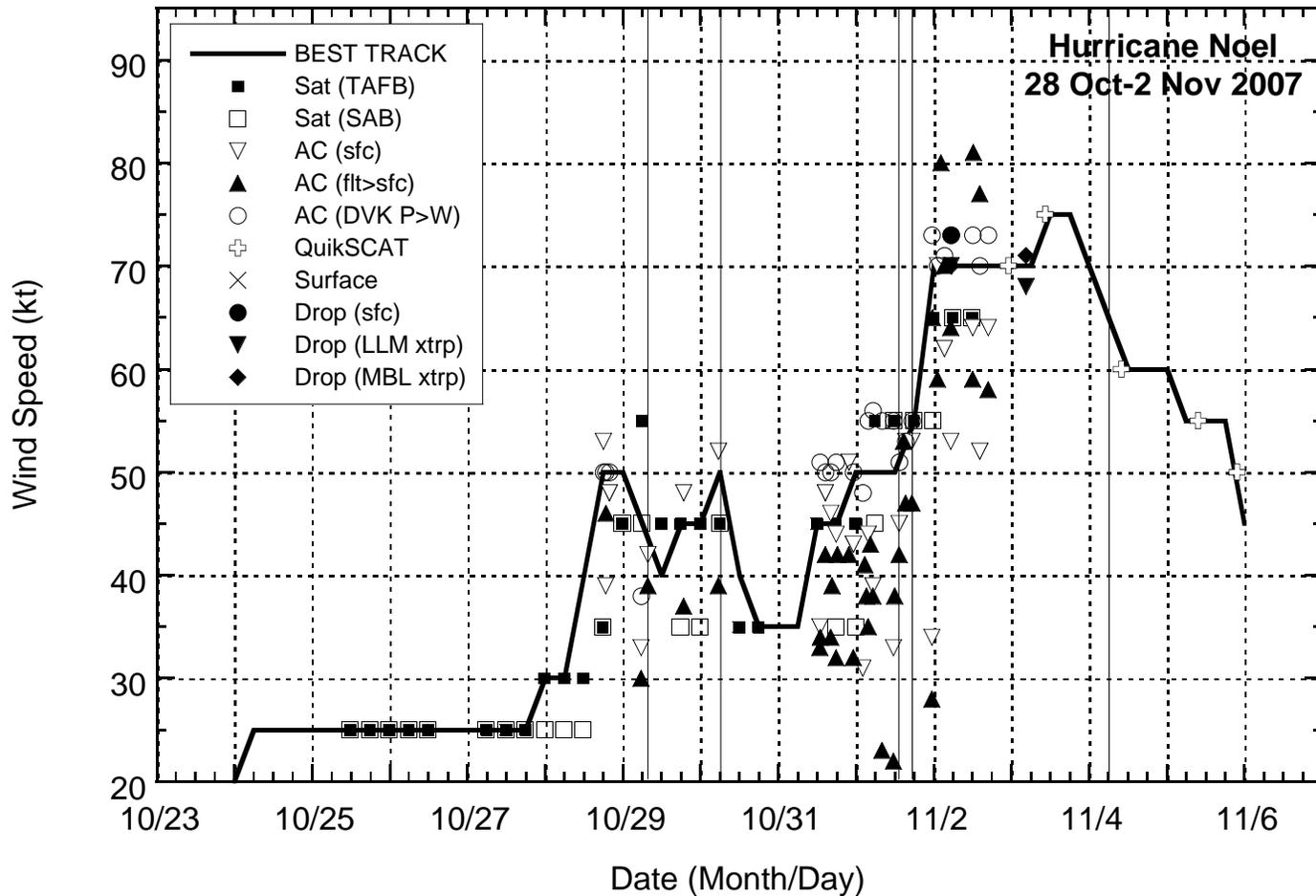


Figure 3. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Noel, 28 October-2 November 2007. Aircraft observations have been adjusted for elevation using 90%, 80%, and 80% reduction factors for observations from 700 mb, 850 mb, and 1500 ft, respectively. Dropwindsonde observations include actual 10 m winds (sfc), as well as surface estimates derived from the mean wind over the lowest 150 m of the wind sounding (LLM), and from the sounding boundary layer mean (MBL). Estimates during the extratropical stage are partially based on analyses from the Canadian Hurricane Center and the Ocean Prediction Center. Dashed vertical lines indicated 0000 UTC. Thin solid vertical lines denote landfalls.

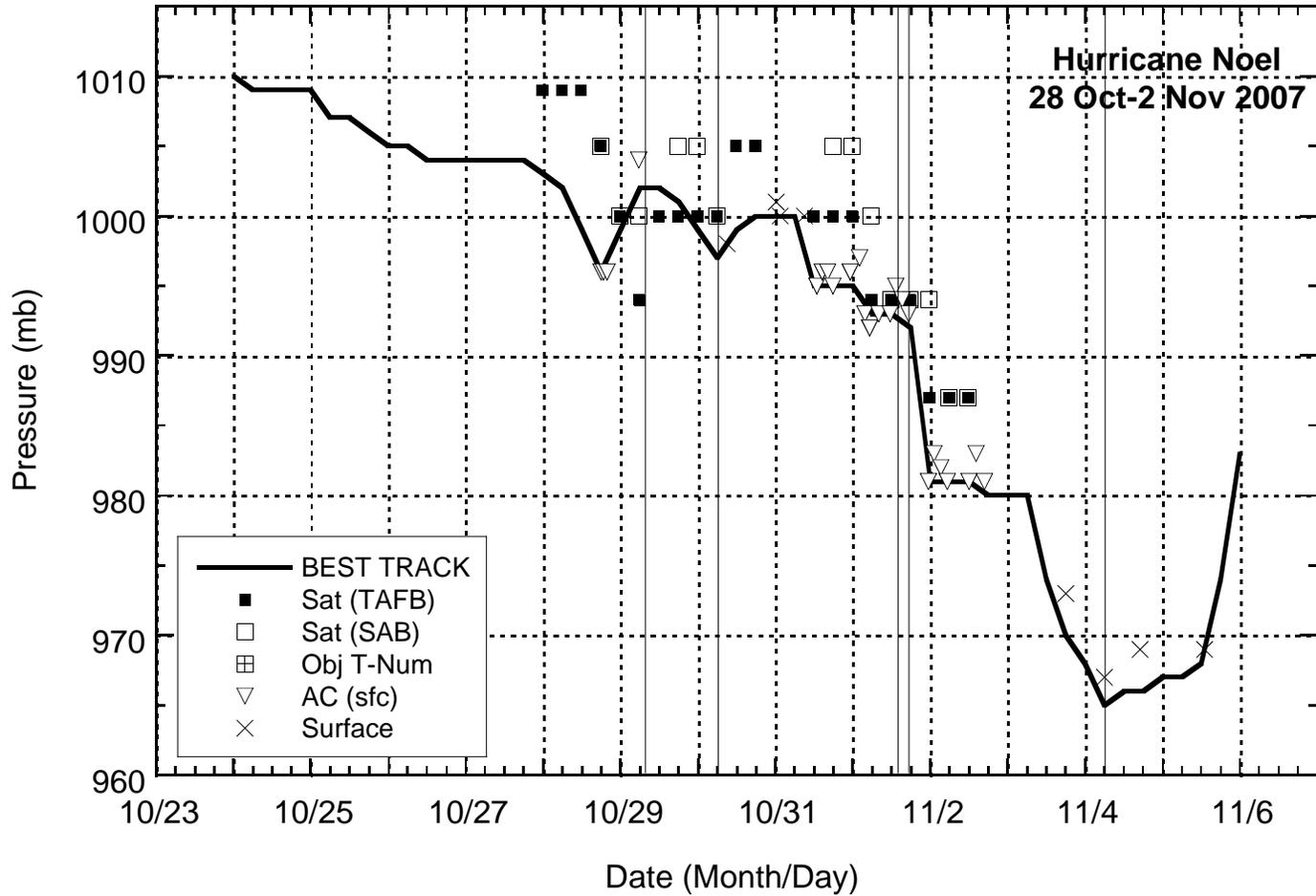


Figure 4. Selected pressure observations and best track minimum central pressure curve for Hurricane Noel, 28 October-2 November 2007. Estimates during the extratropical stage are primarily based on analyses from the Canadian Hurricane Center and the NOAA Ocean Prediction Center. Dashed vertical lines indicated 0000 UTC. Thin solid vertical lines denote landfalls.

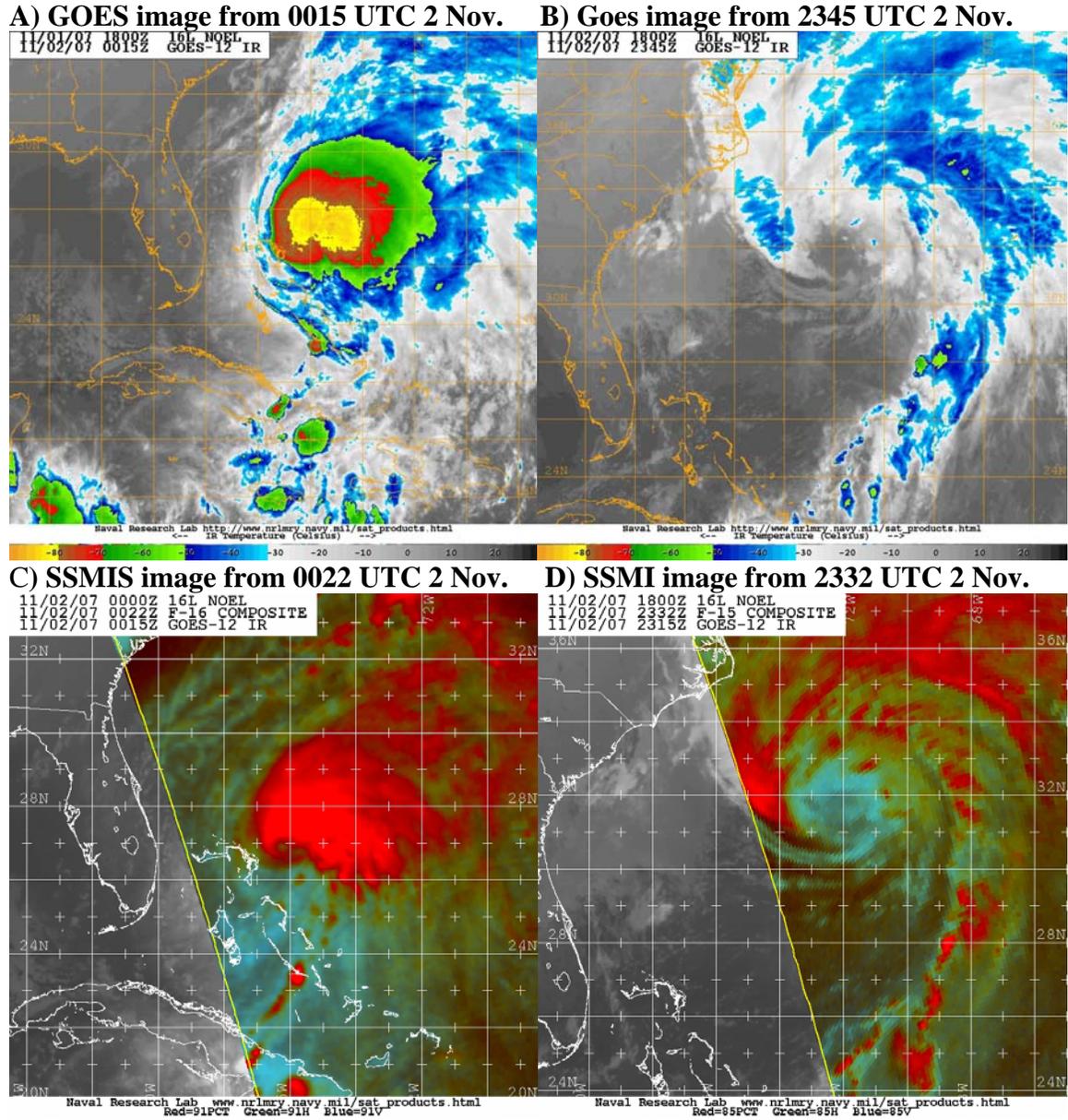


Figure 5. Geostationary (A and B) and microwave (C and D) satellite images of the approximate times that Noel obtained hurricane strength (A and C) and when Noel became extratropical (B and D). Note the dramatic decrease in inner-core convection during this 24-h period. Images are courtesy of the Naval Research Laboratory.