NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

HURRICANE NEWTON

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4 – 7 September 2016

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NASA TERRA MODIS IMAGE OF HURRICANE NEWTON AT 1825 UTC 6 SEPTEMBER 2016 WHILE IT WAS CENTERED OVER THE SOUTHERN PART OF THE BAJA CALIFORNIA PENINSULA.

Newton was a category 1 hurricane (on the Saffir-Simpson Hurricane Wind Scale) that struck Cabo San Lucas and then made landfall farther north along the west coast of Baja California Sur. Newton weakened to a tropical storm after moving over the Gulf of California and made a second landfall along the coast of Sonora. Newton degenerated to a remnant low before it moved into southern Arizona. Five fisherman died during Newton when their shrimp boat capsized in rough seas in the Gulf of California.

Hurricane Newton

4 – 7 SEPTEMBER 2016

SYNOPTIC HISTORY

Newton had its origins in a tropical wave that crossed the west coast of Africa early on 25 August. Although the wave initially had some deep convection, the associated shower and thunderstorm activity decreased significantly once the wave moved over the Atlantic Ocean. The wave moved quickly across the tropical Atlantic at low latitudes, reaching the Lesser Antilles on 29 and 30 August and then Central America on 1 and 2 September. A pre-existing surface trough and area of deep convection, likely triggered by an eastward-moving convectively coupled Kelvin wave in late August, were already located off the southern coast of Mexico, and the tropical wave moved westward into that region by 3 September. Low pressure developed early on 4 September, with the deep convection becoming sufficiently organized to classify the system as a tropical depression at 1200 UTC. The depression strengthened into a tropical storm 6 h later at 1800 UTC while centered about 210 n mi south of Manzanillo, Mexico. The "best track" chart of the tropical cyclone's path is given in Fig. 1, with the wind and pressure histories shown in Figs. 2 and 3, respectively. The best track positions and intensities are listed in Table 1[1].

When it formed, Newton was located along the southwestern periphery of a mid-tropospheric ridge that extended across the Gulf of Mexico and northern Mexico, with a deep-layer trough covering the western United States and extending southwestward over the Pacific Ocean. This pattern caused the cyclone to move north-northwestward and northwestward for several days—slowly at first, and then faster as it approached the trough. At the same time, Newton was located over very warm 30°C waters and in an environment of minimal deep-layer shear, and it went through a 36-h period of rapid intensification (RI) from 1800 UTC 4 September through 0600 UTC 6 September while it approached the southern tip of the Baja California peninsula. During the period of RI, Newton became a hurricane by 1800 UTC 5 September about 115 n mi west-southwest of Cabo Corrientes, Mexico (Fig. 4), and then reached its peak intensity of 80 kt at 0600 UTC 6 September when it was centered 50 n mi south-southeast of Cabo San Lucas.

Newton's northern and eastern eyewall struck the southern tip of the Baja California peninsula a couple of hours later, and the cyclone's center passed offshore of Cabo San Lucas by just a few miles (Fig. 5a). The hurricane weakened slightly while its eastern eyewall moved over the mountainous terrain of Baja California Sur (Fig. 5b), and it made landfall near El Cuñaño on the western side of the peninsula around 1400 UTC 6 September with maximum winds of 75 kt (Fig. 5c). Newton gradually weakened through the day while its center moved north-northwestward up the spine of the peninsula, and the convection became more asymmetric and

[1] A digital record of the complete best track, including wind radii, can be found on line at ftp://ftp.nhc.noaa.gov/atcf. Data for the current year's storms are located in the *btk* directory, while previous years' data are located in the *archive* directory.

displaced to the north of the center (Fig. 5d). However, Newton appears to have maintained hurricane intensity during its trek across the peninsula, with microwave images showing the redevelopment of a closed eyewall around 0000 UTC 7 September (Fig. 5e). Even though Newton's center subsequently emerged over the warm waters of the Gulf of California, deep-layer southerly shear increased and caused further weakening, with the cyclone becoming a tropical storm by 0600 UTC about 50 n mi west of Guaymas. Newton made a second landfall, with an intensity of 55 kt, around 0830 UTC 7 September just south of Bahía de Kino and then continued to weaken quickly over the state of Sonora due to the rugged terrain and increasing shear (Fig. 5f). Satellite images indicate that Newton lost all of its associated deep convection later that day, and it is estimated that the cyclone degenerated to a remnant low by 1800 UTC while it was centered just south of the United States-Mexico border about 35 n mi southwest of Nogales, Arizona. The remnant low turned northeastward and dissipated near the Arizona-New Mexico border soon after 0600 UTC 8 September.

METEOROLOGICAL STATISTICS

Observations in Newton (Figs. 2 and 3) include subjective satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB) and the Satellite Analysis Branch (SAB), and objective Advanced Dvorak Technique (ADT) estimates from the Cooperative Institute for Meteorological Satellite Studies/University of Wisconsin-Madison. Observations also include flight-level, stepped frequency microwave radiometer (SFMR), and dropwindsonde observations from one flight of the 53rd Weather Reconnaissance Squadron of the U. S. Air Force Reserve Command. Data and imagery from NOAA polar-orbiting satellites including the Advanced Microwave Sounding Unit (AMSU), the NASA Global Precipitation Mission (GPM), the European Space Agency's Advanced Scatterometer (ASCAT), and Defense Meteorological Satellite Program (DMSP) satellites, among others, were also useful in constructing the best track of Newton.

Two ships reported winds of tropical storm force in association with Newton. The *Zim Haifa* (4XIM) reported tropical-storm-force winds for about 9 h on 5 September when it was located near the coast of Mexico to the east of Newton. The maximum reported winds were 50 kt at 0600 and 0900 UTC, with the anemometer situated about 36 m above the water line. The cruise ship *Carnival Miracle* (H3VS), whose anemometer is about 71 m above the water line, reported maximum winds of 36 kt southwest of Newton's center at 0500 UTC 6 September. Selected surface observations from land stations are given in Table 2.

Winds and Pressure

Data from an Air Force Hurricane Hunter flight late on 5 September indicate that Newton became a hurricane around 1800 UTC that day, with the plane measuring a peak 700-mb flight-level wind of 74 kt at 2027 UTC. In addition, an eye had become apparent on visible and infrared satellite imagery by 1800 UTC, and objective ADT estimates had risen to T4.0. By the end of the flight, the aircraft reported a peak flight-level wind of 87 kt at 2305 UTC and a surface SFMR wind of 69 kt at 2301 UTC. Objective satellite intensity numbers continued to increase after the Air Force flight, and Newton's estimated peak intensity of 80 kt at 0600 UTC 6 September is based on the ADT estimate from that time.

Sustained hurricane-force winds were reported at a couple of stations in the southern part of Baja California Sur. A station just west of the central area of Cabo San Lucas reported a sustained wind of 68 kt and a gust to 101 kt at an elevation of 224 m at 0840 UTC 6 September. At a much higher elevation of 1949 m, a station at Sierra Laguna measured a sustained wind of 86 kt at 1040 UTC. Sustained hurricane-force winds likely occurred over other parts of Baja California Sur, but no other observations are available. Elsewhere, sustained tropical-storm-force winds were reported in the states of Colima, Nayarit (Islas Marías), and Sonora, but they likely occurred in Jalisco and Sinaloa as well. Near Newton's second landfall in Sonora, a sustained wind of 39 kt and a gust to 56 kt were reported at Bahía de Kino, and a sustained wind of 35 kt with a gust to 45 kt was reported at Hermosillo.

Newton's estimated minimum central pressure of 977 mb at 0600 UTC 6 September coincides with the hurricane's peak intensity and is based on earlier aircraft data and pressure data from stations at the southern tip of the Baja California peninsula. Pressure readings from San Lucas and Todos Santos, when corrected for altitude, were as low as 979 mb when Newton's center made its closest approach. Since Newton is assumed to have weakened slightly when it was near the southern tip of the Baja California peninsula, the minimum pressure at 0600 UTC is estimated to be 977 mb.

Reports from a storm chaser indicate that Newton's eye moved over Cabo San Lucas, with the wind going calm by 0915 UTC and lasting until about 1050 UTC. This observation is corroborated by microwave imagery, which shows Cabo San Lucas located inside the eyewall within the northern and eastern portion of Newton's large eye at 0835 and 1012 UTC (Figs. 5a and 5b). The chaser's minimum reported pressure of 984.3 mb was nearly steady for about 35 minutes, and it was not as low as the pressure measurements from San Lucas and Todos Santos farther to the west and northwest. These data suggest that although Cabo San Lucas was within the eastern portion of Newton's eye, the exact center of the cyclone likely missed Cabo San Lucas by a few miles to the west.

Although Newton did not cross the United States-Mexico border as a tropical cyclone, it did produce tropical-storm-force gusts in the elevated terrain of southern Arizona above 7,000 ft on the morning of 7 September before it became a remnant low. A station at Hopkins in Santa Cruz County measured a wind gust to 59 kt at an elevation of 7,120 ft, while another station near Sierra Vista in Cochise County reported a gust to 50 kt at an elevation of 7,677 ft.

Rainfall and Flooding

Newton and its precursor disturbance caused flooding rains across southern Mexico, the coast of western Mexico, and the southern part of the Baja California peninsula. A rainfall analysis produced by the Meteorological Service of Mexico (Fig. 6) indicates that a maximum of 13.90 inches (353 mm) occurred near Acapulco, Mexico, between 31 August and 8 September. A storm total of 12.62 inches (320.5 mm) also occurred at Cihuatlán in the state of Jalisco, and 12.20 inches (309.9 mm) was measured at Mapastepec in the state of Chiapas. Up to 5 inches (125 mm) of rain fell in parts of Baja California Sur, especially in the municipality of Mulegé. Two to three inches (50-70 mm) occurred in the state of Sonora.

Heavy rainfall began falling across southern Arizona while Newton was still a tropical cyclone. More than an inch of rain fell in a swath extending across the far southeastern part of the state into southwestern New Mexico, and more than 6 inches occurred at locations in Cochise, Pima, and Graham Counties. The highest reported amount was 6.57 inches in the Rincon Mountains east of Tucson. The rainfall caused minor flash flooding in some parts of southeastern Arizona.

CASUALTY AND DAMAGE STATISTICS

Newton caused five direct deaths[2] while it was a tropical cyclone: five fisherman drowned when their shrimp boat, the *Mariano Pérez X*, capsized in rough seas in the Gulf of California while traveling between Ensenada and Mazatlán.[3] Before Newton became a tropical cyclone, heavy rainfall and flooding caused another three deaths in the state of Chiapas, and one death occurred in Petatlán in the state of Guerrero when a person was swept away in a river.

The governor of Baja California Sur announced that Newton caused 700 million pesos (~37 million USD) in damage in the state.[4] Although Newton knocked out power, blew out some windows, and caused some damage to homes in Cabo San Lucas, the resort areas at the southern tip of the Baja California peninsula escaped major damage. Most of the damage in Baja California Sur resulted from heavy rains in the municipality of Mulegé. In Santa Rosalía, rockslides and landslides buried dozens of houses and vehicles, and there was a lack of potable water due to damage to a water line. Communities such as Heroica Mulegé and San Ignacio had significant damage and were cut off due to debris on the Transpeninsular Highway.

On the other side of the Gulf of California, damage also occurred in the municipality of Guaymas in the state of Sonora to the south of Newton's second landfall. Unofficially, wind gusts of 70 kt were measured at a marina in San Carlos[5], and waves as high as 4 m (13 ft) were reported at Bahía de Kino. [6] More than 3,000 homes and 50 business were damaged[7], and about 90% of Guaymas and San Carlos lost electricity. Total damage in Guaymas is estimated to be 1.1 billion pesos (~58 million USD).

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[2] Deaths occurring as a direct result of the forces of the tropical cyclone are referred to as "direct" deaths. These would include those persons who drowned in storm surge, rough seas, rip currents, and freshwater floods. Direct deaths also include casualties resulting from lightning and wind-related events (e.g., collapsing structures). Deaths occurring from such factors as heart attacks, house fires, electrocutions from downed power lines, vehicle accidents on wet roads, etc., are considered "indirect" deaths.

[3] Mexico News Daily (9 September 2016). Torrential rains cause damage in Mulegé. http://mexiconewsdaily.com/news/torrential-rains-cause-damage-in-mulege/

[4] SDPNoticias.com (11 October 2016). 'Newton' dejó daños por 700 mdp en BCS. http://www.sdpnoticias.com/local/baja-california-sur/2016/10/11/newton-dejo-danos-por-700-mdp-en-bcs

[5] San Carlos Media Hub (12 September 2016). Hurricane Newton wreaks havoc in Guaymas and San Carlos. http://sancarlos.tv/hurricane-newton-wreaks-havoc-in-guaymas-and-san-carlos/

[6] El Imparcial.com (7 September 2016). Entra "Newton" por Kino; deja 90% de Guaymas sin luz. https://www.elimparcial.com/EdicionEnLinea/Notas/sonora/07092016/1125438-entra-newton-por-kino-deja-90-de-guaymas-sin-luz.html

[7] Meganoticias (14 September 2016). Estiman mil cien millones de pesos en daños por Newton. https://meganoticias.mx/tu-ciudad/guaymas/ultimo-minuto/item/194627-estiman-mil-cien-millones-de-pesos-en-danos-por-newton.html

Heavy rainfall and flooding from Newton's precursor disturbance caused some damage in the states of Guerrero and Chiapas. Approximately 2,000 homes were damaged in the two states, and over 200 people were rescued in the Campestre La Laguna neighborhood southeast of Acapulco when floodwaters rose to 60 cm (2 ft). In Chiapas, flooding occurred in the capital city of Tuxtla Gutiérrez, affecting about 3,500 people.[8]

Flash flooding in southern Arizona affected U.S. Highway 92 in Cochise County and led to a swift-water rescue of two people and a dog in Hereford. Some roads in Tucson were barricaded near the Tanque Verde Wash.

FORECAST AND WARNING CRITIQUE

Newton's genesis was well forecast. Table 3 provides the number of hours in advance of formation associated with the first NHC Tropical Weather Outlook (TWO) forecast in each likelihood category. A low (< 40%) chance of genesis during the next five days was introduced into the TWO 174 h (7.25 days) before Newton formed, and the probability was raised to a high (> 60%) chance 96 h (4 days) before genesis. For the shorter-term 48 h forecast, the precursor disturbance was given a low chance of formation 96 h (4 days) before genesis and a high chance 54 h (2.25 days) before genesis.

A verification of NHC official track forecasts for Newton is given in Table 4a. Newton was a short-lived cyclone, and verification statistics are only available through 48 h. Official forecast track errors were lower than the mean official errors for the previous 5-yr period only at 12 h and were higher between 24 and 48 h. However, climatology and persistence model (OCD5) errors were significantly larger than their respective 5-yr means, indicative of the fact that Newton's recurvature was not typical of most eastern Pacific tropical cyclones. Figure 7 shows that the official track forecasts had very little cross-track error, and verification statistics indicate that official along-track errors were as much as 85% higher than the official cross-track errors. For example, at 36 h, official cross-track errors were about 10 n mi while along-track errors were about 70 n mi. NHC's forecasts were too slow and did not bring Newton's center to the Baja California peninsula or northwestern mainland Mexico soon enough.

A homogeneous comparison of the official track errors with selected guidance models is given in Table 4b. The National Weather Service's Global Forecast System (GFSI) and Hurricane Weather Research and Forecasting (HWFI) models performed exceptionally well, having the lowest errors and beating the NHC official track forecasts at all forecast times. The Hurricane Forecast Improvement Project (HFIP) Corrected Consensus Approach (HCCA) also performed well, having lower errors than the official forecasts between 24 and 48 h.

A verification of NHC official intensity forecasts for Newton is given in Table 5a. Official forecast intensity errors were greater than the mean official errors for the previous 5-yr period from 12 to 36 h but were lower at 48 h. OCD5 errors were larger than their respective 5-yr averages through 36 h, likely due to Newton's period of rapid intensification, followed by its quick

[8] FloodList (6 September 2016). Mexico—deadly floods in Chiapas and Guerrero, Hurricane Newton approaches west coast. http://floodlist.com/america/mexico-deadly-floods-chiapas-guerrero-hurricane-newton-approaches-west-coast

weakening over land. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 5b. No model beat the NHC official intensity forecasts at all forecast times. However, the U.S. Navy COAMPS-TC model (CTCI) and the Navy version of the Geophysical Fluid Dynamics Laboratory model (GFNI) performed the best overall, beating the NHC intensity forecasts at three of the four available forecast verification times. Even though NHC did not explicitly forecast RI and had a low bias in its forecasts during the strengthening phase, the official intensity forecasts still had lower errors than all the models at 24 h.

Coastal watches and warnings associated with Newton are given in Table 6. Due to Newton's genesis close to land and the slow bias in NHC's track forecasts, lead times for some of the watches and warnings were shorter than the typical 48- and 36-h lead times. For example, the hurricane watch and warning for the southern part of the Baja California peninsula only provided lead times of 30 h and 24 h, respectively, before the onset of tropical-storm-force winds in that area.

ACKNOWLEDGMENTS

The National Weather Service Weather Forecast Office (WFO) in Tucson, Arizona, provided information on wind gusts, rainfall, and impacts in southeastern Arizona due to Newton. The Meteorological Service of Mexico (CONAGUA) also provided rainfall data. Josh Morgerman from iCyclone is thanked for the eyewitness account and helpful meteorological data he provided from Cabo San Lucas when the core of the hurricane moved over the city.

Table 1. Best track for Hurricane Newton, 4-7 September 2016.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
04 / 0600	15.1	105.0	1005	30	low
04 / 1200	15.4	105.1	1005	30	tropical depression
04 / 1800	15.7	105.2	1002	35	tropical storm
05 / 0000	16.5	105.4	1000	40	“
05 / 0600	17.6	105.8	998	45	“
05 / 1200	18.6	106.5	994	55	“
05 / 1800	19.7	107.6	988	65	hurricane
06 / 0000	20.9	108.6	983	75	“
06 / 0600	22.1	109.5	977	80	“
06 / 1200	23.4	110.5	978	75	“
06 / 1400	23.9	110.8	979	75	“
06 / 1800	24.9	111.4	982	70	“
07 / 0000	26.4	111.9	987	65	“
07 / 0600	28.0	111.9	993	60	tropical storm
07 / 0830	28.7	111.8	998	55	“
07 / 1200	29.6	111.7	1002	40	“
07 / 1800	31.1	111.4	1006	30	low
08 / 0000	32.3	110.6	1010	20	“
08 / 0600	33.0	109.6	1014	15	“
08 / 1200					dissipated
06 / 0600	22.1	109.5	977	80	maximum winds and minimum pressure
06 / 1400	23.9	110.8	979	75	landfall near El Cuñaño, Baja California Sur, Mexico
07 / 0830	28.7	111.8	998	55	landfall about 15 n mi south of Bahía de Kino, Sonora, Mexico

Table 2. Selected surface observations for Hurricane Newton, 4-7 September 2016.

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)	Sustained (kt)	Gust (kt)	
Mexico						
Baja California Sur						
San Lucas (22.88N 109.93W) (224 m)	6/0840	978.5	6/0810	68	101	
Cabo San Lucas (22.89N 109.91W) (27 m)	6/0847	984.3				
Cabo Pulmo (23.45N 109.42W) (25.9 m)	6/1030	998.2	6/1450	53	73	
Todos Santos (23.45N 110.22W) (48 m)	6/1120	979.3	6/1230	36	61	
Sierra Laguna (23.56N 110.00W) (1949 m)	6/1050	979.0	6/1040	86	134	
Bahia de Loreto (26.01N 111.35W) (25 m)	6/2230	989.7	6/2140	52	125	
Loreto (MMLT) (26.01N 111.21W) (15 m)			6/1554	45		
Colima						
Manzanillo (MMZO) (19.14N 104.56W)			5/1644	40		
Nayarit						
Islas Marias (21.63N 106.53W)	5/0000	1001.6	6/0215	36	55	
Sinaloa						
Obispo (24.25N 107.19W)	5/0000	1000.1	6/1830	27	34	
Topolobampo (25.58N 109.05W)	5/1015	1002.2	6/1700	28	45	
Sonora						
Bahia de Kino (29.01N 111.14W) (150 m)	7/0920	999.4	7/0950	39	56	
Guaymas (27.97N 110.92W) (3 m)				37	57	
Caborca (30.77N 112.44W) (188 m)			7/1800	25	38	
Hermosillo (MMHO) (29.09N 111.05W) (191 m)			7/0928	35	45	
Guerrero						
Acapulco Observatory						13.90
Acapulco						10.39
Jalisco						
Cihuatlán						12.62

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)	Sustained (kt)	Gust (kt)	
Arizona						
Hopkins (7120 ft)			7/1319		59	3.33
Sierra Vista 14 SSE (7677 ft)			7/1627		50	0.78
Rincon (8209 ft)			7/1537		34	6.57
Scout Camp (7554 ft)			7/1637		33	1.92
Nogales International Airport (3955 ft)			7/1610		31	
Tucson 16 E (3425 ft)			7/1507		30	1.12
Muleshoe Ranch (4560 ft)			7/1503		30	2.03
Sierra Vista 9 ESE (4344 ft)			7/1734		30	1.82
Tucson 11 NE (2867 ft)			7/1338		29	1.46
Douglas (Bisbee) International Airport (4150 ft)			7/1641		28	
Bisbee 2 N (5377 ft)			7/1553		28	1.44
Libby Army Airfield – Sierra Vista Municipal Airport (4719 ft)			7/1703		27	1.71
Tucson 11 ENE (2762 ft)			7/1715		26	1.38
Davis Monthan AFB (2675 ft)			7/2258		26	1.05
Oro Valley (2805 ft)			7/2353		25	
Sierra Vista 9 SE (4606 ft)			7/1730		25	3.18
Sells 1 WSW (2262 ft)			7/1514		25	0.39
Columbine						6.53
Miller Carr Canyon						6.03
Dan Saddle						6.03
Carr RAWS						5.40
Sierra Vista 8 S						5.12
Noon Creek						4.96
Tucson 4 SW						4.80
Noon Creek near Safford						4.77
Mt. Lemmon						4.52
Green Valley 11 ESE						4.29
Ash Canyon						4.21

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)	Sustained (kt)	Gust (kt)	
Dragoon						4.21
White Tail						3.83
Sierra Vista 10 SSE						3.82
Long Park						3.62
Sierra Vista 9.2 SSE						3.58
Green Valley 15 ENE						3.28
Rio Rico 9 NW						3.12
Sierra Vista 6 SE						3.10
Sierra Vista						3.05

Table 3. Number of hours in advance of formation associated with the first NHC Tropical Weather Outlook forecast in the indicated likelihood category. Note that the timings for the "Low" category do not include forecasts of a 0% chance of genesis.

	Hours Before Genesis	
	48-Hour Outlook	**120-Hour Outlook**
Low (<40%)	96	174
Medium (40%-60%)	72	150
High (>60%)	54	96

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Newton, 4-7 September 2016. Mean errors for the previous 5-yr period are shown for comparison. Official errors that are smaller than the 5-yr means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	**20.6**	40.0	71.0	118.8			
OCD5	58.9	155.4	280.6	419.5			
Forecasts	10	8	6	4			
OFCL (2011-15)	23.4	36.4	47.2	59.4			
OCD5 (2011-15)	36.6	74.2	116.5	159.7			

Table 4b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Newton, 4-7 September 2016. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 4a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	19.7	34.3	63.7	110.8			
OCD5	56.5	144.6	263.6	387.1			
GFSI	**17.3**	**29.9**	**43.5**	**74.7**			
EMXI	23.9	41.4	74.4	134.2			
EGRI	33.1	65.2	94.1	123.9			
CMCI	41.8	78.6	120.3	207.6			
GHMI	26.2	49.6	71.0	124.9			
HWFI	**18.4**	**29.7**	**55.6**	**86.5**			
CTCI	26.6	56.2	89.4	124.1			
GFNI	38.2	57.5	**63.6**	**86.4**			
TCON	22.1	35.9	**60.0**	**99.0**			
TVCE	20.6	36.9	64.9	**105.1**			
TVCX	21.8	38.5	65.4	**108.1**			
GFEX	**19.1**	34.5	**56.6**	**99.1**			
HCCA	22.3	**34.1**	**39.8**	**63.2**			
FSSE	20.0	36.1	**55.2**	**90.7**			
AEMI	**18.9**	37.0	**61.6**	**98.3**			
BAMS	57.9	112.9	163.1	168.4			
BAMM	46.7	84.4	125.7	137.1			
BAMD	44.0	80.4	129.6	162.4			
Forecasts	8	6	4	2			

Table 5a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Newton, 4-7 September 2016. Mean errors for the previous 5-yr period are shown for comparison. Official errors that are smaller than the 5-yr means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	9.5	10.6	14.2	**10.0**			
OCD5	13.3	15.0	19.5	14.0			
Forecasts	10	8	6	4			
OFCL (2011-15)	5.9	9.8	12.5	14.0			
OCD5 (2011-15)	7.7	12.8	16.4	18.8			

Table 5b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Newton, 4-7 September 2016. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 5a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	9.4	6.7	10.0	7.5			
OCD5	13.5	11.2	14.3	10.5			
DSHP	11.5	10.2	12.0	10.5			
LGEM	10.4	8.8	11.0	10.5			
GHMI	12.4	15.2	10.0	**5.5**			
HWFI	11.6	19.7	17.0	**4.0**			
CTCI	**8.5**	10.0	**8.0**	**4.5**			
GFNI	**8.8**	12.7	**7.0**	**6.0**			
ICON	10.1	12.3	12.3	**7.0**			
IVCN	9.8	11.7	11.3	**6.5**			
HCCA	**9.1**	7.3	**6.3**	12.5			
FSSE	**8.4**	7.5	**5.3**	10.5			
GFSI	15.0	20.5	15.0	16.5			
EMXI	15.0	20.0	16.0	13.0			
Forecasts	8	6	4	2			

Table 6. Watch and warning summary for Hurricane Newton, 4-7 September 2016.

Date/Time (UTC)	Action	Location
4 / 2100	Hurricane Watch issued	Cabo San Lázaro to San Evaristo
5 / 0300	Tropical Storm Watch issued	San Evaristo to Loreto
5 / 0300	Tropical Storm Watch issued	Cabo San Lázaro to Puerto San Andresito
5 / 0300	Tropical Storm Watch issued	Mazatlán to Huatabampito
5 / 0300	Tropical Storm Warning issued	Manzanillo to Cabo Corrientes
5 / 0300	Hurricane Watch modified to	La Paz to San Evaristo
5 / 0300	Hurricane Warning issued	La Paz to Santa Fe
5 / 0900	Tropical Storm Watch modified to	San Evaristo to Santa Rosalía
5 / 0900	Tropical Storm Watch modified to	Cabo San Lázaro to Punta Abreojos
5 / 0900	Tropical Storm Watch modified to	Mazatlán to Guaymas
5 / 0900	Tropical Storm Warning issued	La Paz to San Evaristo
5 / 1500	Tropical Storm Watch discontinued	San Evaristo to Santa Rosalía
5 / 1500	Tropical Storm Watch discontinued	Cabo San Lázaro to Punta Abreojos
5 / 1500	Tropical Storm Watch modified to	Mazatlán to Bahía Tempehuaya
5 / 1500	Tropical Storm Watch issued	Mulegé to Bahía San Juan Bautista
5 / 1500	Tropical Storm Watch issued	Bahía Kino to Puerto Libertad
5 / 1500	Tropical Storm Warning modified to	San Evaristo to Mulegé
5 / 1500	Tropical Storm Warning issued	Puerto Cortés to Punta Abreojos
5 / 1500	Tropical Storm Warning issued	Bahía Tempehuaya to Bahía Kino
5 / 1500	Hurricane Watch modified to	San Evaristo to Loreto
5 / 1500	Hurricane Watch modified to	Puerto Cortés to Cabo San Lázaro
5 / 1500	Hurricane Warning discontinued	La Paz to Santa Fe
5 / 1500	Hurricane Warning issued	Puerto Cortés to San Evaristo
5 / 2100	Tropical Storm Watch discontinued	Mulegé to Bahía San Juan Bautista
5 / 2100	Tropical Storm Watch discontinued	Bahía Kino to Puerto Libertad

Date/Time (UTC)	Action	Location
5 / 2100	Tropical Storm Warning modified to	San Evaristo to Bahía San Juan Bautista
5 / 2100	Tropical Storm Warning modified to	Bahía Tempehuaya to Puerto Libertad
5 / 2100	Hurricane Watch discontinued	Puerto Cortés to Cabo San Lázaro
5 / 2100	Hurricane Warning modified to	Cabo San Lázaro to San Evaristo
6 / 0300	Tropical Storm Watch discontinued	All
6 / 0300	Tropical Storm Warning discontinued	Manzanillo to Cabo Corrientes
6 / 0300	Tropical Storm Warning modified to	Cabo San Lázaro to Punta Abreojos
6 / 0300	Tropical Storm Warning modified to	Mulegé to Bahía San Juan Bautista
6 / 0300	Tropical Storm Warning modified to	Mazatlán to Puerto Libertad
6 / 0300	Hurricane Watch discontinued	San Evaristo to Loreto
6 / 0300	Hurricane Watch issued	Guaymas to Puerto Libertad
6 / 0300	Hurricane Warning modified to	Cabo San Lázaro to Mulegé
6 / 0900	Tropical Storm Warning modified to	Mazatlán to Guaymas
6 / 0900	Hurricane Watch modified to	Bahía Kino to Puerto Libertad
6 / 0900	Hurricane Warning issued	Guaymas to Bahía Kino
6 / 1800	Tropical Storm Warning modified to	Bahía Tempehuaya to Guaymas
6 / 1800	Hurricane Warning modified to	Cabo San Lázaro to Todos Santos
6 / 2100	Tropical Storm Warning modified to	Altata to Guaymas
6 / 2100	Tropical Storm Warning discontinued	Bahía Kino to Puerto Libertad
6 / 2100	Hurricane Watch discontinued	All
6 / 2100	Hurricane Warning modified to	Cabo San Lázaro to Santa Fe
6 / 2100	Hurricane Warning modified to	La Paz to Mulegé
6 / 2100	Hurricane Warning modified to	Guaymas to Puerto Libertad

Date/Time (UTC)	Action	Location
7 / 0300	Tropical Storm Warning modified to	Puerto San Andresito to Punta Abreojos
7 / 0300	Tropical Storm Warning discontinued	Mulegé to Bahía San Juan Bautista
7 / 0300	Tropical Storm Warning discontinued	Altata to Guaymas
7 / 0300	Tropical Storm Warning issued	Loreto to Bahía San Juan Bautista
7 / 0300	Tropical Storm Warning issued	Topolobampo to Guaymas
7 / 0300	Hurricane Warning discontinued	Cabo San Lázaro to Santa Fe
7 / 0300	Hurricane Warning discontinued	La Paz to Mulegé
7 / 0900	Tropical Storm Warning discontinued	Puerto San Andresito to Punta Abreojos
7 / 0900	Tropical Storm Warning discontinued	Loreto to Bahía San Juan Bautista
7 / 0900	Tropical Storm Warning modified to	Topolobampo to Puerto Libertad
7 / 0900	Hurricane Warning discontinued	All
7 / 1200	Tropical Storm Warning discontinued	All

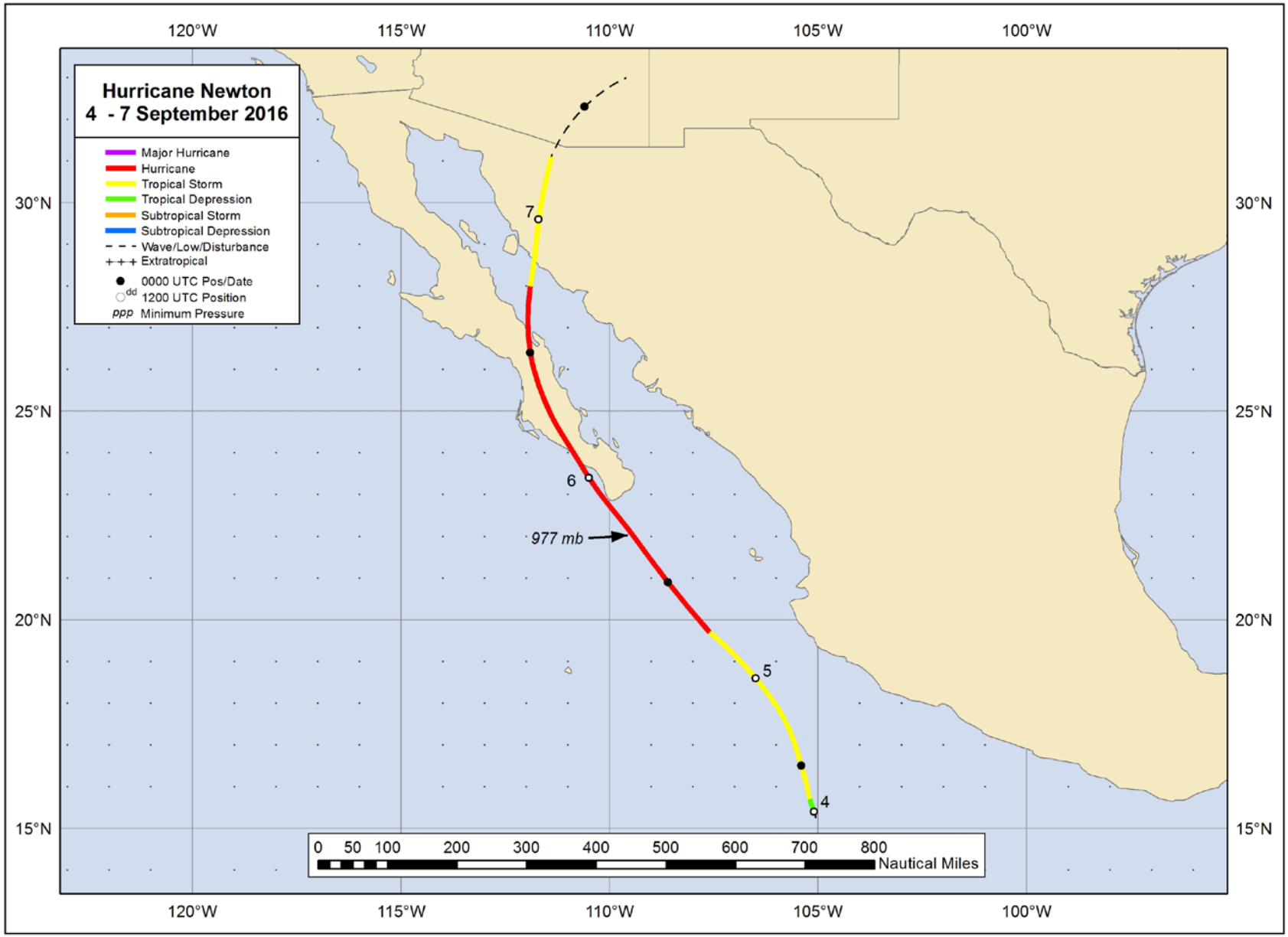

Figure 1. Best track positions for Hurricane Newton, 4-7 September 2016.

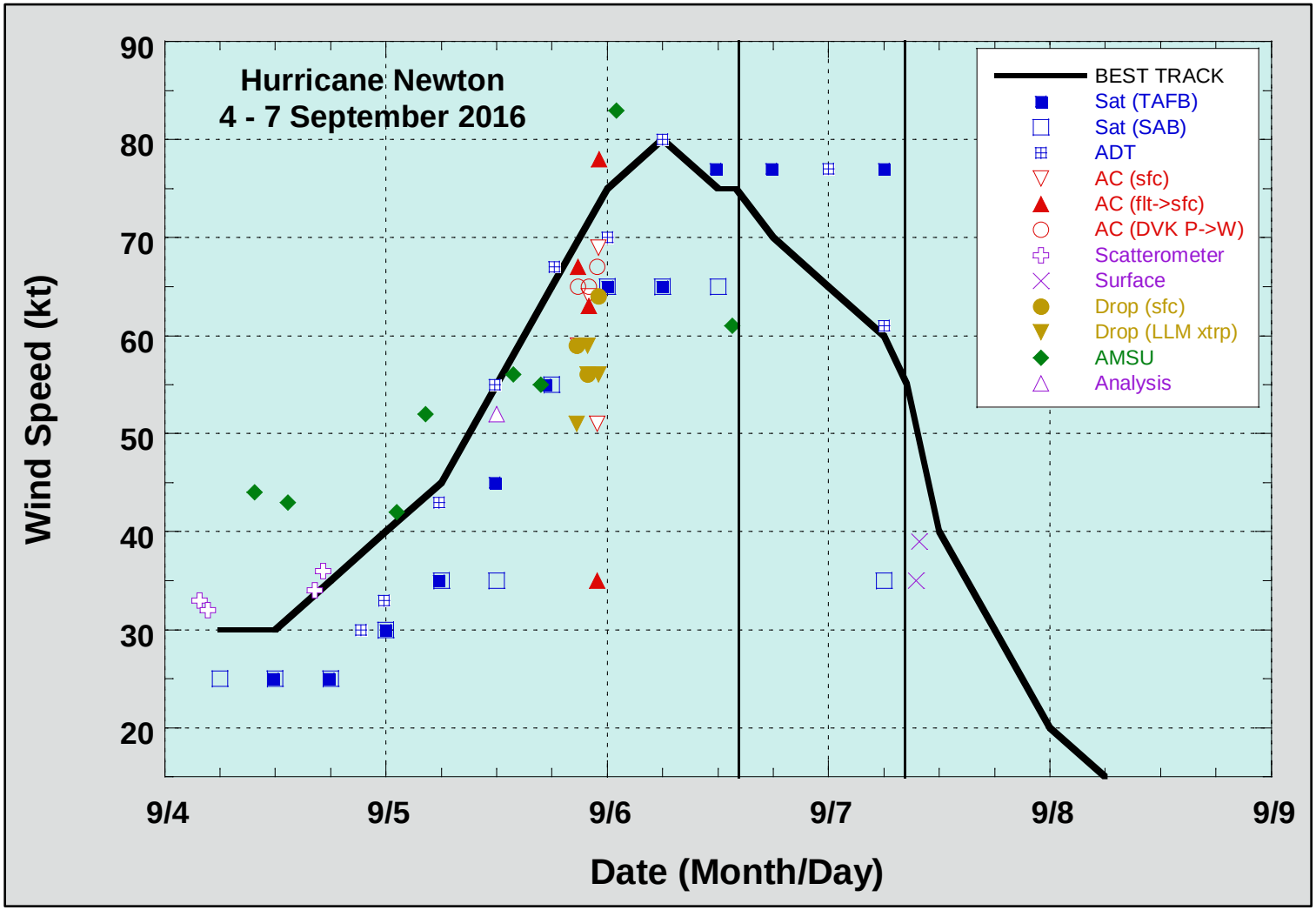

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Newton, 4-7 September 2016. Aircraft observations have been adjusted for elevation using a 90% adjustment factor for observations from 700 mb. Dropwindsonde observations include actual 10 m winds (sfc), as well as surface estimates derived from the mean wind over the lowest 150 m of the wind sounding (LLM). Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Dashed vertical lines correspond to 0000 UTC, and solid vertical lines correspond to landfalls.

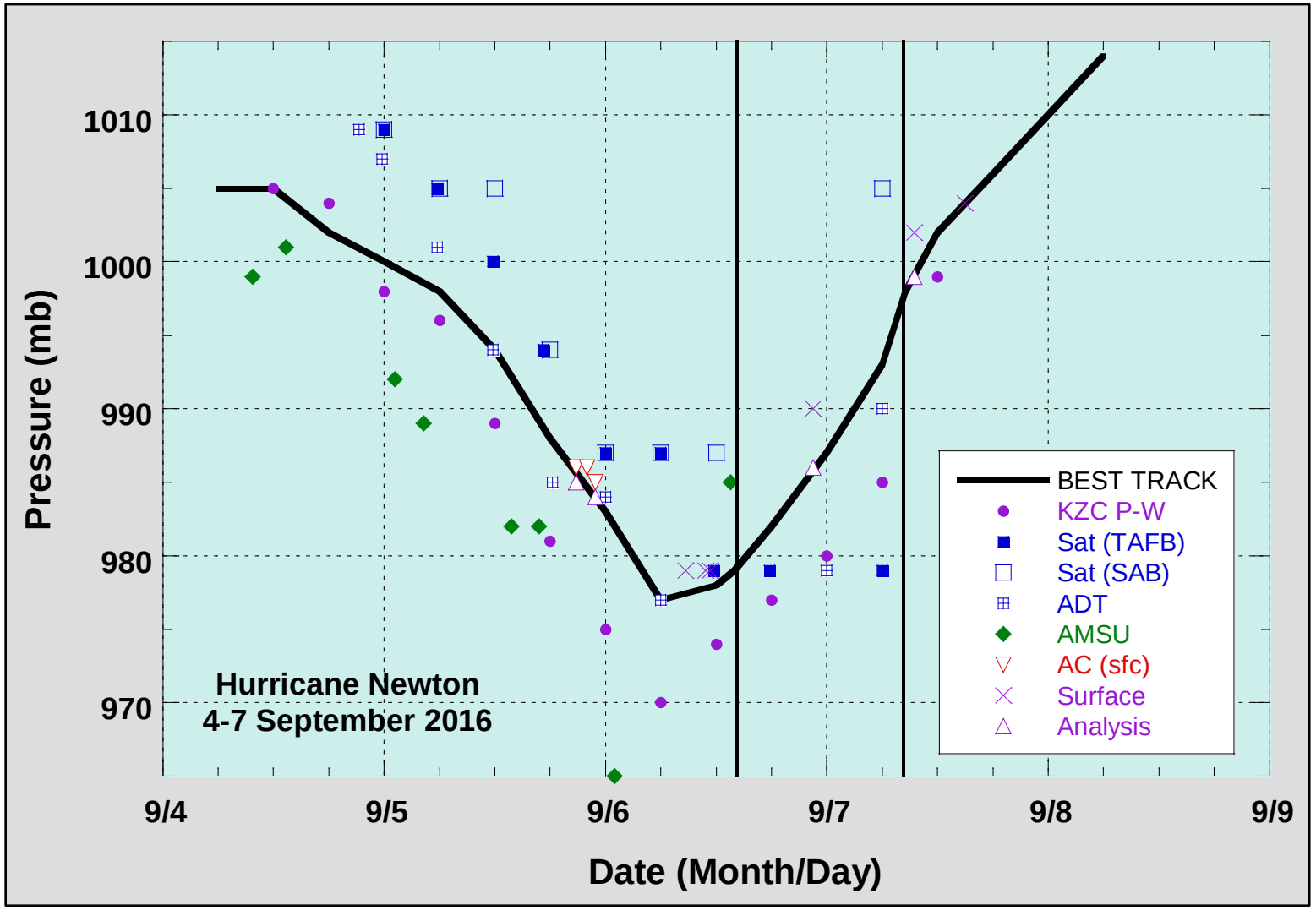

Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Newton, 4-7 September 2016. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship. Dashed vertical lines correspond to 0000 UTC, and solid vertical lines correspond to landfalls.

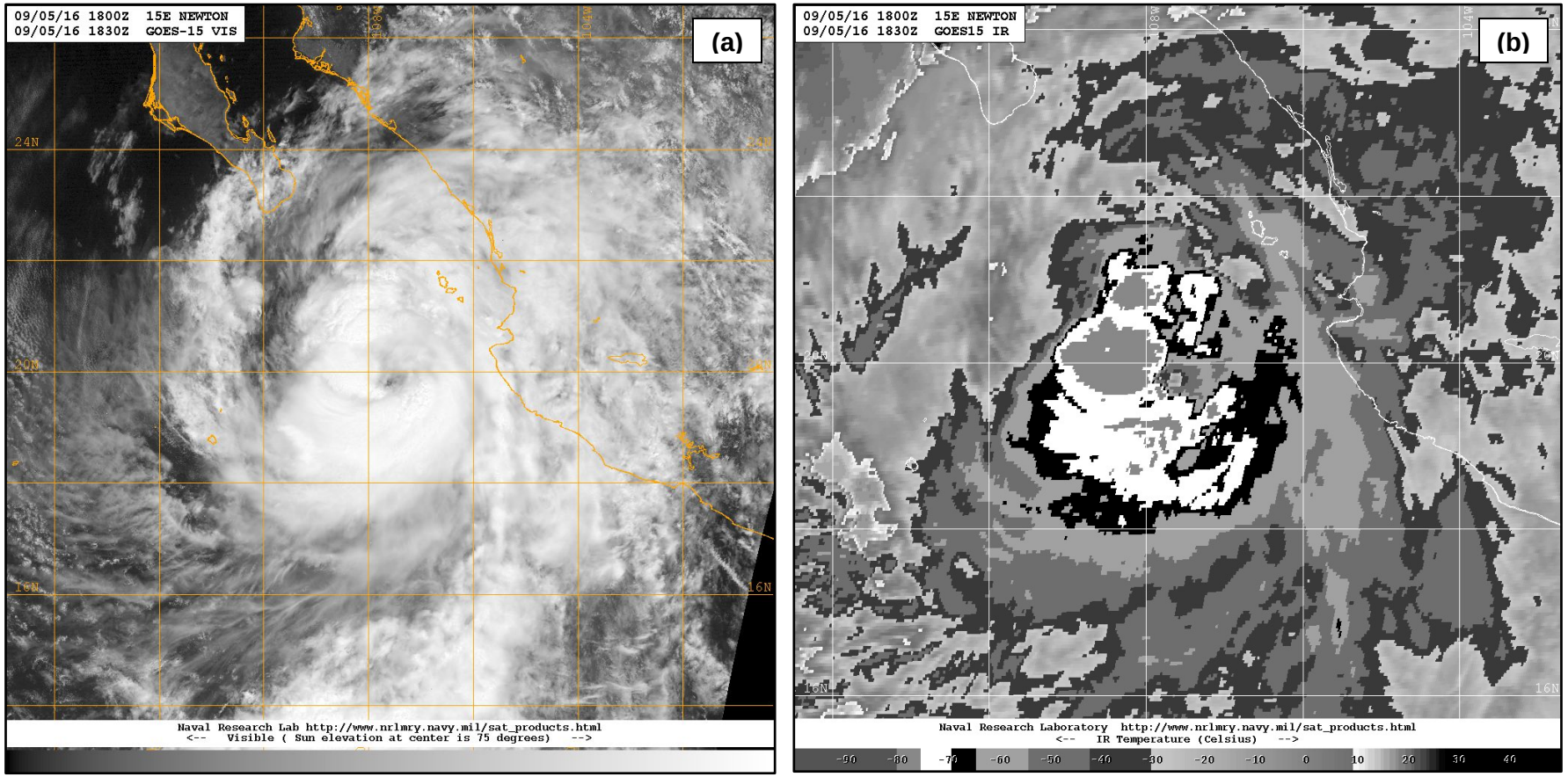

Figure 4. GOES-15 (a) visible and (b) infrared satellite images of Newton at 1830 UTC 5 September, just after it became a hurricane. Images courtesy of the Naval Research Laboratory.

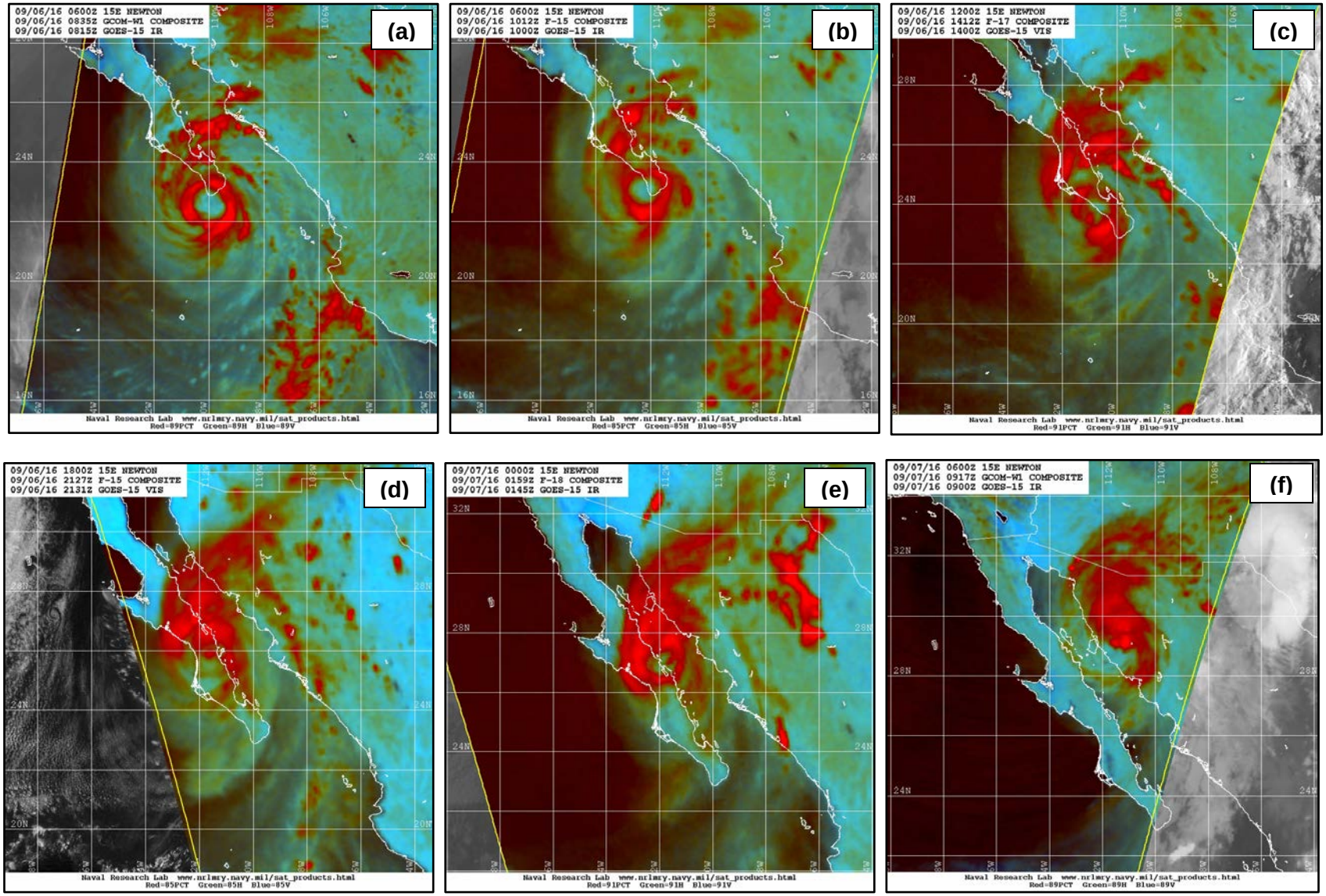

Figure 5. Series of 85- and 91-GHz microwave images showing the evolution of Hurricane Newton's convective structure at (a) 0835 UTC 6 September, (b) 1012 UTC 6 September, (c) 1412 UTC 6 September, (d) 2127 UTC 6 September, (e) 0159 UTC 7 September, and (f) 0917 UTC 7 September. Images courtesy of the Naval Research Laboratory.

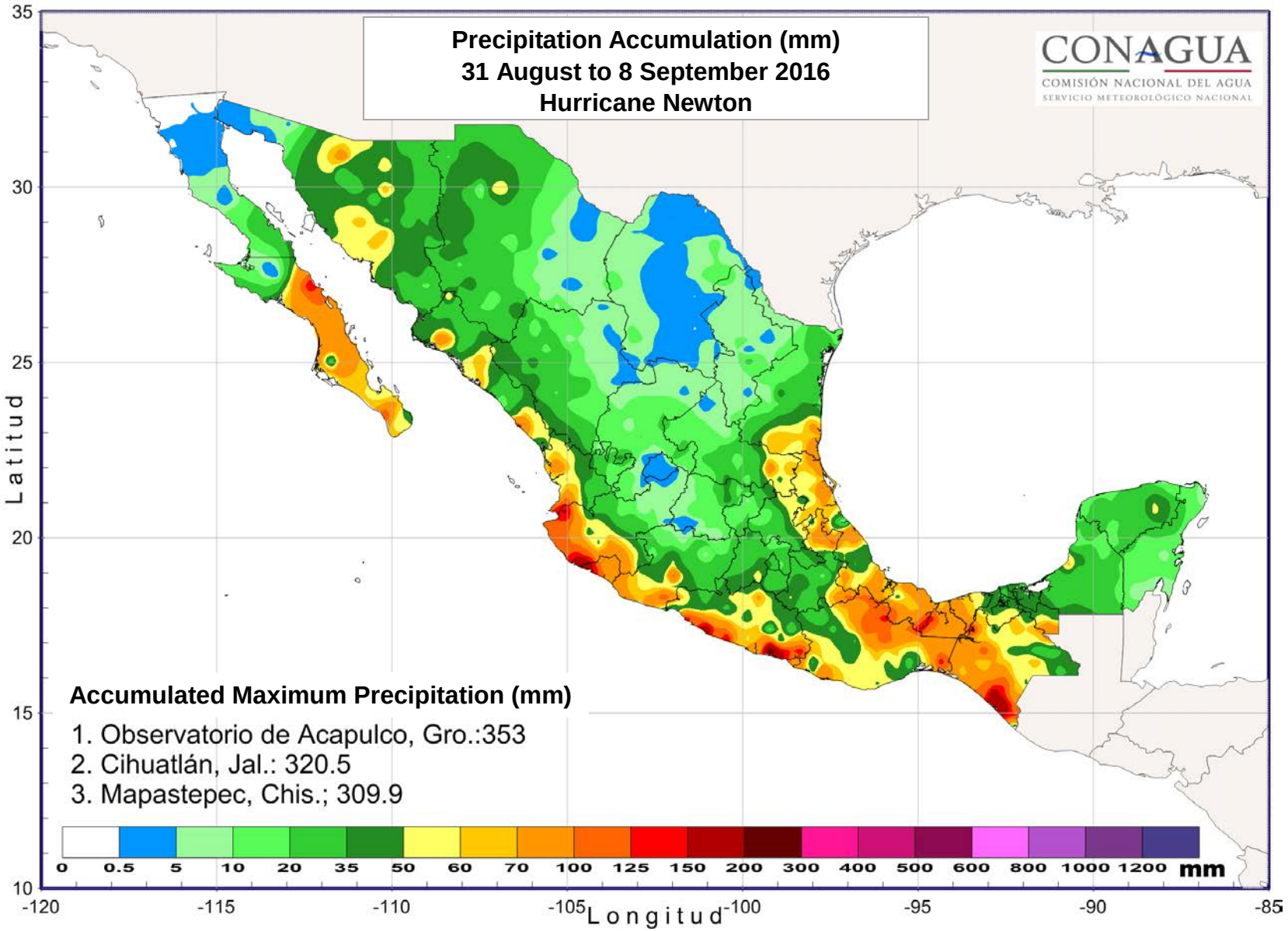

Figure 6. Rainfall accumulation (mm) in Mexico from Hurricane Newton and its precursor disturbance between 31 August and 8 September 2016. Image courtesy of CONAGUA, the National Meteorological Service of Mexico.

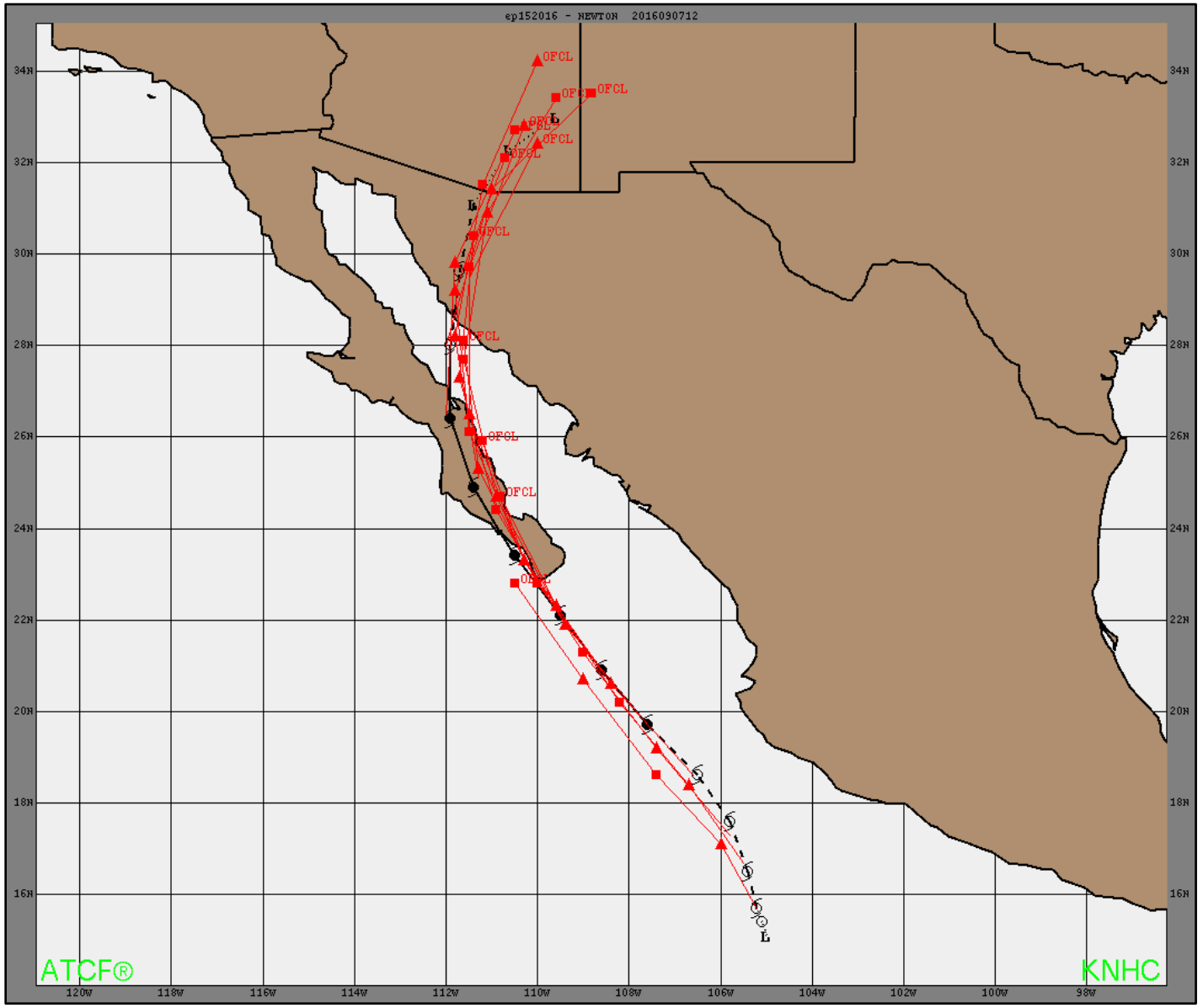

Figure 7. Official 48-h track forecasts (red) for Hurricane Newton, 4-7 September 2016. The best track is given by the thick black line with positions given at 6 h intervals.