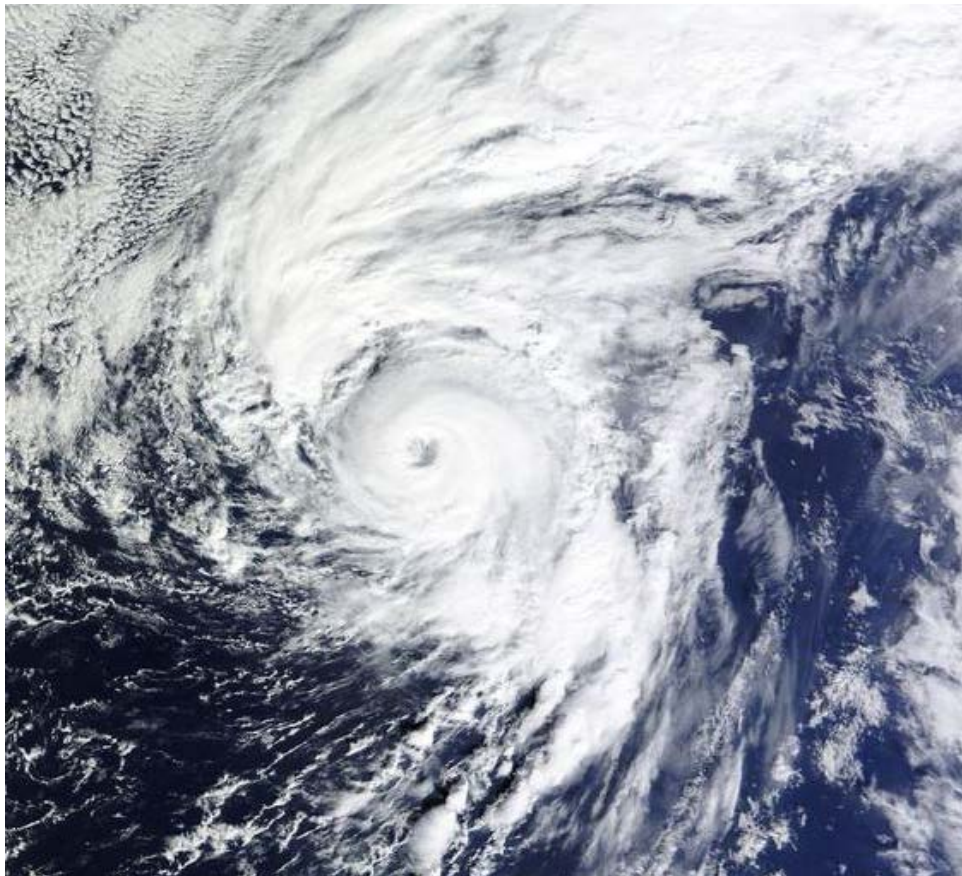# NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

HURRICANE ALEX

(AL012016)

12 – 15 January 2016

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National Hurricane Center
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NASA-MODIS VISIBLE IMAGE OF ALEX AT 1530 UTC 14 JANUARY 2016.

Alex was a very unusual January hurricane in the northeastern Atlantic Ocean, making landfall on the island of Terceira in the Azores as a 55-kt tropical storm.

Hurricane Alex

12 – 15 JANUARY 2016

SYNOPTIC HISTORY

The precursor disturbance to Alex was first noted over northwestern Cuba on 6 January as a weak low along a stationary front. A strong mid-latitude shortwave trough caused the disturbance to intensify into a well-defined frontal wave near the northwestern Bahamas by 0000 UTC 7 January. The extratropical low then moved northeastward, passing about 75 n mi north of Bermuda late on 8 January.   Steered under an anomalous blocking pattern over the east-central Atlantic Ocean, the system turned east-southeastward by 10 January, and strengthened to a hurricane-force extratropical low. The change in track caused the system to move over warmer (and anomalously warm) waters, and moderate convection near the center on that day helped initiate the system's transition to a tropical cyclone.

The low began to weaken as it lost its associated fronts, diving to the south-southeast late on 11 January around a mid-latitude trough over the eastern Atlantic. Significant changes were noted the next day, with the large area of gale-force winds shrinking and becoming more symmetric about the cyclone's center. Convection also increased near the low, and by 1800 UTC 12 January, frontal boundaries appeared to no longer be associated with the cyclone. It is estimated that a subtropical storm formed around 1800 UTC that day about 1000 n mi west-southwest of the Canary Islands - the subtropical designation being based on the system's weak warm core and its collocation with an upper-level low. The "best track" chart of Alex'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].

Alex moved east-northeastward, and little change in strength occurred over the next day. Convection increased substantially late on 13 January, however, and a small central dense overcast with an eye-like feature became evident while Alex moved northeastward. Despite sea-surface temperatures of about 22°C, rapidly cooling upper-level temperatures along the storm's path and weakening shear likely triggered the cyclone to quickly strengthen. The increase in deep convection caused the warm core to deepen while Alex moved farther from the upper-level low, and Alex shed its subtropical characteristics late that night. By 0600 UTC 14 January, Alex became a hurricane, and 6 h later, it reached a peak intensity of 75 kt while located about 400 n mi south-southwest of the Azores. The hurricane started to weaken late that day as it moved across 18°C waters, with a significant decrease in central convection noted. Alex also turned to the north while it weakened since it was becoming steered by a large mid-latitude trough approaching from the west. The cyclone continued to lose strength while it approached the Azores, and Alex made landfall on the island of Terceira at 1315 UTC 15 January with maximum

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[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.

sustained winds of 55 kt. At the time of landfall, however, the inner wind maximum was weakening, with an outer wind maximum forming along an incipient warm front to the east. Thus, the strongest winds were well east of the landfall location. The system was in the process of a quick extratropical transition with decreasing central convection, and by 1800 UTC that day, Alex became extratropical. The extratropical cyclone moved rapidly toward the north-northwest and eventually to the west, becoming absorbed within a larger extratropical low over the far north Atlantic just after 0000 UTC 17 January.

METEOROLOGICAL STATISTICS

Observations in Alex (Figs. 2 and 3) include subjective satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB) and the Satellite Analysis Branch (SAB), and objective Advanced Dvorak Technique (ADT) estimates from the Cooperative Institute for Meteorological Satellite Studies/University of Wisconsin-Madison. 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 Alex.

The estimated 75-kt peak intensity of Alex is based on Dvorak satellite intensity estimates from TAFB and SAB.

Ship reports of winds of tropical storm force associated with Alex are given in Table 2.

Selected surface observations are given in Table 3. A peak wind gust of 50 kt was recorded in Ponta Delgada on Sao Miguel Island. Given the large wind field, other islands in the central and eastern Azores likely experienced sustained tropical-storm-force winds, although few reports are available.

Alex is the first hurricane to form in the Atlantic basin in January since 1938, and the first hurricane to be ongoing in January since Alice in 1955.

The increase to hurricane-force winds shown on the last best track point for Alex should not be interpreted as an overall strengthening of the cyclone. Rather, the area of maximum winds on the northwest side had reached the Greenland high terrain, which created stronger winds in that area. The NHC track follows the Ocean Prediction Center's analysis that the post-tropical cyclone was then absorbed by a larger extratropical low.

CASUALTY AND DAMAGE STATISTICS

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

FORECAST AND WARNING CRITIQUE

Special outlooks on this out-of-season system were issued about every 24 h, and the genesis forecasts for Alex correctly anticipated the possibility of this unusual January cyclone. NHC first issued a special Tropical Weather Outlook (TWO) with a low (< 40%) probability of 5-day formation roughly 5 days before genesis. Probabilities were raised to a medium (40 – 60%) chance of 5-day genesis three days later. One day before formation, the system was given a 40% chance of formation during the next 2 days. However, the system never entered the high category prior to genesis. Global models also provided some useful guidance that a strong cyclone would form, although none of them indicated the development of a tropical cyclone.

A verification of NHC official track forecasts for Alex is given in Table 4a. Official forecast track errors were near 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 4b. Guidance and NHC track errors were fairly low given the unusual nature of Alex, although there were too few cases to provide a meaningful intercomparison of the models.

A verification of NHC official intensity forecasts for Alex is given in Table 5a. Official forecast intensity errors were higher than the mean official errors for the previous 5-yr period through 24 h, and then lower at 36 h. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 5b. None of the models anticipated Alex's forming into a hurricane (or even intensifying significantly, see Figure 4), and thus the models and the NHC intensity forecast had rather large 12- and 24-h errors.

A tropical storm warning was issued for the eastern Azores, and a hurricane warning was issued for the central Azores at 1500 UTC 14 January. These warnings were discontinued 24 h later.

Table 1.   Best track for Hurricane Alex, 12-15 January 2016.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
07 / 0000	26.6	75.3	1010	40	extratropical
07 / 0600	27.6	74.7	1003	45	"
07 / 1200	28.7	73.8	997	50	"
07 / 1800	30.0	72.5	987	55	"
08 / 0000	31.4	70.6	986	55	"
08 / 0600	32.4	68.8	986	55	"
08 / 1200	33.0	67.1	991	45	"
08 / 1800	33.5	65.0	991	45	"
09 / 0000	34.0	62.9	991	45	"
09 / 0600	34.5	60.5	991	50	"
09 / 1200	35.0	58.3	989	55	"
09 / 1800	35.1	56.1	985	60	"
10 / 0000	34.4	54.2	981	65	"
10 / 0600	33.7	52.7	981	65	"
10 / 1200	32.9	51.2	979	65	"
10 / 1800	32.1	49.1	980	60	"
11 / 0000	31.6	46.5	980	55	"
11 / 0600	31.6	44.6	980	55	"
11 / 1200	31.3	43.4	980	55	"
11 / 1800	30.0	42.5	982	50	"
12 / 0000	28.4	41.7	985	50	"
12 / 0600	26.3	40.2	988	50	"
12 / 1200	25.0	38.0	988	50	"
12 / 1800	25.1	35.9	988	50	subtropical storm
13 / 0000	25.4	34.7	988	50	"
13 / 0600	25.6	33.6	989	45	"
13 / 1200	26.0	32.5	989	45	"
13 / 1800	26.7	31.4	990	45	"

14 / 0000	27.9	30.4	988	55	"
14 / 0600	29.3	29.6	985	65	hurricane
14 / 1200	30.8	28.7	981	75	"
14 / 1800	32.5	28.0	981	75	"
15 / 0000	33.9	27.6	984	70	"
15 / 0600	35.4	27.2	986	65	"
15 / 1200	38.0	27.0	986	55	tropical storm
15 / 1315	38.7	27.1	986	55	"
15 / 1800	41.5	27.7	986	55	extratropical
16 / 0000	45.1	28.9	984	55	"
16 / 0600	48.9	30.2	982	55	"
16 / 1200	53.0	32.0	980	55	"
16 / 1800	56.0	37.0	979	55	"
17 / 0000	57.0	42.0	978	70	"
17 / 0600					absorbed
14 / 1200	30.8	28.7	981	75	minimum pressure and maximum wind
15 / 1315	38.7	27.1	986	55	Landfall on Terceira Island, Azores

Table 2.   Selected ship reports with winds of at least 34 kt during the subtropical and tropical stages of Hurricane Alex, 12-15 January 2016.

Date/Time (UTC)	Ship/Buoy call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
13 / 0600	2FGX5	24.0	27.2	160 / 38	1019.1
13 / 2000	9HA295	28.9	25.7	100 / 35	1009.4
14 / 0000	9HA295	28.4	26.7	160 / 46	1007.1
14 / 0800	9HA295	27.6	28.5	220 / 38	1003.6
14 / 1800	BATFR1	36.4	26.2	090 / 35	1011.3
14 / 1900	BATFR1	36.6	26.1	100 / 36	1011.1
14 / 2100	BATFR1	36.9	25.8	100 / 36	1011.4
14 / 2200	BATFR1	37.0	25.7	090 / 36	1011.8
14 / 2300	BATFR1	37.2	25.5	090 / 39	1011.2
14 / 2300	ZCEF3	37.3	27.6	070 / 38	1012.9
15 / 0000	BATFR1	37.3	25.4	100 / 36	1011.3
15 / 0100	ZCEF3	37.2	28.6	060 / 35	1013.3
15 / 0100	BATFR1	37.4	25.3	100 / 37	1010.2
15 / 0300	BATFR1	37.7	25.0	100 / 39	1009.4
15 / 0400	BATFR1	37.8	24.9	110 / 42	1008.6
15 / 0500	BATFR1	37.8	24.8	100 / 43	1008.1
15 / 0600	9HA356	37.0	21.2	130 / 35	1016.3
15 / 0600	BATFR1	37.9	24.6	110 / 44	1007.3
15 / 1000	BATFR1	38.3	24.1	120 / 37	1007.2
15 / 1100	BATFR1	38.4	24.0	120 / 38	1006.3
15 / 1200	BATFR1	38.4	23.9	120 / 39	1007.8
15 / 1300	BATFR1	38.5	23.8	130 / 44	1007.6
15 / 1400	BATFR1	38.5	23.6	140 / 44	1007.5
15 / 1500	BATFR1	38.5	23.5	140 / 40	1007.2

Table 3.   Selected surface observations for Hurricane Alex, 12 -15 January 2016.

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)	Storm tide (ft)	Estimated Inundation (ft)	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	10–min Sustained (kt)	Gust (kt)				
International Civil Aviation Organization (ICAO) Sites									
Azores									
LPPD- Ponta Delgada (Sao Miguel Island)			15/1130	37	50				
LPAZ- Santa Maria Airport	15/1000	1001	15/1130	36	48				
LPLA- Lajes Field (Terceira Island)	15/1339	988							

[a] Date/time is for sustained wind when both sustained and gust are listed.

Table 4a.   NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track
forecast errors (n mi) for Alex. 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	30.8	**44.2**	70.3				
OCD5	53.2	121.6	259.1				
Forecasts	6	4	2				
OFCL (2011-15)	28.4	45.0	60.4				
OCD5 (2011-15)	48.3	101.5	161.5				

Table 4b.   Homogeneous comparison of selected track forecast guidance models (in n mi) for Alex. 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	33.7	37.9	70.3				
OCD5	58.7	145.0	259.1				
GFSI	40.9	42.7	75.3				
GHMI	**30.7**	**31.1**	**64.3**				
HWFI	47.1	75.5	**35.4**				
EMXI	**26.7**	**35.8**	84.9				
CMCI	41.7	62.7	128.5				
AEMI	37.7	41.8	**63.5**				
TVCN	35.3	**36.0**	**43.7**				
LBAR	44.9	98.4	133.1				
BAMD	40.4	68.1	115.8				
BAMM	**32.5**	46.0	74.9				
BAMS	**26.8**	**23.6**	**25.1**				
Forecasts	5	3	2				

Table 5a.   NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Alex. 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	15.0	18.8	**10.0**				
OCD5	22.5	47.5	45.0				
Forecasts	6	4	2				
OFCL (2011-15)	6.2	9.4	11.5				
OCD5 (2011-15)	7.3	10.8	13.3				

Table 5b.   Homogeneous comparison of selected intensity forecast guidance models (in kt) for Alex. 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.

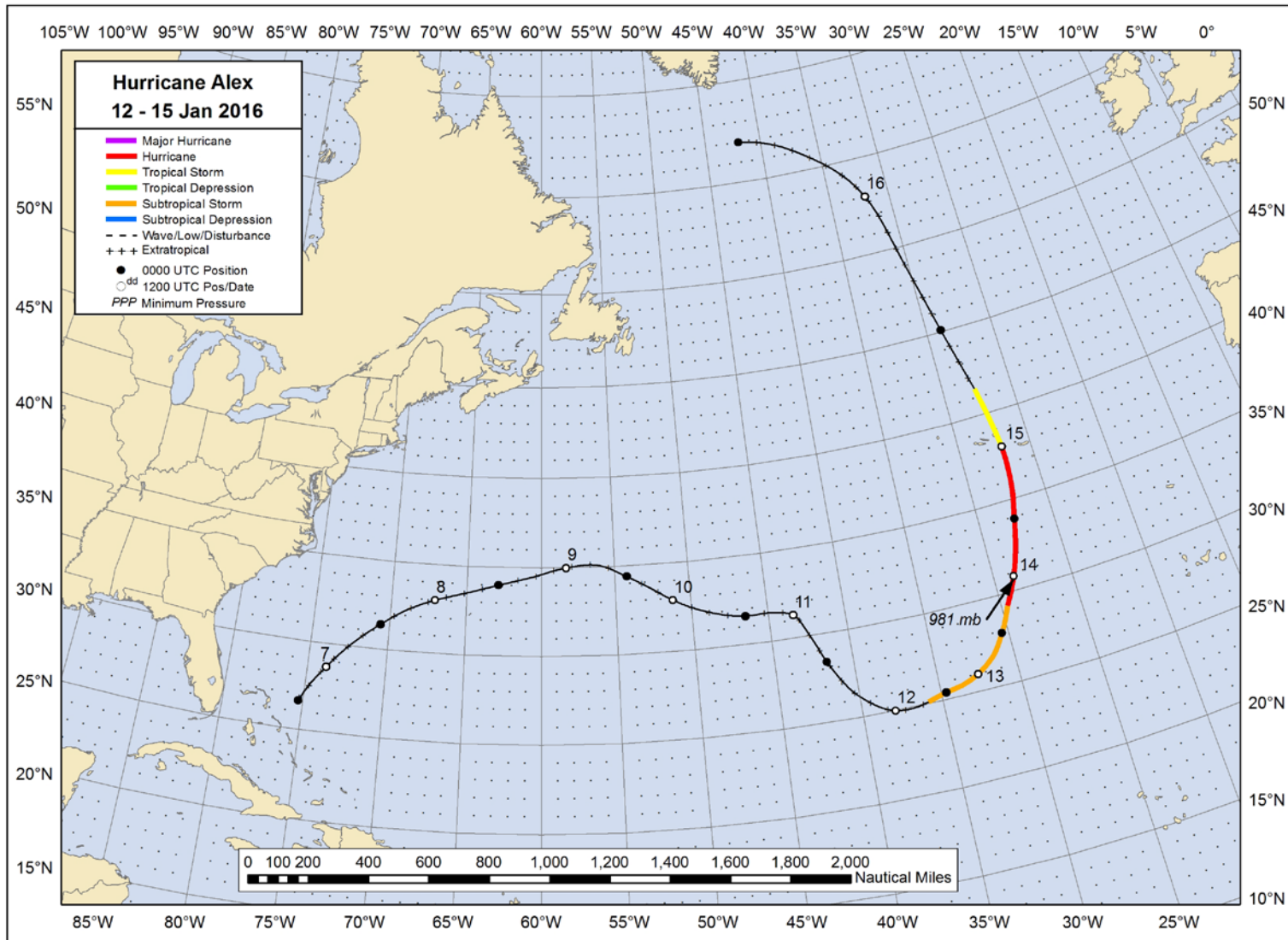| Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	16.3	25.0	10.0				
OCD5	22.8	57.5	45.0				
GHMI	**12.5**	25.0	13.0				
HWFI	**14.5**	**24.5**	**8.5**				
IVCN	**15.5**	**23.0**	**9.0**				
DSHP	19.0	**21.5**	11.0				
LGEM	17.3	**22.5**	**9.0**				
GFSI	19.3	**23.5**	10.0				
EMXI	19.5	25.0	10.5				
Forecasts	4	2	2				

Figure 1.   Best track positions for Hurricane Alex, 12-15 January 2016. Track during the extratropical stage is partially based on analyses from the Ocean Prediction Center.
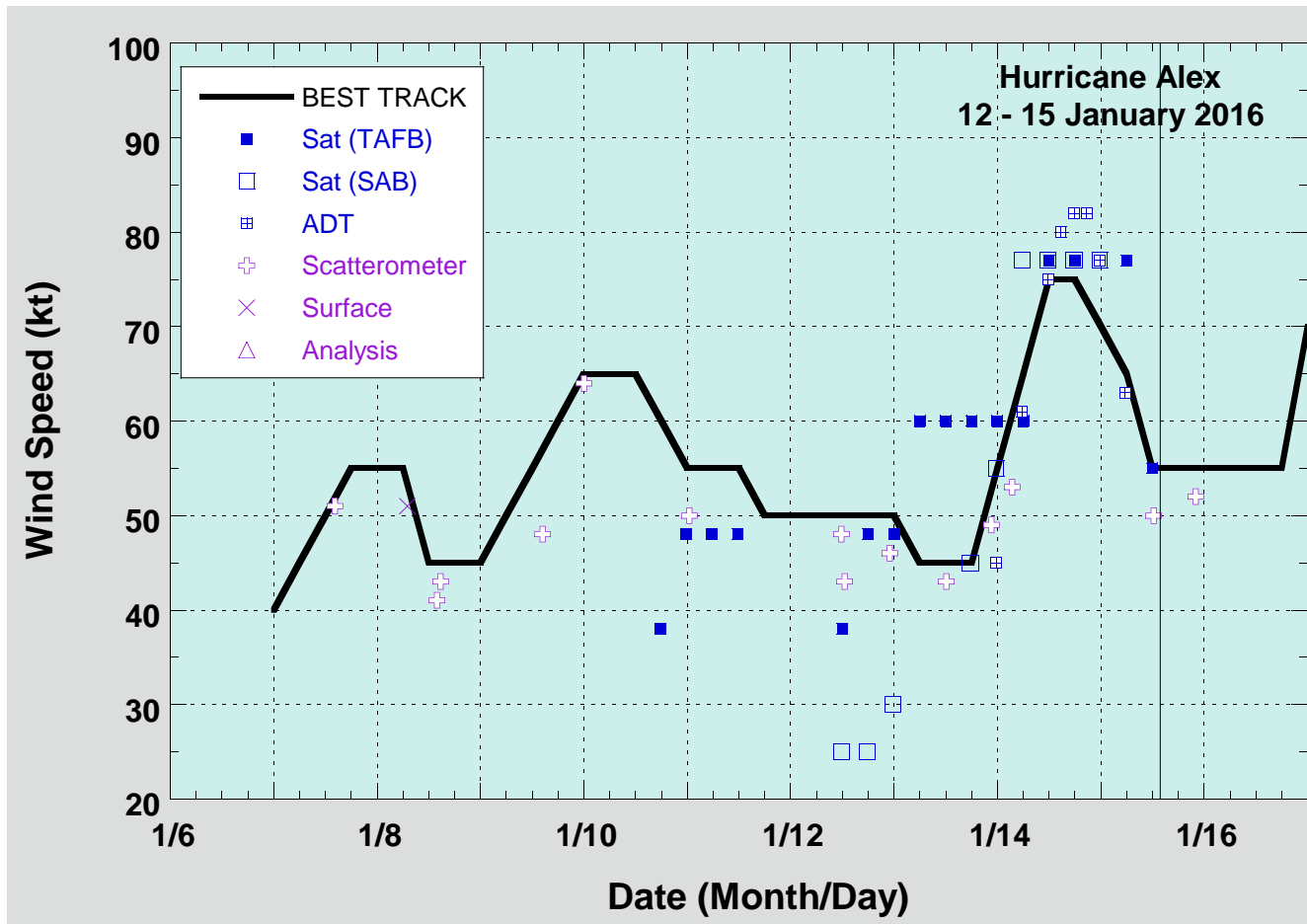
Figure 2.   Selected wind observations and best track maximum sustained surface wind speed curve for Alex.   Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. Dashed lines refer to 0000 UTC, and the solid line denotes landfall.
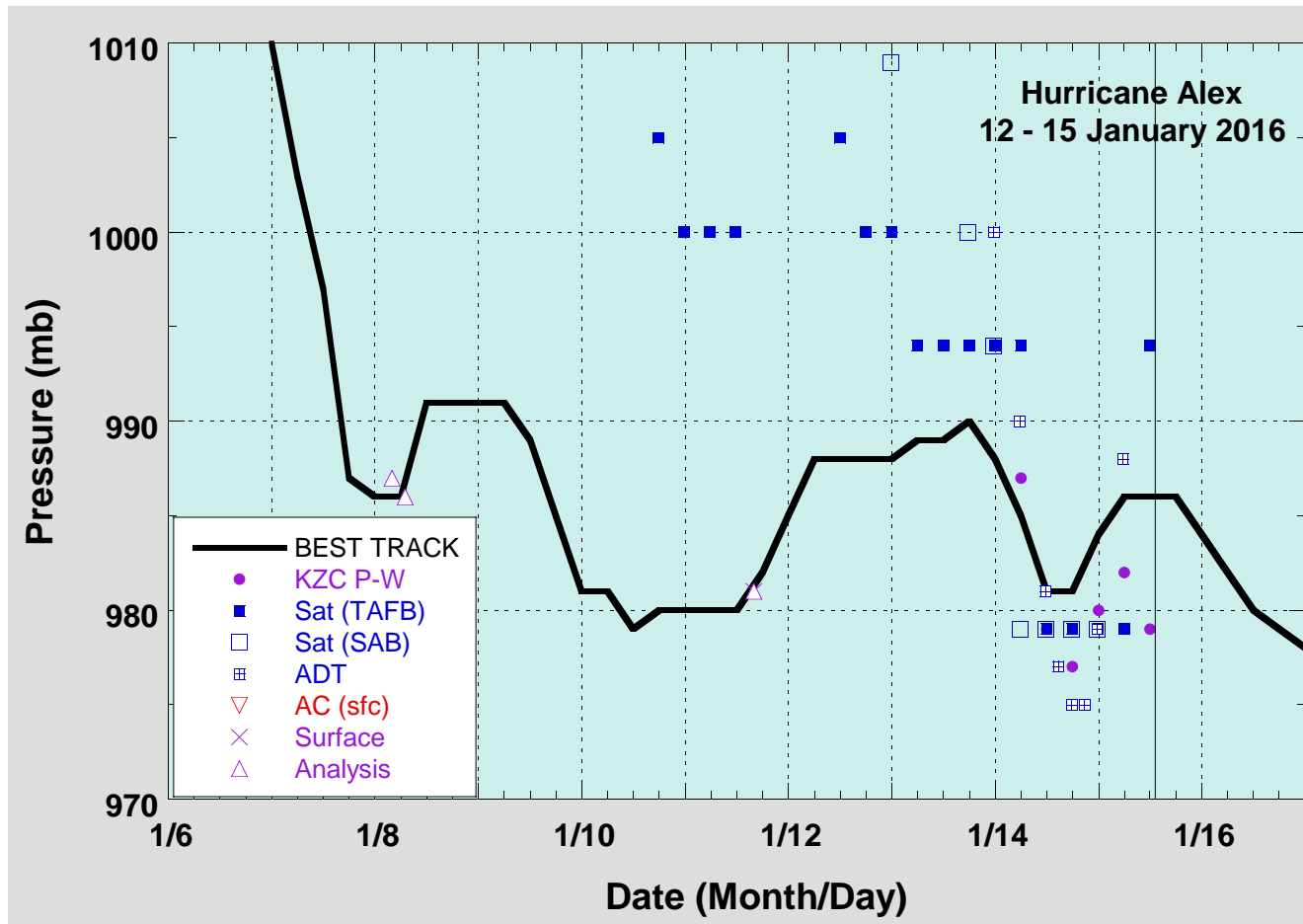
Figure 3.   Selected pressure observations and best track minimum central pressure curve for Alex. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship. Dashed lines refer to 0000 UTC, and the solid line denotes landfall.
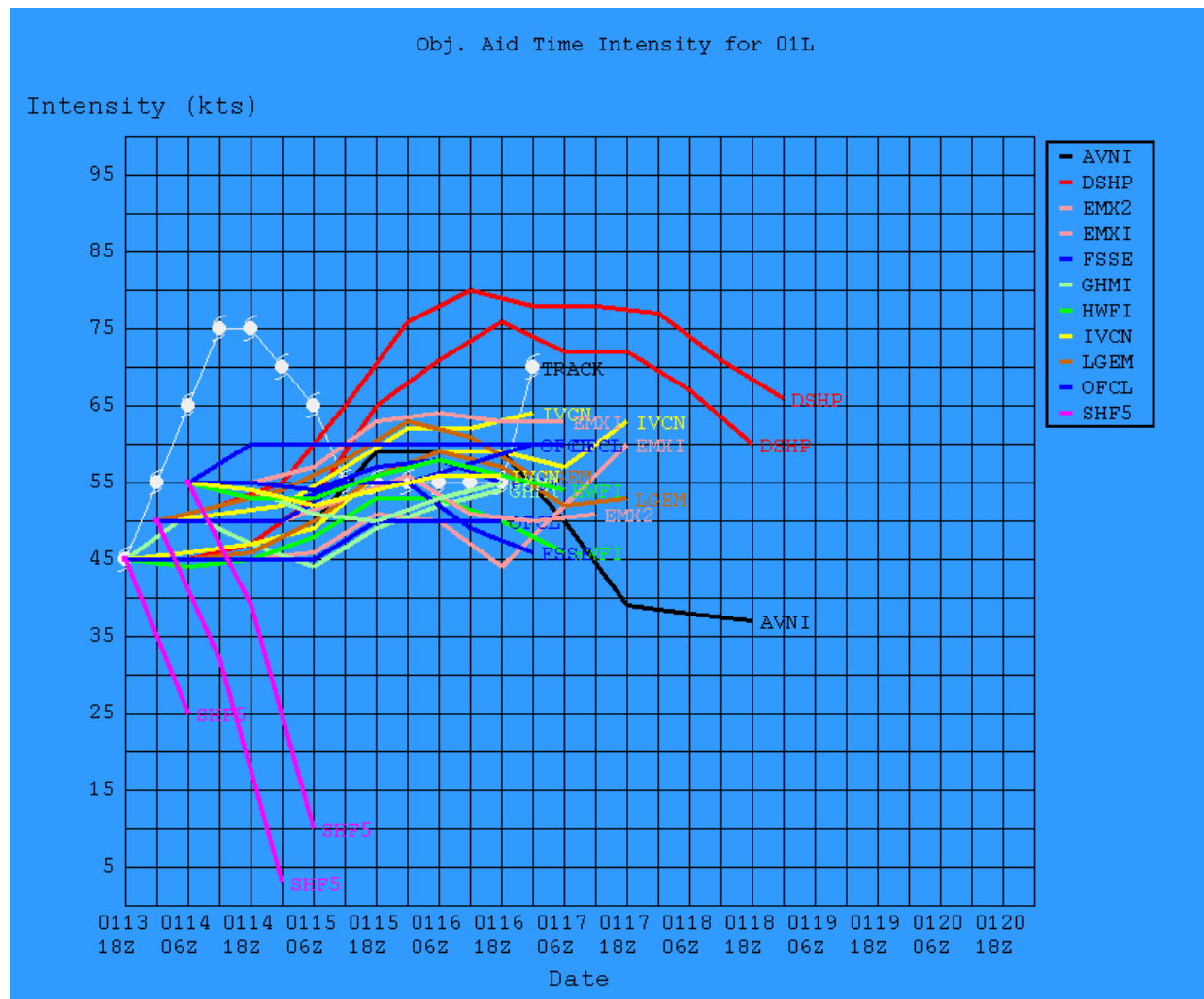
Figure 4.   Guidance and NHC intensity forecasts (colored lines) and verifying intensities (tropical cyclone symbols) for selected models during the first 3 operational forecasts of Alex (1800 UTC 13 January to 0600 UTC 14 January).