



NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

HURRICANE FABIO (EP072018)

30 June–6 July 2018

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MODIS SATELLITE IMAGE OF HURRICANE FABIO NEAR ITS PEAK INTENSITY ON 3 JULY 2018.
IMAGE COURTESY OF NASA MODIS LAND RAPID RESPONSE TEAM

Fabio was a category 2 hurricane (on the Saffir-Simpson Hurricane Wind Scale) that formed a few hundred miles off the southwestern coast of Mexico and remained offshore.

Hurricane Fabio

30 JUNE–6 JULY 2018

SYNOPTIC HISTORY

Fabio formed from a tropical wave that departed the west coast of Africa on 16 June. The wave transited the tropical Atlantic and Caribbean over the next week or so with minimal shower and thunderstorm activity. After crossing Central America late on 26 June deep convection began to increase in association with the wave when it moved over the far eastern North Pacific Ocean. The wave continued westward during the next couple of days, passing south of the Gulf of Tehuantepec early on 28 June. Later that day, the wave spawned a broad low pressure area several hundred n mi south-southeast of Acapulco, Mexico. Convection continued to increase and became better organized in association with the broad low during the next day or so, and by 1800 UTC 30 June the circulation became better defined, resulting in the formation of a tropical depression centered about 500 n mi south of Manzanillo, Mexico. 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 1¹.

After genesis, the cyclone moved west-northwestward around the southwestern portion of a mid-level ridge that was located over central Mexico, and the depression gradually strengthened and became a tropical storm 12 h later. The cyclone was situated within a favorable environment consisting of warm water, low vertical wind shear, and a moist atmosphere. As a result, the large tropical cyclone continued to steadily strengthen over the next couple of days, attaining hurricane status by 1200 UTC 2 July. While moving west-northwestward to northwestward Fabio reached its estimated peak intensity of 95 kt (cover photo) by 1800 UTC 3 July when it was located about 560 n mi southwest of the southern tip of the Baja California peninsula. Fabio maintained its peak intensity for about 12 h, then began moving over cooler SSTs which induced weakening. The hurricane moved over even colder waters shortly thereafter, and a period of rapid weakening began around 0600 UTC 4 July. Fabio weakened to a tropical storm by 0600 UTC 5 July, while it was located about 800 n mi west-southwest of the southern tip of the Baja California peninsula. Later that day, deep convection decreased in coverage as the storm moved into a more stable environment and the system degenerated into a post-tropical cyclone with 35-kt winds by 0600 UTC 6 July. The cyclone continued to slowly weaken while it moved west-northwestward over the next 72 h, and dissipation occurred by 1200 UTC 9 July, when the system was approaching the central North Pacific basin, about 1600 n mi west-northwest of the southern tip of the Baja California peninsula.

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.

METEOROLOGICAL STATISTICS

Observations in Fabio (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 and Satellite Consensus (SATCON) 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 Fabio.

Fabio's estimated peak intensity of 95 kt at 1800 UTC 3 July is based on a blend of subjective Dvorak T-numbers of 5.0 (90 kt) from SAB and TAFB, and ADT estimates that peaked at T6.0 (115 kt) between about 1800 UTC 3 July and 0200 UTC 4 July. Given the large spread between the objective and subjective estimates there is more uncertainty than normal regarding Fabio's estimated peak intensity. Since the eye was somewhat ragged in both microwave and infrared imagery (Figs. 4 and 5) and there were no consecutive images on 3 July in which the subjective Dvorak T-numbers would have been indisputably higher (Fig. 5), more weight was given to the lower subjective estimates and the real-time operational assessment of 95 kt. The CIMSS SATCON intensity estimates use objective ADT T-numbers as input, which caused those estimates to also be above the subjective Dvorak T-numbers.

There were no ship reports of tropical storm force winds in association with Fabio.

CASUALTY AND DAMAGE STATISTICS

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

FORECAST AND WARNING CRITIQUE

The genesis of Fabio was extremely well forecast (Table 2). The potential for tropical cyclone formation was first introduced into the Tropical Weather Outlook with a low chance of formation 6 days before development occurred. The 5-day chance of genesis was raised to the medium category (40–60%) at 0000 UTC 25 June, still more than 5 days before formation, and to the high category (> 60%) exactly 5 days (120 h) before development occurred. In fact, the system was given a 90% chance or greater of formation beginning 4.5 days before genesis. Fabio's development was also predicted well in the short range (48 h) as it was assigned a

medium chance of formation 66 h before development, and a high chance of formation 30 h before genesis. Confidence in Fabio's development was very high since the global models were in good agreement in developing a large and intense tropical cyclone off the coast of Mexico more than 7 days in advance.

A verification of NHC official track forecasts for Fabio is given in Table 3a. Official forecast track errors were comparable to the mean official errors for the previous 5-yr period through 48 h, but were much lower than the long-term average at 72 h through 120 h. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. Among the individual track models, the GFSI and EMXI slightly outperformed the official forecast through 36 h and 48 h, respectively. Several of the consensus models also had slightly lower mean track errors than the official forecasts through 36 h, with the GFEX (consensus of the GFS and ECMWF) exhibiting lower errors than the official forecast through 72 h.

A verification of NHC official intensity forecasts for Fabio is given in Table 4a. Official forecast intensity errors were comparable to the mean official errors for the previous 5-yr period. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. The intensity consensus models (ICON and IVCN) were the best performing models for Fabio, outperforming the NHC forecasts at 24 h and beyond. The HWRF (HWFI) and HMON (HMNI) hurricane models were among the best intensity guidance at 72 and 96 h. The SHIPS and LGEM models exhibited a significant high bias for Fabio, and both predicted rapid intensification to occur at various 24-h intervals within the first couple of days of the forecast period beginning at 0600 UTC 1 July. The SHIPS model had the highest intensity errors for Fabio, due in part to a new rapid intensification predictor (separate from the SHIPS Rapid Intensification Index) that was triggered and led to the over-prediction of Fabio's rate of strengthening and peak intensity. For example, the SHIPS model at 1200 and 1800 UTC 1 July predicted peak intensities of 137 kt and 146 kt, respectively. The over-prediction of the SHIPS and LGEM models also influenced the forecasts of the FSSE and HCCA models, which exhibited a high bias around that time. Since Fabio's low-level structure improved during the morning of 1 July, and the tropical cyclone was expected to remain within a favorable environment of low vertical wind shear, warm waters (28–29°C), and a moist atmosphere, the official forecast also indicated rapid strengthening, but it was not as aggressive as the statistical guidance or the FSSE and HCCA models (Fig. 6). Although Fabio steadily strengthened from just after genesis until it reached its peak intensity on 3 July, the rate of intensification never qualified as rapid (30 kt in 24 h). As a result, the NHC intensity forecasts for Fabio also exhibited a high bias, but not as much as the aforementioned guidance. Interestingly, the HWRF model did not predict nearly enough intensification, but that model contributed to the lower ICON and IVCN consensus predictions that best captured Fabio's intensity.

There were no coastal watches or warnings issued in association with Fabio.



Table 1. Best track for Hurricane Fabio, 30 June–6 July 2018.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
30 / 1800	11.0	103.8	1006	30	tropical depression
01 / 0000	11.3	104.8	1005	30	"
01 / 0600	11.6	105.8	1002	40	tropical storm
01 / 1200	12.0	106.8	1000	45	"
01 / 1800	12.3	107.9	998	50	"
02 / 0000	12.4	108.8	996	55	"
02 / 0600	12.5	109.6	993	60	"
02 / 1200	12.9	110.4	989	65	hurricane
02 / 1800	13.5	111.3	983	70	"
03 / 0000	14.2	112.4	979	75	"
03 / 0600	14.7	113.6	973	85	"
03 / 1200	15.0	114.8	969	90	"
03 / 1800	15.5	116.0	964	95	"
04 / 0000	16.2	117.3	964	95	"
04 / 0600	16.7	118.7	968	90	"
04 / 1200	16.9	119.9	970	85	"
04 / 1800	17.4	121.0	973	80	"
05 / 0000	18.1	122.2	977	75	"
05 / 0600	19.0	123.4	988	60	tropical storm
05 / 1200	19.8	124.8	992	55	"
05 / 1800	20.4	126.2	998	45	"
06 / 0000	20.9	127.4	1003	40	"
06 / 0600	21.3	128.5	1005	35	low
06 / 1200	21.8	129.5	1006	30	"
06 / 1800	22.5	130.5	1006	30	"
07 / 0000	23.2	131.5	1006	30	"



Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
07 / 0600	23.7	132.4	1006	30	"
07 / 1200	24.2	133.4	1007	25	"
07 / 1800	24.7	134.4	1007	25	"
08 / 0000	25.2	135.2	1007	20	"
08 / 0600	25.6	136.1	1007	20	"
08 / 1200	25.9	137.1	1007	20	"
08 / 1800	26.2	138.1	1007	20	"
09 / 0000	26.4	138.7	1008	15	"
09 / 0600	26.5	139.1	1008	15	"
09 / 1200					dissipated
03 / 1800	15.5	116.0	964	95	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%)	102	144
Medium (40%-60%)	66	136
High (>60%)	30	120



Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Fabio, 30 June–6 July 2018. 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	26.5	33.3	45.8	53.2	59.2	62.9	50.4
OCD5	33.0	50.5	74.9	102.5	188.3	218.3	280.5
Forecasts	20	18	16	14	10	6	2
OFCL (2013-17)	21.8	33.2	43.0	53.9	80.7	111.1	150.5
OCD5 (2013-17)	34.9	70.7	109.1	146.1	213.8	269.0	339.7

Table 3b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Fabio, 30 June–6 July 2018. 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	27.2	35.6	43.6	49.1	54.8	67.8	
OCD5	36.3	57.4	81.1	115.3	216.1	253.7	
GFSI	25.7	33.8	42.7	49.6	44.1	72.2	
HWFI	29.6	42.6	53.0	63.2	72.4	82.0	
HMNI	29.1	45.4	58.6	68.4	80.4	99.3	
EMXI	24.1	34.7	42.9	46.2	70.4	92.2	
CMCI	28.0	37.9	46.6	51.8	63.9	98.0	
NVGI	26.4	40.0	52.4	54.9	66.1	51.1	
AEMI	26.5	36.4	44.3	53.8	42.5	53.3	
HCCA	25.8	33.9	43.1	53.0	60.0	71.8	
FSSE	25.6	34.0	41.9	50.4	60.1	76.4	
TVCX	26.2	34.8	41.2	49.1	60.4	90.2	
GFEX	24.1	32.0	37.6	43.6	51.4	77.6	
TVCA	26.5	35.4	43.4	51.4	61.7	92.1	
TVCE	26.5	36.0	44.3	53.4	63.0	91.9	
TABD	31.0	42.4	46.6	57.0	58.3	73.5	
TABM	28.3	48.0	60.0	67.2	75.8	117.3	
TABS	33.0	62.3	77.7	77.0	78.6	146.7	
Forecasts	17	15	13	11	7	4	

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Fabio, 30 June–6 July 2018. 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	5.5	9.2	10.0	10.0	14.0	16.7	15.0
OCD5	5.2	9.8	11.4	13.3	18.5	14.5	15.5
Forecasts	20	18	16	14	10	6	2
OFCL (2013-17)	5.8	9.6	11.8	13.2	15.1	15.1	14.6
OCD5 (2013-17)	7.6	12.4	15.6	17.7	19.8	20.8	19.6

Table 4b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Fabio, 30 June–6 July 2018. 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	5.3	9.3	10.8	12.3	17.1	21.2	
OCD5	5.4	10.6	12.8	14.9	13.6	13.2	
GFSI	8.6	14.9	16.0	16.4	15.9	19.5	
HWFI	5.6	9.9	11.9	15.2	12.0	8.5	
HMNI	6.1	10.0	13.7	15.6	8.9	10.8	
EMXI	7.6	14.6	19.3	22.5	15.6	8.2	
HCCA	5.5	9.0	10.8	10.7	16.9	19.2	
FSSE	5.7	9.1	10.8	12.1	20.7	30.5	
LGEM	5.2	7.5	9.7	13.1	17.3	15.8	
DSHP	6.0	13.5	20.4	28.6	37.9	39.5	
ICON	5.5	9.0	9.7	8.5	11.4	19.0	
IVCN	5.3	8.8	8.8	8.2	9.9	16.8	
Forecasts	17	15	13	11	7	4	

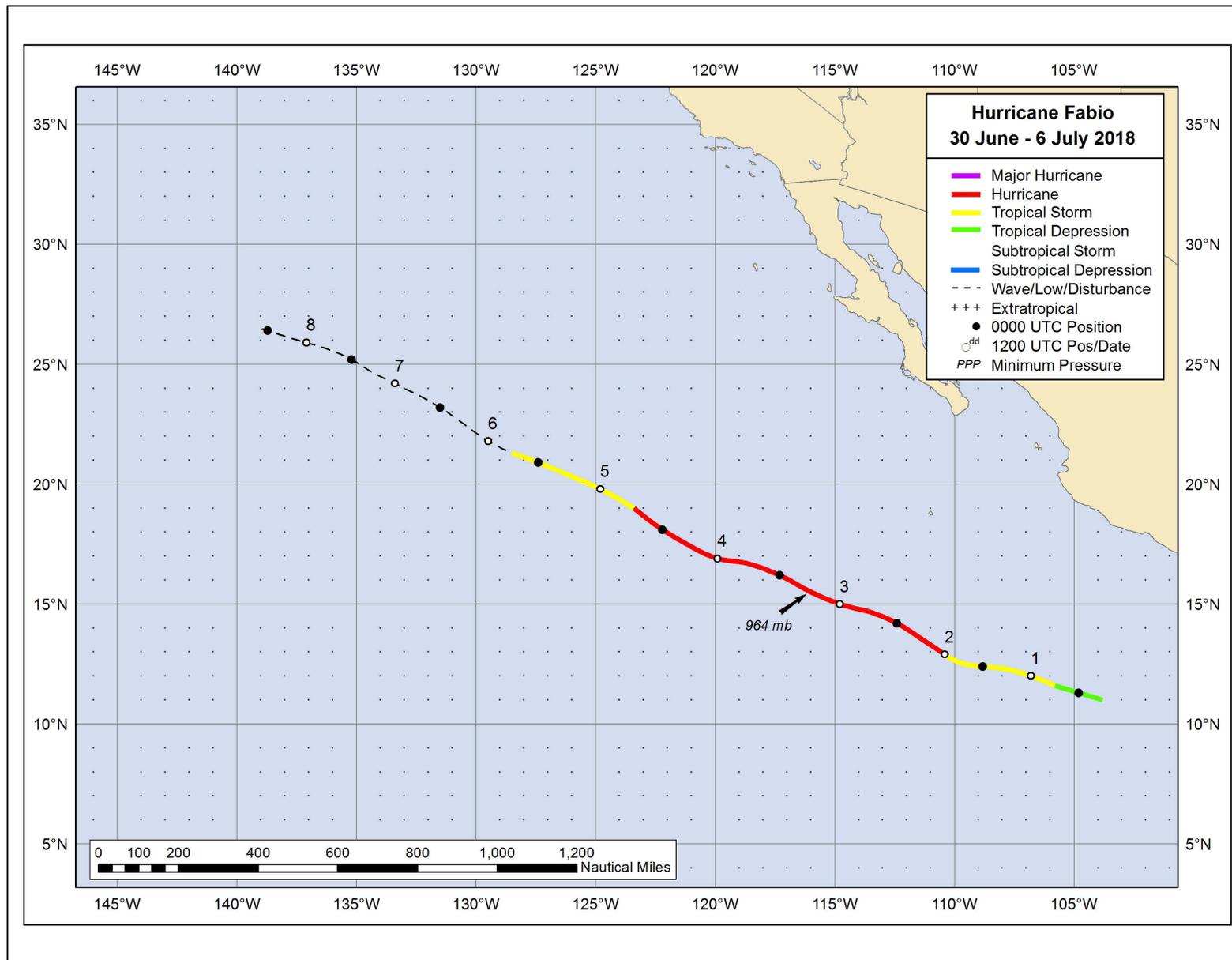


Figure 1. Best track positions for Hurricane Fabio, 30 June–6 July 2018.

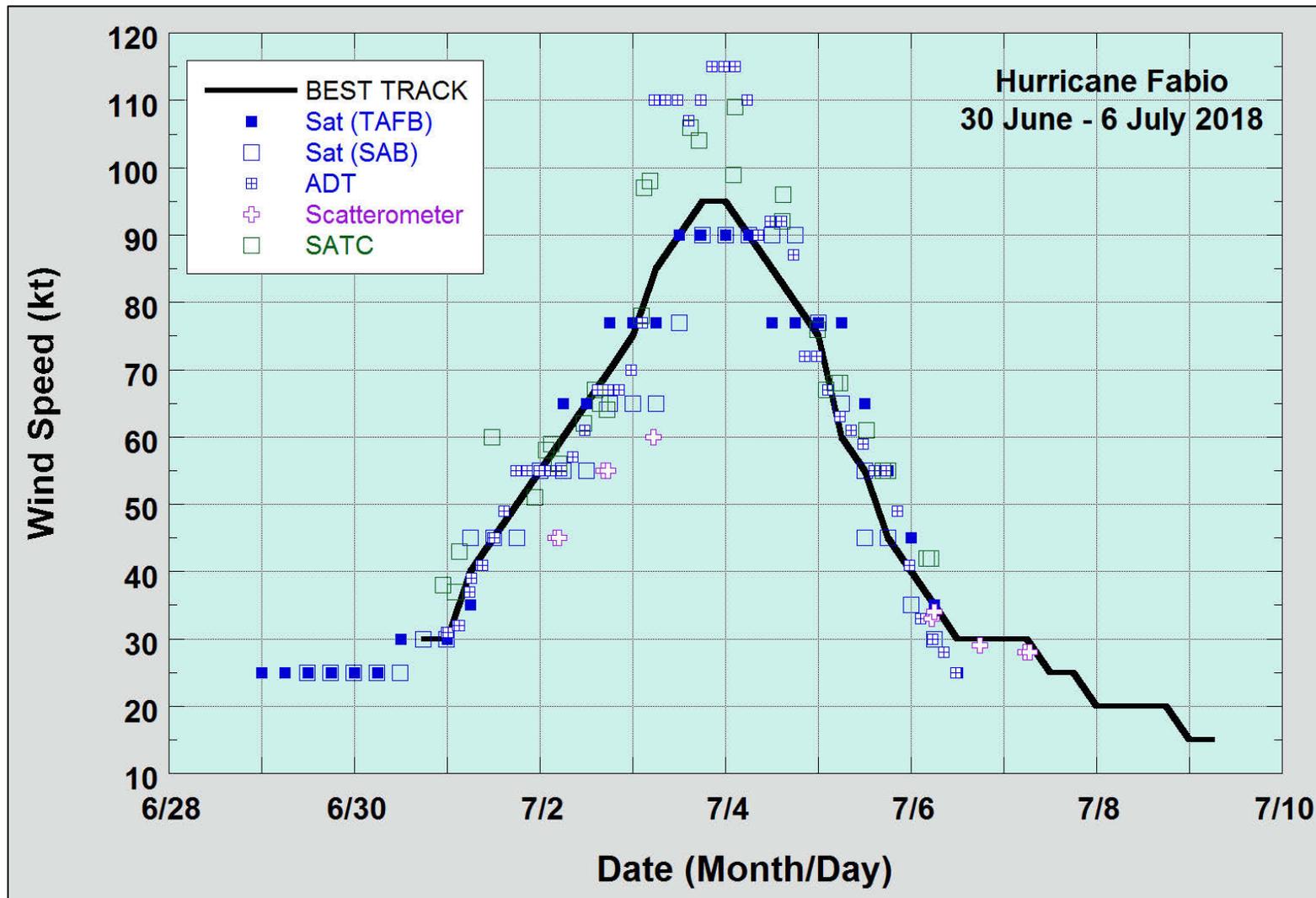


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Fabio, 30 June–6 July 2018. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON (SATC) intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. Dashed vertical lines correspond to 0000 UTC.

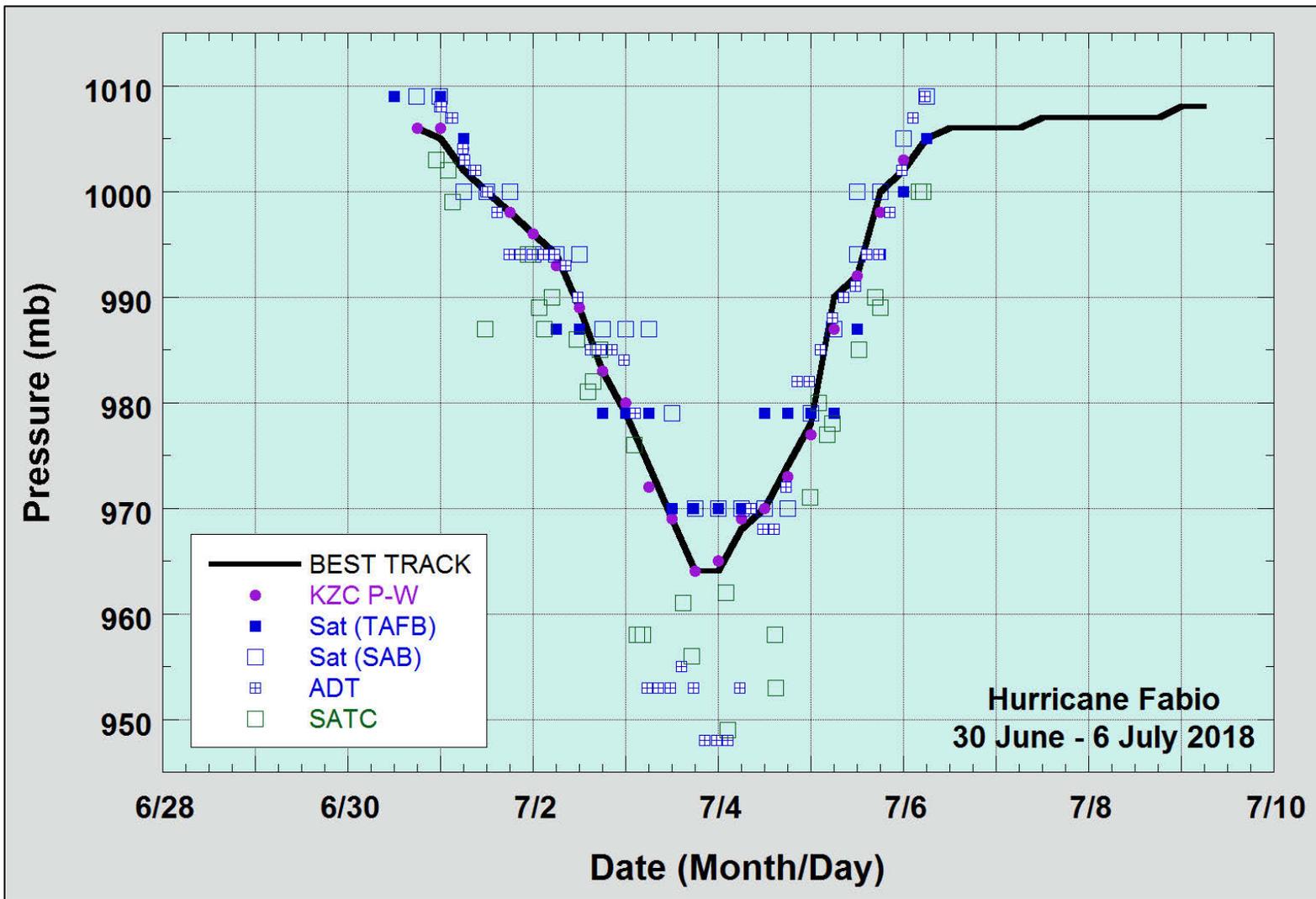


Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Fabio 30 June–6 July 2018. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship. SATCON (SATC) intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. Dashed vertical lines correspond to 0000 UTC.

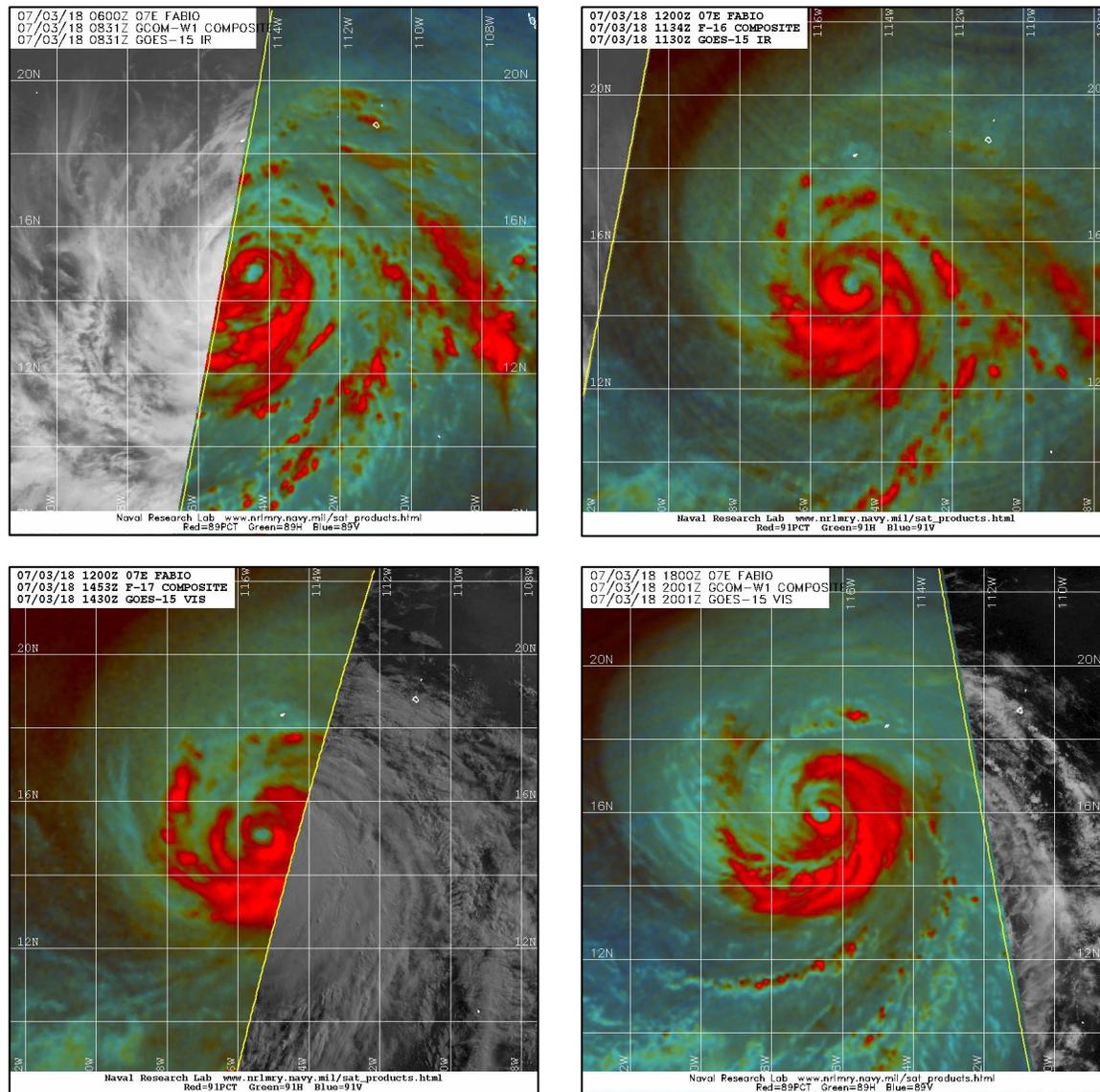


Figure 4. 89–91-GHz microwave images of Hurricane Fabio from 0831 UTC to 2001 UTC 3 July, showing the structure of the inner core during the time leading up to the hurricane’s estimated peak intensity at 1800 UTC 3 July. Images courtesy of the Naval Research Laboratory.

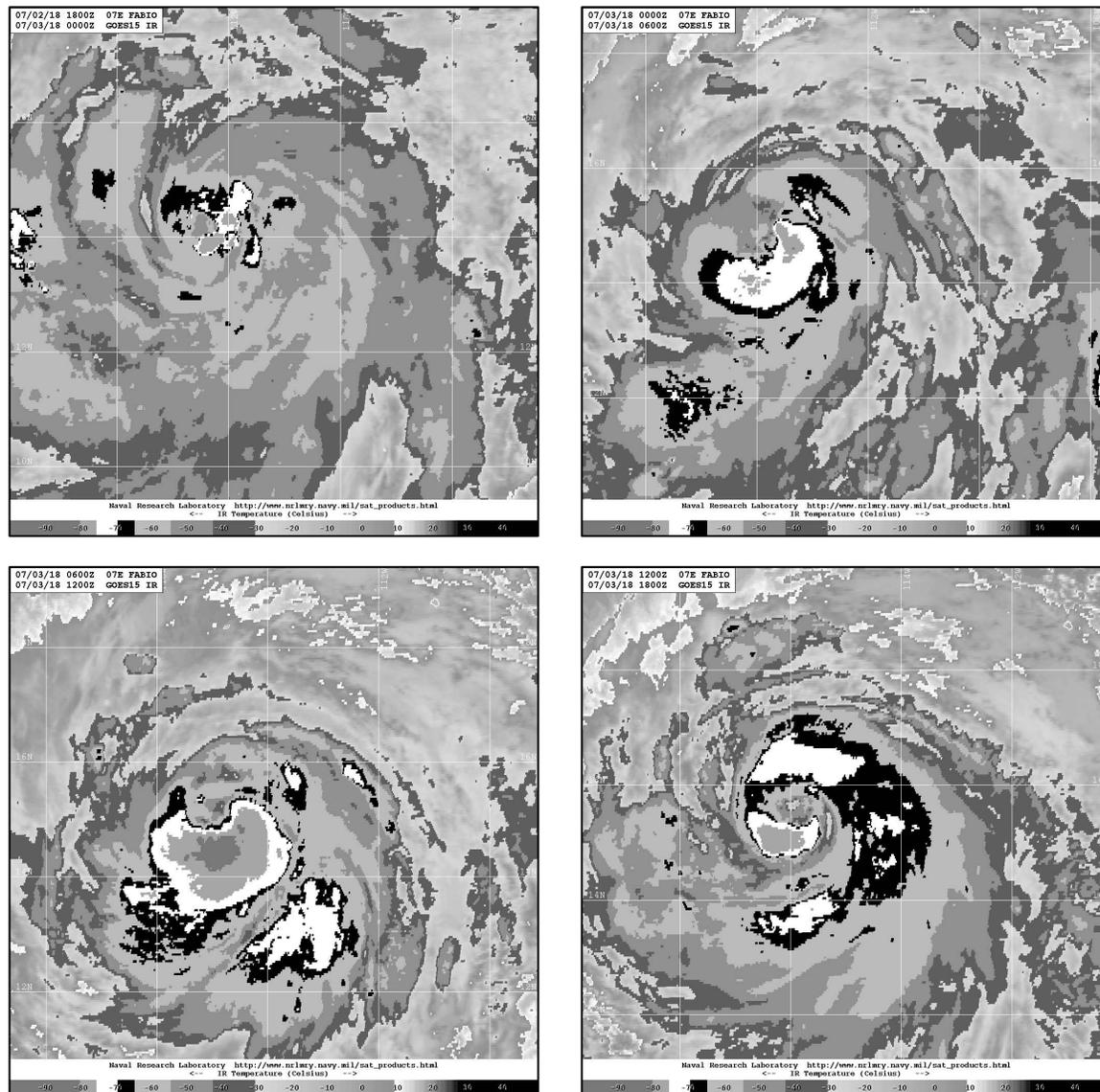


Figure 5. GOES-15 infrared satellite images with the Dvorak BD enhancement at 6 h intervals on 3 July showing the gradual clearing and warming of the eye. Fabio is estimated to have reached its peak intensity of 95 kt by 1800 UTC 3 July (bottom right image). Images courtesy of the Naval Research Laboratory.

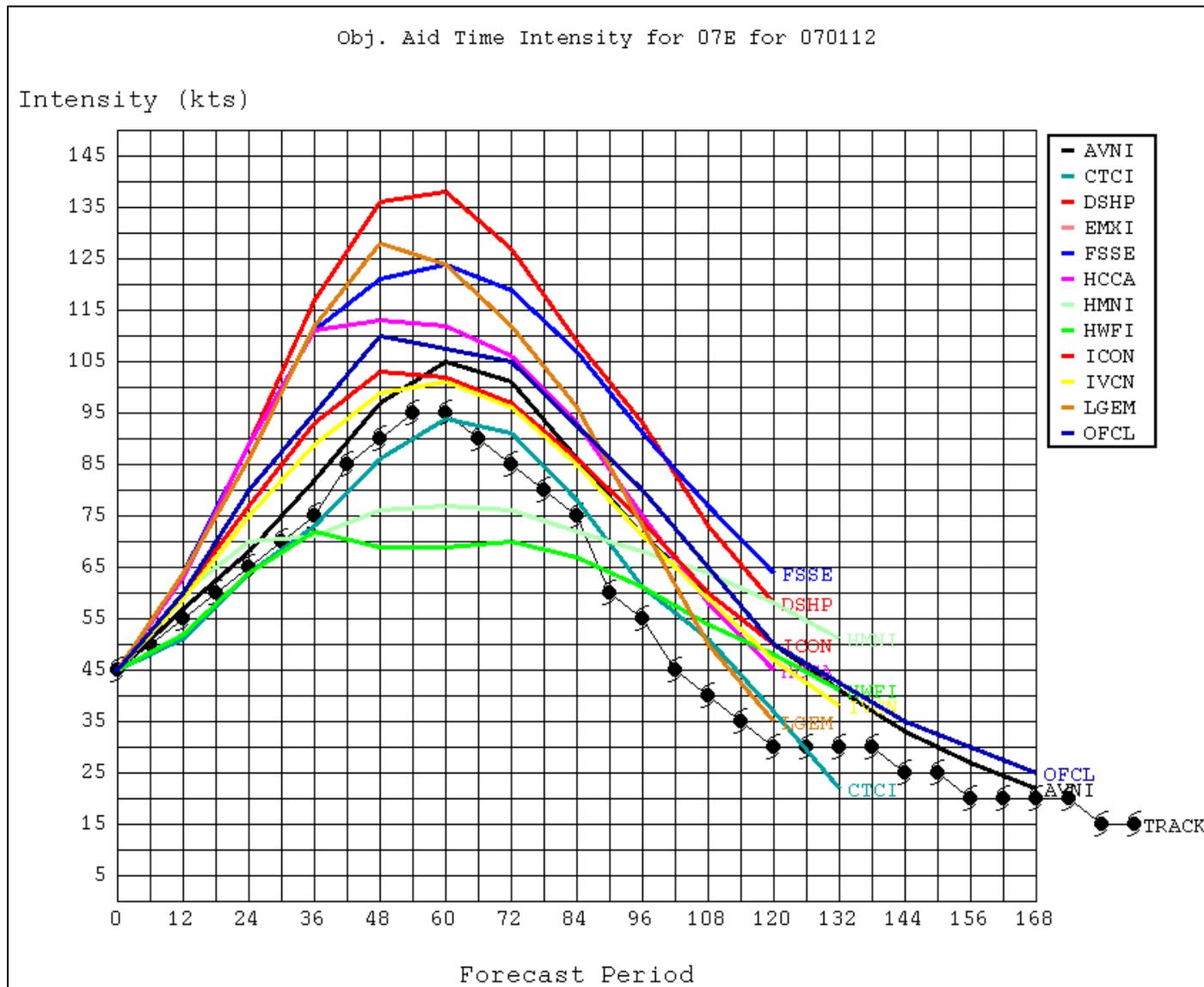


Figure 6. Intensity guidance and the NHC official forecast in knots (dark blue; OFCL) at 1200 UTC 1 July with the verifying best track intensity at 6-h intervals in knots (black hurricane symbols). Note the over-prediction of Fabio's peak intensity by most of the model guidance. Also note the under-prediction of Fabio's intensity by the HWRF model (HWFI, green).