NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

HURRICANE ULIKA

(EP192016)

26 – 30 September 2016

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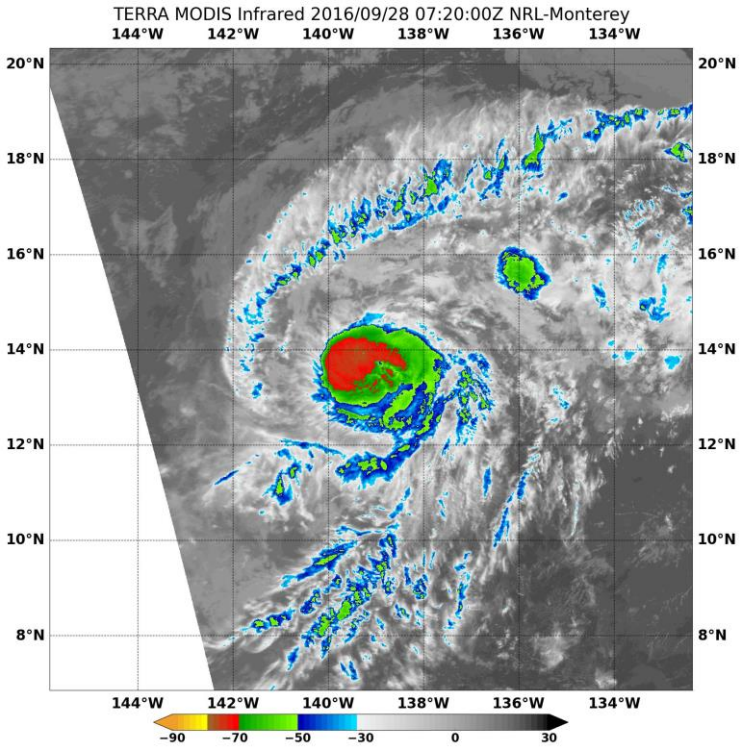
19 May 2017[1]



MODIS INFRARED IMAGE OF ULIKA FROM THE TERRA SATELLITE AT 0720 UTC 28 SEPTEMBER. IMAGE COURTESY OF NRL/MONTEREY CA.

Ulika was a category 1 hurricane (on the Saffir-Simpson Hurricane Wind Scale) that meandered across the boundary between the NHC and CPHC areas of responsibility.

[1] Original report date 28 February 2017. Updated 19 May 2017 to include additional analysis from CPHC.

Hurricane ULIKA

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SYNOPTIC HISTORY

Ulika formed along a portion of the Intertropical Convergence Zone (ITCZ) that was drawn northward as part of the inflow into Hurricane Paine during the 16-20 September period. As the ITCZ re-established itself in the wake of the hurricane, a trackable cloud cluster formed near 13N 125W on 21 September, possibly aided by a weak tropical wave moving westward into the area. The disturbance moved west-southwestward within the ITCZ and gradually developed. A low pressure area formed on 23 September, with the associated circulation becoming better defined on 25 September. When the convection subsequently became better organized, a tropical depression formed near 0600 UTC 26 September about 1055 n mi east-southeast of the island of Hawaii. 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[2].

The depression moved slowly westward after genesis, crossing 140°W into the Central Pacific Hurricane Center area of responsibility between 1200-1800 UTC 26 September. An upper-level low to the north and northwest of the cyclone then caused it to turn northward and northeastward, with the center crossing back into the National Hurricane Center area of responsibility between 1200 and 1800 UTC 27 September. During its excursion into the Central Pacific, the cyclone became a tropical storm and was given the Central Pacific basin name Ulika. Continued intensification led to Ulika becoming a hurricane with an estimated peak intensity of 65 kt early on 28 September while it was centered about 990 n mi east-southeast of Hawaii.

Later on 28 September, southwesterly vertical wind shear increased, with Ulika weakening to a tropical storm as a result. The upper-level low steered the storm northward for part of 28-29 September, followed by a turn toward the northwest on the northeast side of the low. This led to Ulika again moving into the Central Pacific basin late on 29 September. As that occurred, the associated convection dissipated, and Ulika quickly decayed to a remnant low pressure area on 30 September about 740 n mi east of Hawaii. The remnants of Ulika persisted for a few more days as they moved westward and west-southwestward to the south of the Hawaiian Islands, dissipating about 400 n nm south of Hawaii by 0600 UTC 3 October.

[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.

METEOROLOGICAL STATISTICS

Observations in Ulika (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), the Central Pacific Hurricane Center, and the Joint Typhoon Warning Center. They also include 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 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 Ulika.

The estimated peak intensity of 65 kt is based on a blend of various satellite intensity estimates, which showed a greater than normal spread that was likely due to the small size of the cyclone. There were no surface observations of tropical-storm-force or greater winds from Ulika.

CASUALTY AND DAMAGE STATISTICS

There were no reports of damage or casualties associated with Ulika.

FORECAST AND WARNING CRITIQUE

The genesis of Uilka was poorly forecast. The disturbance that became the cyclone was first mentioned in the Tropical Weather Outlook 54 h before genesis as having a low chance of development (< 40%) in the 3-5 day range (Table 2). It was first mentioned in the 2 day range with a low probability 42 h before genesis. The chance of development was raised to the medium category (40-60 % chance) in the 3-5 day range 42 h before genesis, but was not raised to medium category in the 0-2 day range until the time of genesis. The chances were not raised to the high category (>60 % chance) in either time range until after genesis occurred. The most likely reason for the poor forecasts is that the global models forecasted a low pressure area that more resembled a weak vortex in the ITCZ than a tropical cyclone.

A verification of NHC official track forecasts for Ulika is given in Table 3a. Official forecast track errors were comparable to the mean official errors for the previous 5-yr period. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. While the overall number of forecasts is small, the GFS Ensemble Mean (AEMI), the ECMWF model (EMXI), and the HWRF hurricane model (HWFI) performed as well as or better than the official forecasts. Generally, the track forecasts accurately caught the non-climatological, sinusoidal motion of Ulika.

A verification of NHC official intensity forecasts for Ulika is given in Table 4a. Official forecast intensity errors were generally lower than the mean official errors for the previous 5-yr period, except at 12-h where the errors were about the same. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. The official forecasts were generally better than those of the intensity guidance from 24-48 h. At 12 h, several of the guidance models had lower average errors than the official forecasts.

A verification of CPHC official track forecasts for Ulika is given in Table 5a. Official forecast track errors were lower than the mean official errors for the most recently available previous 5-yr period for all forecast periods. A homogeneous comparison of the official track errors with selected guidance models is given in Table 5b. While the overall number of forecasts is quite small, the GFS Ensemble Mean (AEMI) and two variations of the Consensus Track Guidance (TVCA and TVCX) performed as well or better than the official forecasts. Generally, the track forecasts accurately depicted the non-climatological motion of Ulika around 140°W.

A verification of CPHC official intensity forecasts for Ulika is given in Table 6a. Official forecast intensity errors were similar or greater than the mean official errors for the most recently available previous 5-yr period for the 12 h to 36 h forecast periods, and significantly lower than the mean official errors for the 48 h and 72 h forecast periods. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 6b. The Hurricane Weather Research and Forecasting Model (HWRF) performed better than the official forecasts at the 12h to 36h forecast periods, and the Consensus Intensity Guidance (ICON and IVCN) generally performed as well or slightly better than the official forecasts at all forecast periods. Generally, neither the model guidance nor the official forecasts accurately predicted Ulika's intensification to a hurricane on 28 September, with larger errors observed at the 24h and 36h forecast periods than at the 48h and 72h periods.

No coastal watches or warnings were issued for Ulika.

Table 1. Best track for Hurricane Ulika, 26 – 30 September 2016.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
25 / 1200	11.8	137.4	1009	25	low
25 / 1800	11.5	138.1	1008	25	"
26 / 0000	11.3	138.6	1008	25	"
26 / 0600	11.2	139.1	1007	30	tropical depression
26 / 1200	11.3	139.7	1006	30	"
26 / 1800	11.5	140.2	1005	30	"
27 / 0000	11.6	140.4	1005	30	"
27 / 0600	11.9	140.4	1004	35	tropical storm
27 / 1200	12.2	140.2	999	45	"
27 / 1800	12.6	139.8	997	50	"
28 / 0000	13.1	139.4	995	55	"
28 / 0600	13.6	139.1	992	65	hurricane
28 / 1200	14.1	138.8	992	65	"
28 / 1800	14.8	138.7	994	60	tropical storm
29 / 0000	15.5	138.8	997	55	"
29 / 0600	16.0	139.1	1000	50	"
29 / 1200	16.5	139.5	1003	45	"
29 / 1800	16.9	139.9	1006	40	"
30 / 0000	17.5	140.6	1008	35	"
30 / 0600	17.9	141.3	1009	30	tropical depression
30 / 1200	18.2	142.1	1010	30	low
30 / 1800	18.5	142.9	1011	30	"
01 / 0000	18.6	144.0	1012	30	"
01 / 0600	18.7	145.3	1013	25	"
01 / 1200	18.7	146.9	1013	25	"
01 / 1800	18.5	148.8	1013	25	"
02 / 0000	17.7	150.5	1013	25	"
02 / 0600	17.1	152.1	1013	25	"
02 / 1200	16.6	153.6	1013	25	"

02 / 1800	16.0	155.0	1014	25	"
03 / 0000	15.4	156.5	1014	25	"
03 / 0600					dissipated
28 / 0600	13.6	139.1	992	65	maximum wind and minimum pressure

Table 2. Number of hours in advance of formation associated with the first NHC Tropical Weather Outlook forecast in the indicated likelihood category. Note that the timings for the "Low" category do not include forecasts of a 0% chance of genesis.

	Hours Before Genesis	
	48-Hour Outlook	**120-Hour Outlook**
Low (<40%)	42	54
Medium (40%-60%)	0	42
High (>60%)	-	-

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Ulika, 26 – 30 September 2016. Mean errors for the previous 5-yr period are shown for comparison. Official errors that are smaller than the 5-yr means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	**17.3**	**34.9**	47.6	59.7	89.7		
OCD5	26.9	71.9	117.8	157.6	396.4		
Forecasts	10	8	6	4	1		
OFCL (2011-15)	23.4	36.4	47.2	59.4	89.0	123.6	159.5
OCD5 (2011-15)	36.6	74.2	116.5	159.7	245.6	331.1	427.4

Table 3b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Ulika, 26 – 30 September 2016. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 3a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	17.3	34.9	47.6	59.7	89.7		
OCD5	26.9	71.9	117.8	157.6	396.4		
GFSI	27.1	46.4	61.3	67.3	130.2		
EMXI	23.9	35.4	**35.7**	**47.5**	**62.4**		
CMCI	29.0	37.2	52.7	73.5	154.0		
NVGI	27.0	67.6	112.3	131.3	111.9		
HWFI	21.5	39.0	**42.7**	**41.3**	**55.0**		
GHMI	22.1	48.9	78.7	112.7	122.3		
GFNI	41.9	79.8	112.9	141.4	**48.0**		
AEMI	**16.2**	**28.7**	**37.2**	**45.4**	**70.1**		
HCCA	19.1	40.1	55.2	70.7	92.0		
TVCX	19.6	41.4	56.4	64.7	**75.0**		
GFEX	20.1	36.9	**45.3**	**56.1**	110.9		
TVCE	21.4	43.5	59.9	66.7	**81.4**		
BAMD	74.3	138.5	196.0	244.9	**54.8**		
BAMM	33.0	66.2	103.3	148.5	130.2		
BAMS	24.1	40.2	**45.4**	68.1	254.7		
Forecasts	10	8	6	4	1		

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Ulika, 26 – 30 September 2016. Mean errors for the previous 5-yr period are shown for comparison. Official errors that are smaller than the 5-yr means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	6.0	**4.4**	**6.7**	**10.0**	**5.0**		
OCD5	6.4	10.4	18.7	27.5	11.0		
Forecasts	10	8	6	4	1		
OFCL (2011-15)	5.9	9.8	12.5	14.0	15.5	16.3	14.9
OCD5 (2011-15)	7.7	12.8	16.4	18.8	21.1	20.9	19.7

Table 4b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Ulika, 26 – 30 September 2016. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 4a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	6.0	4.4	6.7	10.0	5.0		
OCD5	6.4	10.4	18.7	27.5	11.0		
HWFI	**5.8**	6.5	7.3	13.3	**4.0**		
GHMI	**4.9**	6.9	18.5	23.8	**3.0**		
GFNI	**5.3**	9.5	16.0	27.0	10.0		
DSHP	7.1	7.6	8.2	11.0	**4.0**		
LGEM	6.4	7.4	10.3	15.5	14.0		
ICON	**5.5**	6.0	9.7	15.3	**2.0**		
IVCN	**5.3**	5.3	8.5	13.5	**2.0**		
GFSI	**3.8**	5.9	9.3	15.8	**4.0**		
EMXI	6.1	13.0	19.3	23.3	6.0		
Forecasts	10	8	6	4	1		

Table 5a. CPHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Ulika, 26 – 30 September 2016. Mean OFCL errors for the most recently available previous 5-yr period are shown for comparison. Official errors that are smaller than the 5-yr mean are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	**17.6**	**25.9**	**32.8**	**44.2**	**78.1**		
OCD5	45.0	121.8	198.8	258.3	350.8		
Forecasts	4	4	4	4	3		
(CP) OFCL (2010-14)	27.9	44.1	56.7	73.9	132.3		

Table 5b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Ulika, 26 – 30 September 2016. Errors smaller than the CPHC official forecast are shown in boldface type.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	17.6	25.9	32.8	44.2	78.1		
OCD5	45.0	121.8	198.8	258.3	350.8		
GFSI	18.9	**23.9**	**29.6**	53.1	139.9		
EMXI	25.0	49.0	67.2	86.8	109.3		
CMCI	24.1	44.8	58.4	52.7	**60.0**		
HWFI	25.0	26.7	34.7	51.2	**77.3**		
EGRI	28.9	42.8	55.3	66.9	79.3		
GHMI	24.5	30.8	**30.1**	**27.9**	105.0		
AEMI	**15.4**	**16.8**	**16.0**	**33.2**	100.9		
TVCX	**16.4**	**20.8**	**31.5**	**37.4**	**60.7**		
GFEX	**14.3**	**19.6**	**28.4**	48.5	85.8		
TVCA	18.7	**18.8**	**25.8**	**31.9**	**62.9**		
BAMD	**13.4**	37.4	61.7	109.4	207.6		
BAMM	27.6	51.2	61.6	90.4	127.8		
BAMS	43.2	90.5	127.1	142.5	167.7		
Forecasts	4	4	4	4	3		

Table 6a. CPHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Ulika, 26 – 30 September 2016. Mean OFCL errors for the most recently available 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	5.0	13.8	13.8	**7.5**	**1.7**		
OCD5	5.5	13.3	17.3	12.8	18.3		
Forecasts	4	4	4	4	3		
(CP) OFCL (2010-14)	4.8	8.6	11.6	13.8	18.5		

Table 6b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Ulika, 26 – 30 September 2016. Errors smaller than the CPHC official forecast are shown in boldface type.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	5.0	13.8	13.8	7.5	1.7		
OCD5	5.5	**13.3**	17.3	12.8	18.3		
HWFI	**2.8**	**7.8**	**12.0**	10.0	5.7		
GHMI	7.5	13.8	**8.8**	**5.5**	9.7		
DSHP	6.0	15.5	17.3	12.5	3.7		
LGEM	7.3	18.5	22.3	17.8	8.7		
ICON	5.5	**13.5**	14.5	9.5	2.0		
IVCN	5.5	**13.3**	14.3	9.5	2.0		
GFSI	9.0	19.3	20.5	14.5	**1.3**		
EMXI	10.0	21.5	22.3	13.5	4.0		
Forecasts	4	4	4	4	3		

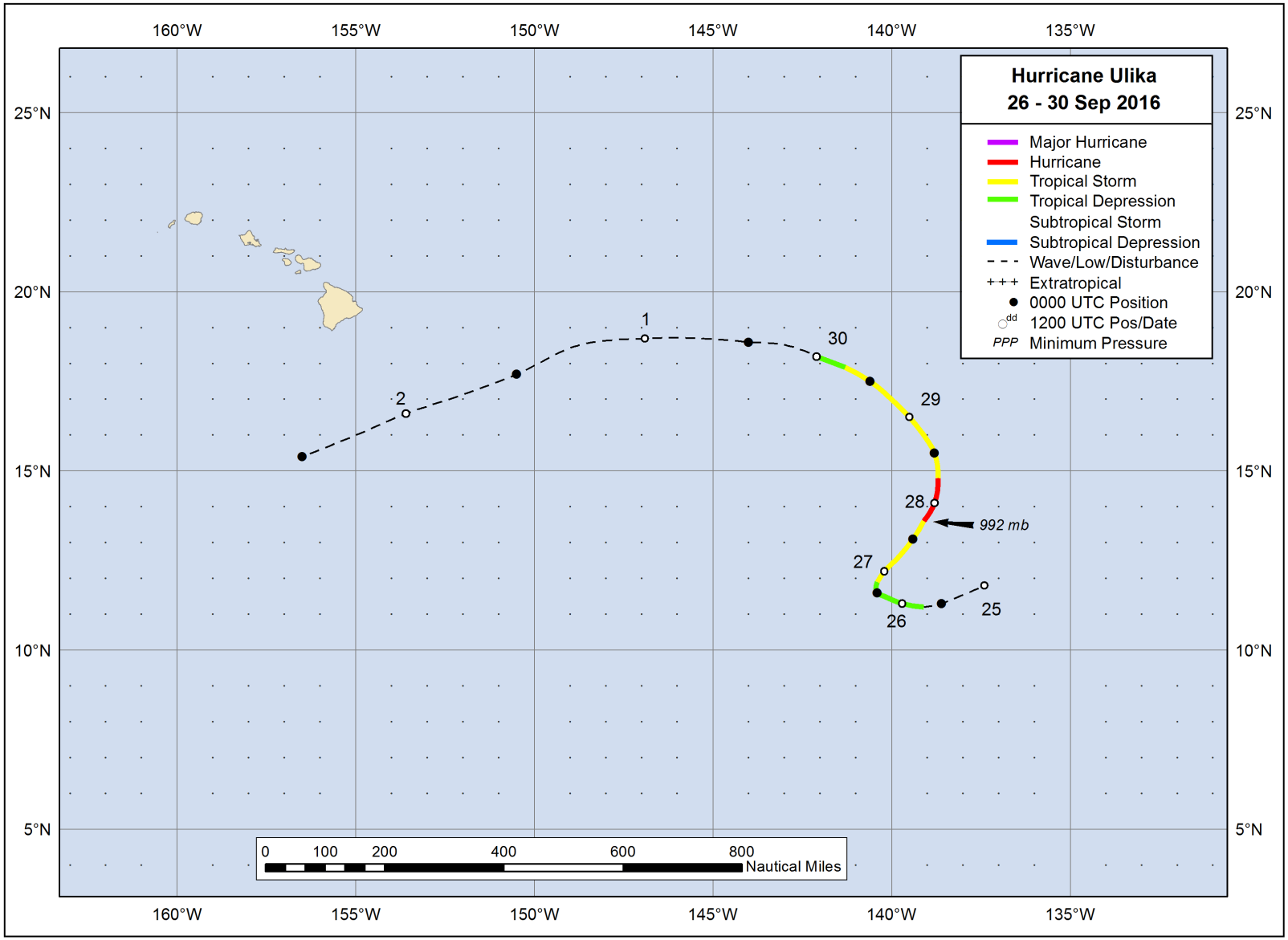

Figure 1. Best track positions for Hurricane Ulika, 26 – 30 September 2016. Track west of 140°W is based on information from the Central Pacific Hurricane Center.

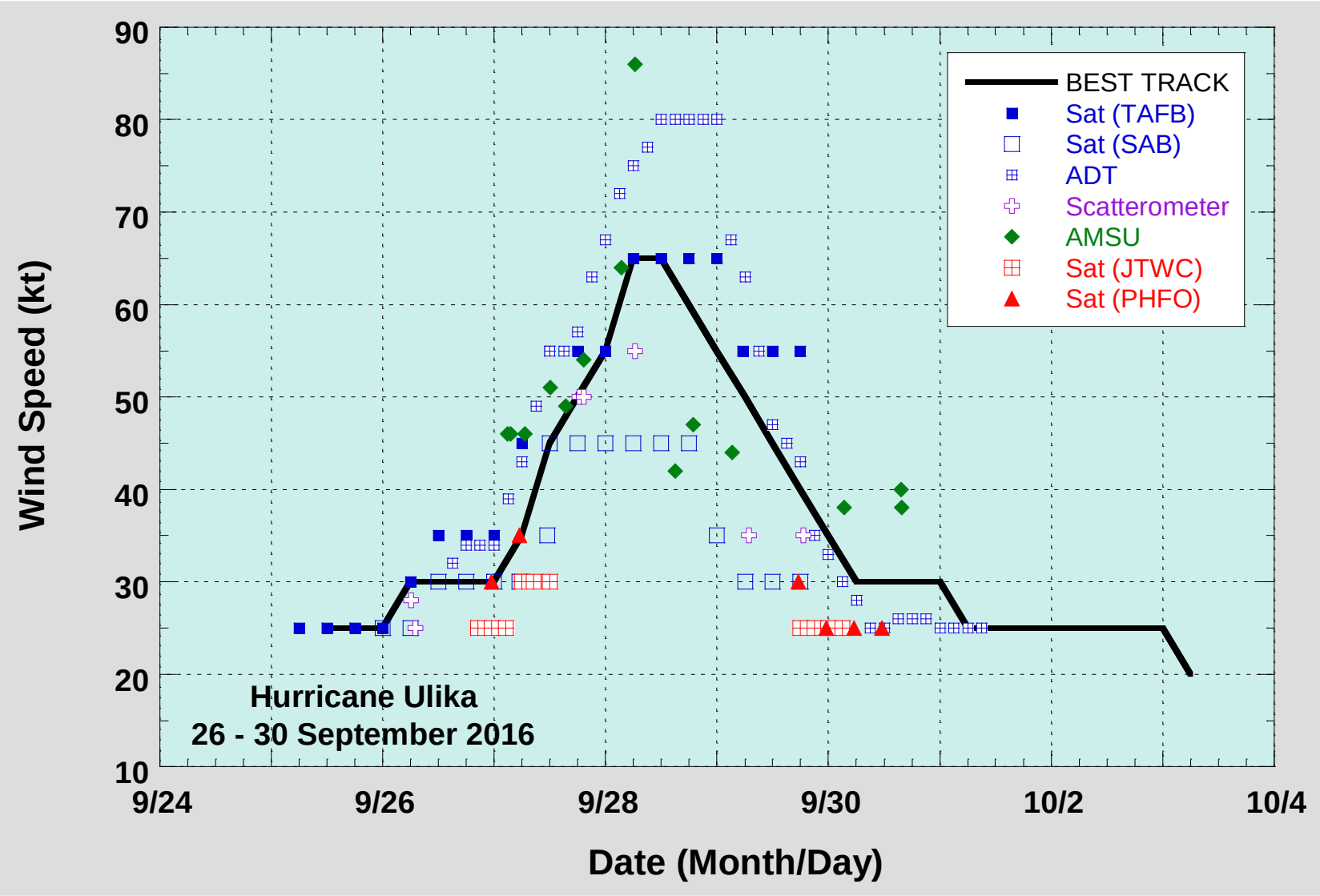

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Ulika, 26 – 30 September 2016. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Dashed vertical lines correspond to 0000 UTC.

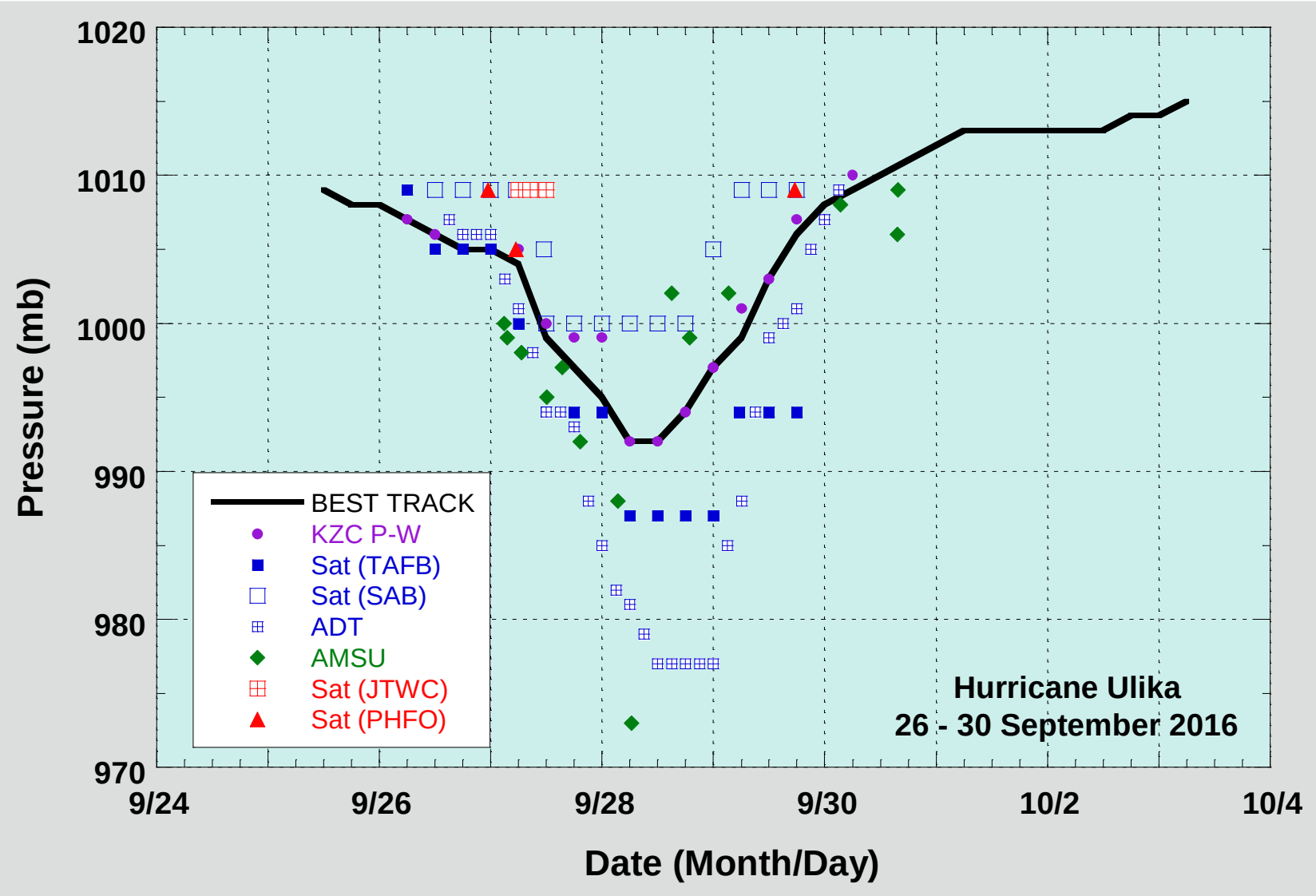

Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Ulika, 26 – 30 September 2016. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship. Dashed vertical lines correspond to 0000 UTC.