# NATIONAL HURRICANE CENTER
# TROPICAL CYCLONE REPORT

# TROPICAL STORM VICTOR

(AL202021)

29 September – 4 October 2021

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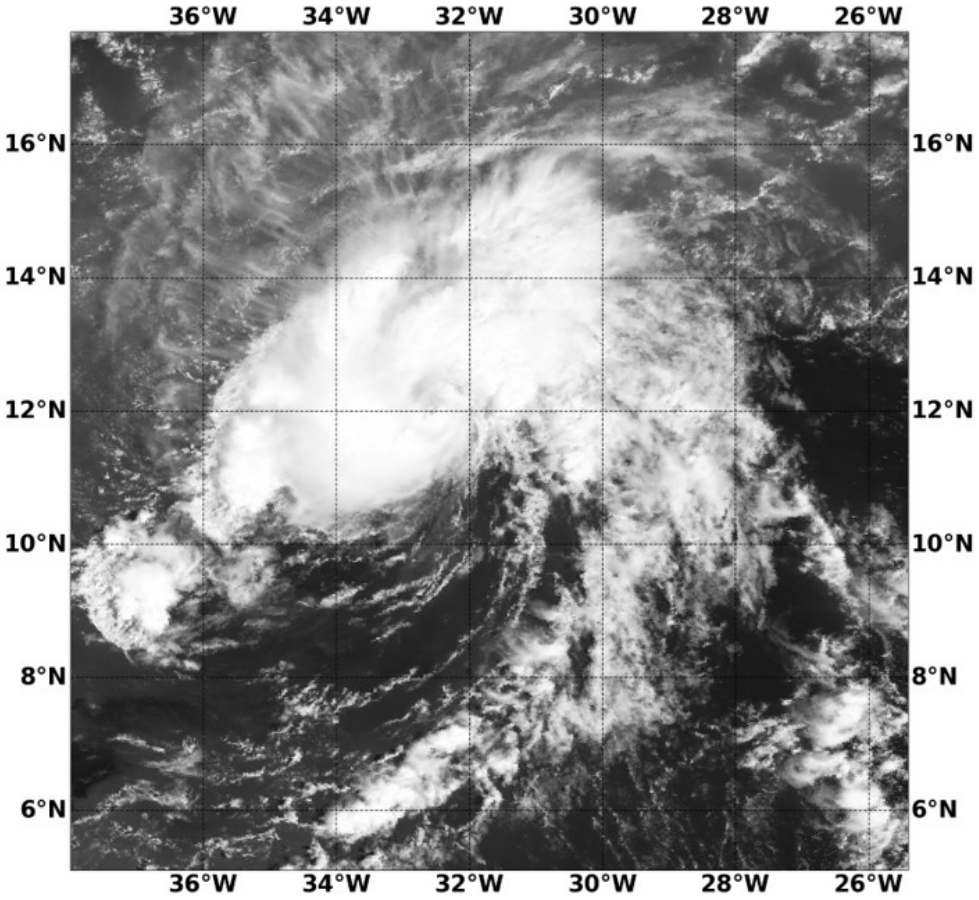
National Hurricane Center
2 December 2021




GOES-16 VISIBLE SATELLITE IMAGE AT 1220 UTC 1 SEPTEMBER 2021 WHEN VICTOR WAS AT ITS PEAK INTESITY OF 55 KT OVER THE EASTERN TROPICAL ATLANTIC. IMAGE COURTESY OF NAVAL RESEARCH LABORATORY, MONTEREY, CA.

Victor was a tropical storm that remained over the open Atlantic Ocean and did not directly affect any land areas.

# Tropical Storm Victor

**29 SEPTEMBER – 4 OCTOBER 2021**

## SYNOPTIC HISTORY

Victor originated from a vigorous tropical wave that moved off the west coast of Africa early on 27 September. The disturbance was accompanied a broad low-pressure area, surface pressure falls of at least -3 mb 24 $h^{-1}$, and a large area of disorganized convection. The westward-moving, low-latitude system (6°– 8° N latitude) gradually became better organized over the next two days, and scatterometer surface wind data early on 29 September indicated that the low had developed a well-defined surface center and that winds were just below tropical-storm strength. It is estimated that a tropical depression had formed around 1200 UTC that day when the system was located about 465 n mi south of the Cabo Verde Islands. The depression strengthened into a 35-kt tropical storm 6 h later. The "best track" chart of Victor'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].

After forming, Victor moved west-northwestward for the next four days along the southwestern periphery of a deep-layer ridge situated over the eastern tropical Atlantic. During that time, the cyclone gradually strengthened within a conducive environment consisting of very low 850–200-mb vertical wind shear less than 5 kt and sea-surface temperatures of 28°–29° C. However, mid-level moisture content was less than ideal for significant strengthening to occur, with 700–500-mb relative humidity values ranging between 55%–65% throughout most of the cyclone's existence as a tropical storm. Despite the favorable low-shear conditions, intermittent intrusions of the aforementioned dry mid-level air hindered the formation of persistent deep convection near the center, and Victor only managed to reach a peak intensity of 55 kt by 1200 UTC 1 October when the cyclone was located around 600 n mi west-southwest of the Cabo Verde Islands (cover photo). Victor maintained that peak intensity for another 6 h before the onset of a gradual weakening trend, induced by modest southerly vertical wind shear and entrainment of drier air. Victor turned northwestward into a weakness in the subtropical ridge and weakened to a tropical depression 24 h later at 1800 UTC 2 October when the disorganized system was located about 825 n mi west of the Cabo Verde Islands. The direction of the wind shear steadily veered around to a southwesterly direction while the magnitude increased to around 20 kt over the next 36 h, resulting in the associated convection gradually being displaced to the northeast of the low-level center. By early on 4 October, Victor's low-level circulation became elongated in a north-to-south orientation, and the cyclone degenerated into a surface trough of low pressure by 1200 UTC that day when it was located more than 1200 n mi west of the Cabo Verde Islands. Victor's shallow remnants then moved westward within easterly trade-wind flow and dissipated by early 5

[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.

October over the south-central subtropical Atlantic Ocean more than 500 n mi northeast of the Leeward Islands.

## METEOROLOGICAL STATISTICS

Observations in Victor (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), 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 Victor.

A ship with call sign **TBWUK3**, located about 260 n mi east-northeast of the pre-Victor low pressure system, reported a 35-kt southerly wind at approximately 50-meters elevation at 0200 UTC 29 September.

Victor's estimated peak intensity of 55 kt at 1200 UTC and 1800 UTC 1 October is based on subjective Dvorak intensity estimates of T3.5/55 kt from TAFB and SAB. This intensity estimate is also supported by ASCAT surface wind data of 51–52 kt around that time. The estimated minimum pressure of 997 mb also at 1200 UTC and 1800 UTC 1 October is based on a blend of the Dvorak satellite pressure estimates and the Knaff-Zehr-Courtney pressure-wind relationship.

## CASUALTY AND DAMAGE STATISTICS

There were no reports of damage or casualties associated with Tropical Storm Victor.

## FORECAST AND WARNING CRITIQUE

The genesis of Victor was exceptionally well forecast. Table 2 provides the number of hours in advance of formation associated with the first NHC Tropical Weather Outlook (TWO) forecast in each likelihood category. The disturbance that became Victor was first mentioned in the Atlantic TWO with a low chance (<40%) of formation during the next 5 days 144 h prior to genesis. The 5-day probabilities reached the medium (40-60%) and high categories (>60%) 126 h and 60 h, respectively, prior to Victor developing into a tropical cyclone. The 2-day genesis probabilities were similarly impressive, with low, medium, and high chances of genesis predicted 72 h, 48 h, and 36 h, respectively, before Victor developed into a tropical depression.

A verification of NHC official track forecasts for Victor is given in Table 3a. The official forecast mean errors (OFCL) were higher than the 5-yr means at all forecast times, but especially

at 96 h where average track errors were more than 80% worse than the long-term mean. In contrast, OCD5 errors were significantly better than their 5-yr means, indicating that Victor's track was easier to predict than average. The larger-than-average OFCL track forecast errors in the 36–96-h forecast period were due to a right-of-track bias in the first few NHC track forecasts when a stronger and more vertically deep Victor was expected to move farther east into a weakness in the subtropical ridge (Fig. 4). A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b and forecast skill against OCD5 is illustrated in Fig. 5. OFCL track forecasts displayed some modest skill through 36 h but had very little skill thereafter, with negative skill noted at the 48-h forecast period. OFCL track forecasts were bested by all of the consensus aids at most forecast times, with the GFEX simple-consensus model (average of the GFS & ECMWF solutions) outperforming the official forecasts all available times. The best performing dynamical models were the ECMWF (EMXI) and Canadian (CMCI) models. Ironically, the GFSI (interpolated GFS) was the poorest performing individual global model for Victor with track errors that exceeded the OFCL errors at all forecast times.

A verification of NHC official intensity forecasts for Victor is given in Table 4a. The official NHC intensity forecasts (OFCL) were slightly better than the 5-yr means at 12 h and 24 h, but the OFCL errors were significantly higher than the 5-yr means at 36–96 h. For comparison, a similar pattern is evident in the OCD5 forecasts where better-than-average errors also occurred at 12 h and 24 h, with significantly larger than average errors in the 36–96-h forecast period. The large OFCL errors in the middle and later forecast periods were due to incorrect predictions that Victor would strengthen into a 65-70-kt hurricane (Fig. 6). A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b and forecast skill against OCD5 is illustrated in Fig. 7. The official forecasts had some skill through 96 h, and were even more skillful than the bulk of the intensity guidance at the 12- and 24-h forecast periods. However, OFCL intensity forecasts were considerably less skillful than nearly all of the guidance at 36, 48, 60, 72, and 96 h. The best performing intensity models were the various consensus models. The best-performing global models were the ECMWF (EMXI), UKMET (EGRI), GFS (GFSI), and GFS-Ensemble Mean (AEMI), with the GFSI showing considerable skill in the 24-72-h period. However, the best overall intensity forecast aid was the regional model HMNI (interpolated Multi-scale Ocean-coupled Non-hydrostatic or HMON model), which displayed skill comparable to or better than the GFSI intensity forecasts at 36-96 h.

No coastal watches and warnings were required for Victor.

## *ACKNOWLEDGEMENTS*

Special thanks to Senior Hurricane Specialist John Cangialosi for producing the Victor "best track" map (Fig. 1).

Table 1. Best track for Tropical Storm Victor, 29 September – 4 October 2021.

| Date/Time (UTC) | Latitude (°N) | Longitude (°W) | Pressure (mb) | Wind Speed (kt) | Stage |
|---|---|---|---|---|---|
| 29 / 0000 | 7.0 | 22.0 | 1008 | 30 | low |
| 29 / 0600 | 7.4 | 23.0 | 1007 | 30 | " |
| 29 / 1200 | 7.8 | 24.1 | 1006 | 30 | tropical depression |
| 29 / 1800 | 8.1 | 25.1 | 1005 | 35 | tropical storm |
| 30 / 0000 | 8.3 | 26.0 | 1005 | 35 | " |
| 30 / 0600 | 8.7 | 27.1 | 1004 | 40 | " |
| 30 / 1200 | 9.2 | 28.4 | 1003 | 40 | " |
| 30 / 1800 | 9.8 | 29.5 | 1001 | 45 | " |
| 01 / 0000 | 10.5 | 30.6 | 999 | 50 | " |
| 01 / 0600 | 11.0 | 31.8 | 998 | 50 | " |
| 01 / 1200 | 11.4 | 33.0 | 997 | 55 | " |
| 01 / 1800 | 11.8 | 33.9 | 997 | 55 | " |
| 02 / 0000 | 12.1 | 34.9 | 999 | 50 | " |
| 02 / 0600 | 12.5 | 35.8 | 1001 | 45 | " |
| 02 / 1200 | 12.7 | 36.7 | 1005 | 35 | " |
| 02 / 1800 | 13.5 | 37.7 | 1007 | 30 | tropical depression |
| 03 / 0000 | 14.4 | 38.4 | 1007 | 30 | " |
| 03 / 0600 | 15.1 | 39.2 | 1007 | 30 | " |
| 03 / 1200 | 15.7 | 40.0 | 1007 | 30 | " |
| 03 / 1800 | 16.5 | 41.0 | 1007 | 30 | " |
| 04 / 0000 | 17.2 | 42.1 | 1007 | 30 | " |
| 04 / 0600 | 17.8 | 43.1 | 1009 | 25 | " |
| 04 / 1200 | | | | | dissipated |
| 01 / 1200 | 11.4 | 33.0 | 997 | 55 | maximum wind and minimum pressure |

Table 2. Number of hours in advance of formation of Victor 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%) | 72 | 144 |
| Medium (40%-60%) | 48 | 126 |
| High (>60%) | 36 | 60 |

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Victor, 29 September – 4 October 2021. 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 | 60 | 72 | 96 | 120 |
| OFCL | 31.5 | 52.7 | 68.8 | 92.2 | 113.4 | 152.5 | 232.5 | |
| OCD5 | 42.4 | 67.6 | 91.9 | 88.3 | 112.6 | 163.7 | 301.0 | |
| Forecasts | 18 | 16 | 14 | 12 | 10 | 8 | 4 | |
| OFCL (2016-20) | 23.9 | 36.3 | 49.1 | 63.9 | 79.0 | 94.1 | 128.1 | 169.7 |
| OCD5 (2016-20) | 45.1 | 97.2 | 157.2 | 216.7 | 271.1 | 325.4 | 414.4 | 490.0 |

Table 3b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Tropical Storm Victor, 29 September – 4 October 2021. 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 | 60 | 72 | 96 | 120 |
| OFCL | 31.8 | 49.6 | 68.7 | 92.2 | 113.2 | 152.5 | 232.5 | |
| OCD5 | 41.3 | 64.7 | 89.6 | **88.3** | 115.6 | 163.7 | 301.0 | |
| GFSI | 37.9 | 52.3 | 75.0 | 102.9 | 131.8 | 177.0 | 321.9 | |
| EMXI | 32.4 | **49.3** | **65.8** | **66.8** | **51.0** | **62.8** | **68.4** | |
| CMCI | **28.5** | **42.8** | **65.3** | **89.0** | **92.1** | **123.1** | **160.9** | |
| NVGI | 41.1 | 63.3 | 83.7 | 110.7 | 143.6 | 206.4 | 328.8 | |
| AEMI | 32.3 | **45.2** | **58.6** | **74.9** | **95.3** | **136.3** | 232.6 | |
| HWFI | 43.6 | 69.3 | 107.3 | 155.4 | 209.6 | 298.1 | 499.8 | |
| HMNI | 33.0 | **42.6** | **57.2** | **85.2** | 114.7 | **144.1** | **169.6** | |
| EGRI | 39.7 | 70.0 | 94.5 | 110.0 | 129.4 | 154.6 | **190.9** | |
| HCCA | 33.4 | 49.7 | 71.2 | 93.2 | **110.5** | 158.2 | 234.6 | |
| TVCX | 31.8 | 50.1 | 70.9 | **87.1** | **104.4** | **145.3** | **226.2** | |
| GFEX | **31.6** | **44.9** | **63.9** | **78.8** | **87.1** | **117.2** | **192.7** | |
| TVCA | 32.9 | 49.6 | 70.3 | **87.4** | **109.4** | 153.8 | 247.4 | |
| TVCE | **31.6** | **46.9** | **67.0** | **87.1** | **110.3** | 153.0 | **230.2** | |
| TVDG | 31.8 | **48.6** | 71.0 | **85.6** | **107.8** | **148.7** | 234.0 | |
| TABD | 61.7 | 136.4 | 232.9 | 350.6 | 420.5 | 525.3 | 666.5 | |
| TABM | 46.0 | 88.6 | 150.0 | 223.6 | 269.9 | 344.7 | 439.7 | |
| TABS | 40.4 | 60.6 | 87.4 | 115.7 | 143.9 | 179.1 | 253.7 | |
| Forecasts | 16 | 14 | 13 | 12 | 9 | 8 | 4 | |

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Tropical Storm Victor, 29 September – 4 October 2021. 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 | 60 | 72 | 96 | 120 |
| OFCL | **2.5** | **5.9** | 10.4 | 14.2 | 19.0 | 20.0 | 18.8 | |
| OCD5 | 5.1 | 10.8 | 15.0 | 22.6 | 27.6 | 30.1 | 31.5 | |
| Forecasts | 18 | 16 | 14 | 12 | 10 | 8 | 4 | |
| OFCL (2016-20) | 5.4 | 8.0 | 9.6 | 10.9 | 11.5 | 12.1 | 13.3 | 14.5 |
| OCD5 (2016-20) | 7.0 | 11.0 | 14.3 | 16.8 | 18.3 | 19.7 | 21.7 | 23.0 |

Table 4b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Tropical Storm Victor, 29 September – 4 October 2021. 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 | 60 | 72 | 96 | 120 |
| OFCL | 2.8 | 6.8 | 11.2 | 14.2 | 19.4 | 20.0 | 18.8 | |
| OCD5 | 4.9 | 10.9 | 15.8 | 22.6 | 25.8 | 30.1 | 31.5 | |
| GFSI | 3.9 | **5.9** | **5.7** | **4.5** | **4.8** | **7.4** | **11.2** | |
| EMXI | 4.8 | 8.6 | 11.2 | **11.2** | **9.0** | **9.5** | **10.8** | |
| CMCI | 4.4 | 7.8 | **10.1** | **10.4** | **9.4** | **9.5** | **9.8** | |
| NVGI | 4.7 | 10.1 | 14.0 | 17.5 | 23.7 | 32.2 | 42.0 | |
| HWFI | 4.5 | 8.1 | **10.4** | 14.9 | 20.0 | 22.2 | 28.8 | |
| HMNI | 4.4 | 7.4 | **5.7** | **5.7** | **4.6** | **8.0** | **3.2** | |
| EGRI | 4.1 | **6.2** | **7.5** | **9.6** | **10.6** | **9.9** | **7.2** | |
| AEMI | 4.6 | 7.7 | **9.2** | **8.5** | **4.7** | **4.0** | **2.8** | |
| HCCA | 3.9 | 7.4 | **7.9** | **11.5** | **15.3** | **18.0** | **17.0** | |
| DSHP | 4.4 | 8.6 | **8.9** | **9.7** | **14.0** | **16.4** | **17.8** | |
| LGEM | 4.1 | 7.3 | **7.8** | **7.4** | **9.8** | **12.2** | **10.8** | |
| ICON | 3.1 | **6.3** | **6.8** | **8.8** | **12.0** | **14.5** | **15.2** | |
| IVCN | 3.1 | **6.3** | **7.1** | **9.2** | **12.8** | **15.6** | **15.8** | |
| IVDR | 3.4 | **6.3** | **6.2** | **8.6** | **11.9** | **15.2** | **15.5** | |
| Forecasts | 16 | 14 | 13 | 12 | 9 | 8 | 4 | |

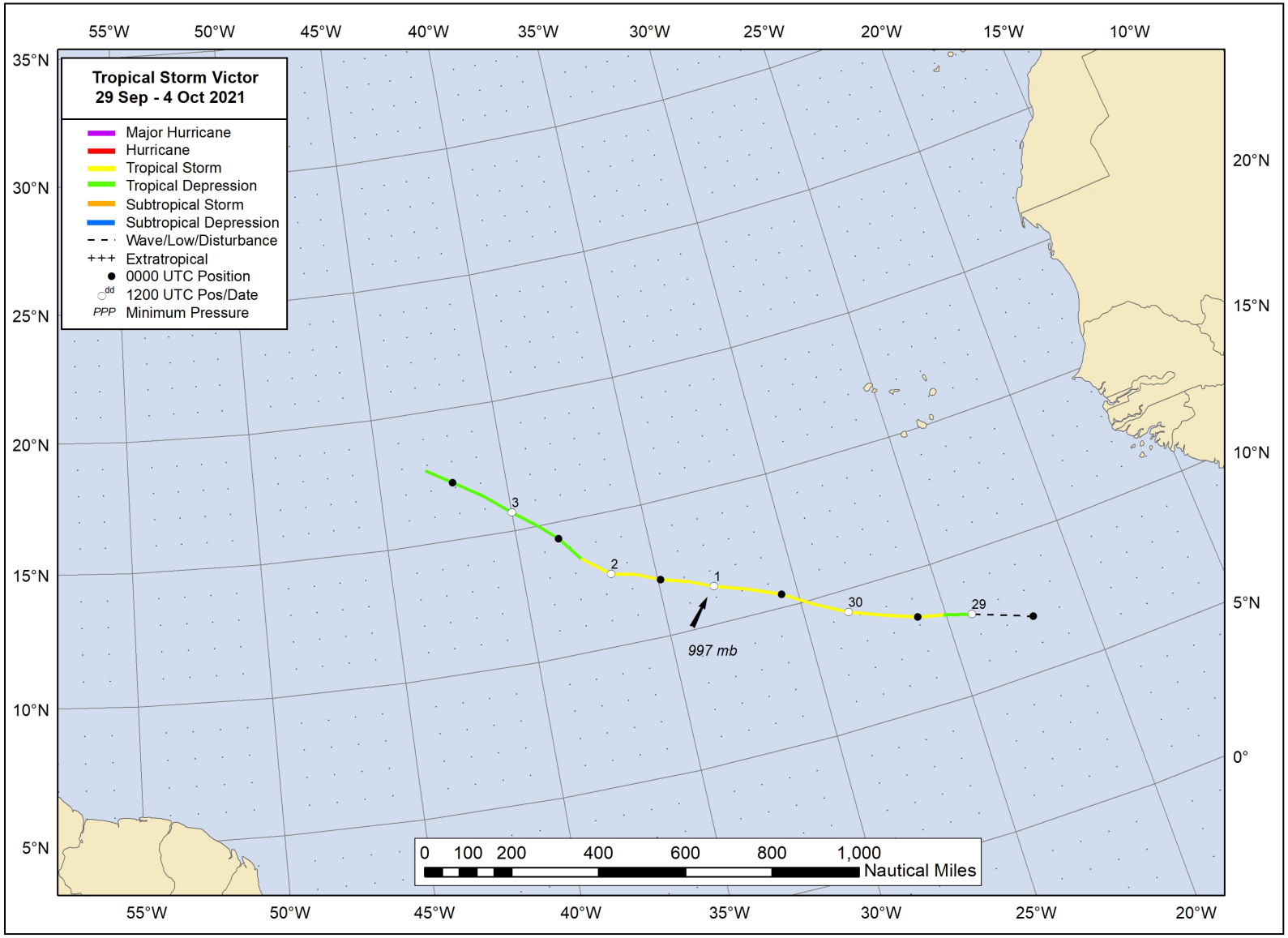



Figure 1. Best track positions for Tropical Storm Victor, 29 September – 4 October 2021.

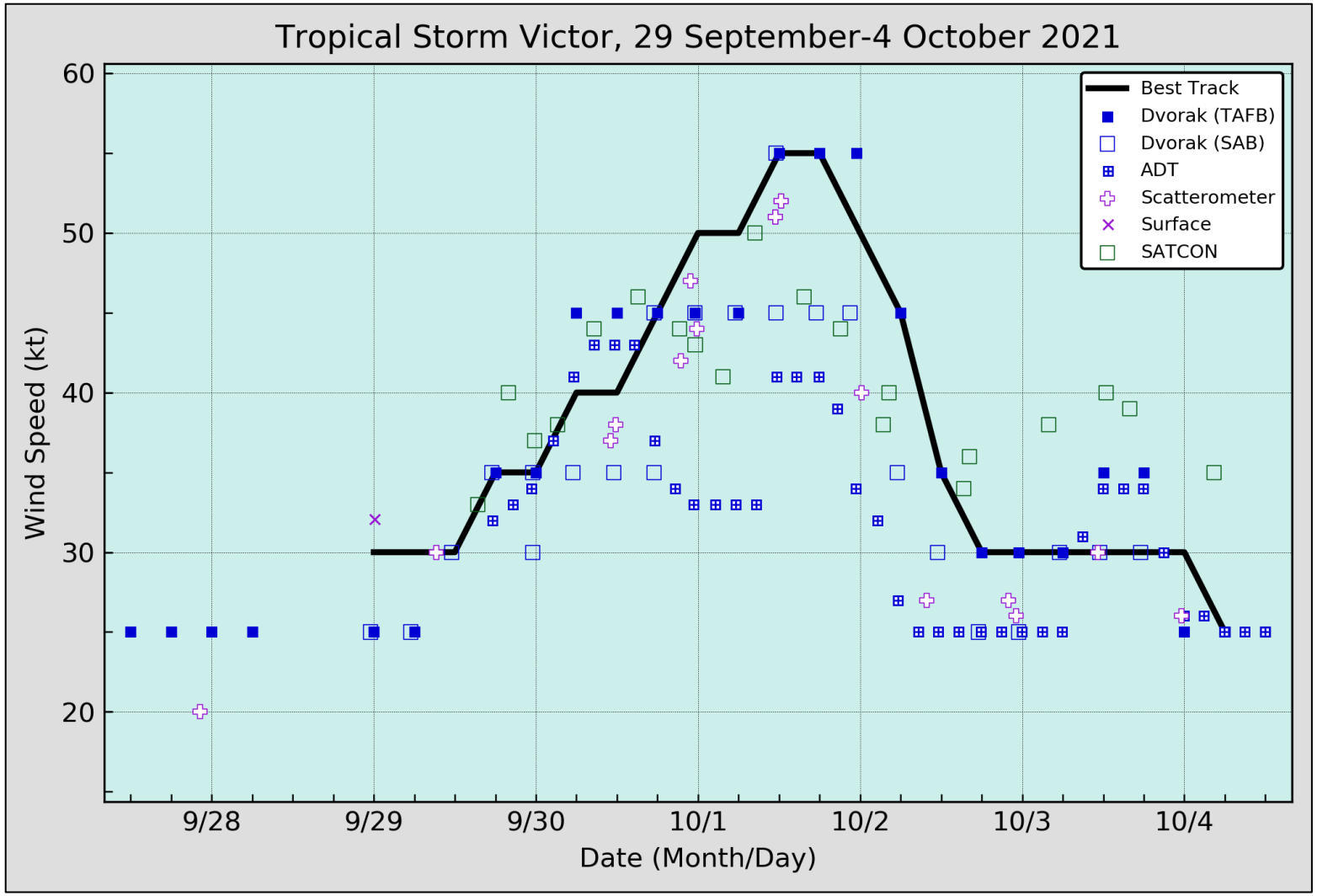



Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Victor, 29 September – 4 October 2021. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. Dashed vertical lines correspond to 0000 UTC.

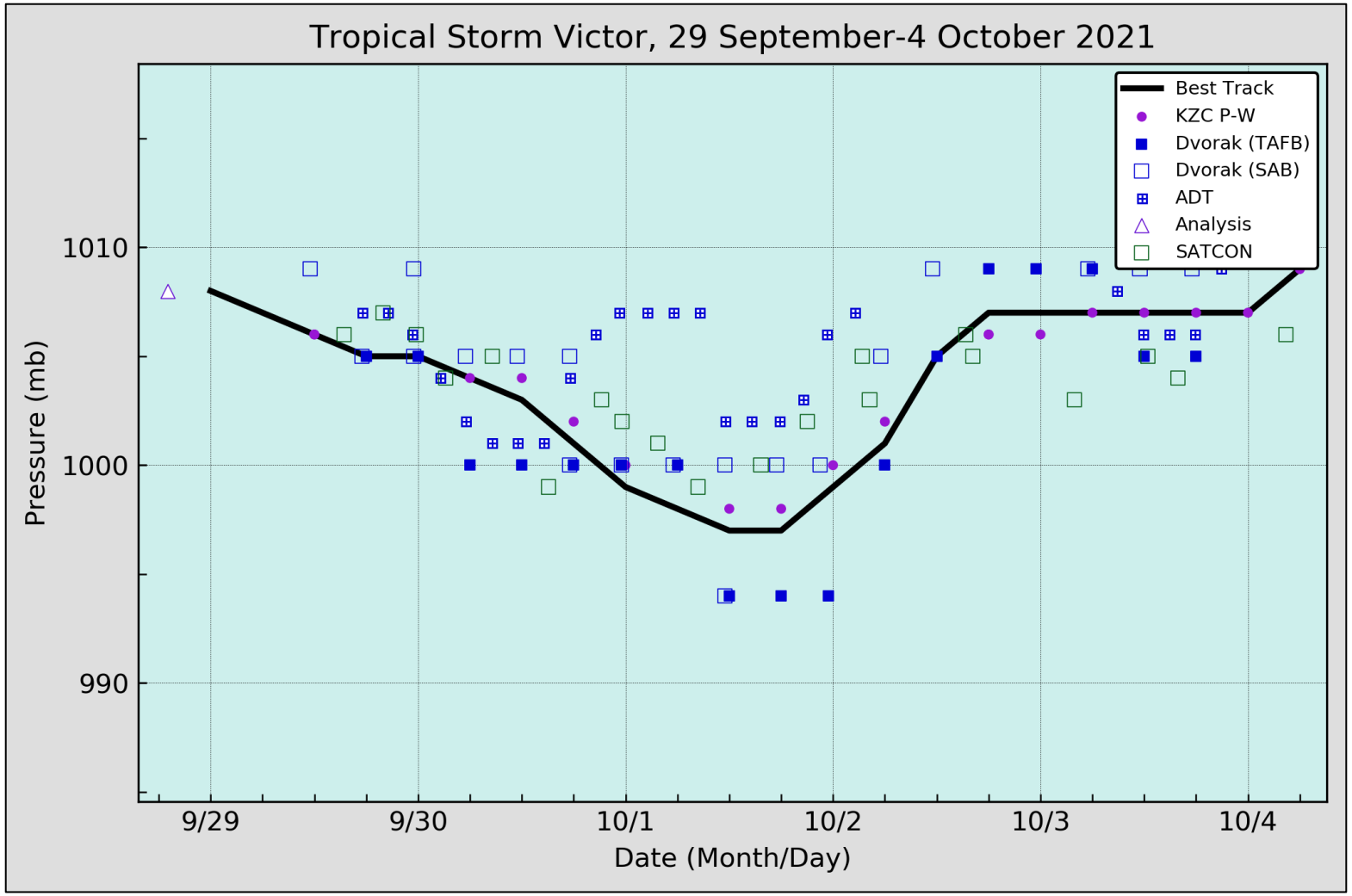



Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Victor, 29 September – 4 October 2021. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship. Dashed vertical lines correspond to 0000 UTC.

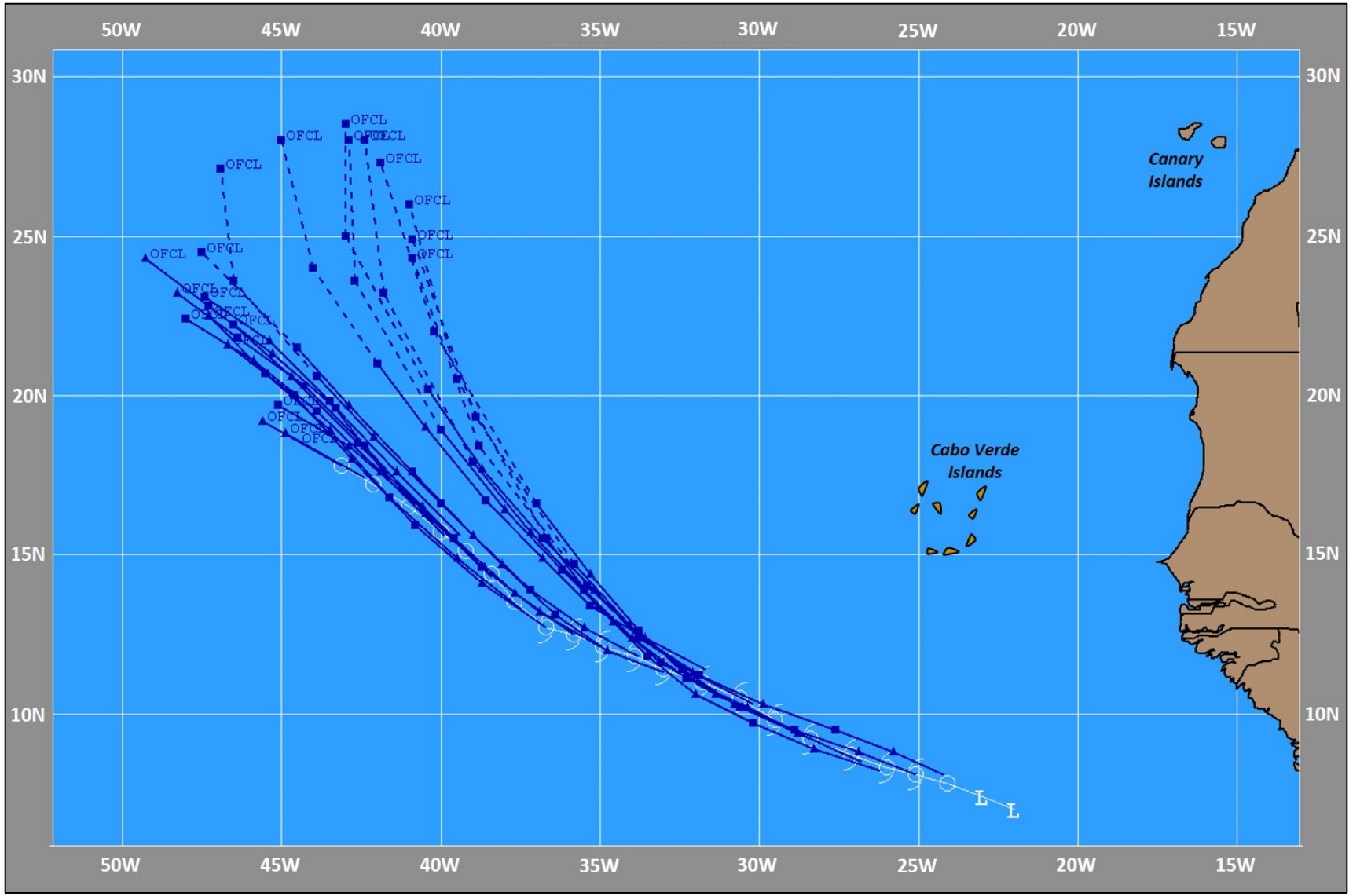



Figure 4. NHC 120-h official track forecasts (OFCL; solid blue lines) for Tropical Storm Victor, 29 September – 4 October 2021. Victor's 'best track' intensity is denoted by the solid white line marked with status symbols at 6-h intervals.

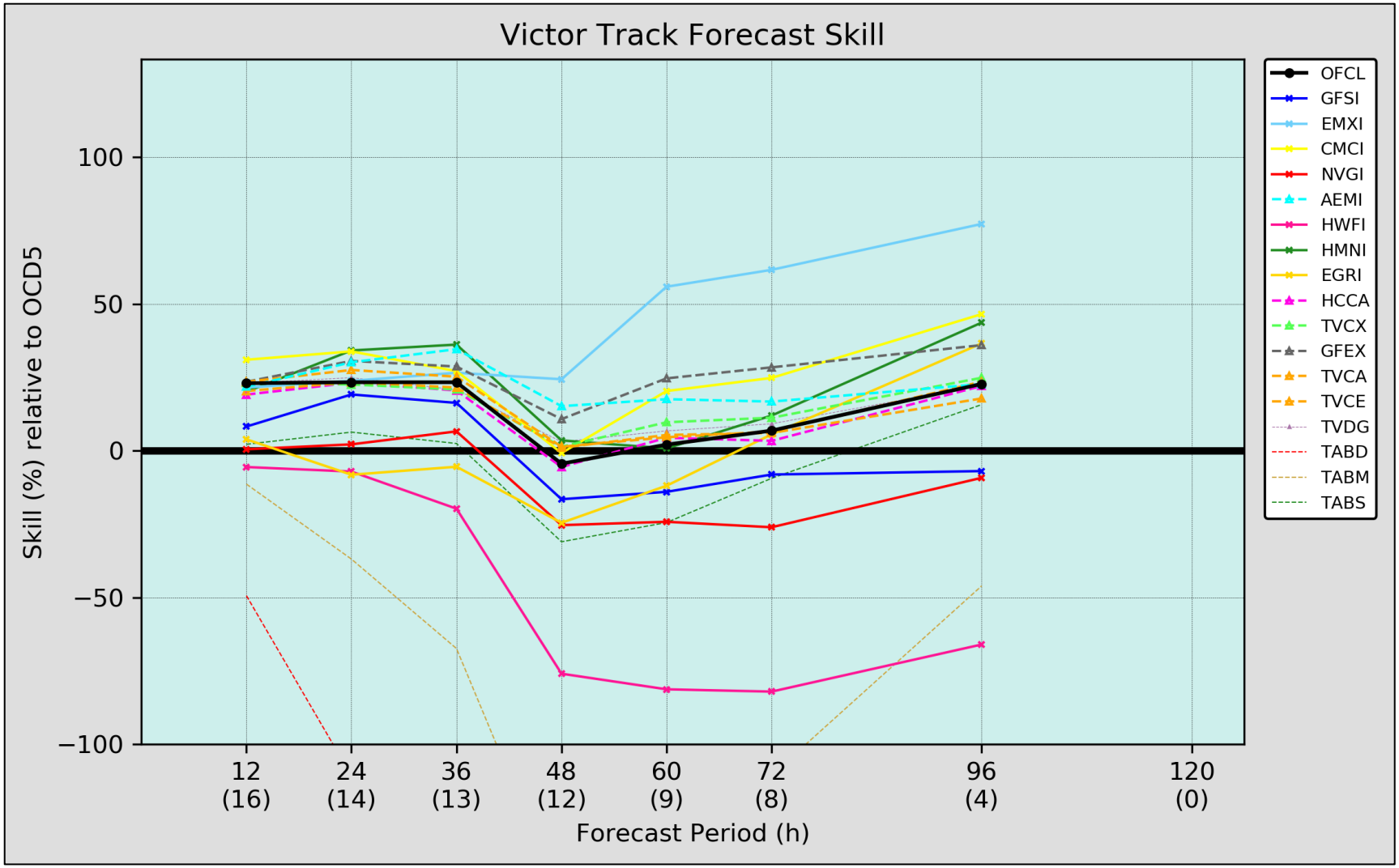



Figure 5. Track forecast skill of the official forecasts and selected models for Tropical Storm Victor, 29 September – 4 October 2021.

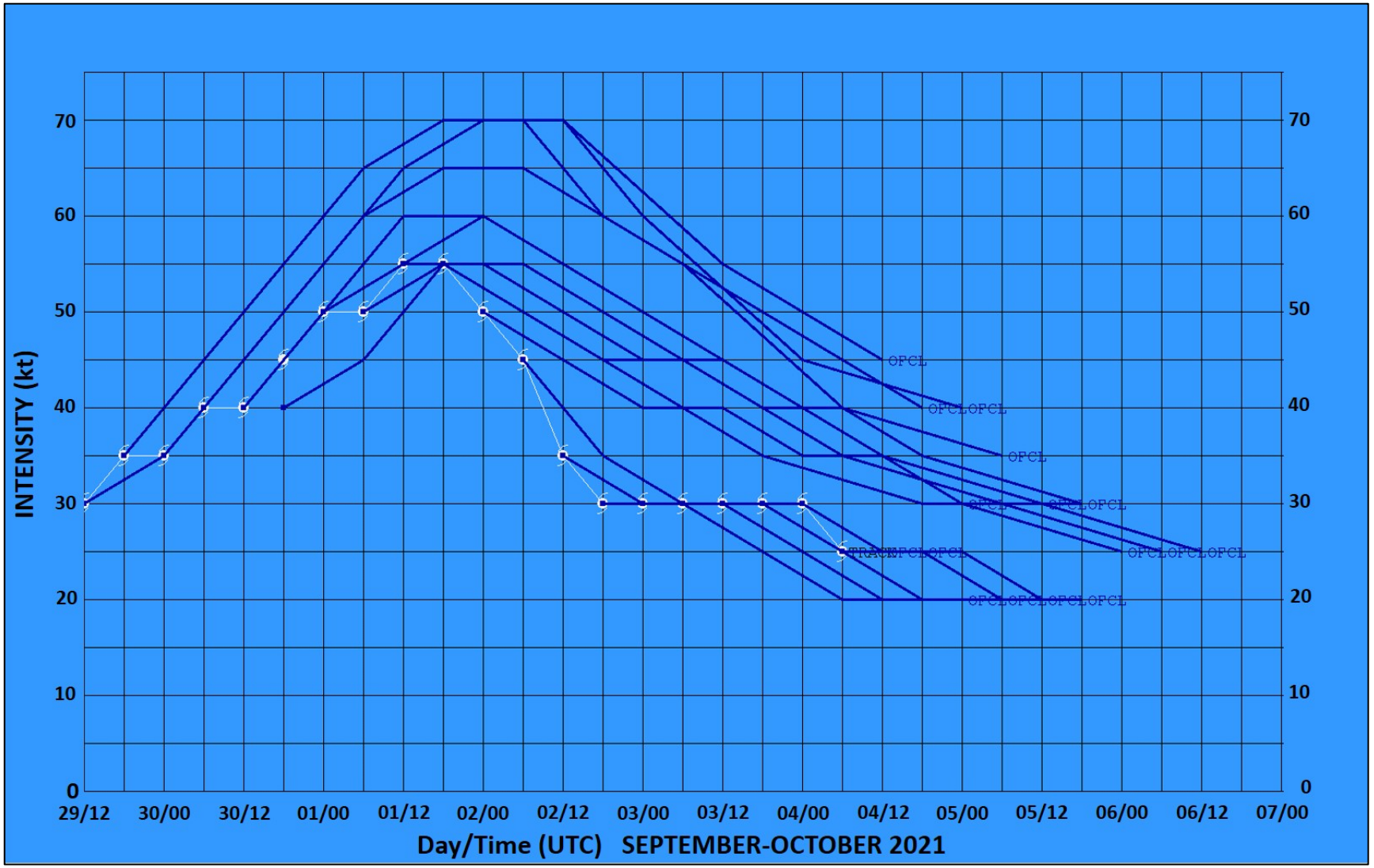



Figure 6. NHC 120-h official intensity forecasts (OFCL; solid blue lines) for Tropical Storm Victor, 29 September – 4 October 2021. Victor's 'best track' intensity is denoted by the solid white line marked with status symbols at 6-h intervals.

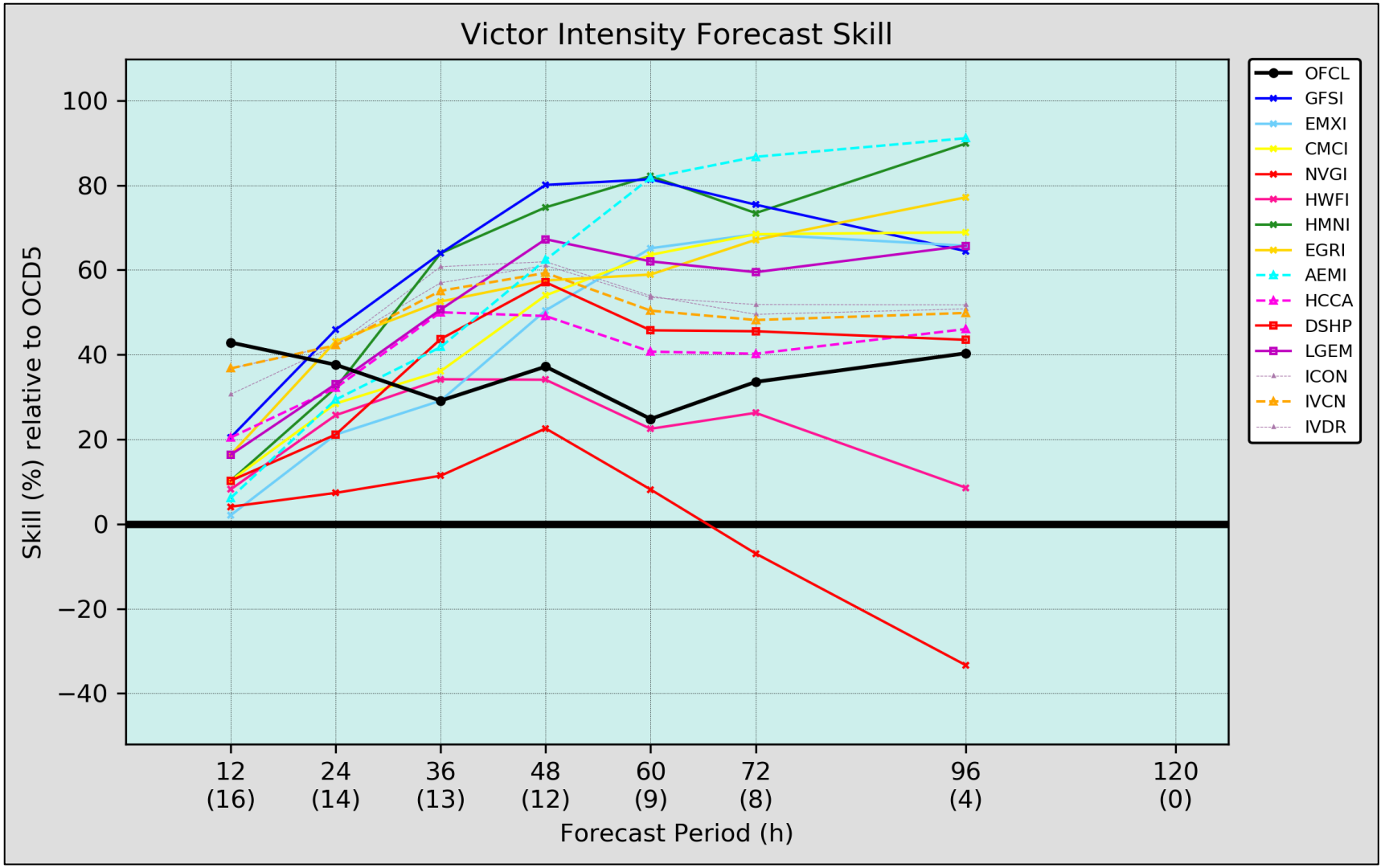



Figure 7. Intensity forecast skill of the official forecasts (OFCL) and selected models for Tropical Storm Victor, 29 September – 4 October 2021.