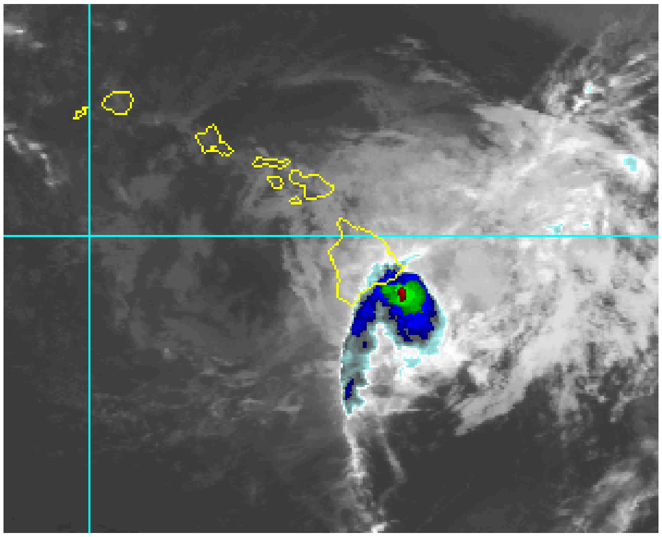
NATIONAL HURRICANE CENTER CENTRAL PACIFIC HURRICANE CENTER TROPICAL CYCLONE REPORT

HURRICANE ISELLE

(EP092014)

31 July–9 August 2014

Todd B. Kimberlain and Michael J. Brennan
National Hurricane Center
Derek R. Wroe
Central Pacific Hurricane Center
12 June 2018[1]



GOES WEST IMAGE OF TROPICAL STORM ISELLE JUST PRIOR TO LANDFALL AT 1200 UTC 8 AUGUST 2014

Iselle was the first tropical cyclone to make landfall in the State of Hawaii since 1992. Iselle peaked as a category 4 hurricane (on the Saffir-Simpson Hurricane Wind Scale) in the eastern Pacific basin and weakened into a tropical storm before making landfall on the Island of Hawaii.

[1] Original report released 29 January 2015. Updated 12 February 2016 to include best track analysis; updated 11 June 2018 to include summary, verification, impacts and damages from CPHC and to make minor wording and typo corrections.

Hurricane Iselle

31 JULY–9 AUGUST 2014

SYNOPTIC HISTORY

Iselle originated from an easterly wave that emerged from the northwest coast of Africa on 14 July. Although the wave produced little to no convection while moving across the Atlantic basin, it became convectively active when it reached the eastern Pacific basin on 25 July. The low-latitude wave initially changed little in organization, likely as a result of the northerly and subsident upper-level outflow associated with Hurricane Hernan to its northwest. By the time the wave crossed 110°W, the deep convection associated with the wave re-developed but did not become better organized, possibly due to enhanced easterly shear. A well-defined atmospheric Kelvin wave passing the wave around 29 July resulted in large-scale conditions conducive for genesis, including a decrease of the easterly shear and a more moist environment, and by 1200 UTC 30 July, a low pressure area formed in association with the wave about 825 n mi south-southwest of the southern tip of the Baja California peninsula. Deep convection accompanying the low remained disorganized until early on 31 July, when it increased in coverage and curved bands began to develop. A tropical depression formed by 1200 UTC 31 July, and the cyclone strengthened into a tropical storm 6 h later. The "best track" chart of Iselle'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[2].

Iselle intensified while it moved west-northwestward during the next couple of days around the southwestern periphery of a mid-level ridge extending westward from Mexico. The cyclone reached hurricane strength 36 h after genesis, at 0000 UTC 2 August, and then rapidly intensified in an environment of moderate north-northeasterly shear during the following 24 h, while the hurricane's heading became more westerly. After becoming a major hurricane on 3 August, the hurricane's intensification rate temporarily slowed down until later that day, when the vertical wind shear over Iselle decreased significantly and the cyclone was moving nearly parallel to the 26°C SST isotherm. These factors likely contributed to the evolution of Iselle on 4 August into an annular structure (Knaff et al. 2003) characterized by a large eye, an axisymmetric ring of deep convection, and a distinct lack of convective bands (Fig. 4).

Some additional intensification took place on 4 August in a very low shear environment, and Iselle reached an estimated peak intensity of 120 kt at 1800 UTC while it approached 140°W. The forward speed then decreased, and Iselle's heading shifted to just south of due west as a mid-latitude middle- to upper-level trough temporarily weakened the ridge to the north of the cyclone and caused the ridge's orientation to change. An increase in westerly shear and less favorable thermodynamic conditions disrupted Iselle's annular structure, and weakening

[2] 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.

commenced on 5 August. A re-strengthening mid-level ridge over the central Pacific resulted in Iselle moving at a faster forward speed, and the hurricane crossed into the central Pacific basin around 0000 UTC 6 August.

Some fluctuations in intensity occurred on 6 August as Iselle's forward motion toward the west-northwest gradually increased. Continued weakening was confirmed by the arrival of aircraft reconnaissance early on 6 August while vertical wind shear began to slowly relax. By the end of 6 August, Iselle briefly reintensified and reacquired a circular, though cloud-filled eye as the upper-level trough to the north retreated.

Gradual weakening resumed on 7 August as the upper-level trough to the north dug toward Iselle and cause an increase in vertical wind shear. On 8 August, the strong vertical wind shear steadily disrupted the system, and the eye disappeared on satellite imagery. A gradual decrease in forward motion occurred as the deep ridge to the north weakened, and Iselle began to interact with the high terrain on the Island of Hawaii. Aircraft reconnaissance and island-based radar confirmed the weakening, and by 0600 UTC 8 August Iselle was downgraded to a tropical storm when it was centered approximately 40 n mi southeast of Cape Kumukahi, the easternmost tip of the Island of Hawaii.

The center of Iselle made landfall at about 1230 UTC 8 August on the Kau coast of the Island of Hawaii just east of the town of Pahala. In addition to increasing vertical wind shear, interaction with the high terrain (Mauna Kea rises to 4,205 m or 13,796 ft, and the elevation of the Mauna Loa summit is 4,170 m or 13,680 ft) of the Island of Hawaii just before and, most dramatically, after landfall led to a severe disruption to the core circulation of Iselle at both lower and upper levels. Steady weakening continued as the system moved west of the Island of Hawaii late on 8 August, and Iselle was downgraded to a remnant low by 0600 UTC 9 August when it was centered approximately 100 n mi south-southwest of the Island of Kauai. Under persistent vertical wind shear, the remnant low dissipated nearly 650 n mi west-southwest of the main Hawaiian Islands on 10 August.

METEOROLOGICAL STATISTICS

Observations in Iselle (Figs. 2 and 3) include subjective satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB), the Satellite Analysis Branch (SAB), CPHC, the Joint Typhoon Warning Center (JTWC), and objective Advanced Dvorak Technique (ADT) estimates from the Cooperative Institute for Meteorological Satellite Studies/University of Wisconsin-Madison. Data and imagery from NOAA polar-orbiting satellites including the Advanced Microwave Sounding Unit (AMSU), the NASA Tropical Rainfall Measuring Mission (TRMM), 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 Iselle.

Aircraft observations include flight-level, stepped frequency microwave radiometer (SFMR), and dropwindsonde observations from 6 flights (including 22 center fixes) of the 53rd Weather Reconnaissance Squadron (WRS) of the U.S. Air Force Reserve Command. In addition, the NOAA AOC G-IV aircraft flew 3 missions around Iselle.

National Weather Service WSR-88D Doppler radar data from near Naalehu on the Island of Hawaii were used to track the center of Iselle.

Selected surface observations from land stations are given in Table 2. No ship reports and no buoy reports of tropical-storm-force winds or greater were received in association with Iselle.

Winds and Pressure

The estimated peak intensity of 120 kt for Iselle is based on Dvorak satellite classifications of T6.0/115 kt from TAFB and SAB at 1200 UTC 4 August, and UW-CIMSS ADT values of T6.3/122 kt around the same time.

Flights conducted by 53rd WRS Hurricane Hunter aircraft began early on 6 August when Iselle was nearly 800 n mi east of the State of Hawaii and continued through 8 Aug, after the system had made landfall.

Late on 7 August when the center of Iselle was within 150 n mi of the Island of Hawaii, 53rd WRS Hurricane Hunters were still able to discern an eyewall, even though the satellite appearance of the system was degrading. At 2300 UTC 7 August, a peak 700-mb flight-level wind in the northeast quadrant was reported to be 72 kt, which would suggest an intensity of 65 kt. A dropwindsonde released around that time reported a likely unrepresentative surface wind of 75 kt, while the surface-adjusted dropwindsonde winds were computed at 67 kt. Meanwhile, the SFMR wind retrievals came in at a maximum of 68 kt, and the maximum sustained winds for 0000 UTC 8 August were therefore held at 70 kt.

Iselle was downgraded to a tropical storm at 0600 UTC 8 August as it neared the southeast coast of the Island of Hawaii. Satellite imagery continued to show a degradation of the structure of Iselle with warming cloud tops, and the 53rd WRS Hurricane Hunters were no longer able to discern an eyewall. Just after 0530 UTC 8 August, the peak 700-mb flight level wind in the northeast quadrant was 60 kt, which would suggest an intensity of 54 kt, and the maximum nearby SFMR wind retrieval was 57 kt. Dropwindsondes from around this time reported a maximum surface wind of 59 kt, while surface-adjusted dropwindsonde winds were at most 49 kt. Thus, Iselle was downgraded to a tropical storm at 0600 UTC 8 August with maximum sustained surface winds of 60 kt.

Weakening continued up to, and particularly after, landfall at 1230 UTC 8 August. The final report from the 53rd WRS Hurricane Hunters that night placed the center about 20 n mi off the southeast coast of the Island of Hawaii just after 1030 UTC 8 August. Dropwindsondes from just after 0900 UTC had surface-adjusted winds of up to 44 kt, and the maximum 700-mb flight-level wind from near that time was 52 kt, which would suggest an intensity of 49 kt. The weather station nearest to Iselle at landfall was the Pali2 RAWS, located less than 10 n mi to the northeast. This station recorded sustained winds of 37 kt with a gust to 57 kt at 1300 UTC, but this site, like all platforms in Hawaii, is subject to terrain influence. Based on these data and the continued deterioration of Iselle's appearance on satellite, the maximum sustained winds at 1200 UTC and at landfall were estimated to be 50 kt.

The high terrain of the Island of Hawaii combined with increasing vertical wind shear led to a large disruption to the circulation of Iselle, and it was difficult for the 53rd WRS Hurricane Hunter aircraft, which had dropped down to a flight level of 850 mb, to locate the center near 1800 UTC 8 August. Interactions with the complex topography of the Hawaiian Islands called into question the SFMR wind retrievals and flight-level winds being representative of the winds directly driven by Iselle. The strongest SFMR wind retrieval was 41 kt in the north quadrant just before 1730 UTC, and the strongest flight-level wind recorded just after 1900 UTC was 44 kt, which would suggest an intensity of 35 kt. The maximum sustained winds were lowered to 40 kt at 1800 UTC. It is worthy to note that the Lanai Airport (PHNY) on the Island of Lanai recorded sustained winds as high as 44 kt and gusts to 54 kt between 1800 UTC and 1900 UTC. Another station, Lanai1 RAWS, which is located less than 10 nm to the west, reported sustained winds of at most 25 kt with gusts to 44 kt in the hours leading up to this time, and the winds at Lanai Airport were deemed to be enhanced by island topography and not representative maximum sustained winds directly generated by Iselle.

The estimated landfall pressure of 1001 mb was based on the final message from the 53rd WRS Hurricane Hunters at 1033 UTC 8 August, approximately two hours before landfall.

Storm Surge

Iselle made landfall in a rural portion of the state, and the nearest water level observation station ILOH1 located in Hilo, approximately 35 n mi to the northeast, reported a maximum storm surge of 0.8 feet above normal tide levels. Due to the strength of Iselle and the lack of a prominent nearshore shelf in the deep waters surrounding the relatively young volcanic Island of Hawaii, storm surge values were expected to be limited to about 2 feet, while high total water levels produced mainly by very large surf were the primary impact in coastal areas.

Total water level includes the combined effects of storm surge, tide, and waves. Due to the deep ocean waters and the absence of a nearshore shelf around the Island of Hawaii, very large seas affected coastal areas. This was particularly noted in the small community of Kapoho, which sits on relatively flat land near the eastern tip of the Island of Hawaii, and to a lesser degree in the community of Hawaiian Paradise Park, which is located about 10 n mi to the northwest. Waves estimated at 25 feet led to significant run up, causing total water levels to reach 8–10 feet above ground level.

Rainfall and Flooding

While Iselle produced heavy rainfall across the entire Hawaiian Island chain, the greatest amounts of rain were recorded on the Island of Hawaii, where the system made landfall. Most of the east- and southeast-facing slopes of the Island of Hawaii received 6–10 inches of rain, and where the forcing of deep moisture up the terrain was maximized, a fairly large area measured over 12 inches of rain, with the highest rainfall total of 15.25 inches observed at the site of the Kulani NOAA Weather Radio (NWR) transmitter. Easterly low-level flow around the circulation of Iselle produced rainfall totals generally in the 2–5 inch range over east-facing slopes of the remainder of the state, though gages in the mountainous interior of the Island of Kauai received 7–9 inches of rain.

Moderate flooding was confined to the southeast portion of the Island of Hawaii near the landfall location. On 8 August, a small bridge at Kaalaala Gulch near Wood Valley was partially washed out as flood waters overwhelmed a culvert, and flood waters at Kawa Flats near Punaluu forced the closure of Highway 11. Flood waters also damaged a road in Naalehu near the southern tip of the Island of Hawaii. A map of rainfall totals is shown in Fig. 5.

CASUALTY AND DAMAGE STATISTICS

Iselle caused one direct death. On 8 August, a woman hiking in the remote Na Pali Coast State Park on the Island of Kauai drowned as she attempted to cross a rain-swollen Hanakoa Stream.

On September 12, 2014, President Obama declared that a major disaster existed for Hawaii County (Island of Hawaii) and Maui County in the State of Hawaii, with the greatest damage focused along east and southeast portions of the Island of Hawaii. Total monetary losses in the State of Hawaii range between $148 million and $325 million, and according to media reports, FEMA assessors verified that on the Island of Hawaii 11 homes were destroyed and 50 homes had suffered some degree of damage.

Significant damage on the Island of Hawaii was attributed to strong winds toppling large numbers of albizia trees (falcataria moluccana) (Fig. 6). This invasive species was introduced to the State of Hawaii in the early 20th century. The tree is renowned for its fast growth rates, which lead to heights in excess of 200 feet, and shallow root systems that render the trees vulnerable to toppling. These aspects, combined with rapid rates of spread of the albizia during the past several decades, contributed to the damage on the Island of Hawaii, including the electrical infrastructure. At the peak, more than 33,000 customers were without power on the Island of Hawaii, and more than 1,000 customer remained without power over two weeks later.

An additional 8,000 customers lost power on Maui County due to high winds, and localized wind damage occurred in rural areas at higher elevations. A large, steel structure at Ulupalakua Ranch at approximately 1,900 ft elevation was destroyed by a brief period of strong winds on the morning of 8 August (Fig. 7), and stands of trees were toppled in the Polipoli Spring State Recreation Area at 6,100 ft in elevation around that time.

Large losses were incurred in the agricultural sector due to wind damage, and the U.S. Department of Agriculture designated Hawaii County as a primary natural disaster area. The Hawaii Department of Agriculture estimated losses to the papaya industry to be $53 million, and a Hawaii Papaya Industry Association spokesperson noted significant losses of papaya trees heavily bearing fruit that were ready to harvest. Media reported damage to numerous smaller farm operations in the coffee, macadamia nut, and floriculture sectors across the Puna and Kau Districts of the Island of Hawaii, with one large macadamia nut producer losing over 2,000 trees and a large coffee producer sustaining a loss of approximately 1,000 trees.

Localized, yet significant, damage resulted from large surf in the small community of Kapoho near the eastern tip of the Island of Hawaii. The combination of about 2 feet of storm surge and, more importantly, waves estimated to be at 25 feet, produced total water levels of 8–10 feet above ground level, This combination of surge and high surf damaged numerous homes in Kapoho, causing flooding of residences and displacing some from their foundations (Fig. 8). In addition, the road running along the coast was stripped of pavement (Fig. 9).

Figure 10 shows the locations of the most extensive damage that were observed in the eastern portion of the Island of Hawaii.

FORECAST AND WARNING CRITIQUE

Genesis forecasts of Iselle recognized the possibility of genesis well in advance, but did not anticipate the actual genesis as the event approached (Table 3). The system from which Iselle developed was introduced into the short-range portion of the Tropical Weather Outlook (TWO) 36 h prior to formation and reached the medium category (30% to 50%) 18 h prior to genesis. However, the probabilities were only raised to the high category (greater than 50%) at the time of genesis. In contrast, the disturbance from which Iselle developed was introduced into the extended-range portion of the TWO nearly a week before genesis occurred. While there was greater lead time provided with respect to the genesis of Iselle, the forecasts incorrectly anticipated that large-scale conditions would become conducive for tropical cyclone formation sooner than they actually did. The negative effects related to the proximity of Hurricane Hernan cited previously were likely a cause for the delay in genesis. A medium chance of development within 5 days was indicated 60 h before genesis, and the probability was raised to the high category 36 h before Iselle formed.

A verification of NHC official track forecasts for Iselle is given in Table 4a. Official forecast track errors were substantially lower than the mean official errors for the previous 5-yr period and near-record values through 72 h. A homogeneous comparison of the official track errors with selected guidance models is given in Table 4b. Overall, the official forecast outperformed most of the guidance throughout the forecast period, and even bested the hard-to-beat multi-model consensus, TVCE at 36 h and beyond. Only TCON and TVCE slightly bested the official track forecasts in the very short term (12 and 24 h), with FSSE, AEMI, and BAMS slightly outperforming the official track forecast at 120 h.

A verification of NHC official intensity forecasts for Iselle is given in Table 5a. Official forecast intensity errors were much greater than the mean official errors for the previous 5-yr period, especially beyond 36 h. The large errors at later times in the forecast period are largely associated with the rapid intensification of Iselle, which was not anticipated, and the development of the cyclone's annular structure. The latter occurrence caused Iselle to retain a much higher intensity than what intensity guidance indicated was likely, given the marginal or even unfavorable thermodynamic conditions that prevailed. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 5b. The intensity guidance for Iselle performed rather poorly, especially at later forecast times. Although the official forecast also had large errors, it bested all of the guidance through 36 h. Only the regional dynamical models, GHMI and HWFI, and multi-model consensus, IVCN, outperformed the official forecast from 72 to 120 h.

A verification of CPHC official track forecasts for Iselle is given in Table 6a. Official track errors were substantially lower than the mean official errors for the previous 5-yr period. A homogeneous comparison of the CPHC official track errors with selected guidance models is given in Table 6b. The official forecast outperformed all guidance at and beyond 36 h and was better than most guidance in the 12 and 24 h time ranges, including the GFSI and HWFI.

A verification of CPHC official intensity forecasts for Iselle is given in Table 7a. Overall, the official forecast intensity errors were slightly greater than the mean official errors over the previous 5-yr period at 24 and 36 h and were lower at all other time periods. A homogeneous comparison of the CPHC official intensity errors with selected guidance models is given in Table 7b. The official forecast performed well in the first 24 h, when errors were smaller than all of the guidance with the exception of the HWFI at 24 h. The HWFI, GHMI, and ICON errors were slightly less than the official forecast at 36 and 48 h and were slightly greater than the official forecast at 72 h.

Watches and warnings associated with Iselle are given in Table 8. A Tropical Storm Watch was issued for the Island of Hawaii at 2100 UTC 5 August, about 60 h before tropical-storm-force winds are estimated to have first arrived along the southeast coast of the island. The watch was upgraded to a Tropical Storm Warning at 1700 UTC 6 August, slightly more than 36 h before the arrival of tropical-storm-force winds. Following a brief, unanticipated re-intensification late on 6 August, the Tropical Storm Warning was upgraded to a Hurricane Warning at 2100 UTC 6 August, due to uncertainty in the weakening rate and future intensity of Iselle when it was forecast to be affecting the Island of Hawaii. The Hurricane Warning did not verify as Iselle was downgraded to a tropical storm approximately 3.5 hours prior to landfall.

A Tropical Storm Watch was issued for the islands of Maui County (Maui, Molokai, Lanai, and Kahoolawe) at 0900 UTC 6 August, and this watch was upgraded to a Tropical Storm Warning at 2100 UTC 6 August. Terrain effects were prominent on the four islands comprising Maui County, complicating the determination of the onset time of tropical-storm-force winds. Tropical-storm-force winds were measured on the Island of Kahoolawe at 1727 UTC 8 August and shortly later at the Lanai City Airport on the Island of Lanai. Around this time on the Island of Maui, a steel structure was destroyed in Ulupalakua at 1,900 feet in elevation, while large stands of trees were blown down in the Polipoli Spring State Recreation Area at 6,100 feet in elevation, and the nearby Kula 1 RAWS station measured wind of tropical storm force. Based on the observation from the Island of Kahoolawe, lead times for the Tropical Storm Watch and Tropical Storm Warning were more than 56 and 44 h, respectively, which is 8 to 10 h longer than the lead times prescribed in the watch/warning definitions.

The Tropical Storm Watch was extended westward to the Island of Oahu at 1500 UTC 6 August, and was upgraded to a Tropical Storm Warning at 0300 UTC on 7 August. A Tropical Storm Watch was issued for Kauai County (Islands of Kauai and Niihau), and this watch was upgraded to a Tropical Storm Warning at 1500 UTC 7 August. The warnings on Oahu and Kauai County did not verify, since Iselle rapidly weakened late on 8 August after interacting with the high terrain of the Island of Hawaii.

ACKNOWLEDGEMENTS

The National Weather Service Forecast Office in Honolulu, HI, provided surface observations, rain gauge data, reports of storm damage, and an aerial damage survey. The National Data Buoy Center and the National Ocean Service provided meteorological and tide gauge data, and the Federal Emergency Management Agency provided ocean inundation information. David Roth of the Weather Prediction Center in College Park, MD, provided the total rainfall graphic. Other observations were provided by the U.S. Geological Survey, the National Interagency Fire Center, and the State of Hawaii.

References

Knaff, J.A., J.P. Kossin, and M. DeMaria, 2003: Annular Hurricanes. *Wea. Forecasting*, 18, 204-223.

Table 1. Best track for Hurricane Iselle, 31 July–9 August 2014.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
30 / 1200	11.3	117.9	1010	20	low
30 / 1800	11.6	119.3	1009	20	"
31 / 0000	11.9	120.4	1009	25	"
31 / 0600	12.1	121.1	1008	25	"
31 / 1200	12.4	121.8	1007	30	tropical depression
31 / 1800	12.8	122.5	1005	40	tropical storm
01 / 0000	13.2	123.4	1003	45	"
01 / 0600	13.6	124.3	1001	50	"
01 / 1200	13.9	125.2	998	55	"
01 / 1800	14.2	126.0	995	60	"
02 / 0000	14.6	126.9	991	65	hurricane
02 / 0600	14.8	127.9	988	70	"
02 / 1200	14.9	128.8	983	75	"
02 / 1800	15.0	129.6	975	85	"
03 / 0000	15.1	130.5	967	95	"
03 / 0600	15.2	131.4	966	95	"
03 / 1200	15.4	132.3	965	100	"
03 / 1800	15.7	133.2	964	100	"
04 / 0000	15.9	134.2	964	100	"
04 / 0600	16.0	135.2	958	110	"
04 / 1200	16.1	136.1	952	115	"
04 / 1800	16.1	136.9	947	120	"
05 / 0000	16.0	137.6	951	115	"
05 / 0600	15.9	138.3	955	110	"
05 / 1200	15.9	139.1	957	110	"
05 / 1800	16.2	139.9	967	95	"
06 / 0000	16.5	141.0	968	95	"
06 / 0600	16.7	142.3	977	85	"
06 / 1200	16.9	143.8	985	75	"
06 / 1800	17.0	145.2	982	80	"
07 / 0000	17.4	146.7	980	85	"

07 / 0600	17.9	148.3	982	80	"
07 / 1200	18.2	149.8	985	75	"
07 / 1800	18.7	151.5	990	70	"
08 / 0000	18.9	153.1	992	70	"
08 / 0600	18.9	154.4	997	60	tropical storm
08 / 1200	19.2	155.3	1001	50	"
08 / 1800	19.4	157.3	1006	40	"
09 / 0000	19.8	158.9	1010	35	"
09 / 0600	20.3	160.1	1011	30	low
09 / 1200	20.7	161.2	1011	30	"
09 / 1800	20.8	162.1	1012	25	"
10 / 0000	20.7	163.2	1012	25	"
10 / 0600	20.2	164.5	1012	20	"
10 / 1200	19.7	165.8	1012	20	"
10 / 1800					dissipated
08 / 1230	19.2	155.4	1001	50	Landfall just east of Pahala, Hawaii
04 / 1800	16.1	136.9	947	120	maximum wind and minimum pressure

Table 2. Selected surface observations in the Hawaiian Islands, August 2014.

Location (State of Hawaii)	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)	
International Civil Aviation Organization (ICAO) Sites						
Bradshaw Army Airfield (PHJH)			08/1944	27	39	
Hilo Intl. Aprt. (PHTO)	08/0214	1011.2	08/0932	34	47	4.13
Honolulu Intl. Aprt. (PHNL)	08/1153	1011.5	08/2339	27	36	
Kahului Aprt. (PHOG)	08/1652	1010.2	08/1642	32	48	
Kaneohe Bay Marine Corps Air Station (PHNG)			08/1909	21	39	
Kapalua Aprt. (PHJH)			08/0246	24	35	
Keahole Aprt. Kona (PHKO)	08/0521	1008.8	08/0001	32	39	
Lanai City Aprt. (PHNY)	08/1356	1009.6	08/1816	44	54	
Lihue Aprt. (PHLI)	09/0159	1013.2	08/2124	29	35	2.33
Molokai Aprt. (PHMK)	08/1503	1011.5	08/1449	26	38	
Waimea-Kohala Aprt. (PHMU)	08/0223	1007.8	08/0953	42	49	
Non-METAR Observations						
Honokanaia (HKAH1)	08/1353	1010.2	08/1653	26	49	
Kahoolawe (HFO02)			08/1727	34	52	
Kahuku (KRCH1)			08/2029	25	36	
Kahuku Training (KTAH1)			08/1159	18	38	
Kahului (KLIH1)	08/1630	1009.5	08/1636	30	40	
Kaneloa (KAOH1)			08/1053	31	54	
Kapapala Ranch (KPRH1)			08/1248	24	45	
Kaupo (KPGH1)			08/0535	27	48	
Kawaihae (KWHH1)			08/1100	30	41	
Kawaihae near Waimea (KWHH1)			08/1115	29	51	
Kealakomo (KMOH1)			08/1144	32	56	
Keaumo (KKUH1)			08/0534	17	36	

Kohala Ranch (KHRH1)			07/2135	21	38	
Kula 1 (KLFH1)			08/1800	28	53	
Lanai 1 (LNIH1)			08/1137	25	44	
Makaha Ridge (MKAH1)			08/2158	19	39	
Makapulapai (MKPH1)			08/1429	28	43	
Mokuoloe (MOKH1)			08/1936	27	38	
Oahu Forest NWR (OFRH1)			08/1336	30	63	
Pali2 (PLIH1)			08/1301	37	57	12.86
PTA East (PTAH1)			08/0759	27	40	
PTA Kipuka Alala (PKAH1)			08/0655	24	39	
PTA Range 17 (PTRH1)			08/2049	25	38	
PTA West (PKWH1)			08/2056	34	49	
Schofield East (SCEH1)			08/2058	18	36	
Waianae Valley (WNVH1)			08/0237	10	37	
Waikoloa (WKVH1)			07/2235	29	39	
Marine Observations						
Hilo (ILOH1) 19.73°N 155.06°W			08/0206	31	42	
Kahului Bay (KLIH1) 20.90°N 156.47°W	08/1630	1009.6	08/1636	30	40	
Kawaihae (KWHH1) 20.03°N 155.83°W			08/1100	30	41	
Other						
Anahola No. 2 (ANHH1) 22.13°N 159.32°W						4.34
Glenwood (GLNH1) 19.49°N 155.15°W						14.98
Hanalei (HNIH1) 22.20°N 159.50°W						4.52
Honokaa (HNKH1) 22.07°N 155.46°W						5.18
Island Dairy (ILDH1) 20.00°N 155.29°W						9.75
Kahana Stream (KNRH1) 21.51°N 157.90°W						2.24
Kahua Ranch (KASH1) 20.13°N 155.79°W						3.15
Kalaheo (KHEH1) 21.92°N 156.30°W						3.14

Kamananui Stream (KMRH1) 21.62°N 158.01°W						4.20
Kamuela 1 (KMUH1) 20.00°N 155.60°W						3.03
Kamuela Upper (KUUH1) 20.01°N 155.63°W						4.25
Kapahi (KPIH1) 22.09°N 159.40°W						6.87
Kawainui Stream (KWSH1) 20.10°N 155.70°W						9.64
Kealakomo (KLVH1) 19.30°N 155.14°W						7.88
Kilohana RG (KLOH1) 21.40°N 157.90°W						9.23
Kokee (KOKH1)						3.33
Kulani NWR (KNWH1) 19.50°N 155.30°W						15.25
Laupahoehoe (LPHH1) 19.98°N 155.23°W						2.64
Lihue Vrty Sta (LIHH1) 22.00°N 159.40°W						3.26
Makaha Stream (MKHH1) 21.50°N 158.18°W						2.55
Manoa Lyon Arbo (MNLH1) 21.32°N 157.80°W						3.90
Mauna Loa Slope Obs (MLBH1) 19.53°N 155.58°W						2.20
Moanalua (MOGH1) 21.38°N 157.84°W						3.04
Mohihi Crossing (MCRH1) 22.12°N 159.60°W						3.03
Mount Waialeale (WLLH1) 22.10°N 159.50°W						7.50
Mountain View (MTVH1) 19.52°N 155.14°W						8.13
Nuuanu Upper (NUUH1) 21.35°N 157.82°W						2.71
Omao (OMAH1) 21.92°N 159.48°W						3.35
PH Wainiha (WNHH1) 22.14°N 159.56°W						6.58
Piihonua KPUA (PIIH1) 19.71°N 155.13°W						8.07
Poamoho RG 1 (PMHH1) 21.52°N 157.92°W						2.94

Port Allen (PAKH1) 21.90°N 159.60°W						2.74
Pua Akala (PKLH1) 19.79°N 155.33°W						12.66
Pukalani (PUKH1) 20.83°N 156.34°W						2.68
Punaluu Stream (PNSH1) 21.55°N 157.90°W						2.48
Pupukea Road (PPRH1) 21.66°N 158.05°W						4.32
Puu Kukui (PKKH1) 20.90°N 156.59°W						6.66
Saddle Road Qry (SDQH1) 19.70°N 155.30°W						14.98
South Point (SOPH1) 18.99°N 155.67°W						4.99
Silversword (SLVH1) 19.77°N 155.42°W						9.20
Tunnel RG (TNLH1) 21.40°N 159.66°W						3.01
Waiakea Exp Stn (WEXH1) 19.60°N 155.10°W						6.59
Waiakea Uka (WKAH1) 19.67°N 155.13°W						8.73
Waiakoali (WKRH1) 22.13°N 159.66°W						3.00
Waialae Ridge (WLGH1) 22.09°N 159.57°W						3.56
Wailua Ditch (WLDH1) 22.06°N 159.47°W						5.93
Wailua UH Exp Stn (WUHH1) 22.05°N 159.34°W						4.51
Waimea Plain (WPLH1) 20.01°N 155.60°W						3.19

[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. NOS and COMPS stations report 6-minute average sustained winds.

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 (<30%)	36	162
Medium (30%-50%)	18	60
High (>50%)	0	36

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Iselle. 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	**12.9**	**21.6**	**25.5**	**31.7**	**47.8**	**77.2**	**102.4**
OCD5	22.3	44.1	69.1	92.2	144.4	171.4	216.9
Forecasts	21	21	21	21	21	18	14
OFCL (2009-13)	25.7	41.4	55.0	68.6	97.8	134.2	167.1
OCD5 (2009-13)	37.2	74.8	118.0	162.5	249.4	332.6	413.3

Table 4b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Iselle. 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	11.5	19.9	22.8	29.2	46.3	73.8	105.5
OCD5	19.2	40.0	64.2	85.7	138.4	163.2	228.9
GFSI	14.1	27.4	34.0	40.6	69.5	113.3	121.3
GHMI	18.2	33.8	39.9	46.4	62.3	133.4	220.7
HWFI	12.5	25.4	40.0	50.1	72.0	105.7	137.6
EGRI	16.3	26.6	35.8	47.0	71.9	105.2	172.0
EMXI	14.4	23.0	26.9	31.9	48.9	**70.9**	115.2
CMCI	28.4	49.9	61.9	75.0	102.9	161.0	253.8
TCON	**11.1**	**19.1**	25.9	31.0	49.4	85.0	123.9
TVCE	**10.6**	**19.2**	24.2	29.6	47.1	79.2	119.9
FSSE	11.8	**18.9**	24.8	33.1	55.2	75.9	**101.1**
AEMI	12.7	24.0	34.3	44.0	64.9	88.0	**104.0**
LBAR	16.5	46.9	80.6	112.3	171.1	211.0	142.3
BAMS	25.9	45.5	65.2	82.3	121.2	120.7	**85.8**
BAMM	13.3	23.6	39.3	54.7	92.2	117.3	126.7
BAMD	14.6	24.8	43.3	69.3	139.7	227.3	292.1
Forecasts	18	18	18	18	18	15	12

Table 5a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Iselle. 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	6.7	11.7	17.1	22.1	25.2	27.2	24.6
OCD5	8.1	15.2	21.3	25.1	28.2	30.1	23.62
Forecasts	21	21	21	21	21	18	14
OFCL (2009-13)	6.1	10.4	13.4	14.5	15.0	16.4	16.1
OCD5 (2009-13)	7.7	12.7	16.4	18.8	20.5	20.3	20.8

Table 5b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Iselle. 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	6.6	12.4	17.9	22.9	25.8	26.6	23.8
OCD5	8.5	15.9	21.8	25.7	29.0	28.9	**22.3**
HWFI	9.8	16.2	19.3	**21.4**	**21.6**	**23.2**	**21.1**
GHMI	11.8	20.8	28.4	28.1	**24.6**	**23.3**	**18.4**
DSHP	7.5	13.9	20.6	25.2	30.7	32.5	29.8
LGEM	8.0	16.2	22.8	26.9	28.8	29.5	25.1
IVCN	8.7	16.2	21.9	24.7	**25.1**	**25.5**	**22.0**
FSSE	9.1	16.5	22.8	27.8	32.8	32.9	30.4
Forecasts	19	19	19	19	19	16	13

Table 6a. CPHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Iselle. 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	**22.0**	**29.1**	**34.2**	**36.8**	**58.0**	-	-
OCD5	40.9	65.3	112.9	173.4	382.4	-	-
Forecasts	12	10	8	6	2	0	0
OFCL (2009-13)	35.0	60.3	89.0	124.8	234.7		

Table 6b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Iselle. Errors smaller than the CPHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 6a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	22.0	29.1	34.2	36.8	58.0	-	-
OCD5	40.9	65.3	112.9	173.4	382.4	-	-
GFSI	26.3	43.0	53.7	52.0	63.8	-	-
GHMI	**18.1**	**22.4**	46.1	59.7	98.8	-	-
HWFI	23.8	38.1	49.5	63.2	110.3	-	-
EGRI	**21.5**	30.8	37.6	67.9	68.1	-	-
TCON	**16.8**	**26.2**	35.2	45.5	72.2	-	-
TVCE	**18.2**	**27.1**	34.4	39.8	66.4	-	-
AEMI	29.2	52.3	67.1	75.5	84.5	-	-
LBAR	39.5	60.5	91.0	135.1	350.4	-	-
BAMS	41.4	81.7	125.8	177.6	266.1	-	-
BAMM	36.8	60.0	87.8	114.2	152.1	-	-
BAMD	36.3	54.5	80.2	114.7	218.5	-	-
Forecasts	12	10	8	6	2	0	0

Table 7a. CPHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Iselle. 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	**4.6**	9.5	12.5	**10.0**	**10.0**	-	-
OCD5	7.6	12.6	15.0	14.8	**5.0**	-	-
Forecasts	12	10	8	6	2	-	-
OFCL (2009-13)	4.8	8.5	11.3	13.6	22.2	0	0

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

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	4.6	9.5	12.5	10.0	10.0	-	-
OCD5	7.6	12.6	15.0	14.8	**5.0**	-	-
HWFI	6.5	**9.0**	**9.6**	**6.5**	13.5	-	-
GHMI	8.3	10.5	**9.1**	**8.3**	21.5	-	-
DSHP	8.4	14.0	17.1	16.0	**4.0**	-	-
LGEM	8.7	14.0	16.3	14.8	**8.5**	-	-
ICON	7.9	11.2	**12.1**	**9.3**	11.0	-	-
Forecasts	12	10	8	6	2	0	0

Table 8. Watch and warning summary for Hurricane Iselle, 31 July–9 August 2014.

Date/Time (UTC)	Action	Location
05 / 2100	Tropical Storm Watch issued	Island of Hawaii
06 / 0900	Tropical Storm Watch issued	Islands of Maui, Molokai, Lanai, and Kahoolawe
06 / 1500	Tropical Storm Watch issued	Island of Oahu
06 / 1700	Tropical Storm Watch changed to Tropical Storm Warning	Island of Hawaii
06 / 2100	Tropical Storm Warning changed to Hurricane Warning	Island of Hawaii
06 / 2100	Tropical Storm Watch changed to Tropical Storm Warning	Islands of Maui, Molokai, Lanai, and Kahoolawe
07 / 0300	Tropical Storm Watch changed to Tropical Storm Warning	Island of Oahu
07 / 0300	Tropical Storm Watch issued	Islands of Kauai and Niihau
07 / 1500	Tropical Storm Watch changed to Tropical Storm Warning	Islands of Kauai and Niihau
08 / 1500	Hurricane Warning changed to Tropical Storm Warning	Island of Hawaii
09 / 0000	Tropical Storm Warning discontinued	Island of Hawaii
09 / 0100	Tropical Storm Warning discontinued	Islands of Oahu, Maui, Molokai, Lanai, and Kahoolawe
09 / 0300	Tropical Storm Warning discontinued	Islands of Kauai and Niihau

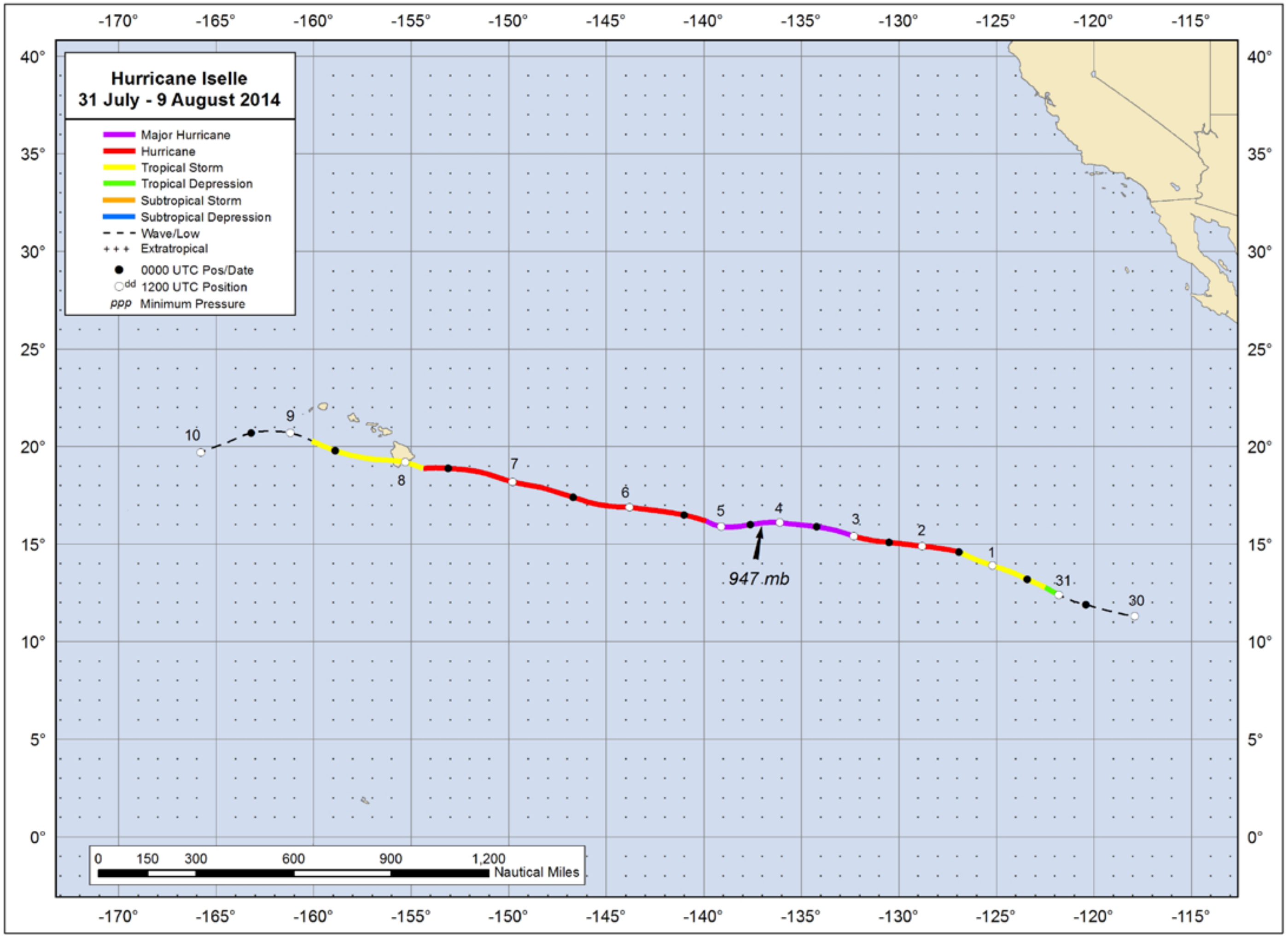


Figure 1. Best track positions for Hurricane Iselle, 31 July–9 August 2014.

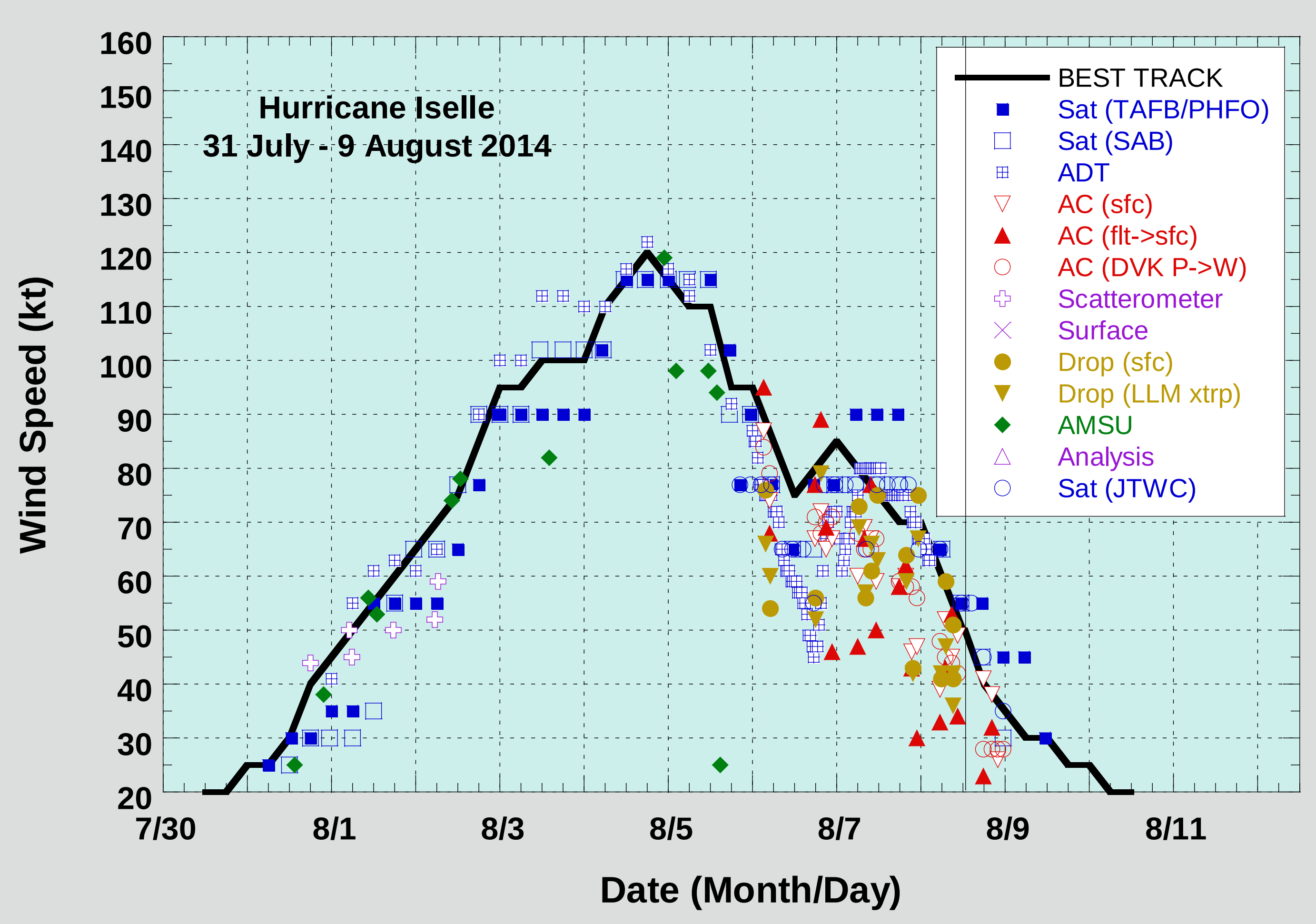


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Iselle, 31 July–9 August 2014. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Dashed vertical lines correspond to 0000 UTC and the solid vertical line corresponds to landfall.

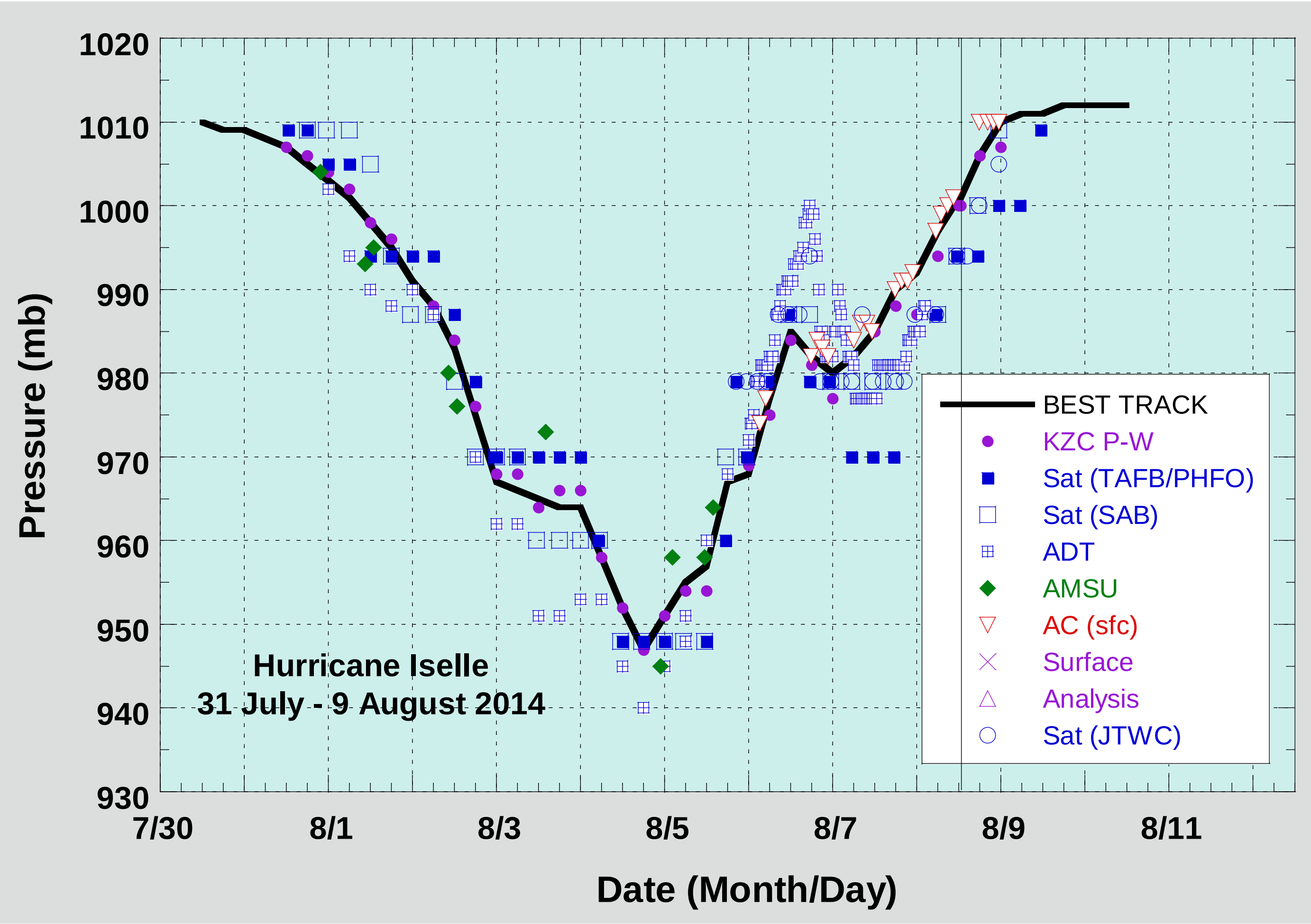


Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Iselle, 31 July–9 August 2014. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological 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 the solid vertical line corresponds to landfall.

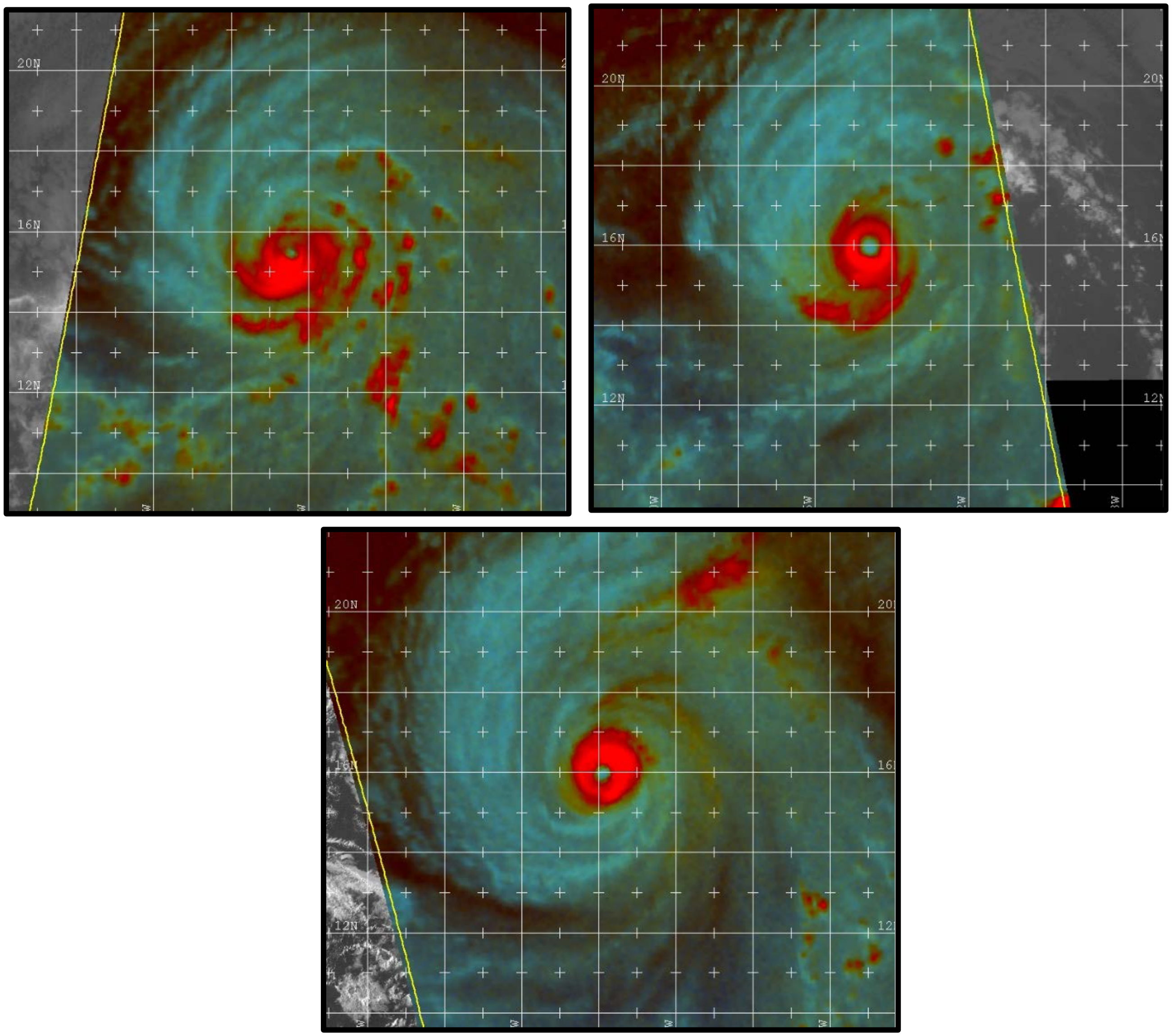


Figure 4. Series of 91-GHz SSMI/S images from 3 to 5 August 2014, showing the evolution of Iselle's inner core structure. Images courtesy of the U.S. Naval Research Lab.

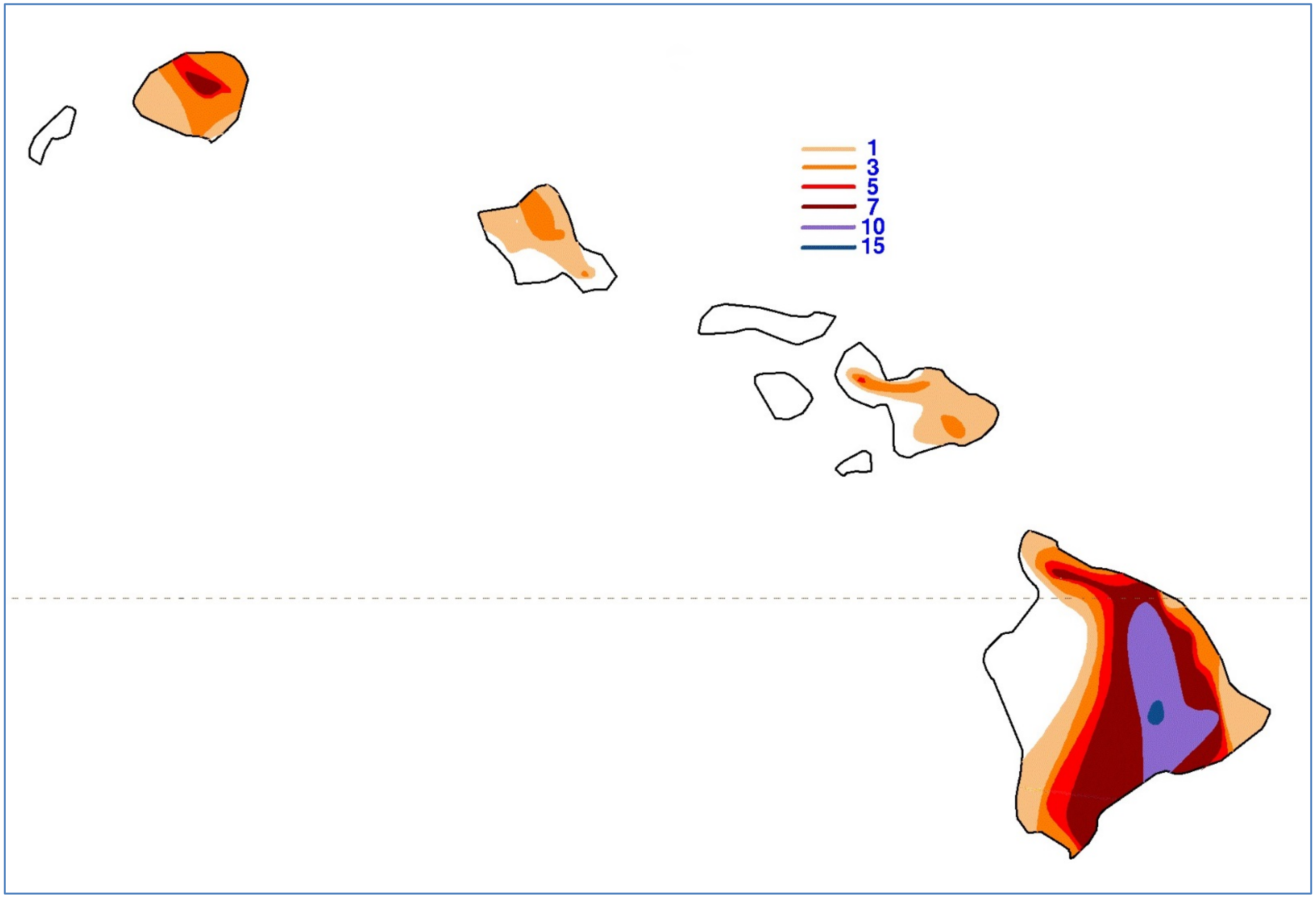


Figure 5. Rainfall analysis (inches) courtesy of the Weather Prediction Center for 7–10 August 2014 over portions of the Hawaiian Islands where reliable rainfall data were available.

Figure 6. One of numerous stands of downed albizia trees in the Puna District of the Island of Hawaii.

Figure 7. The steep terrain contributed to a short period of strong winds at higher elevations. A steel structure in Ulupalakua, Maui at approximately 1,900 ft in elevation was destroyed on the morning of 8 August.

Figure 8. A home in Kapoho on the Island of Hawaii was pushed off its foundation (seen in foreground) and was destroyed.

Figure 9. One of several sections of road in Kapoho on the Island of Hawaii that was stripped of pavement, primarily due to large wave action.

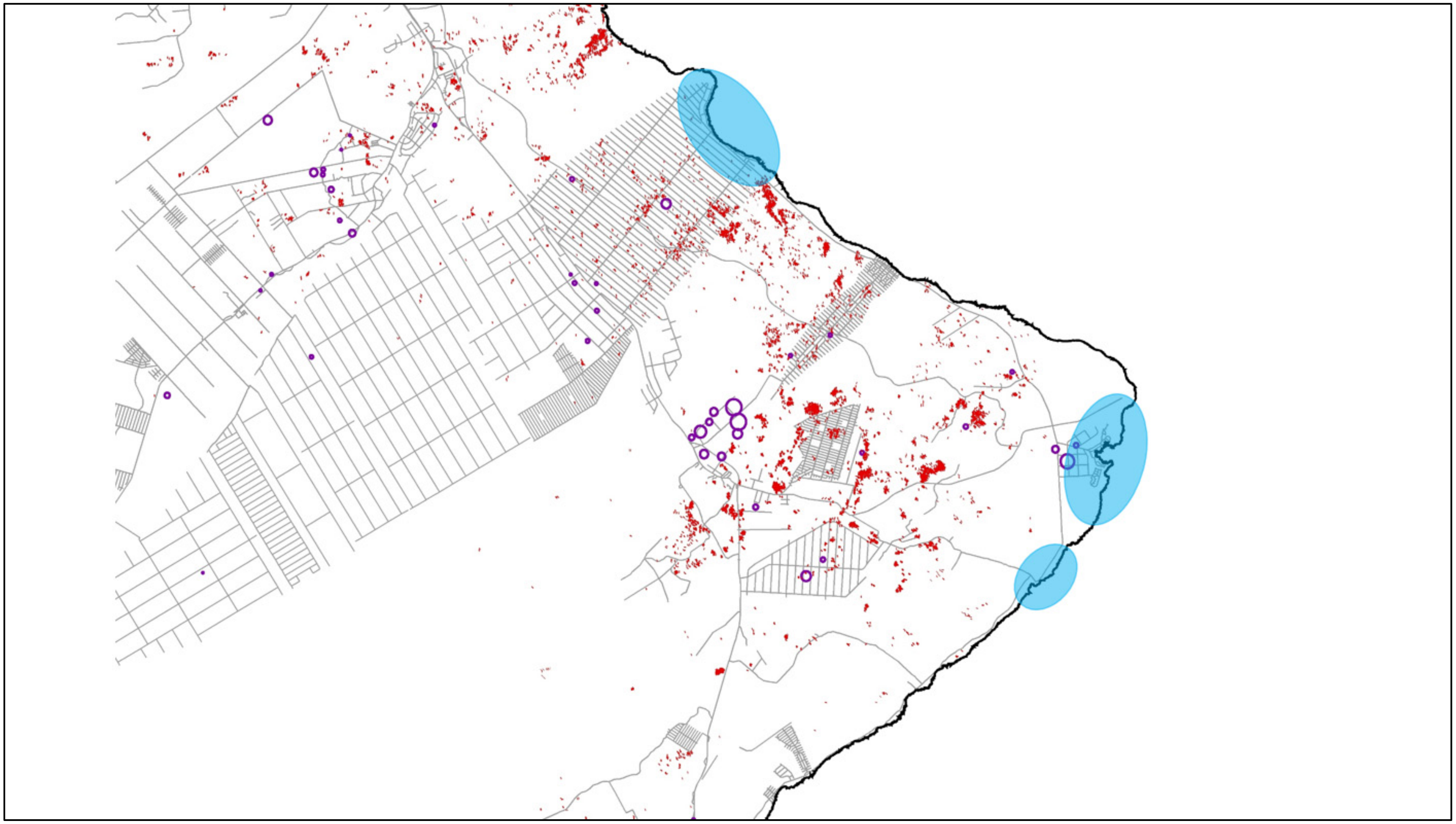


Figure 10. Damage summary for the eastern portion of the Island of Hawaii. The blue shaded areas capture where there was coastal damage due to total water level, primarily in the form of wave action. The red dots signify areas of downed Albizia trees, as determined by an aerial survey and satellite imagery. The purple circles indicate structure damage.