



# NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT<sup>1</sup>

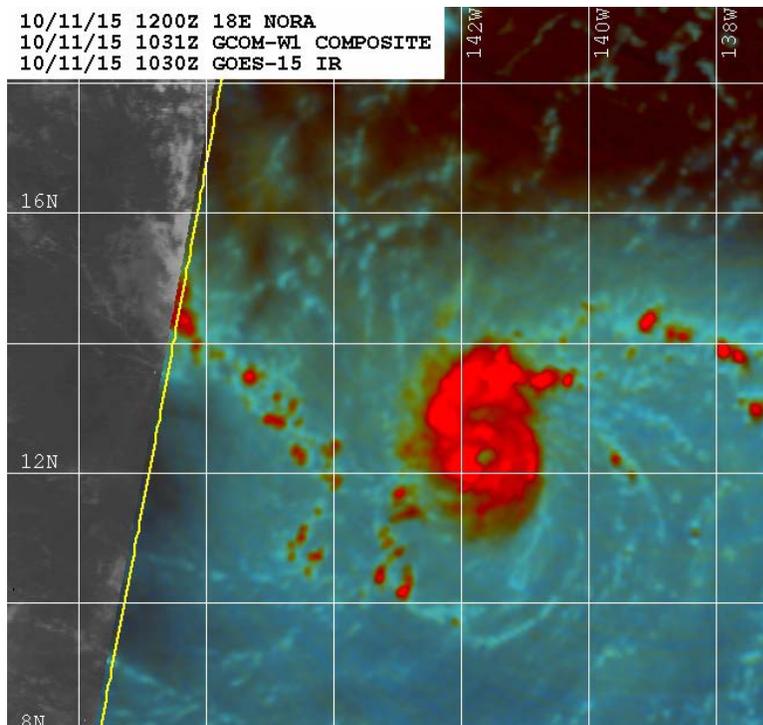
## TROPICAL STORM NORA (EP182015)

9 – 15 October 2015

Lixion Avila  
National Hurricane Center

Jeff Powell  
Central Pacific Hurricane  
Center

26 July 2016



GCOM-W1 SATELLITE IMAGE AT 1031 UTC 11 OCTOBER SHOWING THE MID-LEVEL CENTER OF NORA WHILE IT WAS MOVING ACROSS THE CENTRAL PACIFIC. IMAGE COURTESY OF THE NAVAL RESEARCH LABORATORY.

Nora was a tropical storm that moved from the eastern North Pacific to the central Pacific and dissipated several hundred miles southeast of the main Hawaiian Islands.

<sup>1</sup> Original report date 8 December 2015. Updated 26 July 2016 to include information from CPHC.

# Tropical Storm Nora

9 – 15 OCTOBER 2015

## SYNOPTIC HISTORY

The tropical wave associated with the development of Tropical Storm Nora was first observed moving across the west coast of Africa on 19 September, but was barely detectable during its trek across the tropical Atlantic and the Caribbean Sea on satellite imagery. The wave crossed Central America on 3 October, and by late the next day was generating a distinct but disorganized area of convection several hundred miles south of Acapulco, Mexico. The thunderstorm activity continued to gradually increase over the next several days, but remained disorganized until 8 October, when satellite imagery indicated an increase in organization. A broad area of low pressure developed early the next day, and it is estimated that a tropical depression formed at 1200 UTC 9 October about 1600 miles east-southeast of the Hawaiian Islands. 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<sup>2</sup>.

The depression became a tropical storm at 0000 UTC 10 October while it was embedded within an environment of light shear and moving over anomalously warm waters, which resulted in some additional strengthening. Nora was located south of a subtropical ridge and continued to move toward the west and west-northwest.

Nora crossed 140°W into the central Pacific basin between 0000 and 0600 UTC 11 October at an intensity of 50 kt, and was the sixth tropical cyclone to cross over from the eastern Pacific basin in 2015, following Ela, Guillermo, Hilda, Ignacio and Jimena. Overall, Nora was the fourteenth tropical cyclone of the central North Pacific season. Nora reached a peak intensity of 60 kt at 1800 UTC 11 October (Fig. 4), and maintained that intensity for the next 12 hours, with gradual weakening occurring afterwards. Vertical wind shear was only 10 kt or less as Nora crossed 140W and deep convection was abundant around the low level center, but became increasingly sporadic when the vertical shear increased to 30 kt. Nora began weakening after 0600 UTC 12 October as it moved northwestward into a weakness in the subtropical ridge. Nora became a depression by 0600 UTC October 14, and dissipated at 0000 UTC 16 October a couple of hundred miles southeast of the Big Island of Hawaii.

## METEOROLOGICAL STATISTICS

---

<sup>2</sup> 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 *bt* directory, while previous years’ data are located in the *archive* directory.

Observations in Tropical Storm Nora (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). 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 Nora.

## CASUALTY AND DAMAGE STATISTICS

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

## FORECAST AND WARNING CRITIQUE

Although a low possibility of Nora's five-day potential genesis was first indicated in the Tropical Weather Outlook 108 h before it occurred, the 48-h high probability of genesis was introduced only 6 h before the cyclone formed. All of the genesis forecast lead times are given in Table 2.

A verification of NHC official track forecasts for Nora is given in Table 3a. Official forecast track errors were much greater than the mean official errors beyond 48 h due to the erroneous prediction of Nora's recurvature ahead of a mid-latitude trough. The aforementioned trough bypassed the cyclone, and Nora continued west-northwestward instead (Fig.5).

A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. Many of the models had lower errors than the official forecast primarily beyond 72 h. However, these model errors were much higher than average, likely reflecting that Nora's interaction with the mid-latitude trough represented an unusually difficult forecast scenario.

A verification of NHC official intensity forecasts for Nora is given in Table 4a. Official forecast intensity errors were lower than the mean official errors for the previous 5-yr period during the first 36 hours, and increased significantly after that time. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. In general, both model and NHC intensity forecast errors were quite large.

A verification of CPHC official track forecasts for Nora is given in Table 5a. CPHC track errors for this system were smaller than the previous five-year averages at 12, 24, 36, 48 and 96 h, but larger than the average at 72 h. The track for Nora was too short for a 120-h comparison. In general, the European Global Model and NWS Global Ensemble Forecast System forecasts were better than CPHC while the Canadian and Beta Advection models were worse.



A verification of CPHC official intensity forecasts for Nora is given in Table 5b. CPHC intensity errors for this system were smaller than the previous five-year averages at all times. In general, the ICON and IVCN consensus aids performed better than CPHC, while the regional dynamical models were worse. HWRF also performed quite well beyond the 12-h period.

No watches or warning were issued in association with tropical storm Nora, and no tropical storm force winds were recorded across the Aloha State.



Table 1. Best track for Tropical Storm Nora, 9-15 October, 2015.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
09 / 0600	10.6	130.2	1009	25	low
09 / 1200	10.8	131.6	1008	30	tropical depression
09 / 1800	10.9	133.0	1008	30	"
10 / 0000	11.1	134.5	1006	35	tropical storm
10 / 0600	11.2	135.8	1006	35	"
10 / 1200	11.3	137.0	1004	40	"
10 / 1800	11.5	138.2	1002	45	"
11 / 0000	11.6	139.4	1002	45	"
11 / 0600	11.9	140.8	1000	50	"
11 / 1200	12.1	141.8	998	55	"
11 / 1800	12.2	142.7	993	60	"
12 / 0000	12.3	143.5	993	60	"
12 / 0600	12.4	144.3	993	60	"
12 / 1200	12.5	145.2	996	55	"
12 / 1800	12.7	146.2	999	50	"
13 / 0000	13.1	147.2	1001	45	"
13 / 0600	13.5	147.9	1002	40	"
13 / 1200	13.9	148.5	1002	40	"
13 / 1800	14.3	149.2	1004	40	"
14 / 0000	14.7	149.9	1004	35	"
14 / 0600	14.8	150.4	1004	30	tropical depression
14 / 1200	14.8	150.8	1004	30	"
14 / 1800	15.0	151.0	1004	25	"
15 / 0000	15.3	151.3	1005	25	"
15 / 0600	15.9	151.7	1006	25	"
15 / 1200	16.4	152.2	1008	25	"
15 / 1800	16.6	152.7	1010	25	low
16 / 0000					dissipated
11 / 1800	12.2	142.7	993	60	Maximum winds 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%)	66	108
Medium (40%-60%)	48	66
High (>60%)	6	48

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Nora. 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	28.6	<b>35.2</b>	<b>41.9</b>	67.5	153.0	290.2	485.3
OCD5	29.9	42.5	53.1	68.0	83.1	110.3	161.5
Forecasts	7	7	7	7	7	7	5
OFCL (2010-14)	23.4	36.4	47.2	59.4	89.0	123.6	159.5
OCD5 (2010-14)	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 Tropical Storm Nora during the time the cyclone was in the eastern North Pacific basin. 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	25.5	33.8	43.7	72.3	170.5	313.8	514.0
OCD5	32.5	46.1	56.2	<b>69.2</b>	<b>83.0</b>	<b>125.6</b>	<b>188.1</b>
GFSI	25.9	37.4	<b>41.1</b>	<b>69.0</b>	<b>165.3</b>	<b>291.5</b>	<b>503.8</b>
GHMI	26.0	<b>30.2</b>	<b>35.7</b>	<b>62.4</b>	<b>168.3</b>	379.9	685.0
HWFI	<b>21.9</b>	<b>33.6</b>	<b>42.2</b>	<b>62.0</b>	<b>147.3</b>	<b>231.8</b>	<b>402.7</b>
EMXI	34.0	34.5	<b>41.0</b>	<b>62.6</b>	<b>118.9</b>	<b>231.2</b>	<b>299.1</b>
CMCI	50.2	73.3	93.3	124.3	184.7	334.1	582.9
NVGI	30.7	40.9	56.8	77.2	<b>123.6</b>	<b>247.3</b>	<b>387.4</b>
GFNI	<b>24.5</b>	<b>31.9</b>	<b>31.9</b>	<b>45.6</b>	<b>93.3</b>	<b>275.9</b>	<b>510.3</b>
AEMI	<b>23.8</b>	41.1	58.7	81.6	<b>149.5</b>	<b>257.9</b>	<b>468.8</b>
FSSE	26.7	35.2	46.3	72.3	<b>167.1</b>	<b>299.2</b>	<b>468.0</b>
TVCE	26.1	34.1	45.7	75.1	182.1	328.4	525.9
BAMS	40.1	78.7	115.9	146.4	177.2	<b>195.8</b>	<b>290.9</b>
BAMM	26.7	36.8	<b>40.1</b>	<b>50.4</b>	<b>97.8</b>	<b>217.0</b>	<b>388.8</b>
BAMD	28.7	43.9	56.8	91.9	201.7	484.7	830.1
Forecasts	5	5	5	5	5	5	3



Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Tropical Storm Nora. 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	<b>0.7</b>	<b>3.6</b>	<b>3.6</b>	<b>9.3</b>	28.6	33.6	37.0
OCD5	2.4	3.7	4.6	9.4	14.6	21.6	28.0
Forecasts	7	7	7	7	7	7	5
OFCL (2010-14)	5.9	9.8	12.5	14.0	15.5	16.3	14.9
OCD5 (2010-14)	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 Tropical Storm Nora during the time the cyclone was in the eastern North Pacific basin. 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	1.0	4.0	2.0	10.0	27.0	30.0	31.7
OCD5	2.6	4.4	5.6	<b>9.0</b>	<b>18.4</b>	<b>24.6</b>	<b>28.3</b>
DSHP	2.8	7.0	6.2	<b>5.6</b>	<b>16.2</b>	<b>21.4</b>	<b>24.7</b>
LGEM	3.0	5.0	4.4	<b>5.6</b>	<b>20.4</b>	<b>25.8</b>	<b>24.0</b>
IVCN	3.4	7.2	6.2	<b>5.8</b>	<b>19.6</b>	30.8	35.0
GHMI	4.8	6.2	<b>1.6</b>	<b>9.6</b>	30.0	58.8	70.3
GFNI	6.6	10.6	9.6	12.2	<b>15.8</b>	33.6	32.3
HWFI	5.8	12.2	16.0	13.2	<b>11.6</b>	<b>15.6</b>	<b>20.0</b>
FSSE	2.8	4.8	4.2	10.4	30.0	35.2	36.7
Forecasts	5	5	5	5	5	5	3

Table 5a. Homogeneous comparison of selected track forecast guidance models (in n mi) for Tropical Storm Nora during the time the cyclone was in the Central Pacific basin. 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 (CPHC)	32.7	42.6	56.1	81.9	200.0	239.7	-
OCD5	42.8	75.1	91.5	107.7	<b>163.2</b>	268.9	-
GFSI	<b>29.1</b>	<b>41.5</b>	56.6	<b>75.2</b>	<b>164.6</b>	<b>200.1</b>	-
GHMI	<b>31.5</b>	50.9	77.6	110.2	275.7	405.1	-
HWFI	<b>24.9</b>	<b>36.8</b>	<b>49.8</b>	<b>62.9</b>	<b>144.1</b>	<b>135.4</b>	-
EMXI	<b>24.2</b>	<b>24.8</b>	<b>36.5</b>	<b>62.7</b>	<b>165.9</b>	<b>222.3</b>	-
CMCI	<b>26.8</b>	44.7	71.7	119.8	267.5	350.7	-
TVCE	<b>26.0</b>	<b>34.9</b>	<b>55.7</b>	85.9	209.2	266.5	-
AEMI	<b>24.2</b>	<b>28.1</b>	<b>36.6</b>	<b>54.0</b>	<b>139.5</b>	<b>164.4</b>	-
BAMS	<b>31.7</b>	52.5	59.5	<b>70.7</b>	<b>82.7</b>	<b>59.3</b>	-
BAMM	35.9	55.6	70.9	86.0	228.9	<b>226.5</b>	-
BAMD	100.1	196.2	293.4	395.7	647.2	804.8	-
Forecasts	16	14	12	10	6	2	0

Table 5b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Tropical Storm Nora during the time the cyclone was in the Central Pacific basin. 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 (CPHC)	3.8	6.1	8.8	12.5	21.7	20.0	-
OCD5	3.9	7.9	12.8	15.7	26.5	27.0	-
HWFI	4.9	<b>4.4</b>	<b>5.3</b>	<b>6.1</b>	<b>11.7</b>	<b>15.5</b>	-
GHMI	4.4	6.2	9.4	13.3	28.5	40.0	-
DSHP	4.3	7.8	10.4	<b>11.3</b>	<b>12.0</b>	<b>11.5</b>	-
LGEM	4.2	6.8	<b>6.6</b>	<b>8.7</b>	<b>11.8</b>	<b>16.5</b>	-
ICON	<b>2.9</b>	<b>4.3</b>	<b>4.9</b>	<b>11.0</b>	<b>16.4</b>	21.0	-
IVCN	<b>2.9</b>	<b>4.0</b>	<b>4.7</b>	<b>8.2</b>	<b>14.8</b>	21.0	-
Forecasts	16	14	12	10	6	2	0

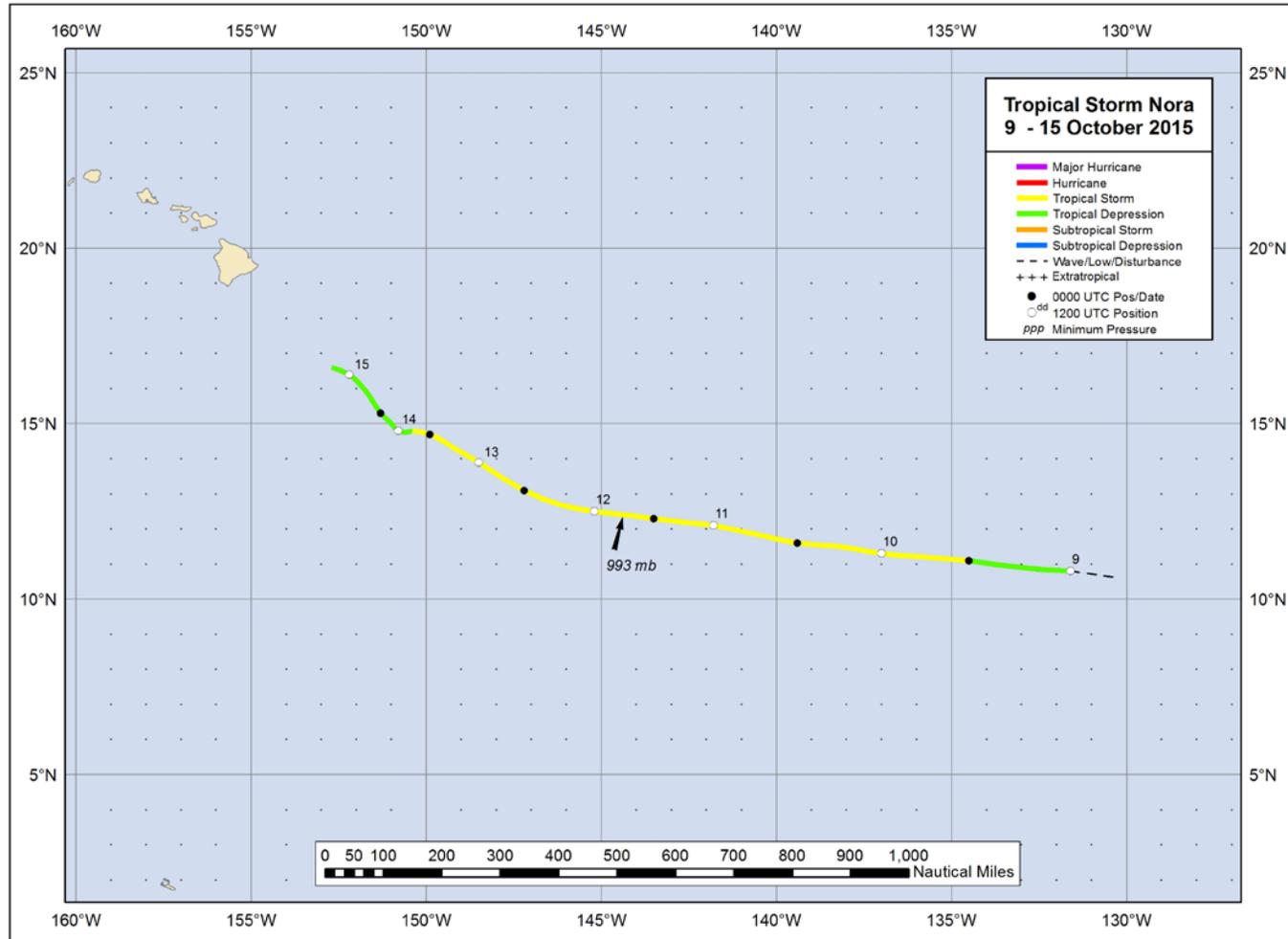


Figure 1. Best track positions for Tropical Storm Nora, 9-15 October 2015.



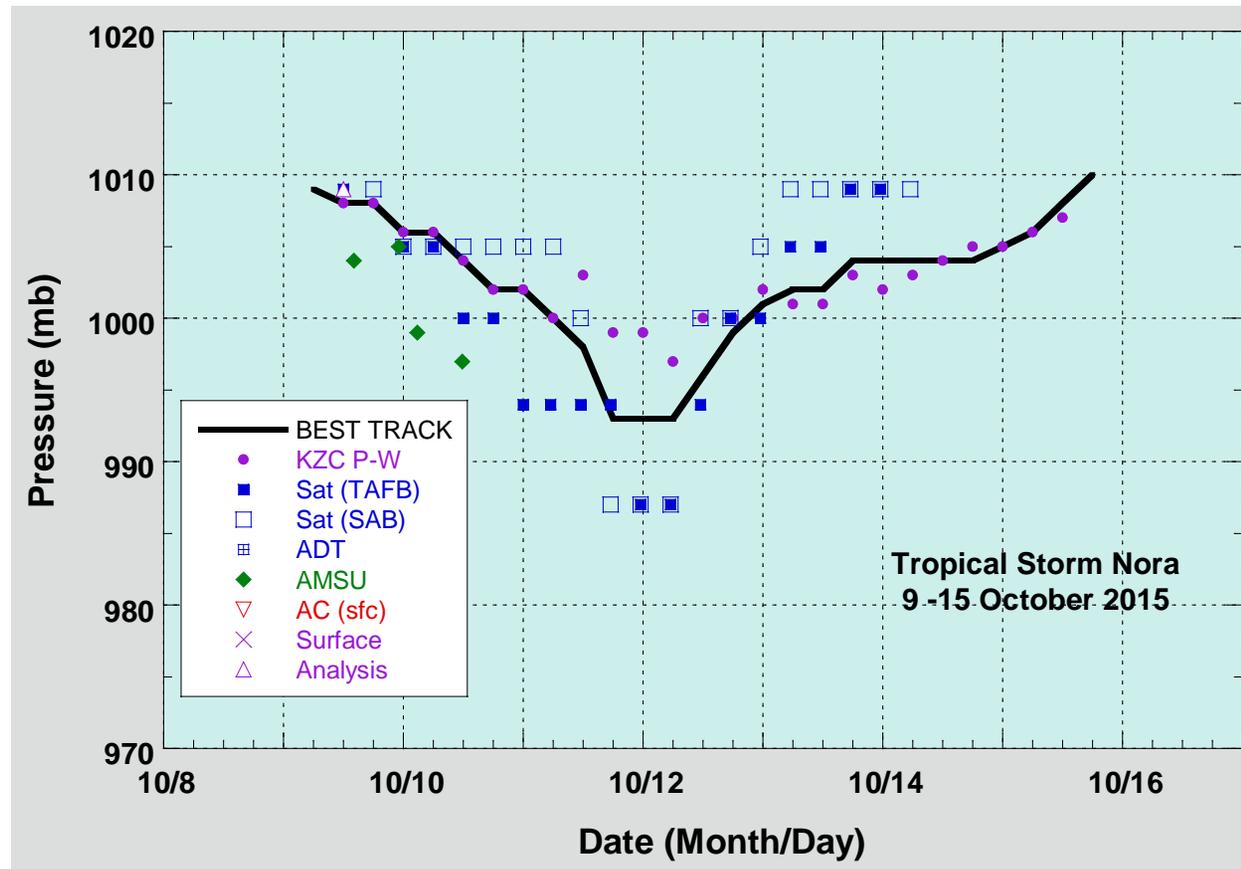


Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Nora, 9-15 October, 2015. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship.

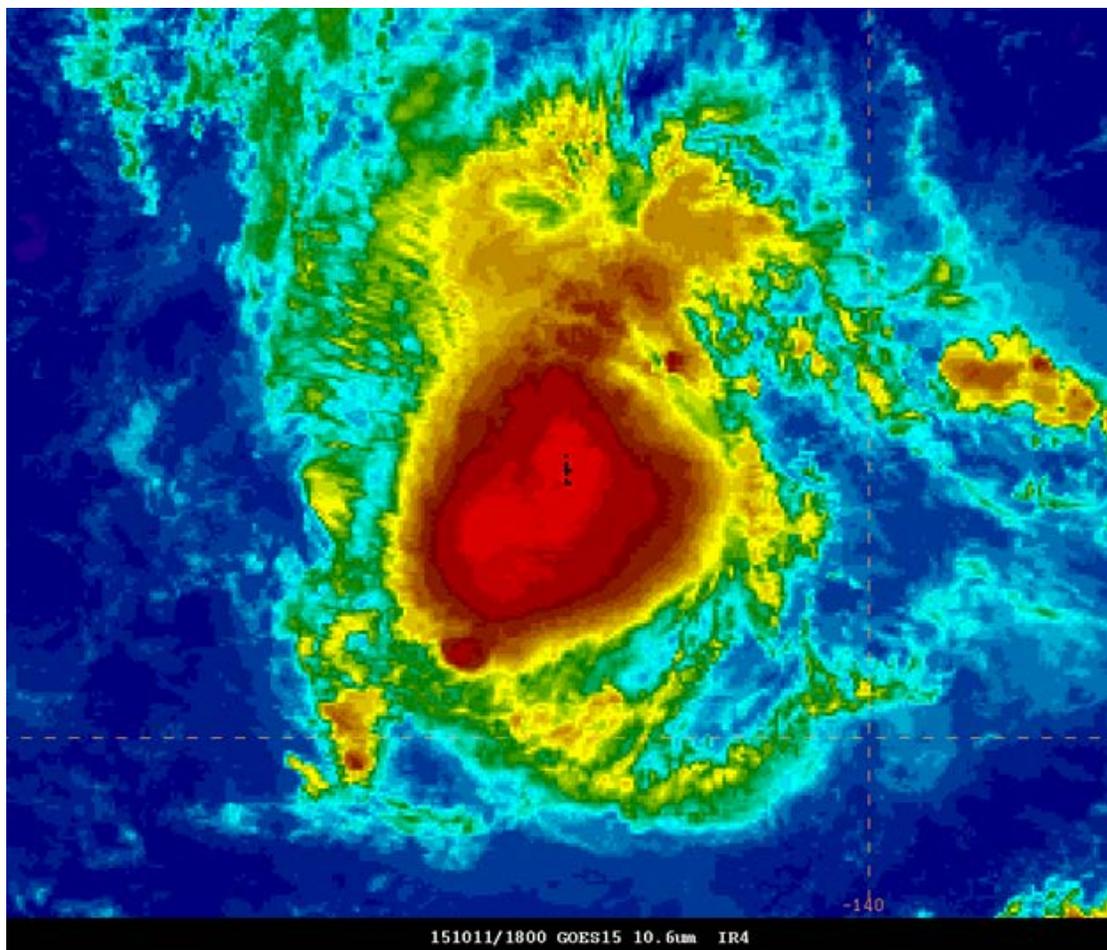


Figure 4. GOES-15 enhanced infrared image of Tropical Storm Nora at 1800 UTC 11 October 2015.

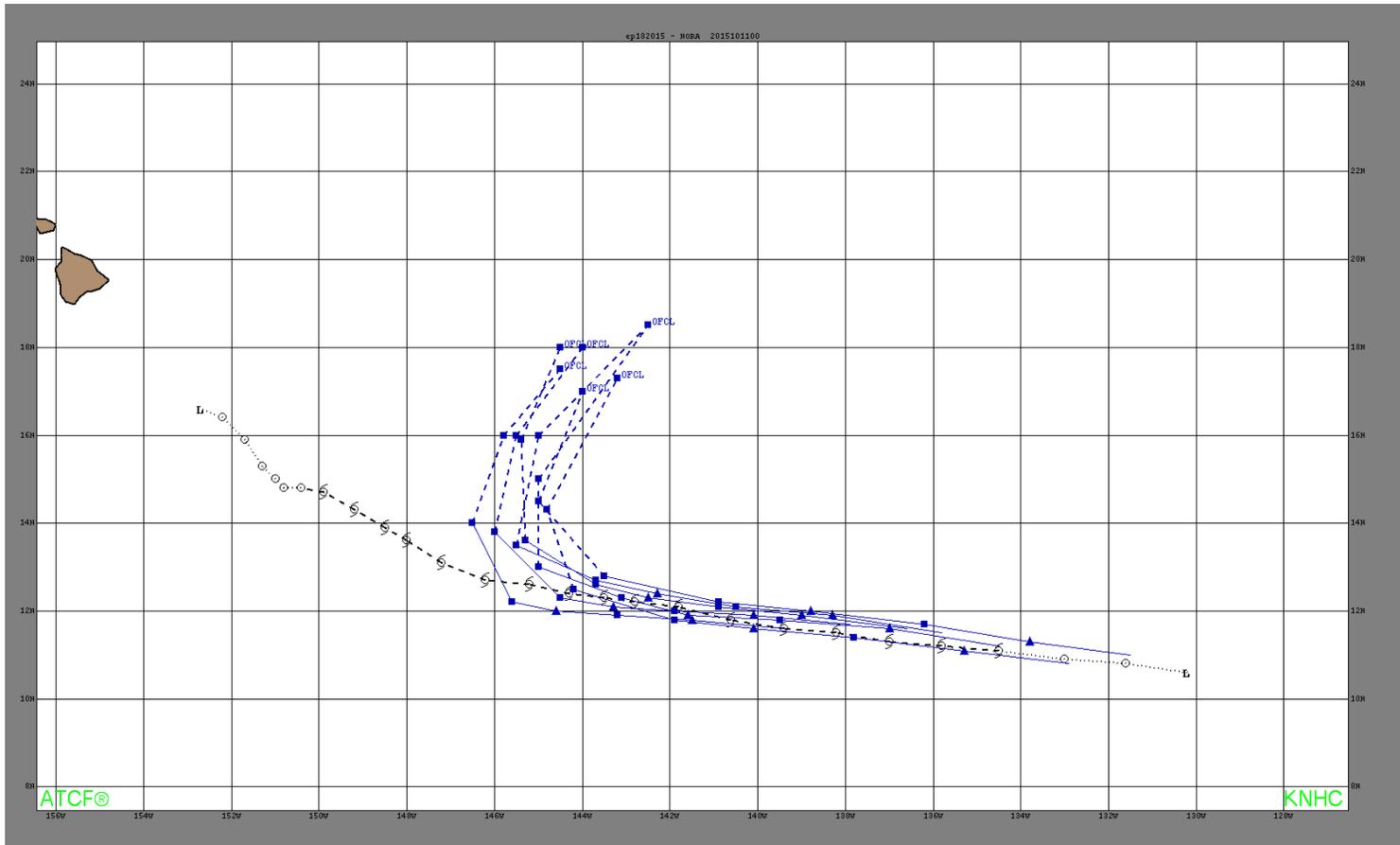


Figure 5. Official NHC forecasts (OFCL) for Nora (blue lines) from 1200 UTC 9 October through 0000 UTC 11 October. Best track is marked in black.