NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

HURRICANE FIONA

(AL072022)

14-23 September 2022

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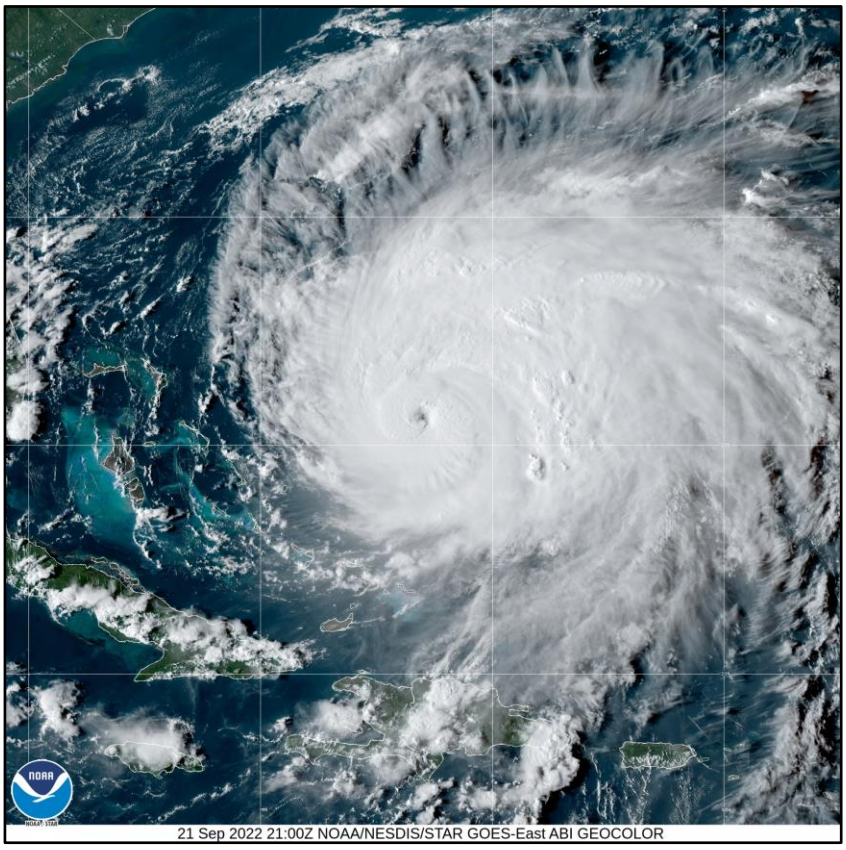


FIONA AS A CATEGORY 4 HURRICANE AT 2100 UTC 21 SEPTEMBER. IMAGE COURTESY OF NOAA/NESDIS/STAR.

Fiona was a large and intense hurricane that made landfalls in Puerto Rico, the Dominican Republic, Grand Turk, and, as an extremely strong extratropical cyclone, in Nova Scotia. It was the deepest cyclone by minimum pressure on record for Canada.

Table of Contents

Hurricane Fiona

14-23 SEPTEMBER 2022

SYNOPTIC HISTORY

Fiona formed from a tropical wave that moved off the African coast late on 7 September. Showers and thunderstorms associated with the wave initially showed some signs of organization after the system moved offshore. However, the associated deep convection diminished over the next several days as the wave continued westward over the eastern tropical Atlantic. By 10-11 September, the wave was producing only minimal shower activity, apparently due to the influence of dry air. Deep convection then increased, but was disorganized, in association with the disturbance while it continued westward across the central Tropical Atlantic on 12-13 September. By late on 13 September, showers and thunderstorms became more consolidated about 900 n mi east of the Lesser Antilles. Around 0600 UTC 14 September, a well-defined low-level circulation formed near the western edge of the main area of deep convection, centered about 775 n mi east of Guadeloupe, and thus the system became a tropical depression at that time. 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].

For the first few days, the system was under the influence of moderate-to-strong westerly vertical wind shear, with the low-level center often being exposed to the west of the deep convection during 14–16 September. However, the shear was not strong enough to prevent the cyclone from strengthening into a tropical storm by 1800 UTC 14 September, and reaching an intensity of 50 kt the next day. With a mid-level anticyclone centered to its north-northwest, Fiona moved on a mostly westward heading and neared the Leeward Islands on 15–16 September. While remaining in a sheared environment, the storm did not change much in intensity, and its maximum winds fluctuated between 45 and 50 kt. The system passed over Guadeloupe just before 0000 UTC on 17 September with an intensity of 50 kt, and then moved into the Caribbean Sea. Fiona moved somewhat erratically but generally westward over the northeastern Caribbean Sea for the next day or so while maintaining peak winds near 50 kt, but showing some increase in organization. On 18 September, the storm turned toward the west-northwest and northwest, and vertical shear relaxed over the system. As a result, Fiona strengthened while nearing the southern coast of Puerto Rico. The system became a hurricane around 1200 UTC 18 September, and made landfall later that day over extreme southwestern Puerto Rico around 1920 UTC (Fig. 4a) with peak sustained winds of about 75 kt. Later on 18 and early on 19 September, Fiona wobbled westward over the Mona Passage with some additional increase in strength. Turning back toward the northwest as the ridge to the north gradually weakened, the eye of the hurricane made landfall on the southeastern coast of the Dominican Republic around 0730 UTC

[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.

19 September (Fig. 4b) with maximum winds near 80 kt. Fiona's center crossed the eastern Dominican Republic and emerged into the Atlantic off the northern coast of that country by 1500 UTC 19 September. Although the hurricane's maximum winds had decreased slightly after moving over eastern Hispaniola, Fiona re-intensified after moving back over water, and it strengthened into a 100-kt major hurricane while approaching the Turks and Caicos early on 20 September. Moving northwestward, Fiona's eye passed over Grand Turk around 1100 UTC that day, and very near East Caicos Island a short time later.

As the subtropical ridge to the north of Fiona continued to weaken, the hurricane turned toward the north-northwest and north later on 20 and 21 September, moving away from the southeastern Bahamas. Meanwhile, while moving in a conducive atmospheric and oceanic environment, the hurricane developed well-defined upper-level outflow and strengthened further, reaching its peak intensity of 120 kt around 0600 UTC 21 September when it was centered about 130 n mi north-northwest of Grand Turk. Continuing northward, Fiona's well-defined eye passed about 300 n mi east of the northern Bahamas early on 22 September. The system was moving through a weakness in the subtropical ridge, and it veered to a north-northeastward heading later on the 22nd in response to a strong mid-tropospheric trough approaching the northeastern U.S. coast. Fiona accelerated north-northeastward to northeastward early on 23 September ahead of the trough and an approaching frontal system, while maintaining category 4 intensity. The hurricane had become quite large, with tropical-storm-force winds extending as far as 300 n mi from the center and hurricane-force winds extending as much as 100 n mi. Fiona's center passed about 100 n mi to the northwest of Bermuda around 1000 UTC 23 September.

Later on 23 September, the cyclone turned northward and accelerated further and merged with the nearby front, becoming an intense (100-kt) extratropical cyclone by 0000 UTC 24 September while centered about 190 n mi southeast of Halifax, Nova Scotia. Fiona then made landfall on the southeastern coast of Nova Scotia around 0700 UTC 24 September as a very strong extratropical cyclone with maximum winds near 85 kt and a minimum pressure of 931 mb. Fiona was the deepest cyclone on record (by minimum pressure) to make landfall in Canada. The system slowed its forward speed while moving northward over eastern Nova Scotia and slowly weakened later on 24 September. While continuing to weaken, post-tropical Fiona moved northeastward to northward across extreme eastern Quebec and Labrador on 25 September, and its maximum winds decreased to below 50 kt. The cyclone maintained minimal gale-force winds on 26 September while moving over the north Atlantic between Labrador and Greenland. It turned east-northeastward and dissipated near the southwest coast of Greenland late on 27 September.

METEOROLOGICAL STATISTICS

Observations in Fiona (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), objective Advanced Dvorak Technique (ADT) estimates and Satellite Consensus (SATCON) 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 flights of the 53rd Weather Reconnaissance Squadron WC-130 aircraft of the U.S. Air Force Reserve

Command and WD-P3 aircraft of the NOAA Aircraft Operations Center. There were 17 flights by the Air Force aircraft that made 60 center fixes (including 4 radar fixes while Fiona was over the Dominican Republic) and 6 flights by the NOAA aircraft that made 16 center fixes. There were also 3 synoptic surveillance missions around Fiona done by the NOAA G-IV aircraft. 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 Fiona.

The maximum intensity of the hurricane, 120 kt, at 0600 UTC 21 September is based on a blend of flight-level and SFMR winds from an Air Force Reserve Hurricane Hunter aircraft and ADT values. The highest 700-mb flight-level wind measured by the aircraft was 133 kt at 0905 UTC on the 21st, which converts to a surface wind of close to 120 kt. The highest SFMR-observed surface winds from the aircraft were 116 kt at 0855 UTC. Objective Dvorak estimates, ADTs, peaked a few hours earlier at near 130 kt. The minimum central pressure of 931 mb at 0000 UTC 23 September is based on a dropwindsonde observation from an Air Force Reserve Hurricane Hunter aircraft at 2309 UTC 22 September with the lowest 700-mb height from the aircraft being observed at that time.

Ship reports of winds of tropical storm force associated with Fiona are given in Table 2, and selected surface observations from land stations, data buoys and Saildrones are given in Table 3. There were four Saildrone encounters with Fiona, with the most severe conditions observed on 22 September when the vessel measured significant wave heights of about 50 ft.

Winds and Pressure

Guadeloupe and Lesser Antilles

Sustained tropical-storm-force winds with gusts of 50 to 60 kt were reported in Guadeloupe and some of the other Leeward Islands. The lowest pressure measured at Guadeloupe was 1002.7 mb.

Puerto Rico and the U.S. Virgin Islands

In Puerto Rico, an elevated observing site at El Cocal Yabucoa measured sustained winds of 68 kt with a gust to 79 kt. Sustained winds of 60 kt with a gust to 90 kt were reported at Ponce. Sustained winds of 61 kt with a gust to 70 kt were observed at Las Mareas.

Sustained winds of 48 kt with a gust to 52 kt were reported at Buck Island (near St. Croix) in the U.S. Virgin Islands.

A minimum pressure of 987.3 mb was observed at Isla Magueyes on the southwest coast of Puerto Rico.

Dominican Republic

The highest wind gust reported from the Dominican Republic was 85 kt at Samaná El Catey. A 70-kt gust was observed at La Romana. In an incomplete report, sustained winds of 54 kt with a gust to 69 kt were measured at Punta Cana.

Storm chaser Josh Morgerman (iCyclone) observed a minimum pressure of 976.7 mb at Boca de Yuma at 0804 UTC 19 September, near the landfall location. A minimum pressure of 984.6 mb was reported from Arroyo Barril.

Turks and Caicos

Sustained winds of 63 kt with a gust to 87 kt were observed at an unofficial site in South Caicos. A pressure of 994.9 mb was reported at Providenciales, but significantly lower pressures likely occurred in and around Grand Turk.

Bermuda

Sustained winds of 62 kt with a gust to 81 kt were observed at the L.F. Wade International Airport in Bermuda. An elevated site at the Maritime Operations Centre in Bermuda reported sustained winds of 76 kt with a gust to 96 kt. The lowest pressure reported was 985.7 mb, at 1025 UTC 23 September, at the National Museum of Bermuda.

Canada

Fiona produced sustained hurricane-force winds as a post-tropical cyclone over portions of Newfoundland and Nova Scotia, with hurricane-force gusts reported at stations in Prince Edward Island and eastern Quebec. A weather station at Beaver Island, Nova Scotia, reported a sustained wind of 68 kt at 0300 UTC 24 September with a gust of 86 kt. Elsewhere, a 66-kt sustained wind with a gust to 96 kt was measured at a weather station in Wreckhouse, Newfoundland, and a gust of 97 kt was recorded by a Citizen Weather Observer Program station in Arisaig, Nova Scotia.

A minimum pressure of 931.2 mb was recorded at 0740 UTC 24 September by Environment and Climate Change Canada buoy 44488, located in eastern Chedabucto Bay. An automated station on Hart Island, Nova Scotia, reported a minimum pressure of 932.7 mb at 0700 UTC that day.

Storm Surge[2]

Fiona produced 1 to 3 ft of storm surge inundation above ground level (AGL) in the U.S. Virgin Islands and along the southern coast of Puerto Rico. The National Ocean Service (NOS) tide gauge at Mayaguez Island, located along the southern coast of Puerto Rico, recorded 2.2 ft above Mean Higher High Water (MHHW). Local reports from emergency managers along the southern coast are consistent with these measurements, although the reports of fresh and saltwater flooding were difficult to differentiate. Elsewhere, the NOS tide gauge at Esperanza on Vieques Island, Puerto Rico, located just east of the main island, measured a water level of 1.2 ft

[2] Several terms are used to describe water levels due to a storm. **Storm surge** is defined as the abnormal rise of water generated by a storm, over and above the predicted astronomical tide, and is expressed in terms of height above normal tide levels. Because storm surge represents the deviation from normal water levels, it is not referenced to a vertical datum. **Storm tide** is defined as the water level due to the combination of storm surge and the astronomical tide, and is expressed in terms of height above a vertical datum, i.e. the North American Vertical Datum of 1988 (NAVD88) or Mean Lower Low Water (MLLW). **Inundation** is the total water level that occurs on normally dry ground as a result of the storm tide, and is expressed in terms of height above ground level. At the coast, normally dry land is roughly defined as areas higher than the normal high tide line, or Mean Higher High Water (MHHW).

above MHHW before the sensor stopped reporting and likely did not record a peak water level. Farther to the west, an NOS tide gauge at Mona Island, located between the main island of Puerto Rico and the Dominican Republic, measured 2.0 ft above MHHW.

The storm surge forecast was 3 to 5 ft above normal tides in the Dominican Republic, and 5 to 8 ft above normal tides in the Turks and Caicos. There were no measurements collected in the impacted areas, but storm surge likely occurred.

A preliminary storm summary from the Canadian Hurricane Centre reported devastating storm surge and wave impacts across a large region including southwestern Newfoundland, eastern and northern Nova Scotia, Prince Edward Island, the east coast of New Brunswick, Iles-de-la-Madeleine, and the Gaspe Peninsula. A Canadian Hydrographic Service (CHS) tide gauge in Shediac, New Brunswick, recorded 3.9 ft above Higher High Water Large Tide (HHWLT; a tidal datum similar to MHHW) before the sensor stopped reporting and likely did not record the peak water level. Another CHS tide gauge at Escuminac, New Brunswick, measured 3.7 ft above HHWLT, and a CHS tide gauge in Port aux Basques, Newfoundland, measured 2.3 ft above HHWLT. These measurements suggest widespread storm surge inundation of 3 to 5 ft AGL. There were also some unofficial reports of surges of up to 7 ft AGL along parts of northern Nova Scotia, southeastern New Brunswick, and northern Prince Edward Island.

Rainfall and Flooding

Guadeloupe and Lesser Antilles

Fiona produced excessive rainfall and significant flooding on Guadeloupe as a sheared tropical storm (Figs. 5 and 6). The mountainous island of Basse-Terre received 10–20 inches (254–508 mm) of rainfall, with locally higher amounts over southern portions of the island. A maximum of 22.22 inches (564.5 mm) was reported in Matouba, where some landslides and mudslides were reported. A few other locations in the Saint-Claude and Capesterre-Belle-Eau municipalities received over 20 inches (508 mm) of rain. This torrential rainfall resulted in flash and river flooding with over 20 water rescues performed, mostly in Basse-Terre and Vieux Habitants. Farther east, the Pointe-à-Pitre International Airport (TFFR) on Grande-Terre reported 10.20 inches (259 mm) of rainfall, and La Désirade Airport (TFFA) received 9.59 inches (243.5 mm) of rainfall.

Elsewhere in the Lesser Antilles, 3–7 inches (76–178 mm) of rainfall occurred over southern portions of Martinique (Fig. 7), with a maximum of 7.52 inches (191 mm) reported in St-Esprit Baldara. The V.C. Bird International Airport (TAPA) on Antigua received 3.77 inches (95.8 mm) of rain. No significant flooding impacts were reported in these locations.

Puerto Rico and the U.S. Virgin Islands

Prior to Fiona, the passage of Earl to the north of Puerto Rico in early September resulted in heavy rainfall that saturated the ground and brought rivers across much of the island to near- or above-normal levels. These antecedent conditions, combined with an extended period of heavy rainfall produced by Fiona, resulted in catastrophic flooding across Puerto Rico. Many

locations received 8–16 inches (203–406 mm) of rainfall during the event, with even higher rainfall totals reported over the southern and eastern portions of the island (Fig. 8). There were numerous observations of over two feet of rainfall, and a storm-total maximum of 32.40 inches (823 mm) was reported by a United States Geological Survey (USGS) rain gauge along the Rio Cerrillos near Ponce. This excessive rainfall resulted in significant flash flooding and landslides. There were thousands of water rescues performed in more than 25 municipalities across Puerto Rico, including over 400 in Salinas where a flash flood emergency was issued. Widespread river flooding occurred, especially in the central and eastern portions of the island. Almost half of the USGS river gauges rose above flood stage, and over a dozen locations crested above major flood stage including along the Rio Cibuco, Rio Grande de Arecibo, Rio Grande de Loiza, Rio Grande de Manati, and Rio Guanajibo. Some river gauges reached crests that surpassed record levels from Hurricane Maria in 2017. Overall, the National Weather Service office in San Juan[3] issued about 50 Flash Flood Warnings and 30 Flood Warnings between 18–20 September.

Fiona generally produced 4–8 inches (102–203 mm) of rainfall over the U.S. Virgin Islands, with a maximum of 8.87 inches (255.3 mm) reported by a CoCoRaHS observation site near Frederiksted on St. Croix. No significant flooding impacts were reported on the U.S. Virgin Islands.

Dominican Republic

Heavy rainfall from Fiona affected northern and eastern provinces of the Dominican Republic (Fig. 9). A swath of 6–12 inches (152–305 mm) of rainfall occurred over far eastern portions of the country near where the center made landfall. A storm-total maximum of 13.71 inches (348.2 mm) of rain was measured at La Romana International Airport (MDLR). Elsewhere, 13.20 inches (335.3 mm) was reported in Miches, and 11.11 inches (282.1 mm) fell at the Punta Cana International Airport (MDPC). The heavy rainfall resulted in flash and river flooding, especially in the provinces of La Altagracia, El Seibo, Hato Mayor, and Samaná. Josh Morgerman (iCyclone) reported flash flooding and submerged vehicles along a highway in La Altagracia province heading towards Punta Cana. The cities of Higüey and Samaná experienced significant flooding, and several other towns were cut off by floodwaters. Flooding along the Yeguada River forced evacuations in Miches.

Canada

Fiona produced heavy rainfall in portions of Atlantic Canada (Fig. 10) despite transitioning into a post-tropical cyclone and interacting with some drier air prior to landfall. A storm-total maximum of 8.35 inches (212.0 mm) of rain was measured at Big Intervale, a Cape Breton Mesonet site in Nova Scotia. Numerous other locations across Nova Scotia reported 4-8 inches (102–203 mm) of rainfall. On Prince Edward Island, 5.02 inches (127.5 mm) was reported at a CoCoRaHS site near Souris. In New Brunswick, 4.67 inches (118.6 mm) was measured in Crowe Brook. There were no significant reports of freshwater flooding.

[3] https://www.weather.gov/sju/fiona2022

CASUALTY AND DAMAGE STATISTICS

Fiona was responsible for 7 direct deaths[4] – 2 each in Puerto Rico, the Dominican Republic, and Canada, and 1 in Guadeloupe. A 54-year-old man drowned in Guadeloupe when his house was washed away by floodwaters near Rivière des Pères. Two men aged 58 and 62 drowned in floodwaters near Bayamón, Puerto Rico. In the Dominican Republic, a 68-year-old man died when he was struck by a falling tree in San José de Matanzas, and an 18-year-old woman was killed when a power pole fell on her while she was riding a motorcycle in Higüey. In Canada, a 73-year-old woman drowned when she was swept out to sea by large waves and storm surge that washed away part of a home in Port aux Basques, Newfoundland. An 81-year-old man with dementia was washed out to sea and presumably drowned in Lower Prospect, Nova Scotia.

There were also 22 indirect deaths, including 21 in Puerto Rico and 1 in Canada. According to the Puerto Rico Department of Health[5] and media reports, three indirect deaths were related to carbon monoxide poisoning, and three others were the result of cardiac incidents during or after the storm. Six elderly individuals (age 65 or older) had head or body trauma cited as a cause of death, with other medical conditions listed for many of these individuals. One fatality each was the result of a generator explosion, electrocution resulting in severe head trauma, stroke with no access to medical services, medical complications following a fall related to power outages, and suicide. The remaining four indirect deaths were the result of various medical incidents combined with limited access to medical services in the aftermath of the storm. In Canada, media reports suggest one indirect death on Prince Edward Island was related to generator use, and several other people were treated for suspected carbon monoxide poisoning.

Fiona produced over $3.09 billion (USD) in combined damage across the Caribbean and in Canada, according to the Global Catastrophe Recap[6] produced by Aon. In Puerto Rico alone, the National Centers for Environmental Information[7] (NCEI) estimates that Fiona caused $2.5 billion (USD) in damages, making it the third costliest hurricane on record for that island, after Maria (2017) and Georges (1998). According to estimates from Catastrophe Indices and Quantification Inc. (CatIQ), Fiona is the costliest extreme weather event on record in Atlantic Canada with about $800 million (CAD) in insured losses.

Guadeloupe

Floodwaters and landslides significantly damaged homes and infrastructure on Basse-Terre. The Rivière des Pères bridge that connects Basse-Terre and Baillif suffered major structural damage, and other roads and bridges were washed out or made impassable by downed

[4] 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.

[5] https://www.salud.gov.pr/CMS/DOWNLOAD/6613

[6] https://www.aon.com/reinsurance/getmedia/08b0306f-790c-4f6a-8c0e-883e91ceba04/20221410-if-q3-2022-gl

[7] NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2023). https://www.ncei.noaa.gov/access/billions/, DOI: 10.25921/stkw-7w73

trees, water, or other debris. About 13,000 customers lost power during the event, and 151,000 people faced water shortages as a result of the storm.

Puerto Rico

Catastrophic flash and river flooding from excessive rainfall resulted in serious damage, particularly in southern and central portions of Puerto Rico (Fig. 11). Flooding along the Rio Nigua near the southern coast inundated a neighborhood in Salinas, resulting in a flash flood emergency that necessitated many water rescues and destroyed some homes. Heavy rainfall in the mountainous interior portions of the island triggered significant landslides and rockfalls that left numerous structures uninhabitable and cut off several municipalities. A temporary bridge that was installed over the Guaonica River in Utuado after Hurricane Maria in 2017 was washed away by floodwaters. Another bridge in Guayama was destroyed, and several other roads and bridges were inundated or made impassable by flooding and debris. Strong winds downed trees and power lines, and some homes suffered roof damage. The entire island (about 1.5 million customers) lost power, and over 760,000 customers dealt with interruptions to water service during and after the event. More than 90% of the commercial crops in Puerto Rico were destroyed, resulting in agricultural losses of over $150 million (USD).

Dominican Republic

Hurricane-force winds and heavy rainfall produced significant damage across some of the eastern provinces of the Dominican Republic (Fig. 12). Strong winds downed trees and power lines, and over 400,000 people lost power. Flooding rains triggered landslides and caused some bridge collapses, and many roads were made impassable by flooding and debris. More than 8,500 homes were damaged, and over 2,000 were destroyed. Over 43,000 people were displaced, with at least 1,500 people relocated to emergency shelters. About 1.2 million people experienced water supply issues during and after the event. It is estimated that over 1 million tareas (155,380 acres) of agricultural land was damaged across the country.

Turks and Caicos & Bermuda

The easternmost islands of the Turks and Caicos were most impacted by Fiona, particularly Grand Turk and Salt Cay. The pier at the Grand Turk Cruise Center was significantly damaged, with some sections broken off and washed up on a nearby beach. Some damage was also reported at the Grand Turk Airport. Numerous trees and power poles were downed by strong winds, and some structures suffered roof damage. Widespread power outages occurred on Grand Turk, Salt Cay, South Caicos, North Caicos, and Middle Caicos. Some asphalt was lifted off of low-lying areas along the North and Middle Caicos Causeway. Limited damage and minor flooding were reported on Providenciales. There were no reported deaths or serious injuries.

On Bermuda, strong winds downed some trees and power lines and caused some minor roof damage. Several roads were blocked by debris, and there were multiple reports of boats that were grounded or sunk by large waves. About 29,000 customers lost power during the event.

Atlantic Canada

Storm surge and large, destructive waves resulted in devastating coastal flooding and significant erosion along the coasts of southwestern Newfoundland, eastern and northern Nova

Scotia, Prince Edward Island, eastern New Brunswick, and Iles-de-la-Madeleine. Over 100 homes were destroyed by large waves and storm surge along the coast of southwestern Newfoundland from Port aux Basques eastward to Burgeo. Many homes and businesses were inundated with up to several feet of water on Iles-de-la Madeleine, and several roads were made impassable by floodwaters and debris. About 60 roads and bridges and at least six schools were damaged on Prince Edward Island. Strong winds downed thousands of trees and power lines across portions of Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland. More than 500,000 customers lost power across Atlantic Canada, including at least 415,000 in Nova Scotia and over 82,000 on Prince Edward Island. Some large trees fell on cars and buildings in Halifax and other cities in Nova Scotia. Many structures suffered roof and window damage. Figure 13 shows some of the impacts of Fiona in Canada.

FORECAST AND WARNING CRITIQUE

Genesis

Forecasts of Fiona's genesis were problematic. The wave from which it developed was introduced in the Tropical Weather Outlook (TWO) while it was still located over western Africa, 186 h prior to genesis with a low (<40%) chance of development within 5 days (Table 4). The system was dropped from the TWO 102 h prior to formation, and re-introduced into the TWO 48 h before genesis with a low chance of development within 5 days. A 2-day genesis probability was not introduced in the low category until just 30 h before formation. The 5-day genesis probability was raised to medium only 18 h before genesis, and the 2-day genesis probability was only raised to medium at the time of formation. Neither the 2- nor 5-day genesis probabilities were set to high before Fiona formed. The location of genesis was also poorly forecast, with only 52% of the NHC Graphical TWO areas correctly capturing the area where Fiona formed (Fig. 14). One of the reasons for the poor official forecasts of tropical cyclone genesis was the disappointing performance by the global models for the prediction of the pre-Fiona disturbance over the tropical Atlantic. Figure 15 shows that none of the 4 global models most commonly used by the NHC predicted a hurricane over the northeastern Caribbean Sea in 5 days.

Track

A verification of NHC official track forecasts for Fiona is given in Table 5a. Official track forecast errors were comparable to the mean official errors for the previous 5-yr period at the 12-h forecast interval, and lower than the mean errors at all later forecast periods. The official errors were significantly lower than the long-term means at 72, 96, and 120 h. A homogeneous comparison of the official track errors with selected guidance models is given in Table 5b. The mean official track forecasts were comparable to or better than the guidance models in most cases, although the corrected consensus model, HCCA, was slightly better than the official forecasts at all forecast times.

Intensity

A verification of NHC official intensity forecasts for Fiona is given in Table 6a. Official intensity forecast errors were below the mean official errors for the previous 5-yr period at 12 through 60 h but the mean official error was larger than the long-term mean at 72 h and much larger than the 5-yr averages at 96 h and 120 h for a sizeable number of cases. In fact, these large official intensity errors at 4 and 5 days had a significant influence on the overall NHC Atlantic intensity forecast verification for 2022. A homogeneous comparison of the mean official intensity errors with selected guidance models is given in Table 6b. The mean official intensity forecast errors were comparable to those from most of the models at 12 through 60 h, but the HCCA and HWRF guidance (HWFI) were notably better than the official forecasts at 96 and 120 h.

Watches and Warnings

Wind watches and warnings associated with Fiona are given in Table 7. A Tropical Storm Watch was issued for the U.S. Virgin Islands and Puerto Rico at 2100 UTC 15 September, and the watch area was upgraded to a Tropical Storm Warning at 1500 UTC 16 September. Surface observations suggest that sustained tropical-storm-force winds reached the U.S. Virgin Islands at around 0800 UTC 18 September, which resulted in watch and warning lead times of 59 h and 41 h, respectively. Sustained tropical-storm-force winds reached Puerto Rico by around 1000 UTC 18 September, resulting in lead times for the Tropical Storm Watch and Warning of 61 h and 43 h, respectively. A Hurricane Watch was issued for Puerto Rico at 0900 UTC 17 September which was 25 h prior to the onset of tropical-storm-force winds, and this was upgraded to a Hurricane Warning at 1500 UTC 17 September, or about 19 h before the onset of tropical-storm-force winds in Puerto Rico. This relatively short lead time for the Hurricane Warning was due to earlier-than-expected intensification of Fiona over the northeastern Caribbean Sea.

No storm surge watches or warnings were issued for Puerto Rico. The peak storm surge forecast was 1 to 3 ft AGL for the southern coast of Puerto Rico and U.S. Virgin Islands. This forecast verified well with available observations.

Impact-Based Decision Support Services (IDSS) and Public Communication

The NHC began communication with emergency managers on Thursday, September 15 as Fiona was developing in the Tropical Atlantic. Four decision support briefings were provided to emergency managers and coordinated through the FEMA Hurricane Liaison Team embedded at the NHC. The briefings were Federal video-teleconferences with FEMA HQ, FEMA Region 2, Puerto Rico, and the U.S. Virgin Islands. These briefings continued through Monday, September 19, until Fiona was well north of Puerto Rico and the U.S. Virgin Islands. The Tropical Analysis and Forecast Branch of NHC provided six live briefings on Fiona from 15 to 20 September to U.S. Coast Guard District 7 in support of their life-saving mission.

ACKNOWLEDGEMENTS

Data in Table 3 were compiled from reports issued by the NWS Weather Forecast Office in San Juan, Puerto Rico, National Data Buoy Center, and NOS Center for Operational Oceanographic Products and Services. International data in Table 3 were provided by Meteo France (Martinique, Guadeloupe, Saint Barthelemy and Saint Martin), Royal Netherlands Meteorological Institute (Saba and Saint Eustatius), Antigua and Barbuda Meteorological Services, Oficina Nacional de Meteorología (Dominican Republic), Turks and Caicos Islands Airports Authority, Bermuda Weather Service, and Environment and Climate Change Canada. Josh Morgerman (iCyclone) provided data he collected during Fiona's landfalls in the Dominican Republic and Canada. Saildrone data were provided by Gregory Foltz and the NOAA Saildrone Hurricane Observations Team: https://www.pmel.noaa.gov/saildrone-hurricane/.

Table 1. Best track for Hurricane Fiona, 14–23 September 2022. The extratropical portion of the track is based on analyses from the Canadian Hurricane Centre and the NOAA Ocean Prediction Center.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
14 / 0600	16.0	47.9	1010	25	tropical depression
14 / 1200	16.4	49.1	1009	30	"
14 / 1800	16.6	50.1	1006	35	tropical storm
15 / 0000	16.6	51.3	1002	45	"
15 / 0600	16.5	52.4	1002	45	"
15 / 1200	16.4	53.6	1002	45	"
15 / 1800	16.3	54.8	1006	50	"
16 / 0000	16.1	56.2	1005	50	"
16 / 0600	15.8	57.5	1005	50	"
16 / 1200	15.8	58.8	1005	45	"
16 / 1800	16.3	60.4	1005	45	"
16 / 2315	16.4	61.4	1002	50	"
17 / 0000	16.4	61.6	1002	50	"
17 / 0600	16.3	62.6	1000	50	"
17 / 1200	16.4	63.3	1000	50	"
17 / 1800	16.5	64.0	1002	50	"
18 / 0000	16.5	64.7	997	50	"
18 / 0600	16.9	65.5	994	55	"
18 / 1200	17.2	66.2	990	65	hurricane
18 / 1800	17.8	66.9	986	75	"
18 / 1920	18.0	67.1	986	75	"
19 / 0000	18.1	67.8	984	75	"
19 / 0600	18.2	68.4	977	80	"
19 / 0730	18.4	68.5	976	80	"
19 / 1200	18.8	68.9	980	75	"
19 / 1800	19.5	69.5	972	85	"
20 / 0000	20.2	70.1	974	95	"
20 / 0600	20.8	70.7	967	100	"

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
20 / 1100	21.4	71.1	962	100	"
20 / 1200	21.5	71.2	961	100	"
20 / 1800	22.3	71.7	959	100	"
21 / 0000	22.9	71.8	951	110	"
21 / 0600	23.5	71.8	939	120	"
21 / 1200	24.2	71.7	937	115	"
21 / 1800	25.1	71.6	937	115	"
22 / 0000	26.0	71.4	934	115	"
22 / 0600	26.9	71.1	934	115	"
22 / 1200	28.0	70.6	936	115	"
22 / 1800	29.5	70.0	936	115	"
23 / 0000	30.9	69.0	931	115	"
23 / 0600	32.5	67.5	936	115	"
23 / 1200	34.3	65.0	935	115	"
23 / 1800	37.8	61.7	940	110	"
24 / 0000	42.3	60.7	932	100	extratropical
24 / 0600	45.0	61.2	931	85	"
24 / 0700	45.2	61.2	931	85	“
24 / 1200	46.8	61.2	938	75	"
24 / 1800	47.9	60.8	952	65	"
25 / 0000	48.8	59.8	968	60	"
25 / 0600	50.6	58.6	972	50	"
25 / 0800	51.3	58.3	974	45	"
25 / 1200	53.1	57.5	981	45	"
25 / 1800	55.5	58.0	984	40	"
26 / 0000	57.5	59.0	985	35	"
26 / 0600	58.5	59.0	985	35	"
26 / 1200	59.5	59.0	986	35	"
26 / 1800	60.5	58.5	988	35	"
27 / 0000	61.5	58.0	994	35	"

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
27 / 0600	62.5	57.0	998	35	"
27 / 1200	63.3	55.0	1000	35	"
27 / 1800	64.0	52.0	1002	25	"
28 / 0000					dissipated
21 / 0600	23.5	71.8	939	120	maximum winds
23 / 0000	30.9	69.0	931	115	minimum pressure
16 / 2315	16.4	61.4	1002	50	landfall in Guadeloupe
18 / 1920	18.0	67.1	986	75	landfall near Punta Tocon, Puerto Rico
19 / 0730	18.4	68.5	976	80	landfall near Boca de Yuma, Dominican Republic
20 / 1100	21.4	71.1	962	100	landfall in Grand Turk
24 / 0700	45.2	61.2	931	85	extratropical cyclone landfall near Lower Whitehead, Nova Scotia
25 / 0800	51.3	58.3	974	45	extratropical cyclone landfall near L'Anse-du-Portage, Quebec

Table 2. Selected ship reports with winds of at least 34 kt for Hurricane Fiona, 14–23 September 2022.

Date/Time (UTC)	Ship call sign	Latitude (°N)	Longitude (°W)	Wind direction/ speed (kt)	Pressure (mb)
23 / 0700	C6CX3	28.5	73.3	340 / 38	1009.2
23 / 1900	C6SE5	43.2	66.1	360 / 35	995.5
23 / 2100	ZCBD3	42.6	65.8	320 / 38	995.8
24 / 0100	C6SE5	43.7	67.0	330 / 41	992.5
24 / 0700	C6SE5	43.9	67.4	320 / 50	993.5
24 / 0700	DXJTY4	46.1	63.3	010 / 51	964.2
24 / 1000	ZCDW9	42.4	53.9	200 / 38	1003.0
24 / 1000	ZCBD3	43.8	66.7	290 / 42	997.8
24 / 1000	DXJTY4	46.1	63.2	360 / 49	964.5
24 / 1000	HPMEYW	47.6	59.1	100 / 51	972.4
24 / 1000	QCQAY5	47.6	59.1	120 / 52	972.8
24 / 1100	DXJTY4	46.1	63.3	070 / 65	963.2
24 / 1100	HPMEYW	47.6	59.1	120 / 57	971.2
24 / 1100	QCQAY5	47.6	59.1	130 / 58	972.2
24 / 1200	DXJTY4	46.1	63.2	330 / 48	967.0
24 / 1200	HPMEYW	47.6	59.1	110 / 56	970.9
24 / 1200	QCQAY5	47.6	59.1	130 / 56	972.0
24 / 1500	ZCBD3	44.1	66.8	320 / 35	998.8
24 / 1800	ZCDW9	43.0	55.9	230 / 48	1003.6
24 / 2100	ZCDW9	43.5	56.7	230 / 50	999.7
25 / 0000	ZCDW9	43.9	57.2	270 / 35	999.8

Table 3. Selected surface observations for Hurricane Fiona, 14–23 September 2022.

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Martinique									
Trinité Caravelle (14.77N 60.88W)	17/0400	1008.1	17/0553	33	48				2.09
Vauclin (14.55N 60.84W)			17/1057	25	48				4.31
Fond-Denis-Cadet (14.74N 61.15W)			17/2246	18	41				2.09
St-Esprit Baldara									7.52
Francois-Simon Dostaly									7.21
Rivière-Pilote									6.96
St-Esprit Gendarmerie									5.76
Francois-Chopot									5.20
Guadeloupe									
International Civil Aviation Organization (ICAO) Sites									
La Désirade AP (TFFA) (16.30N 61.08W)	16/2100	1002.7	17/0600	43 (1 min)	50				9.59
Pointe-à-Pitre Intl. AP (TFFR) (16.27N 61.53W)	17/0000	1002.9	17/0700	28 (1 min)	48				10.20
Basse-Terre Baillif AP (TFFB) (16.01N 61.74W)			17/1000	13 (1 min)	32				17.79
Other Sites									
Matouba (St-Claude) (16.05N 61.69W)									22.22
Maison Volcan (St-Claude) (16.04N 61.67W)									22.00
Neufchateau (Capesterre-Belle-Eau) (16.08N 61.60W)									20.49
Carbet (Capesterre-Belle-Eau) (16.04N 61.64W)									20.01
Guillard (Basse-Terre) (16.00N 61.72W)									18.93
Gros Morne (Petit-Bourg) (16.16N 61.62W)									18.77

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Gros Morne Dole (Gourbeyre) (16.00N 61.67W)									18.64
Roujol (Petit-Bourg) (16.18N 61.59W)									18.61
Bois Debout (Capesterre-Belle-Eau) (16.02N 61.59W)									18.45
Bourg (Vieux-Fort) (15.95N 61.70W)									16.60
Gendarmerie (Vieux-Habitants) (16.05N 61.76W)									16.36
Laurichesse (Vieux-Habitants) (16.08N 61.75W)									15.85
Duclos INRAE (Petit-Bourg) (16.21N 61.66W)									14.33
Sofaia (Ste-Rose) (16.29N 61.73W)									12.85
Convenance (Baie-Mahault) (16.24N 61.60W)									12.84
Morphy (Pointe Noire) (16.25N 61.80W)									12.45
Belle-Riviere (Ste-Rose) (16.28N 61.67W)									12.24
Bellevue (Pointe-Noire) (16.23N 61.78W)									11.94
Col des Mamelles (Pointe-Noire) (16.18N 61.72W)									11.32
Viard (Ste-Rose) (16.31N 61.68W)									10.79
Antigua									
ICAO Sites									
V. C. Bird Intl. AP (TAPA) (17.14N 61.79W)			17/0000	23[l]	38[l]				3.77
Other Sites									
Bethesda (17.05N 61.77W)	17/0210	1005.1	16/2140	26	49				
Sir Vivian Richards Stadium (17.10N 61.78W)	17/0220	1005.1	16/2100	24	40				
Diamonds Estate (17.08N 61.76W)	17/0210	1007.8	16/2200	23	38				

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Cobbs Cross (17.02N 61.77W)	17/0210	1006.4	16/2130	21	42				
Dunbars (17.15N 61.83W)	17/0210	1006.8	16/2300	18	35				
Barbuda									
National Ocean Service (NOS) Sites									
Barbuda (BARA9) (17.59N 61.82W)	17/0630	1006.5							
Other Sites									
Codrington – Hanna Thomas Hospital (17.63N 61.83W)			16/2050	27	44				
Anguilla									
ICAO Sites									
Clayton J. Lloyd Intl. AP (TQPF) (18.20N 63.05W)	16/1729	1012[l]	16/1729	20[l]	35[l]				
Saint Barthelemy									
ICAO Sites									
Saint Barthelemy – Gustaf III AP (TFFJ) (17.90N 62.85W)	17/0800	1007.6	17/0300	34 (1 min)	47				
Other Sites									
Gustavia (78894) (17.90N 62.85W)	17/0900	1007.1	17/0500	37 (1 min)	61				1.68
Saint Martin/Sint Maarten									
ICAO Sites									
Grand Case – Espérance AP (TFFG) (18.10N 63.05W)			17/0600	34 (1 min)	52				
Princess Juliana Intl. AP (TNCM) (18.04N 63.11W)	17/0700	1009	17/0600	28	40				
Saba and Sint Eustatius									
ICAO Sites									

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Sint Eustatius – F. D. Roosevelt AP (TNCE) (17.50N 62.98W)	17/0655	1007	17/0655	27	39				
Saba – Juancho E Yrausquin AP (TNCS) (17.65N 63.22W)			18/0300	27[l]	35[l]				
Other Sites									
Saba – Fort Bay Harbor (17.62N 63.25W)			17/1430	26	44				
U.S. Virgin Islands									
ICAO Sites									
St. Croix – Henry E Rohlsen AP (TISX) (17.70N 64.81W)	18/0653	1005.2	18/0811	33	48				5.27
St. Thomas – Cyril E King AP (TIST) (18.34N 64.97W)	18/0853	1007.6	18/1516	30	45				1.73
NOS Sites									
St. Croix – Lime Tree Bay (LTBV3) (17.69N 64.75W)	18/0654	1004.7	18/0654	32 (10 m)	44	1.09		0.9	
St. Thomas – Charlotte Amalie (CHAV3) (18.33N 64.92W)	18/0806	1007.3	17/0854	28 (8 m)	36	0.67		0.7	
St. Croix – Christiansted (CHSV3) (17.75N 64.70W)	18/0636	1005.3	17/1036	19 (8 m)	33	1.00		0.8	
St. John – Lameshur Bay (LAMV3) (18.32N 64.72W)	18/0806	1008.6				0.74		0.8	
WeatherFlow Sites									
Buck Island (XBUK) (18.28N 64.89W)	18/0903	1006.8	18/1127	48 (12 m)	52				
Sandy Point (XCRX) (17.68N 64.90W)			18/1110	45 (11 m)	52				
Two Brothers (XBRO) (18.34N 64.82W)	18/0810	1008.3	18/1629	40 (6 m)	44				
Community Collaborative Rain, Hail, & Snow Network (CoCoRaHS) Sites									
Frederiksted 2.9 NNE (VI-SC-16) (17.75N 64.87W)									8.87
Frederiksted 0.5 N (VI-SC-11) (17.72N 64.88W)									7.20

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Frederiksted 1.7 ESE (VI-SC-20) (17.70N 64.86W)									6.68
Christiansted 2.1 ENE (VI-SC-24) (17.76N 64.68W)									6.04
Christiansted 1.6 E (VI-SC-10) (17.74N 64.68W)									5.84
Christiansted 1.8 ESE (VI-SC-8) (17.74N 64.68W)									5.29
Puerto Rico									
ICAO Sites									
Aguadilla – Rafael Hernández Intl. AP (TJBQ) (18.50N 67.14W)			18/1750	45[l]	52[l]				
San Juan – Luis Muñoz Marín Intl. AP (TJSJ) (18.45N 66.00W)	18/1856	1007.2	18/1705	37	48				7.14
San Juan – Fernando Luis Ribas Dominicci AP (TJIG) (18.46N 66.10W)			18/1518	31	48				
Ceiba – Roosevelt Roads Naval Station (TJNR) (18.25N 65.63W)	18/0853	1008.4	18/1635	31	46				4.21
NOS Sites									
Magueyes Island (MGIP4) (17.97N 67.05W)	18/1854	987.3	18/2018	38 (8 m)	52	2.15		2.2	
San Juan (SJNP4) (18.46N 66.12W)	18/1918	1004.7	18/1806	38 (7 m)	52	0.32		0.3	
Esperanza (ESPP4) (18.09N 65.47W)	18/0812	1006.3	18/1618	37 (11 m)	46	1.37[l]		1.2[l]	
Mayaguez (MGZP4) (18.22N 67.16W)	18/1954	993.9	18/2024	37 (12 m)	54	0.73		0.6	
Mona Island (MISP4) (18.09N 67.94W)						1.93		2.0	
Culebra (CLBP4) (18.30N 65.30W)						0.57		0.5	
WeatherFlow Sites									
El Cocal Yabucoa *elev. 783 ft* (XECY) (18.02N 65.86W)	18/1357	1004.4	18/1407	68 (39 m)	79				
Las Mareas (XMRS) (17.93N 66.16W)			18/1500	61 (10 m)	70				

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Yabucoa Tanque de Agua *elev. 467 ft* (XYTA) (18.03N 65.84W)	18/0906	1008.1	18/1756	57 (25 m)	64				
Isla Culebrita Light *elev. 236 ft* (XCUL) (18.31N 65.23W)	18/0818	1004.7	18/1149	53 (11 m)	58				
San Juan NAVAID (XJUA) (18.46N 66.13W)	18/1756	1005.9	18/1519	52 (14 m)	58				
Yabucoa – El Negro (XYAB) (18.05N 65.83W)	18/1258	1003.2	18/1742	51 (10 m)	57				
Club Deportivo Del Oeste (XCDP) (18.10N 67.19W)	18/2008	987.4	18/2015	51 (16 m)	73				
Del Rey Marina (XREY) (18.29N 65.63W)	19/0557	1007.1	18/1447	44 (7 m)	48				
Gurabo *elev. 172 ft* (XGUR) (18.26N 65.99W)	18/1739	1004.3	18/1649	35 (10 m)	46				
Aguadilla Jetty (XAGU) (18.43N 67.16W)	18/1934	998.7	18/1959	28 (6 m)	54				
Remote Automated Weather Stations (RAWS) Sites									
Cabo Rojo *elev. 85 ft* (CRRP4) (17.97N 67.16W)			18/2057	42 (6 m)	64				12.19
Camp Santiago *elev. 278 ft* (CSAP4) (18.01N 66.29W)			18/1709	34 (6 m)	56				19.07
Guanica (GCAP4) (17.95N 66.88W)			18/1809	21 (6 m)	51				5.19
United States Geological Survey (USGS) Rain Gauges									
Rio Cerrillos near Ponce (PCEP4) (18.11N 66.60W)									32.40
Barrio Beatriz near Caguas (BZDP4) (18.18N 66.10W)									31.42
Quebrada Blanca near San Lorenzo (SLGP4) (18.16N 66.00W)									31.33
Rio Valenciano near Juncos (VALP4) (18.22N 65.93W)									26.47
La Plaza near Caguas (CAIP4) (18.13N 66.05W)									24.82
Rio Yauco near Yauco (LLYP4) (18.05N 66.84W)									24.47
Lago El Guineo near Villalba (VILP4) (18.17N 66.52W)									24.31

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Rio Grande de Loiza at Trujillo Alto (TRUP4) (18.35N 66.00W)									22.62
Rio Guayanes near Yabucoa (YBUP4) (18.06N 65.90W)									22.38
Barrio Apeadero near Villalba (VINP4) (18.16N 66.46W)									21.05
Quebrada Arenas near San Lorenzo (SLMP4) (18.11N 65.96W)									20.31
Rio Portugues near Tibes near Ponce (PRTP4) (18.10N 66.66W)									19.47
Quebrada Salvatierra near San Lorenzo (SLEP4) (18.18N 66.00W)									19.01
Pueblito del Rio near Las Piedras near Juncos (GUSP4) (18.25N 65.82W)									18.79
Rio Cayaguas at Cerro Gordo near San Lorenzo (SLKP4) (18.15N 65.97W)									18.65
Jagueyes Abajo near Caguas (BZAP4) (18.29N 66.07W)									18.59
Canaboncito near Caguas (CAHP4) (18.21N 66.11W)									17.97
Rio Maunabo at Lizas near Maunabo (MAUP4) (18.03N 65.94W)									17.90
Rio Jacaguas at Juana Diaz (JUAP4) (18.05N 66.51W)									17.30
Lago de Matrullas near Orocovis (OROP4) (18.21N 66.48W)									17.11
Rio Grande de Patillas near Patillas (PATP4) (18.03N 66.03W)									16.88
Canal de Guamani Oeste in Guayama (GMNP4) (18.00N 66.11W)									16.54

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Vaqueria El Nino near Caguas (BZCP4) (18.21N 66.06W)									16.50
Lago Coamo near Los Llanos (LCOP4) (18.02N 66.39W)									15.97
Gurabo Abajo near Gurabo (GARP4) (18.27N 65.91W)									14.60
Lago Vivi near Utuado (VIVP4) (18.24N 66.67W)									14.53
Rio Camuy near Camuy (CMAP4) (18.41N 66.82W)									14.04
Lago Cerrillos near Ponce (PCXP4) (18.08N 66.58W)									14.03
Las Piedras Construction near Juncos (GUVP4) (18.20N 65.84W)									13.85
Rio Caonillas at Paso Palma (JAXP4) (18.22N 66.64W)									13.77
Rio Canovanas near Campo Rico (CNAP4) (18.32N 65.88W)									12.68
Rio Icacos near Naguabo (NGIP4) (18.28N 65.78W)									12.44
Rio de la Plata at Comerio (COMP4) (18.22N 66.22W)									12.05
Bairoa Arriba near Caguas (BZBP4) (18.27N 66.10W)									11.64
Barrio Montones (VAMP4) (18.15N 65.90W)									11.62
Rio Guanajibo near Hormigueros (HORP4) (18.14N 67.15W)									11.51
Rio Rosario near Hormigueros near Mayaguez (MAYP4) (18.17N 67.09W)									11.14
Lago de Cidra near Cidra (DRAP4) (18.20N 66.15W)									10.35

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Rio Usabon near Barran (USAP4) (18.16N 66.31W)									10.34
Lago Blanco near Naguabo (LBLP4) (18.23N 65.79W)									10.29
Lago Patillas near Patillas (PASP4) (18.02N 66.02W)									10.20
Rio Grande near El Verde (VERP4) (18.34N 65.84W)									10.18
Rio Caguas at Villa Blanca (CAMP4) (18.25N 66.03W)									10.12
NWS Cooperative Observer Program (COOP) Sites									
Aibonito 1 S (ALPP4) (18.13N 66.27W)									21.42
San Lorenzo 3 S (SNLP4) (18.15N 65.97W)									20.20
Juncos 1 SE (JNCP4) (18.23N 65.92W)									17.45
Trujillo Alto 2 SSW (TRAP4) (18.33N 66.02W)									10.44
Citizen Weather Observing Program (CWOP)									
Ponce (EW7791) (17.96N 66.62W)			18/1700	60	90				11.30
Lajas (FW2397) (17.97N 67.04W)			18/1716	28[l]	46[l]				
Jayuya (EW6246) (18.19N 66.66.62W)									17.00
CoCoRaHS Sites									
Santa Isabel 3.2 NNE (PR-SI-1) (18.01N 66.38W)									21.36
Juana Diaz 2.9 SW (PR-JD-2) (18.03N 66.54W)									20.83
Jayuya 3.1 SSE (PR-JY-1) (18.18N 66.58W)									19.92
Guayama 1.1 W (PR-GM-2) (17.98N 66.13W)									17.21
Caguas 2.2 NNW (PR-CG-3) (18.26N 66.05W)									16.25

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Lares 1.6 SSW (PR-LR-2) (18.27N 66.89W)									15.38
Rincon 2.8 SE (PR-RN-4) (18.32N 67.22W)									15.00
Rincon 1.5 N (PR-RN-3) (18.36N 67.25W)									14.85
Luquillo 3.0 S (PR-LQ-3) (18.33N 65.72W)									13.47
Finca Aponte (PR-HM-2) (18.15N 65.82W)									13.07
Ponce 5.0 NNW (PR-PC-4) (18.5N 66.65W)									12.99
Mayaguez Arriba (PR-MY-5) (18.22N 67.12W)									12.94
Lajas 2.2 E (PR-LJ-2) (18.04N 67.03W)									11.75
Dominican Republic									
ICAO Sites									
Punta Cana Intl. AP (MDPC) (18.57N 68.36W)	19/0800	990.2[I]	19/0600	54[I]	69[I]				11.11
Samaná El Catey Intl. AP (MDCY) (19.27N 69.73W)	19/1800	993.3	19/1500	36	85				5.13
Las Américas Intl. AP (MDSD) (18.43N 69.67W)	19/1200	1003.7	19/1400	30	45				6.62
Puerto Plata AP (MDPP) (19.76N 70.57W)	20/0000	999.8	20/0000	30	38				5.22
La Romana Intl. AP (MDLR) (18.42N 68.95W)	19/1000	998.3[I]	19/1000	25[I]	70[I]				13.71
Arroyo Barril Intl. AP (MDAB) (19.20N 69.43W)	19/1700	984.6	19/1800	20[I]	40[I]				5.56
Monte Cristi – Osvaldo Virgil AP (MDMC) (19.89N 71.65W)	20/0900	1004.7	20/0600	20	33				2.23
Other Sites									
Boca de Yuma (iCyclone) (18.38N 68.61W)	19/0804	976.5							

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Boca de Yuma (iCyclone) (18.37N 68.61W)	19/0808	976.7							
Punta Cana (iCyclone) (18.56N 68.37W)	19/0754	987.4							
Cabrera (78464) (19.64N 69.91W)	19/2100	992.0	19/1800		55				4.78
Sabana de la Mar (78467) (19.05N 69.39W)	19/1500	999.2	19/1500	44	60				8.26
Santo Domingo (78486) (18.47N 69.87W)	19/2100	1003.6	19/1200	16	46				3.86
Miches									13.20
San Rafael del Yuma									9.41
Samaná									9.34
Los Llanos									8.95
El Seibo									8.75
Hato Mayor									7.53
La Vega									6.90
Juma Bejucal									6.08
Villa Altagracia									5.97
Anamuya									5.80
Gurabo									5.68
Turks and Caicos									
ICAO Sites									
Providenciales Intl. AP (MBPV) (21.77N 72.27W)	20/1650	995.9	20/1640	34	45				0.74
Public/Other Sites									
South Caicos – North District (21.50N 71.53W)			20/1240	63	87				
Pine Cay			20/1550		77				
Leeward Settlement – Moringa Villa (21.81N 72.14W)			20/1430	35	62				
Providenciales – Long Bay (21.79N 72.16W)			20/1824		50				
North Caicos – Whitby (21.96N 71.98W)			20/0920	30[l]	44[l]				
Providenciales – Grace Bay Rd (21.80N 72.18W)	20/1720	994.9	20/1535	27	45				

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Bermuda									
ICAO Sites									
L.F. Wade Intl. AP (TXKF) (32.36N 64.67W)	23/0951	990.9	23/1112	62	81				
Other Sites									
Maritime Operations Centre *elev. 290 ft* (32.38N 64.68W)	23/1002	991.3	23/1123	76 (1 min)	96				
Airport AviMet – 12 (32.37N 64.69W)	23/0953	990.6	23/1054	55 (10 m, 2 min)	73				
Crescent (offshore) NAVAID (32.41N 64.82W)			23/0502	53 (6 m, 10 min)	69				
National Museum of Bermuda *elev. 75 ft* (32.33N 64.83W)	23/1025	985.7	23/0954	38 (21 m, 2 min)	52				
Bermuda Weather Service Office (32.37N 64.68W)	23/0900	991.1							0.89
Canada									
New Brunswick									
ICAO Sites									
Greater Moncton Roméo LeBlanc Intl. AP (CYQM) (46.11N 64.68W)	24/0900	979.1	24/0700	34	54				2.35
Saint John AP (CYSJ) (45.33N 65.89W)	24/0600	986.8	24/1400	32	49				2.69
Fredericton Intl. AP (CYFC) (45.87N 66.53W)	24/0700	991.1	24/1000	25	40				2.09
CoCoRaHS Sites									
Oak Point 0.9 SSW (CAN-NB-5) (45.51N 66.10W)									3.73
Sackville 2.0 N (CAN-NB-159) (45.91N 64.37W)									3.55
Dorchester 1.0 SSE (CAN-NB-16) (45.89N 64.51W)									3.15
Harvey 1.9 SSE (CAN-NB-53) (45.71N 64.70W)									3.07
Other Sites									

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Miscou Island (CWMI) (48.01N 64.50W)			24/1200	47	61				1.69
Crowe Brook (45.58N 65.32W)					46				4.67
Bas Caraquet (CWXS) (47.80N 64.83W)			24/1400	29	44				1.70
Shediac (46.23N 64.55W)								3.9[l]	
Escuminac (47.08N 64.89W)								3.7	
Fundy Park (CAFY) (45.60N 64.95W)									4.15
Oak Point (45.51N 66.10W)									3.76
Newfoundland									
ICAO Sites									
Stephenville Intl. AP (CYJT) (48.54N 58.55W)	24/2300	978.0	24/2300	43	63				2.11
St. Anthony AP (CYAY) (51.39N 56.07W)	25/0700	988.0	24/1015	42	51				1.18
Gander Intl. AP (CYQX) (48.94N 54.57W)	24/1800	995.2	24/1400	32	49				0.28
Deer Lake Reg. AP (CYDF) (49.21N 57.39W)	25/0200	985.1	24/1424	31	46				1.37
St. John's Intl. AP (CYYT) (47.62N 52.74W)	24/0900	1001.3	24/0900	29	41				
Other Sites									
Wreckhouse (CAWR) (47.71N 59.31W)			24/1400	66	96				3.07
Port aux Basques (CAPB) (47.57N 59.15W)			24/1400	56	72				2.03
Sagona Island (CWZN) (47.37N 55.79W)			24/1700	51	60				
Burgeo (CABF) (47.62N 57.62W)			24/1200	44	59				1.46
Ferolle Point (CWXI) (51.02N 57.10W)			24/0900	32	53				
Port aux Basques (47.58N 59.14W)								2.3	
Nova Scotia									
ICAO Sites									
JA Douglas McCurdy Sydney AP (CYQY) (46.16N 60.05W)	24/0900	949.5	24/0900	52	80				3.51

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Halifax Stanfield Intl. AP (CYHZ) (44.88N 63.52W)	24/0600	966.0	24/0700	43	67				3.36
Yarmouth Intl. AP (CYQI) (43.83N 66.09W)	24/0500	991.7	24/0700	31	48				0.93
Cape Breton Mesonet Sites									
Bay St. Lawrence (47.00N 60.47W)					86 (7 m)				
Ingonish Kings Point (46.69N 60.38W)					80 (10 m)				3.28
Jimtown (45.71N 61.90W)					79 (10 m)				5.17
St. Joseph du Moine (46.53N 61.06W)					77 (9 m)				3.45
Chéticamp Island (46.62N 61.03W)					74 (10 m)				
Sampsonville (45.69N 60.85W)					73 (14 m)				5.99
Plateau (46.59N 61.01W)					72 (10 m)				4.03
Inverness (46.23N 61.31W)					68 (10 m)				2.35
Iona (45.96N 60.80W)					68 (10 m)				3.79
Skyline Trail (46.75N 60.91W)					68 (4 m)				5.02
Port Caledonia (46.17N 59.91W)					68 (4 m)				2.57
Gabarus (45.84N 60.14W)					68 (9 m)				3.93
Cap Le Moine (46.48N 60.07W)					67 (9 m)				3.56
Catalone (45.99N 59.99W)					66 (6 m)				2.72
Chéticamp (46.64N 61.00W)					65 (12 m)				
Port Hawkesbury (45.62N 61.36W)					65 (14 m)				6.46
Glace Bay (46.21N 59.99W)					65 (9 m)				2.66
Southside Boularderie (46.18N 60.48W)					64 (10 m)				4.12
Big Intervale (46.84N 60.60W)									8.35
Cape North (46.88N 60.51W)									7.50
Moose Lake (46.55N 60.61W)									7.43

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
River Denys (45.86N 61.25W)									6.36
South Ridge (46.87N 60.50W)									6.11
Aspy Bay (46.92N 60.49W)									6.02
Other Sites									
Hart Island (CWRN) (45.35N 60.98W)	24/0700	932.7	24/1000	47	69				
Eskasoni (CAEI) (45.92N 60.65W)	24/0900	936.1	24/0900	52	67				
Guysborough (iCyclone) (45.40N 61.50W)	24/0715	937.3							
North East Margaree (CWNS) (46.37N 60.98W)	24/1000	938.1							
Sydney (iCyclone) (46.12N 60.20W)	24/0907	946.7							
Beaver Island (CWBV) (44.82N 62.33W)			24/0300	68	86				
St. Paul Island (CWEF) (47.23N 60.14W)			24/1200	66	85				
Arisaig (FW9205) (45.76N 62.17W)			24/0524	65 (6 m)	97				5.79
Grand Etang (CWZQ) (46.55N 61.05W)		940.0	24/0700	51	90				
Sable Island (CWSA) (43.93N 59.96W)		942.5	24/0343	50[l]	92[l]				2.76
Wadden's Cove (FW0729) (46.08N 59.86W)			24/0445	50 (5 m)	81				2.67
North Mountain (46.82N 60.67W)									8.24
North Mountain CS (46.82N 60.67W)									6.87
Norman Tower (46.43N 60.68W)									6.46
Prince Edward Island									
ICAO Sites									
Charlottetown AP (CYYG) (46.28N 63.13W)	24/0900	961.3	24/1300	40	72				3.39
CoCoRaHS Sites									
Souris 2.8 E (CAN-PE-38) (46.36N 62.21W)									5.02
Murray Harbour 2.8 SSE (CAN-PE-59) (45.98N 62.51W)									4.61

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Fortune Bridge 0.9 SSE (CAN-PE-65) (46.34N 62.37W)									4.22
Kingsboro 0.9 ENE (CAN-PE-57) (46.40N 62.10W)									4.19
Murray River 6.5 W (CAN-PE-46) (46.01N 62.70W)									4.10
Other Sites									
East Point (CWEP) (46.46N 61.99W)			24/0500	60	80				3.35
North Cape (CWNE) (47.06N 64.00W)			24/0800	55	73				2.88
Summerside (CWSD) (46.44N 63.84W)			24/1000	48	76				2.47
Stanhope (CANH) (46.42N 63.08W)			24/0900	46	71				3.00
St. Peters (CZSP) (46.45N 62.58W)			24/0600	43	76				3.53
Quebec									
ICAO Sites									
Îles-de-la-Madeleine AP (CYGR) (47.43N 61.78W)	24/0210	991.5[l]			71[l]				
Natashquan AP (CYNA) (50.19N 61.79W)	24/1922	982.3	24/1157	31	46				2.33
Michel-Pouliot Gaspé AP (CYGP) (48.78N 64.48W)	24/1500	986.6	24/1400	21[l]	36[l]				3.44
Other Sites									
Cape Whittle (CWQW) (50.16N 60.06W)			24/0800	55	71				
Iles-de-la-Madeleine (CWGR) (47.43N 61.77W)					67				3.83
Heath Point (CWHP) (49.08N 61.70W)			24/1100	45	57				
Blanc-Sablon (CYBX) (51.44N 57.19W)			24/1200	43	56				1.00
Cap-D'Espoir (CWRZ) (48.42N 64.32W)			24/0900	34	54				

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Offshore									
NOAA Buoys									
41047 – NE Bahamas (27.47N 71.45W)	22/0840	974.6	22/0447	54 (4 m, 1 min)	72				
41046 – E Bahamas (23.82N 68.38W)	21/1910	1006.2	21/0811	43 (4 m, 1 min)	57				
42060 – Caribbean Valley (16.43N 63.33W)	17/0730	1004.0	17/1852	39 (4 m, 1 min)	45				
44027 – Jonesport, ME (44.28N 67.30W)	24/0600	995.3	24/0958	37 (4 m, 1 min)	47				
41048 – W Bermuda (31.83N 69.57W)	23/0150	980.0							
44011 – Georges Bank (41.09N 66.56W)	23/0150	996.6							
Caribbean Integrated Coastal Ocean Observing System (CarICOOS)									
42085 – Ponce (17.87N 66.53W)	18/1700	992.6 [I]	18/1600	51 (4 m)	71				
41053 – San Juan (18.47N 66.10W)	18/1920	1004.8	18/1420	37 (4 m)	46				
41056 – Vieques (18.26N 65.46W)	18/0830	1005.8	18/1150	29 (4 m)	41				
41052 – St. John (18.25N 64.76W)	18/0740	1006.3	18/0540	28 (4 m)	38				
Environment and Climate Change Canada Buoys									
44258 – Halifax Harbour (44.50N 63.40W)	24/0420	964.6	24/0420	49 (5 m)	62				
44488 – East of Chedabucto Bay (45.44N 60.95W)	24/0740	931.2			61				
44139 – Banquereau Banks (44.24N 57.10W)	24/0320	981.2	24/0320	44 (5 m)	58				
44489 – West Chedabucto Bay (45.49N 61.14W)		933.3			56				
44150 – La Have Bank (42.50N 64.02W)	23/2320	983.1	24/0220	43 (5 m)	54				
44137 – East Scotia Slope (42.26N 62.03W)	24/0120	968.0							
NOAA Saildrone Observations									
SD-1078	22/1544	972.1	22/1333	68 (3 m, 1 min)	94				
SD-1031	18/1606	987.3	18/1435	51 (3 m, 1 min)	66				
SD-1040	18/2002	1004.1	18/1859	47 (3 m, 1 min)	59				
SD-1083	15/0618	1011.7	15/1115	38 (3 m, 1 min)	46				

[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 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 the North American Vertical Datum of 1988 (NAVD88).
[e] Estimated inundation is the maximum height of water above ground. The height of the water above Mean Higher High Water (MHHW) is used as a proxy for inundation for NOS tide gauges, and Higher High Water Large Tide (HHWLT) is used for Canadian gauges.
[l] Incomplete
[*] Latitude/longitude of the saildrone at the time of the maximum sustained wind speed

Table 4. Number of hours in advance of formation associated with the first NHC Tropical Weather Outlook (TWO) forecast in the indicated likelihood category. The value in parentheses indicate the number of hours in advance of formation when the disturbance was re-introduced into the TWO. 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%)	30	186 (48)
Medium (40%-60%)	0	18
High (>60%)	-	-

Table 5a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Fiona, 14–23 September 2022. 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	60	72	96	120
OFCL	23.9	**30.2**	**40.8**	**43.9**	**51.9**	**54.1**	**59.1**	**69.7**
OCD5	38.5	68.8	109.9	146.5	186.4	220.5	313.0	393.5
Forecasts	36	34	32	30	28	26	22	18
OFCL (2017-21)	23.6	35.5	47.6	61.4	78.2	91.3	125.6	172.1
OCD5 (2017-21)	45.5	98.3	156.7	213.7	252.4	316.9	403.6	484.6

Table 5b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Fiona, 14–23 September 2022. Errors smaller than the NHC official forecast are shown in boldface type.

Model ID	Forecast Period (h)							
	12	24	36	48	60	72	96	120
OFCL	23.9	30.2	40.8	43.9	51.9	54.1	59.1	69.7
OCD5	38.5	68.8	109.9	146.5	186.4	220.5	313.0	393.5
GFSI	24.9	38.3	55.8	66.6	78.6	88.4	121.1	174.2
EMXI	24.3	33.2	46.6	56.7	68.6	77.0	91.4	131.4
CMCI	27.9	43.0	62.3	82.1	103.1	121.8	160.8	218.1
NVGI	29.6	52.2	73.6	104.6	127.1	144.0	161.3	226.1
HWFI	28.3	46.9	63.5	75.7	81.4	81.0	92.8	114.0
AEMI	**22.5**	33.1	50.4	60.0	71.3	80.1	91.4	99.4
HCCA	**22.9**	**29.1**	**38.6**	**41.9**	**49.6**	**50.4**	**50.7**	**69.6**
GFEX	**22.3**	**30.1**	42.0	48.5	56.5	59.4	65.1	88.2
TVCA	**23.8**	31.8	42.0	47.1	53.2	**53.6**	**55.1**	**56.3**
TVCX	**23.7**	31.8	42.1	47.4	53.6	**53.3**	**53.0**	**55.6**
TVDG	**23.5**	31.7	43.7	48.5	54.9	56.0	59.2	69.7
TABD	28.4	52.4	81.4	116.2	153.7	190.5	271.8	352.1
TABM	27.9	39.7	48.3	56.3	71.2	89.5	133.5	198.2
TABS	47.4	90.4	131.2	165.2	195.3	226.6	286.6	377.3
Forecasts	36	34	32	30	28	26	22	18

Table 6a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Fiona, 14–23 September 2022. 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	60	72	96	120
OFCL	**4.7**	**4.3**	**6.6**	**7.2**	**10.2**	13.8	25.9	36.4
OCD5	8.1	12.3	17.5	25.1	29.5	35.2	45.3	44.8
Forecasts	36	34	32	30	28	26	22	18
OFCL (2017-21)	5.4	8.0	9.5	10.9	11.0	12.1	13.1	14.7
OCD5 (2017-21)	7.0	11.1	14.5	17.1	18.0	20.2	21.9	22.1

Table 6b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Fiona, 14–23 September 2022. Errors smaller than the NHC official forecast are shown in boldface type.

Model ID	Forecast Period (h)							
	12	24	36	48	60	72	96	120
OFCL	4.7	4.3	6.6	7.2	10.2	13.8	25.9	36.4
OCD5	8.1	12.3	17.5	25.1	29.5	35.2	45.3	44.8
HWFI	6.7	7.9	7.9	10.3	10.5	**11.0**	**13.4**	**16.6**
DSHP	5.8	6.3	**6.0**	7.4	10.5	**13.6**	26.5	**35.4**
LGEM	6.2	6.4	6.9	8.2	11.6	14.9	27.3	38.0
IVCN	5.0	5.2	**5.6**	7.3	**10.1**	**12.5**	**21.9**	**30.7**
IVDR	4.9	5.1	**5.8**	7.4	10.2	**12.7**	**21.2**	**29.8**
HCCA	5.0	4.9	**4.2**	**6.5**	**8.1**	**9.3**	**18.2**	**24.1**
GFSI	5.0	5.8	7.6	11.2	15.2	18.4	27.0	**33.6**
EMXI	6.2	9.6	12.9	15.5	19.5	23.7	34.9	48.1
Forecasts	36	34	32	30	28	26	22	18

Table 7. Watch and warning summary for Hurricane Fiona, 14–23 September 2022.

Date/Time (UTC)	Action	Location
15 / 0300	Tropical Storm Watch issued	Saba and St. Eustatius
15 / 0300	Tropical Storm Watch issued	Sint Maarten
15 / 0300	Tropical Storm Watch issued	Montserrat, Antigua, Barbuda, St. Kitts, Nevis, and Anguilla
15 / 1500	Tropical Storm Watch changed to Tropical Storm Warning	Saba and St. Eustatius
15 / 1500	Tropical Storm Watch changed to Tropical Storm Warning	Sint Maarten
15 / 1500	Tropical Storm Watch changed to Tropical Storm Warning	Montserrat, Antigua, Barbuda, St. Kitts, Nevis, and Anguilla
15 / 1500	Tropical Storm Watch issued	Guadeloupe, St. Barthelemy, and St. Martin
15 / 2100	Tropical Storm Watch changed to Tropical Storm Warning	Guadeloupe, St. Barthelemy, and St. Martin
15 / 2100	Tropical Storm Watch issued	U.S. Virgin Islands and Puerto Rico, including Vieques and Culebra
15 / 2100	Tropical Storm Watch issued	British Virgin Islands
16 / 1100	Tropical Storm Watch issued	Dominica
16 / 1500	Tropical Storm Watch changed to Tropical Storm Warning	U.S. Virgin Islands and Puerto Rico, including Vieques and Culebra
16 / 1800	Tropical Storm Watch changed to Tropical Storm Warning	British Virgin Islands
16 / 1800	Tropical Storm Watch issued	Dominican Republic from Cabo Frances Viejo to Barahona
17 / 0300	Tropical Storm Watch modified to	Dominican Republic from Cabo Caucedo to Barahona

Date/Time (UTC)	Action	Location
17 / 0300	Tropical Storm Warning issued	Dominican Republic from Puerto Plata to Cabo Caucedo
17 / 0900	Tropical Storm Watch discontinued	Dominica
17 / 0900	Tropical Storm Warning discontinued	Antigua and Barbuda
17 / 0900	Hurricane Watch issued	Puerto Rico, including Vieques and Culebra
17 / 1200	Tropical Storm Warning discontinued	Montserrat, St. Kitts, Nevis, and Anguilla
17 / 1200	Hurricane Watch issued	Dominican Republic from Puerto Plata to Cabo Caucedo
17 / 1500	Hurricane Watch issued	U.S. Virgin Islands
17 / 1500	Hurricane Watch changed to Hurricane Warning	Puerto Rico, including Vieques and Culebra
17 / 2100	Tropical Storm Warning discontinued	Sint Maarten
17 / 2100	Tropical Storm Warning discontinued	Guadeloupe, St. Barthelemy, and St. Martin
18 / 0000	Tropical Storm Warning discontinued	Saba and St. Eustatius
18 / 0300	Tropical Storm Warning modified to	Dominican Republic from Puerto Plata to Cabo Frances Viejo
18 / 0300	Hurricane Watch modified to	Dominican Republic from Puerto Plata to Cabo Frances Viejo
18 / 0300	Hurricane Warning issued	Dominican Republic from Cabo Frances Viejo to Cabo Caucedo
18 / 0900	Tropical Storm Watch issued	Turks and Caicos and the southeastern Bahamas, including the Acklins,
18 / 1500	Hurricane Watch discontinued	U.S. Virgin Islands

Date/Time (UTC)	Action	Location
18 / 2100	Tropical Storm Watch changed to Tropical Storm Warning	Turks and Caicos and the southeastern Bahamas, including the Acklins,
19 / 0000	Tropical Storm Warning discontinued	British Virgin Islands
19 / 0300	Tropical Storm Warning changed to Hurricane Warning	Turks and Caicos
19 / 0300	Tropical Storm Warning discontinued	U.S. Virgin Islands
19 / 0900	Hurricane Warning changed to Tropical Storm Warning	Puerto Rico, including Vieques and Culebra
19 / 2100	Tropical Storm Watch discontinued	Dominican Republic from Cabo Caucedo to Barahona
19 / 2100	Tropical Storm Warning discontinued	Dominican Republic from Puerto Plata to Cabo Frances Viejo
19 / 2100	Tropical Storm Warning discontinued	Puerto Rico, including Vieques and Culebra
19 / 2100	Hurricane Warning changed to Hurricane Watch and modified to	Dominican Republic from Puerto Plata to Cabo Caucedo
20 / 0900	Hurricane Watch discontinued	Dominican Republic
20 / 2100	Tropical Storm Watch issued	Bermuda
21 / 0300	Tropical Storm Warning discontinued	Southeastern Bahamas, including the Acklins, Crooked Island, Long Cay, the
21 / 0300	Hurricane Warning discontinued	Turks and Caicos
21 / 1200	Tropical Storm Watch changed to Tropical Storm Warning	Bermuda
21 / 1200	Hurricane Watch issued	Bermuda
22 / 0900	Tropical Storm Warning changed to Hurricane Warning	Bermuda

Date/Time (UTC)	Action	Location
22 / 1500	Tropical Storm Watch issued	St. Andrews, New Brunswick to Hubbards, Nova Scotia
22 / 1500	Tropical Storm Watch issued	Brule, Nova Scotia to Cap Madeleine, Quebec
22 / 1500	Tropical Storm Watch issued	Anticosti Island
22 / 1500	Tropical Storm Watch issued	Johan Beetz Bay, Quebec to Parson's Pond, Newfoundland
22 / 1500	Tropical Storm Watch issued	West Bay, Labrador to Hare Bay, Newfoundland
22 / 1500	Tropical Storm Watch issued	St. Lawrence, Newfoundland to Port-Aux-Basques, Newfoundland
22 / 1500	Hurricane Watch issued	Hubbards, Nova Scotia to Brule, Nova Scotia
22 / 1500	Hurricane Watch issued	Prince Edward Island
22 / 1500	Hurricane Watch issued	Isle-de-la-Madeleine
22 / 1500	Hurricane Watch issued	Parson’s Pond, Newfoundland to Port-Aux-Basques, Newfoundland
22 / 1800	Tropical Storm Watch modified to	Sheldrake, Quebec to Parson's Pond, Newfoundland
22 / 1800	Hurricane Watch modified to	Parson’s Pond, Newfoundland to Indian Harbour, Newfoundland
23 / 0300	Tropical Storm Watch changed to Tropical Storm Warning	St. Andrews, New Brunswick to Hubbards, Nova Scotia
23 / 0300	Tropical Storm Watch changed to Tropical Storm Warning	Brule, Nova Scotia to Cap Madeleine, Quebec
23 / 0300	Tropical Storm Watch changed to Tropical Storm Warning	Anticosti Island
23 / 0300	Hurricane Watch changed to Hurricane Warning	Hubbards, Nova Scotia to Brule, Nova Scotia

Date/Time (UTC)	Action	Location
23 / 0300	Hurricane Watch changed to Hurricane Warning	Prince Edward Island
23 / 0300	Hurricane Watch changed to Hurricane Warning	Isle-de-la-Madeleine
23 / 0300	Tropical Storm Watch modified to	Boat Harbor, Newfoundland to West Bay, Labrador
23 / 0300	Tropical Storm Watch changed to Tropical Storm Warning	Sheldrake, Quebec to Parson's Pond, Newfoundland
23 / 0300	Tropical Storm Watch changed to Tropical Storm Warning and	Boat Harbor, Newfoundland to Hare Bay, Newfoundland
23 / 0300	Tropical Storm Watch changed to Tropical Storm Warning and	St. Lawrence, Newfoundland to Francois, Newfoundland
23 / 0300	Hurricane Warning issued	Parson’s Pond, Newfoundland to Francois, Newfoundland
23 / 1200	Hurricane Warning changed to Tropical Storm Warning	Bermuda
23 / 1800	Tropical Storm Warning discontinued	Bermuda
24 / 1800	Tropical Storm Watch discontinued	Boat Harbor, Newfoundland to West Bay, Labrador
24 / 1800	Tropical Storm Warning discontinued	St. Andrews, New Brunswick to Hubbards, Nova Scotia
24 / 1800	Tropical Storm Warning discontinued	Brule, Nova Scotia to Cap Madeleine, Quebec
24 / 1800	Tropical Storm Warning discontinued	Anticosti Island
24 / 1800	Hurricane Warning discontinued	Hubbards, Nova Scotia to Brule, Nova Scotia
24 / 2100	Tropical Storm Warnings and Hurricane Warnings discontinued	All of Atlantic Canada

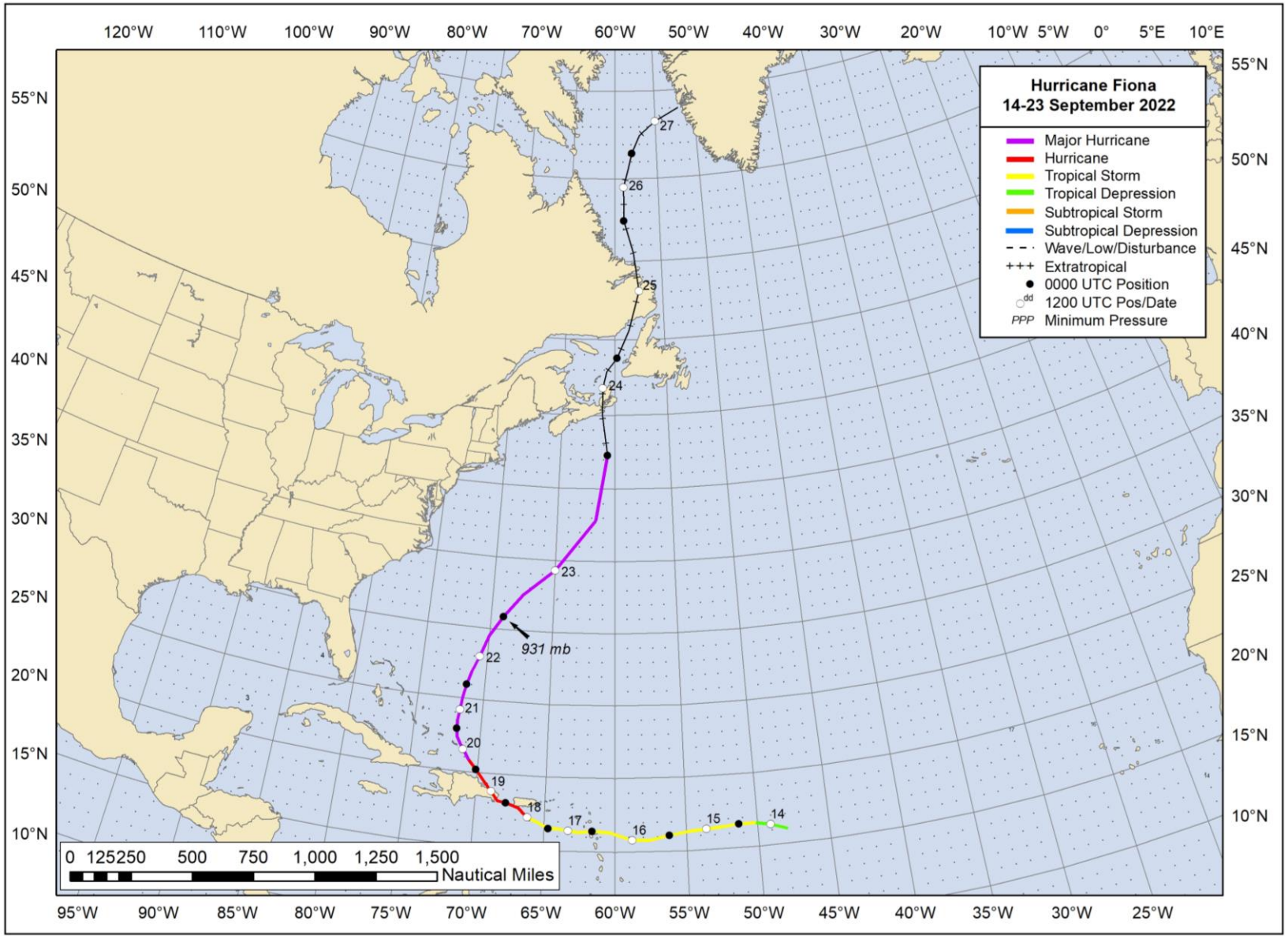


Figure 1. Best track positions for Hurricane Fiona, 14–23 September 2022. The extratropical portion of the track is based on analyses from the Canadian Hurricane Centre and the NOAA Ocean Prediction Center.

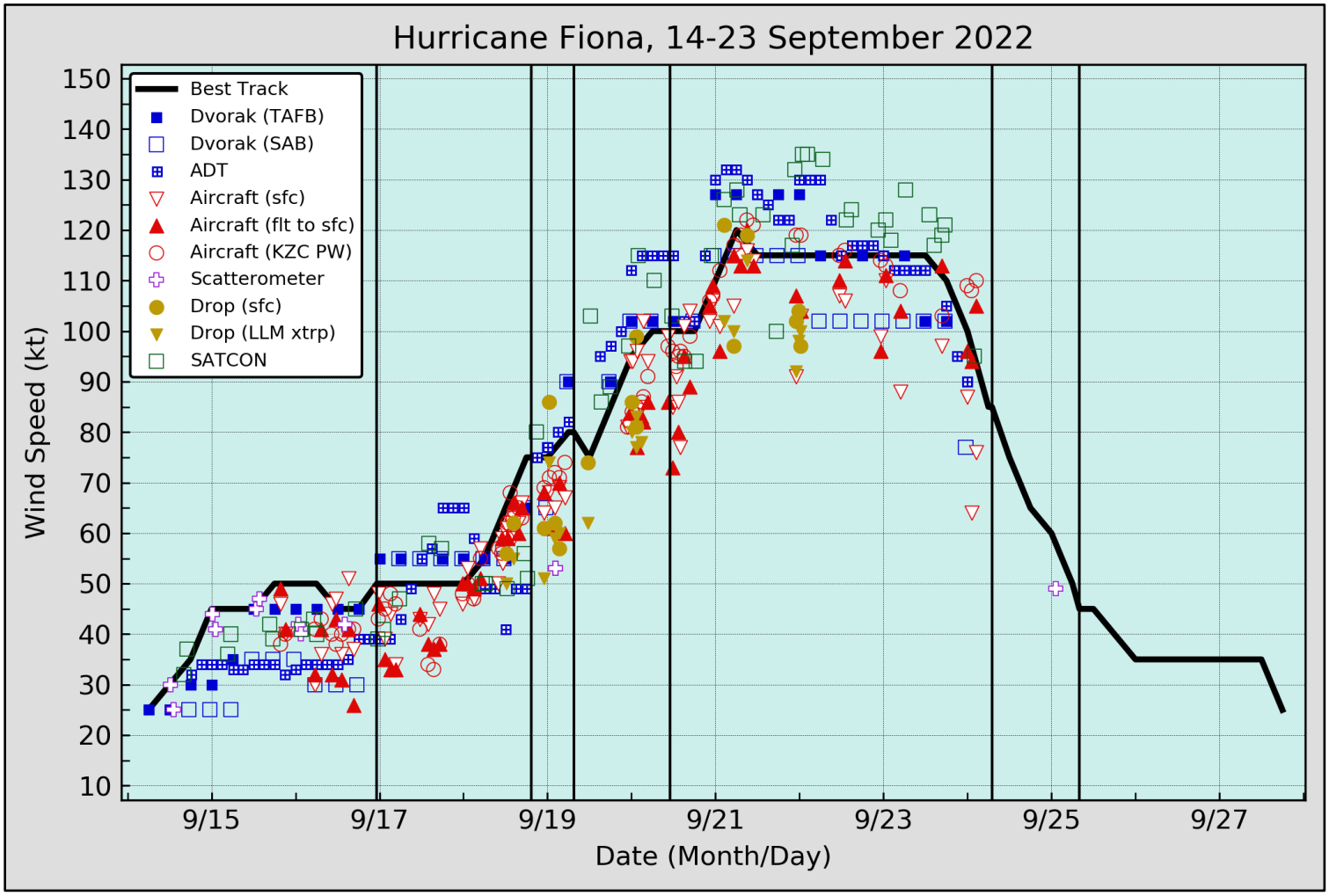


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Fiona, 14–23 September 2022. Aircraft observations have been adjusted for elevation using 90%, 80%, and 75% adjustment factors for observations from 700 mb, 850 mb, and 925 mb, respectively. Dropwindsonde 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). Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. Dashed vertical lines correspond to 0000 UTC, and solid vertical lines correspond to landfalls.

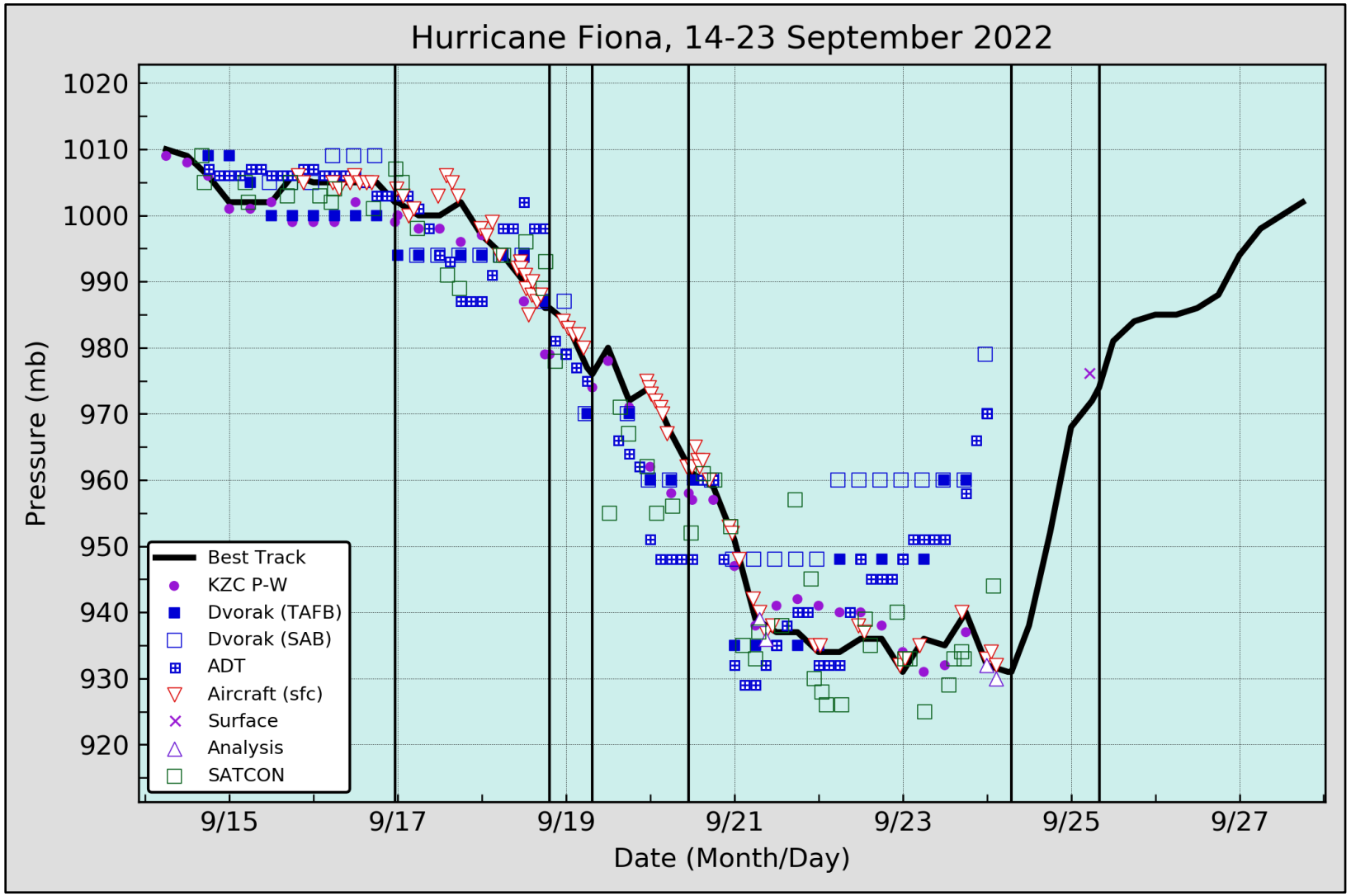


Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Fiona, 14–23 September 2022. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. 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.

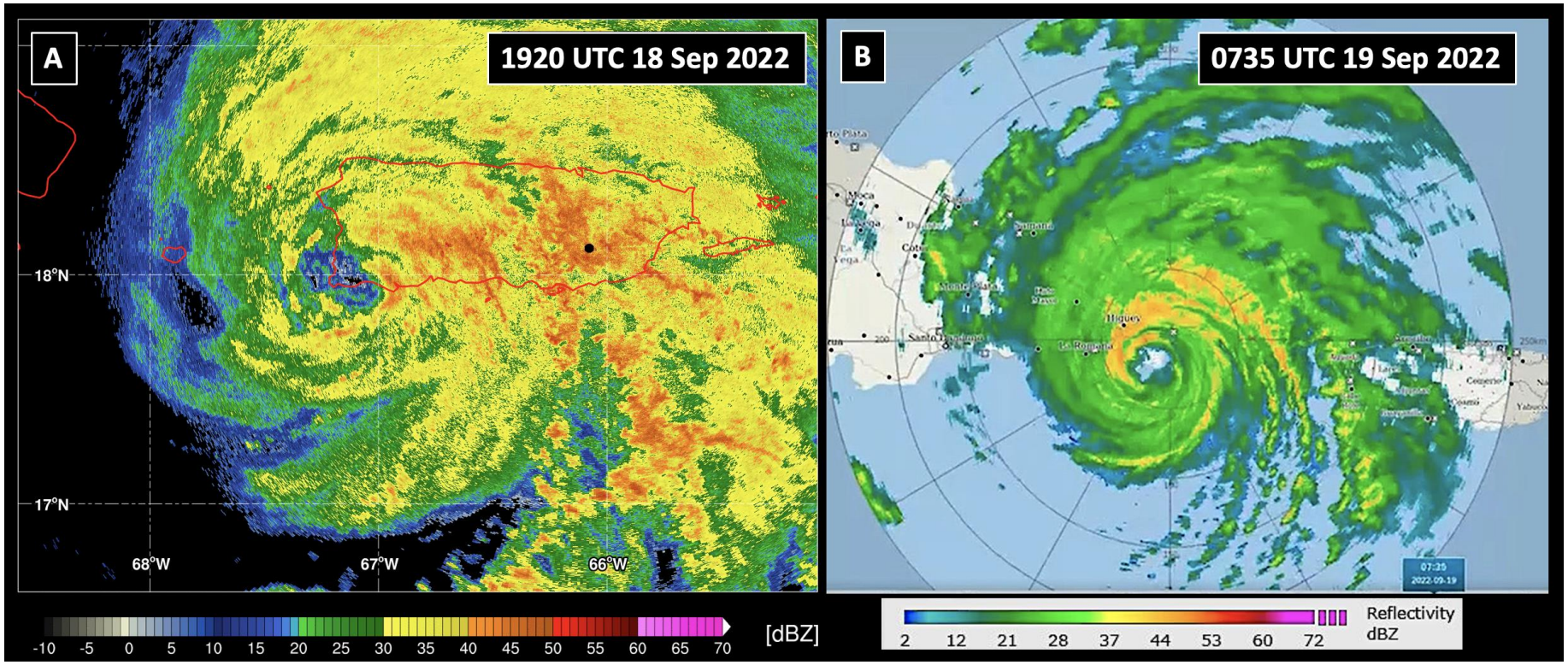


Figure 4. Radar images of Hurricane Fiona at landfall in (a) Puerto Rico and (b) the Dominican Republic. Figure 4a courtesy of NWS San Juan, and Fig. 4b courtesy of the Vaisala Group, the Administration of the Dominican Institute of Civil Aviation, and ONAMET.

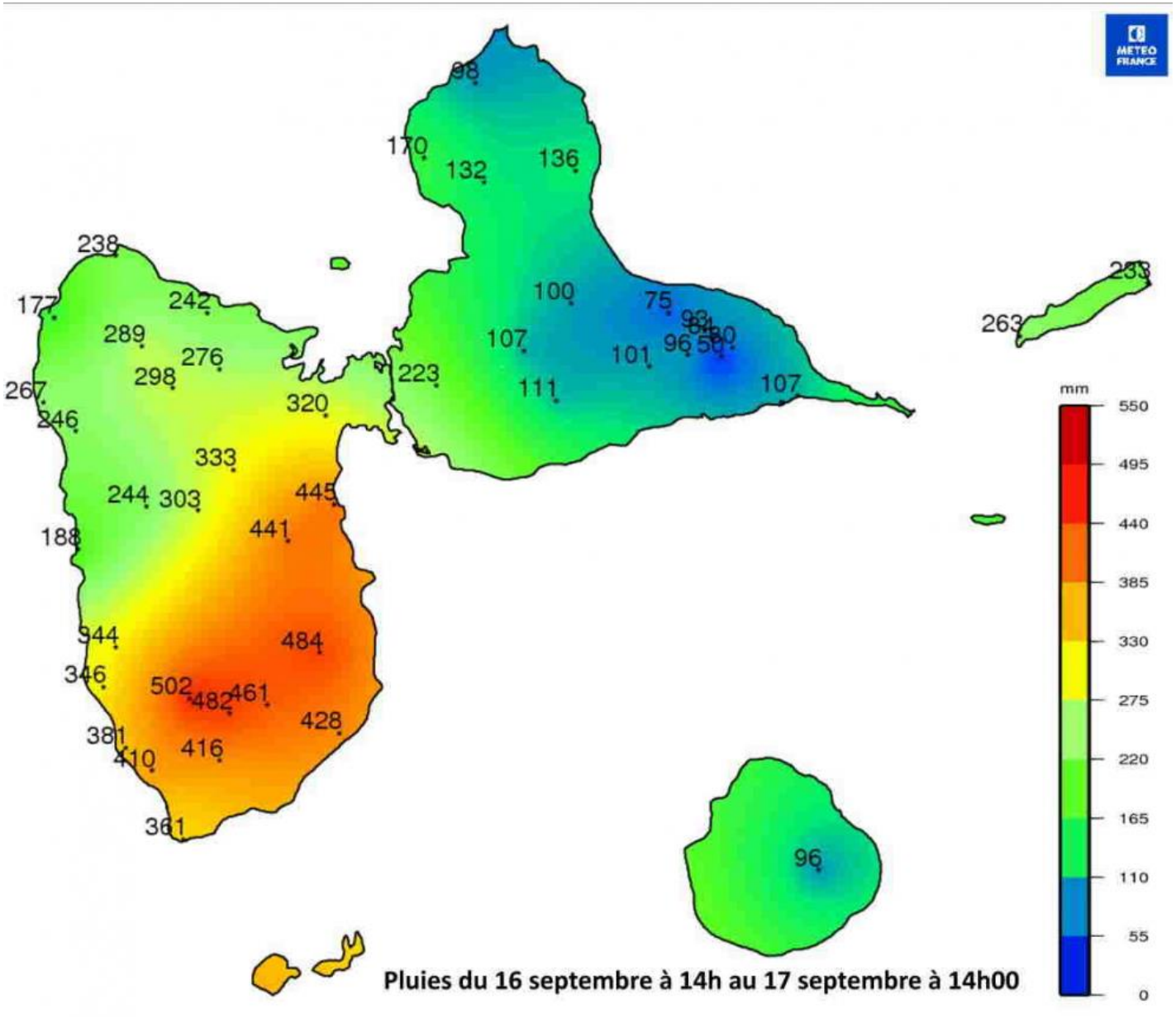


Figure 5. Rainfall accumulations (mm) from Fiona in Guadeloupe. Image courtesy of Meteo France.

Figure 6. Heavy rainfall produced significant flooding in Basse-Terre on Guadeloupe. Photo credit: Lara Balais/Agence France-Presse - Getty Images.

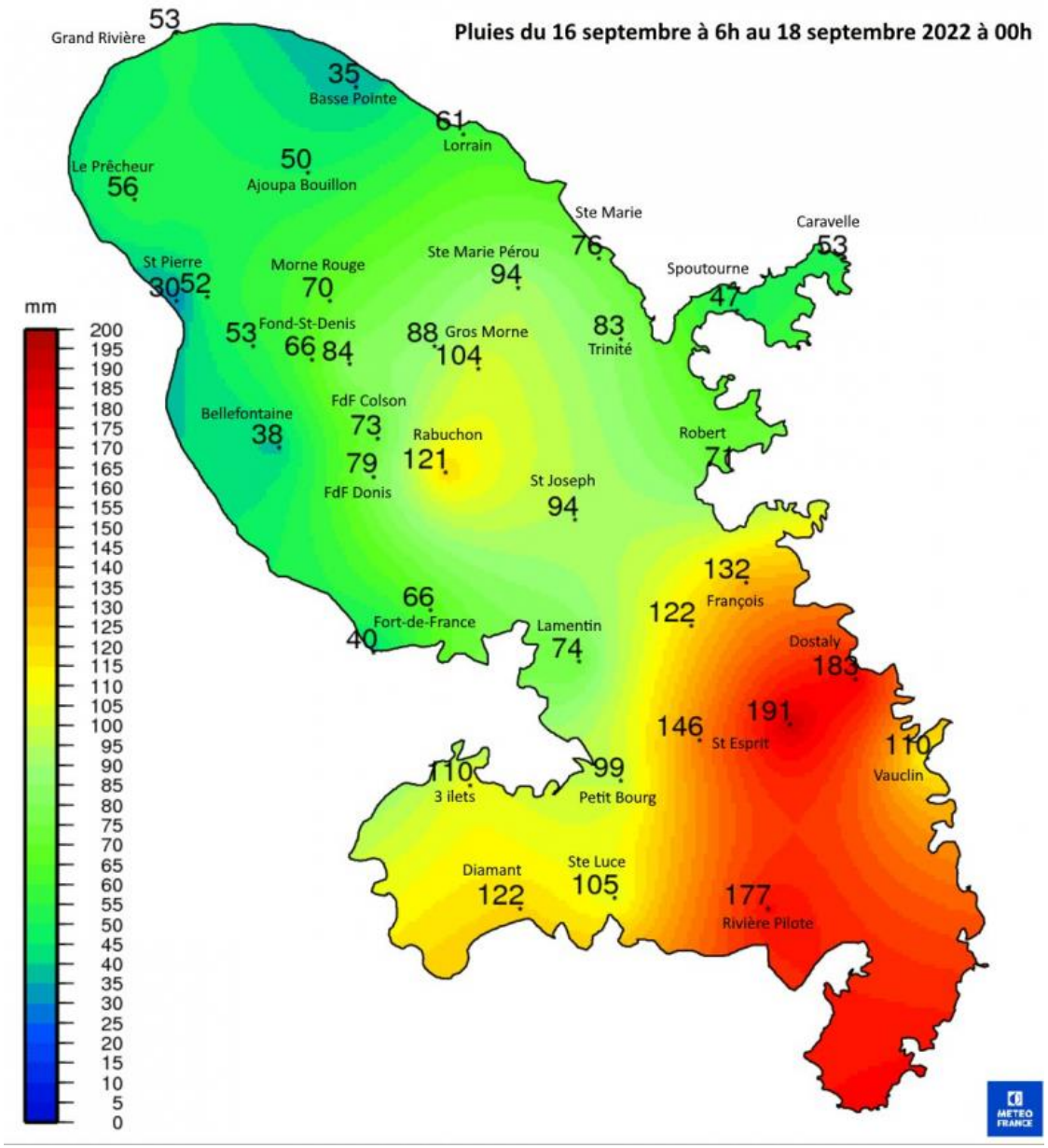


Figure 7. Rainfall accumulations (mm) from Fiona in Martinique. Image courtesy of Meteo France.

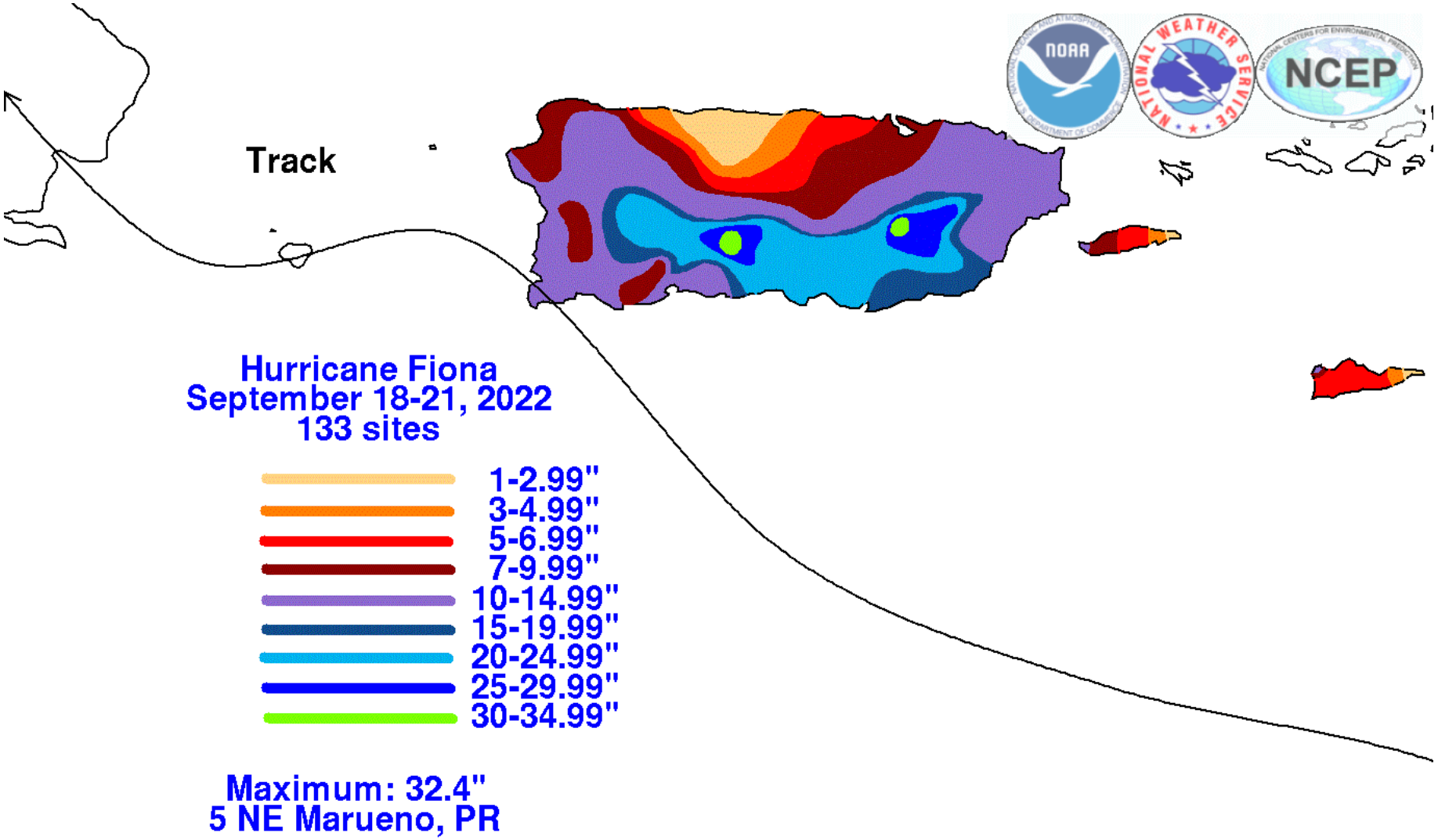
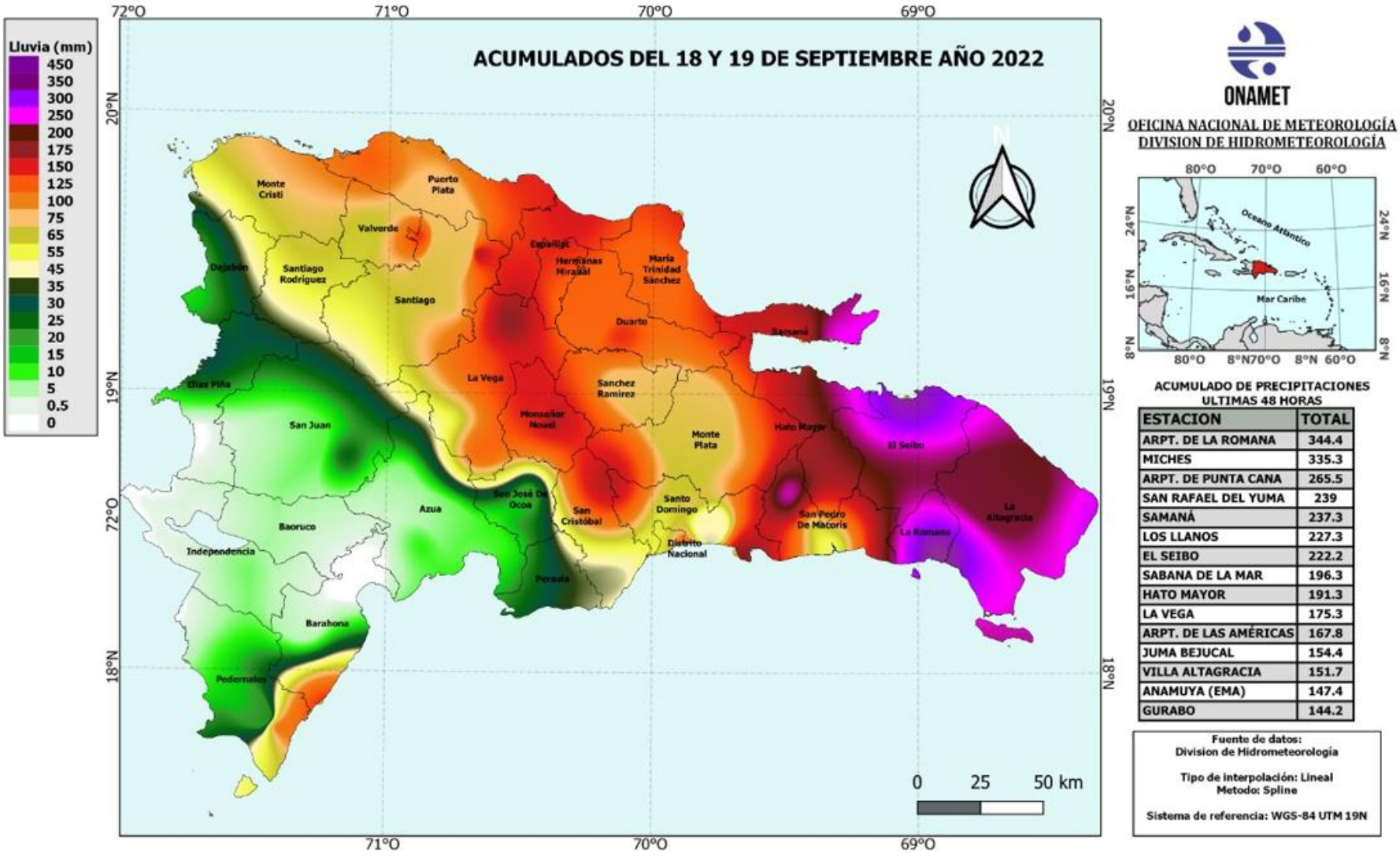


Figure 8. Rainfall accumulations (inches) between 18–21 September 2022 in Puerto Rico and St. Croix from Fiona. Image courtesy of David Roth and Zack Taylor from the NOAA Weather Prediction Center.



ESTACION	TOTAL
ARPT. DE LA ROMANA	344.4
MICHES	335.3
ARPT. DE PUNTA CANA	265.5
SAN RAFAEL DEL YUMA	239
SAMANÁ	237.3
LOS LLANOS	227.3
EL SEIBO	222.2
SABANA DE LA MAR	196.3
HATO MAYOR	191.3
LA VEGA	175.3
ARPT. DE LAS AMÉRICAS	167.8
JUMA BEJUCAL	154.4
VILLA ALTAGRACIA	151.7
ANAMUYA (EMA)	147.4
GURABO	144.2

Figure 9. Rainfall accumulations (mm) from Fiona in the Dominican Republic. Image courtesy of the National Meteorological Service of the Dominican Republic (ONAMET).

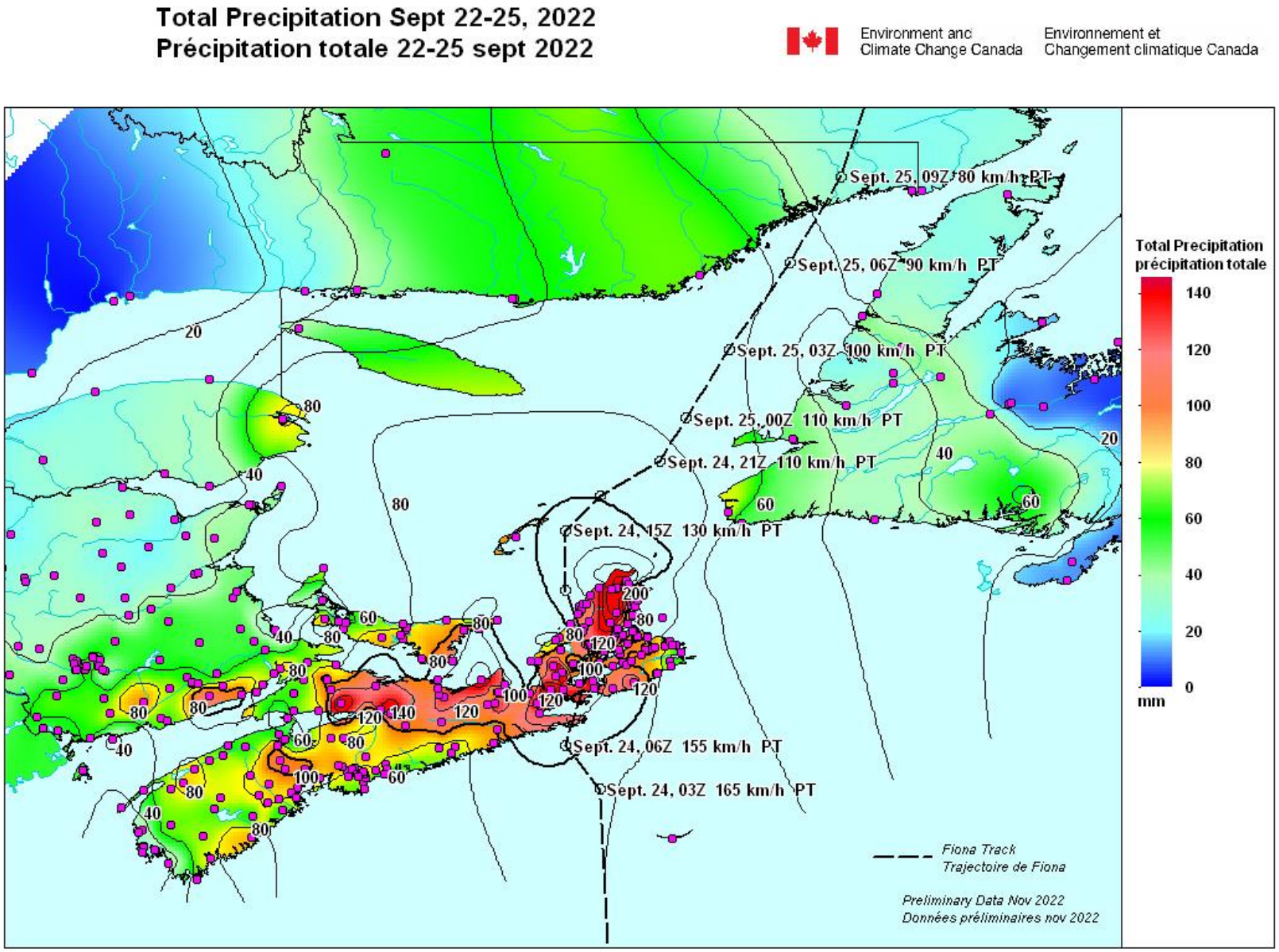


Figure 10. Rainfall accumulations (mm) from Fiona in Canada. Image courtesy of Environment and Climate Change Canada.

Figure 11. Hurricane Fiona impacts in Puerto Rico. Top left: Aerial view of flooded homes in Salinas. Photo credit: Alejandro Granadillo/Associated Press. Top right: Destroyed home in Salinas near the Rio Nigua. Photo credit: Gabriella N. Baez/NPR. Bottom left: A destroyed bridge in Guayama. Photo credit: Ricardo Arduengo/Rueters. Bottom right: A house collapsed into a river in Guayama. Photo credit: Ricardo Arduengo/Rueters.

Figure 12. Hurricane Fiona impacts in the Dominican Republic. Top left: Damage along the coast in Punta Cana. Photo credit: Ricardo Rojas/Reuters. Top right: Submerged vehicles in flash flooding along a highway in La Altagracia province. Photo credit: Josh Morgerman, iCyclone. Bottom left: Downed trees across a road in Boca de Yuma. Photo credit: Josh Morgerman, iCyclone. Bottom right: Roof damage to a building in the Boca de Yuma/San Rafael de Yuma area. Photo credit: Josh Morgerman, iCyclone.

Figure 13. Post-tropical Cyclone Fiona impacts in Atlantic Canada. Top left: Aerial photo of debris from destroyed homes along the coast of Newfoundland in Port aux Basques. Photo credit: Yan Theoret/Canadian Broadcasting Corporation. Top right: Large, battering waves and storm surge destroyed this home in Port aux Basques. Photo credit: Rene Roy/Wreckhouse Press. Bottom left: A significantly damaged high school in Abram-Village on Prince Edward Island. Photo credit: Julien Lecacheur/Radio-Canada. Bottom right: Large tree damage in Halifax, Nova Scotia. Photo credit: Darren Calabrese/The Canadian Press/Associated Press.

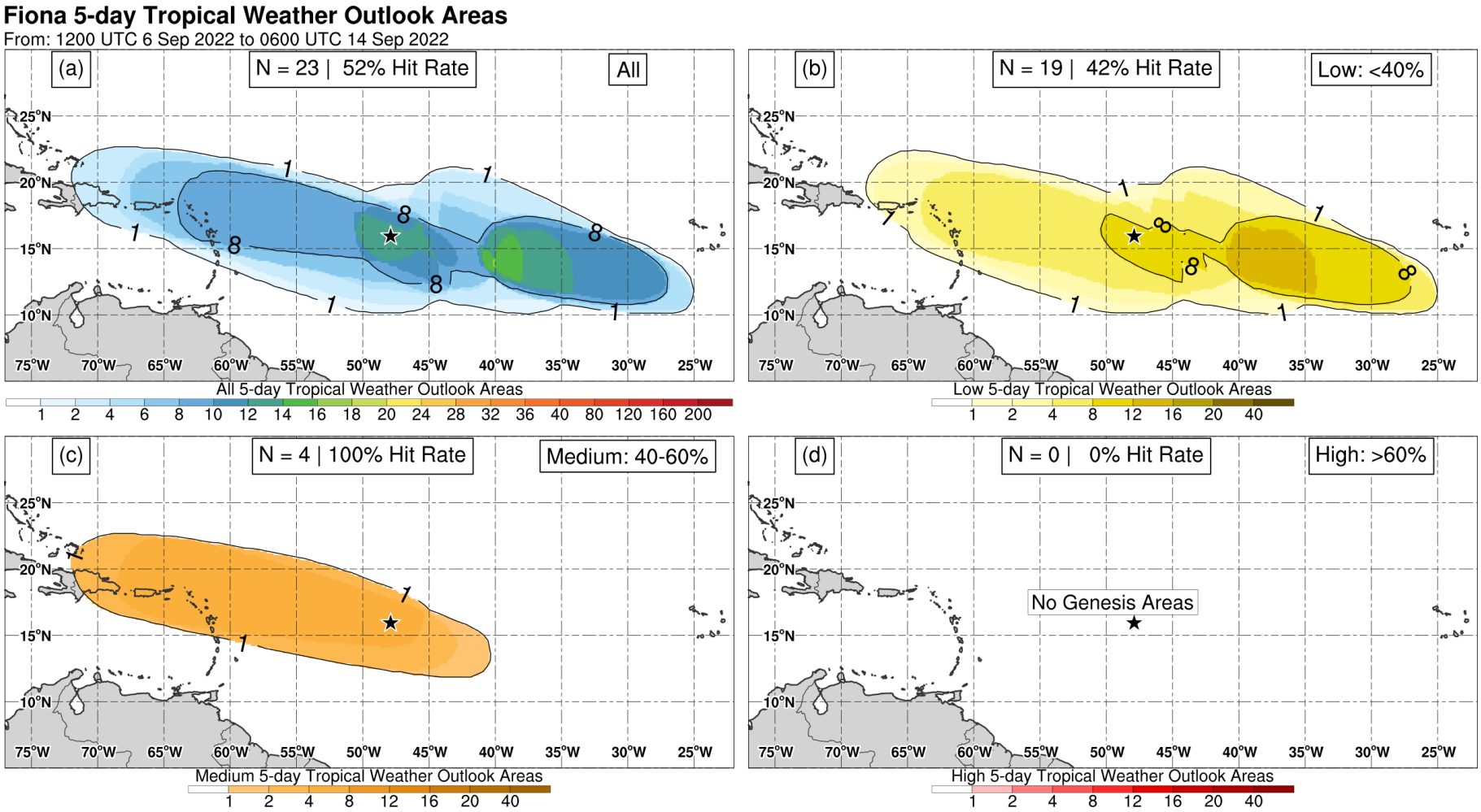


Figure 14. Composites of 5-day tropical cyclone genesis areas depicted in NHC's Tropical Weather Outlooks prior to the formation of Fiona for (a) all probabilistic genesis categories, (b) the low (<40%) category, (c) medium (40–60%) category, and (d) high (>60%) category. The black star in each panel indicates the genesis location of Fiona. The hit rate in each plot indicates the percentage of outlook areas that capture the location of genesis.

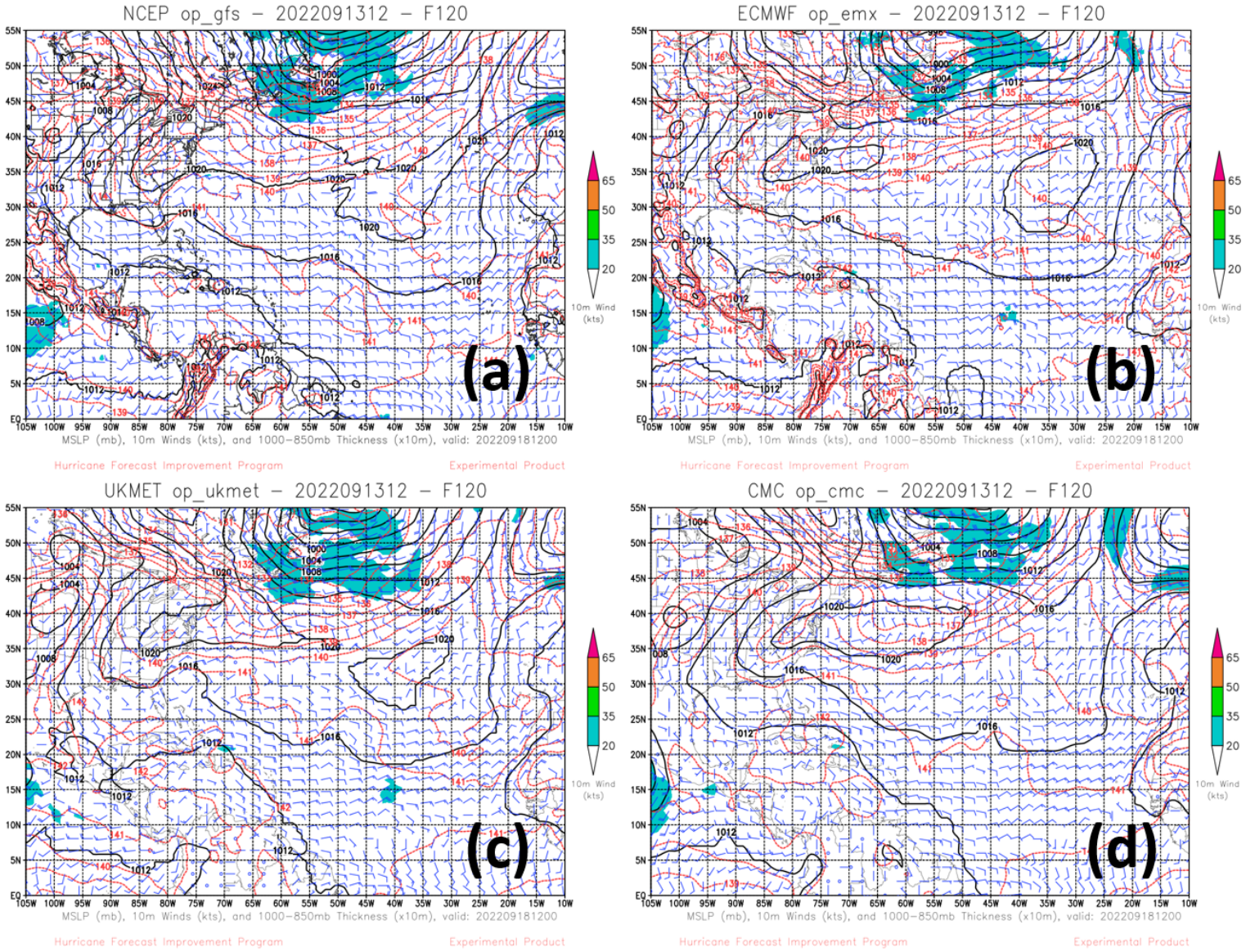


Figure 15. Five-day surface forecasts from 13 September 2022 at 1200 UTC by 4 global models, a) GFS, b) ECMWF, c) U. K. Met Office, and d) Canadian Meteorological Center. At the verifying time, Fiona was a hurricane located just south of Puerto Rico.