Tropical Cyclone Report
Hurricane Celia
(EP042010)
18–28 June, 2010

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Celia was a long-lived hurricane that reached category five strength on the Saffir-Simpson Hurricane Wind Scale. It tied Hurricane Ava as the strongest June hurricane on record in the eastern North Pacific (since reliable records began in the early 1970s). Celia remained over the waters of the eastern North Pacific and did not affect land.

a. Synoptic History

Celia originated from a tropical wave that crossed the west coast of Africa on 5 June. The wave moved uneventfully westward across the tropical Atlantic and Caribbean Sea, reaching the eastern North Pacific by 17 June. Showers and thunderstorms associated with the slow-moving wave increased later that day, and a surface low pressure area formed near the wave axis around 0600 UTC 18 June about 230 n mi southeast of Puerto Escondido, Mexico. A well-defined curved band of deep convection developed on the north side of the circulation during the next 6 to 12 h, and it is estimated that a tropical depression formed around 1800 UTC 18 June about 320 n mi southeast of Acapulco, 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 1[1]. Although the circulation became better defined during the hours after genesis, deep convection associated with the depression nearly dissipated by 0000 UTC 19 June. However, the convection re-developed within the next several hours, and the organization of the cloud pattern continued increasing. An 1145 UTC SSM/I overpass on 19 June indicated the presence of a closed low- to mid-level convective ring, and it is estimated that the depression reached tropical storm status around this time while centered about 290 n mi south-southeast of Acapulco.

Celia moved slowly west-southwestward to westward over the next few days, embedded within low-level westerly flow and moderate northeasterly flow at upper levels associated with a strong ridge to its north. Although the differing flow between lower and upper levels created moderate northeasterly vertical wind shear over the cyclone, Celia steadily intensified after reaching tropical storm strength and is estimated to have reached hurricane strength by 1800 UTC 20 June while centered about 310 n mi south of Acapulco. However, the northeasterly vertical wind shear became stronger during the next several days and prevented Celia from intensifying more significantly, with the intensity remaining between 65 and 85 kt from 1800 UTC 21 June until 1200 UTC 23 June.

[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.

Celia began moving just north of due west early on 23 June with some increase in forward speed to the south of a deep layer ridge. A relaxation of the northeasterly shear resulted in a re-intensification of the cyclone from an intensity of 75 kt at 0600 UTC to 95 kt at 1800 UTC that day. However, the convective structure of the cyclone soon became asymmetric, and the well-defined eye that formed earlier began to disappear in response to a renewed increase in the northeasterly vertical wind shear. The weakening trend continued for another 6 to 12 h, but the convection within the inner core of the hurricane underwent a reorganization and convective tops cooled again. A decrease in vertical wind shear occurred around this time, and Celia began a period of rapid intensification as it turned west-northwestward in response to an amplifying mid- to upper-level trough that weakened the subtropical ridge to its north. The hurricane strengthened from 90 to 140 kt in an 18 h period, with an estimated peak intensity occurring around 0000 UTC 25 June.

During the next couple of days Celia rapidly weakened as it moved over progressively cooler waters and entered a more stable thermodynamic environment. The cyclone fell below major hurricane strength early on 26 June and weakened to a tropical storm by 0000 UTC 27 June while centered about 830 n mi west-southwest of the southern tip of Baja California. The weakening cyclone abruptly slowed down on 27 June as the western extension of the ridge to its north eroded further, in response to an amplifying mid-tropospheric trough near the U.S. west coast. As Celia lost nearly all of its deep convection and became a shallow cyclone, it slowed even further and began drifting west-southwestward to southwestward in weak low-level steering flow on 28 June. Celia then became embedded in a low-level westerly flow and turned east-northeastward, completing a counter-clockwise loop and degenerating into a remnant low about 900 n mi west-southwest of the southern tip of Baja California at 0000 UTC 29 June. The remnant low of Celia drifted northward for another day and then dissipated.

b. Meteorological Statistics

Observations in Celia (Figs. 2 and 3) include satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB) and the Satellite Analysis Branch (SAB), as well as from the Advanced Dvorak Technique (ADT). Data and imagery from NOAA polar-orbiting satellites (including UW CIMSS AMSU-based intensity estimates), the NASA Tropical Rainfall Measuring Mission (TRMM), the European ASCAT, and Defense Meteorological Satellite Program (DMSP) satellites, among others, were also useful in constructing the best track of Celia.

Celia's estimated peak intensity of 140 kt from 0000 to 0600 UTC 25 June is based on subjective satellite intensity estimates of T7.0/140 kt from TAFB and SAB.

There were no reliable ship reports of tropical-storm-force or greater winds received in association with Celia.

c. Casualty and Damage Statistics

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

d. Forecast and Warning Critique

The genesis of Celia was poorly forecast. The area of disturbed weather that eventually developed into Celia was introduced to the National Hurricane Center's Tropical Weather Outlook with a low (10%) probability of formation at 1800 UTC 17 June, 24 hours prior to genesis. The formation probability remained in the low category and did not reach high (60%) until after genesis is estimated to have occurred.

A verification of NHC official track forecasts for Celia is given in Table 2a. The official forecast track errors were 15, 24, 30, 36, 57, 91, and 131 n mi at 12, 24, 36, 48, 72, 96, and 120 h, respectively. These errors were substantially lower the mean official errors for the previous five-year period at all forecast times. The errors for climatology and persistence (OCD5) were lower than the five-year mean, indicating that that the forecasts for Celia were easier than normal. An examination of forecast track errors (not shown) indicates a minor northward track bias, largely from early forecasts which did not anticipate Celia's persistent west-southwesterly motion. A homogeneous comparison of the official track errors with selected guidance models is given in Table 2b. The official track errors were generally below those for all of the model guidance except the model consensus (TVCN) which outperformed all guidance at 36 h and beyond, and the GFS ensemble mean at day 5 which had the smallest errors.

A verification of NHC official intensity forecasts for Celia is given in Table 3a. Official forecast intensity errors were 8, 10, 11, 11, 16, 15, and 18 kt for 12, 24, 36, 48, 72, 96, and 120 h, respectively. These official errors were lower than the mean official errors for the previous five-year period and exhibited a low bias at 48 h and beyond. This was true even though the errors for climatology and persistence (OCD5) were higher than the five-year mean, especially for forecasts beyond 72 h, and suggest that intensity forecasts for Celia were more difficult than normal. The official forecasts failed to anticipate the period of rapid intensification that began around 0600 UTC 24 June. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 3b. The official intensity forecasts had lower average errors than all of the guidance, except for DSHP and LGEM at 72 and 96 h.

Table 1. Best track for Hurricane Celia, 18-28 June 2010.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
18 / 0600	13.0	94.4	1010	20	low
18 / 1200	13.2	95.0	1010	20	"
18 / 1800	13.4	95.5	1009	25	tropical depression
19 / 0000	13.2	96.0	1009	25	"
19 / 0600	13.0	96.5	1007	30	"
19 / 1200	12.8	97.0	1005	35	tropical storm
19 / 1800	12.5	97.5	1002	40	"
20 / 0000	12.2	98.1	997	50	"
20 / 0600	12.0	98.8	994	55	"
20 / 1200	11.8	99.3	991	60	"
20 / 1800	11.6	100.0	987	65	hurricane
21 / 0000	11.5	100.6	987	65	"
21 / 0600	11.5	101.3	987	65	"
21 / 1200	11.5	102.0	984	70	"
21 / 1800	11.6	102.8	980	75	"
22 / 0000	11.6	103.6	977	80	"
22 / 0600	11.6	104.4	973	85	"
22 / 1200	11.6	105.2	973	85	"
22 / 1800	11.7	106.0	973	85	"
23 / 0000	11.7	106.8	977	80	"
23 / 0600	11.8	107.7	980	75	"
23 / 1200	12.0	108.7	973	85	"
23 / 1800	12.1	109.8	966	95	"
24 / 0000	12.2	111.0	970	90	"
24 / 0600	12.3	112.1	970	90	"
24 / 1200	12.3	113.3	962	100	"
24 / 1800	12.5	114.3	948	115	"
25 / 0000	12.9	115.4	921	140	"
25 / 0600	13.2	116.5	921	140	"
25 / 1200	13.6	117.6	938	125	"
25 / 1800	14.0	118.5	953	110	"
26 / 0000	14.6	119.4	962	100	"
26 / 0600	15.1	120.3	970	90	"

26 / 1200	15.4	121.1	973	85	"
26 / 1800	15.6	121.8	984	70	"
27 / 0000	15.7	122.5	994	55	tropical storm
27 / 0600	15.8	123.1	997	50	"
27 / 1200	15.8	123.5	1000	45	"
27 / 1800	15.6	123.9	1002	40	"
28 / 0000	15.4	124.1	1005	35	"
28 / 0600	15.3	124.1	1005	35	"
28 / 1200	15.2	124.1	1005	35	"
28 / 1800	15.1	123.9	1006	30	remnant low
29 / 0000	15.2	123.6	1006	30	"
29 / 0600	15.3	123.5	1006	30	"
29 / 1200	15.4	123.5	1007	25	"
29 / 1800	15.5	123.5	1008	25	"
30 / 0000	15.7	123.5	1008	25	"
30 / 0600	16.0	123.4	1009	25	"
30 / 1200	16.2	123.4	1010	20	"
25 / 0000	12.9	115.4	921	140	Maximum wind and minimum pressure

Table 2a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Celia, 18-28 June 2010. Mean errors for the five-year period 2005-9 are shown for comparison. Official errors that are smaller than the five-year means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	**15.3**	**23.9**	**29.7**	**35.5**	**56.9**	**90.8**	**131.4**
OCD5	28.3	62.8	97.3	130.8	178.2	212.0	212.8
Forecasts	36	34	32	30	26	22	18
OFCL (2005-9)	30.8	51.5	71.6	89.6	120.9	155.0	192.0
OCD5 (2005-9)	38.9	75.3	115.7	155.8	226.9	275.1	321.5

Table 2b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Celia, 18-28 June 2010. 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 2a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	13.0	20.5	27.5	33.6	54.8	82.3	116.5
OCD5	24.7	57.7	96.1	127.8	175.1	199.8	179.0
GFSI	26.4	43.4	60.5	71.8	94.8	132.3	198.4
GFDI	15.1	28.0	43.5	64.8	104.3	157.4	222.8
HWFI	20.5	34.5	45.2	58.9	91.2	116.9	125.1
GFNI	30.6	41.8	49.0	55.7	68.2	90.6	119.9
NGPI	21.2	29.4	37.2	45.9	69.6	106.1	139.2
EMXI	24.4	42.0	55.2	65.3	91.3	130.4	191.1
AEMI	24.7	42.8	59.3	68.4	73.5	94.0	**96.5**
FSSE	16.5	23.6	30.3	41.2	66.2	98.3	177.8
TVCN	15.6	20.8	**26.3**	**34.4**	**50.7**	**79.0**	**102.6**
TVCC	21.5	21.0	32.9	42.6	94.9	126.6	148.7
LBAR	23.7	66.8	121.2	179.2	279.1	307.1	275.2
BAMS	21.9	36.1	55.2	78.9	126.6	185.2	281.5
BAMM	27.0	51.4	75.4	99.9	146.1	189.4	235.6
BAMD	39.6	71.3	100.4	128.9	183.7	257.0	321.9
Forecasts	26	24	23	21	18	14	11

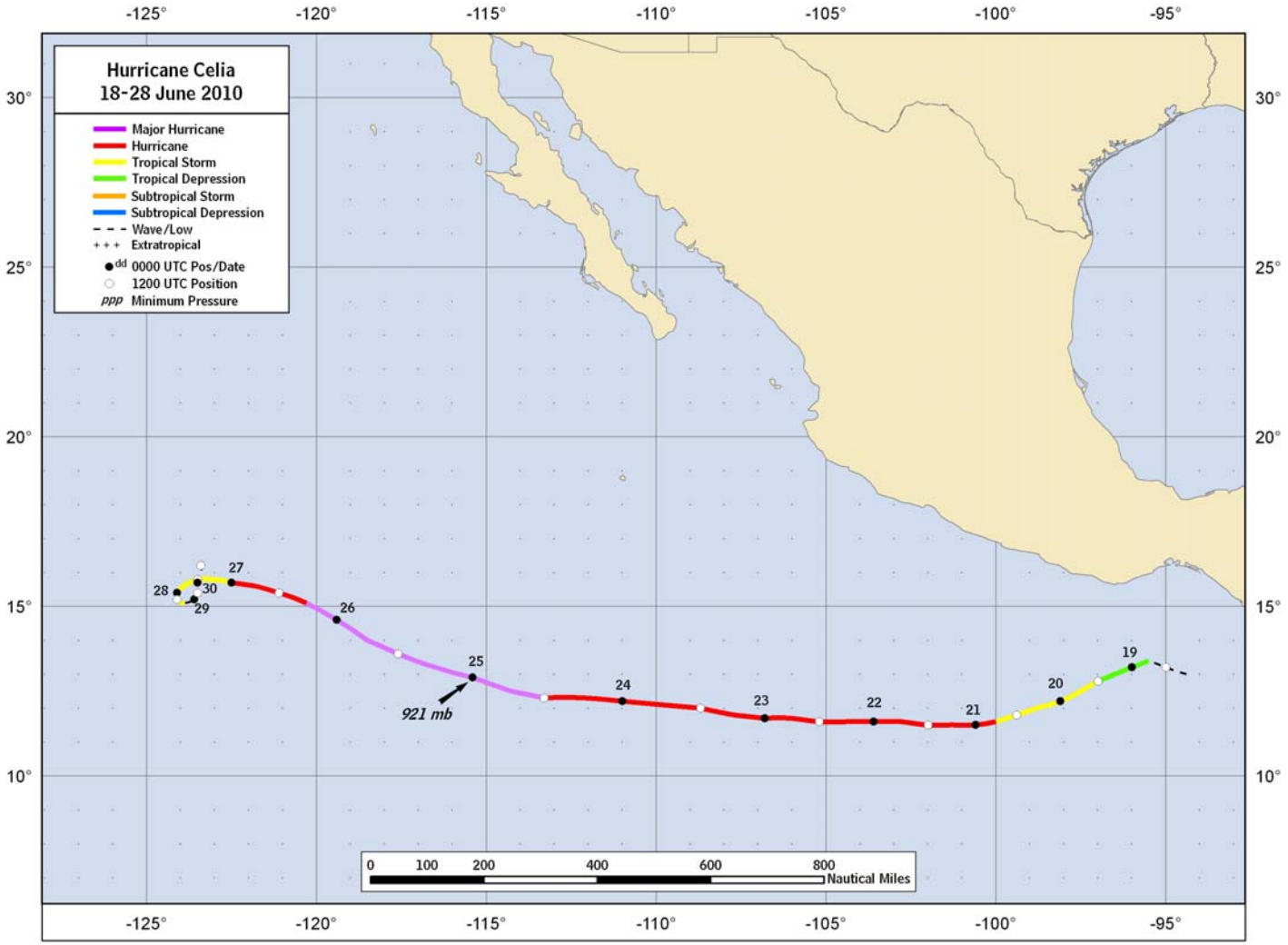
Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Celia, 18-28 June 2010. Mean errors for the five-year period 2005-9 are shown for comparison. Official errors that are smaller than the five-year means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	7.9	**9.6**	**11.3**	**11.2**	**15.8**	**15.0**	**17.5**
OCD5	11.6	15.9	18.2	20.5	28.3	29.2	34.9
Forecasts	36	34	32	30	26	22	18
OFCL (2005-9)	6.3	10.5	13.8	15.5	17.5	19.0	18.8
OCD5 (2005-9)	7.1	11.6	15.0	17.4	18.7	19.8	19.4

Table 3b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Celia, 18-28 June 2010. 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	7.9	9.5	11.3	11.6	15.8	15.3	15.7
OCD5	11.6	15.9	18.5	21.3	28.0	29.9	33.3
GHMI	9.6	12.1	16.8	20.7	24.5	27.6	27.1
HWFI	10.1	17.1	24.7	31.9	38.2	41.8	37.4
DSHP	10.6	12.3	13.1	14.4	**15.7**	**15.1**	16.1
LGEM	10.3	12.7	13.5	15.9	**13.8**	**15.5**	18.7
ICON	8.7	11.5	13.9	17.9	19.9	22.8	23.5
IVCN	8.6	11.4	14.0	17.5	19.6	22.3	24.1
FSSE	8.6	10.3	11.9	16.0	18.2	24.0	29.6
Forecasts	34	32	30	28	24	20	15

Figure 1. Best track positions for Hurricane Celia, 18-28 June, 2010.



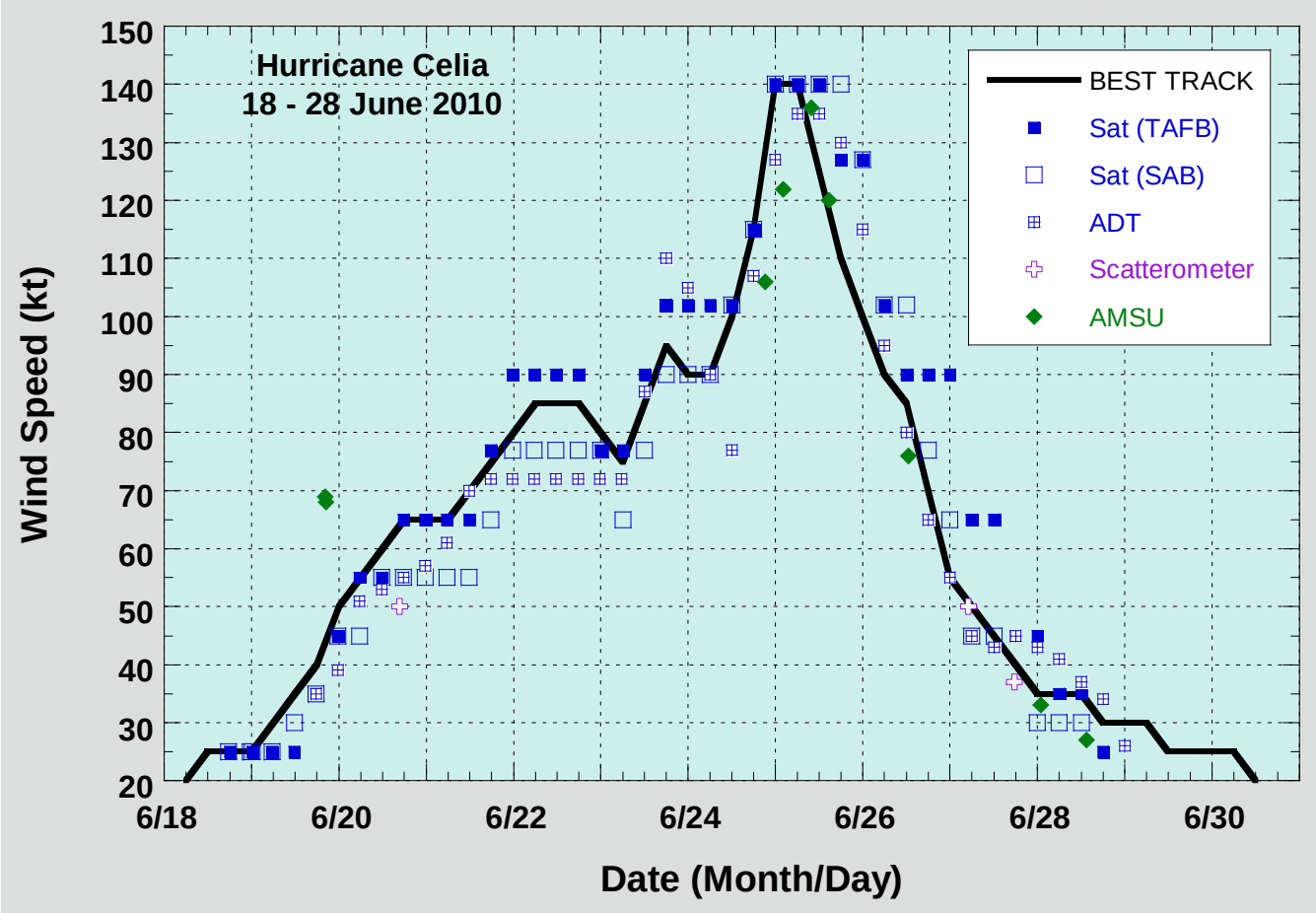


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Celia, 18-28 June, 2010. Advanced Dvorak Technique estimates represent linear averages over a three-hour period centered on the nominal observation time. Dashed vertical lines correspond to 0000 UTC.

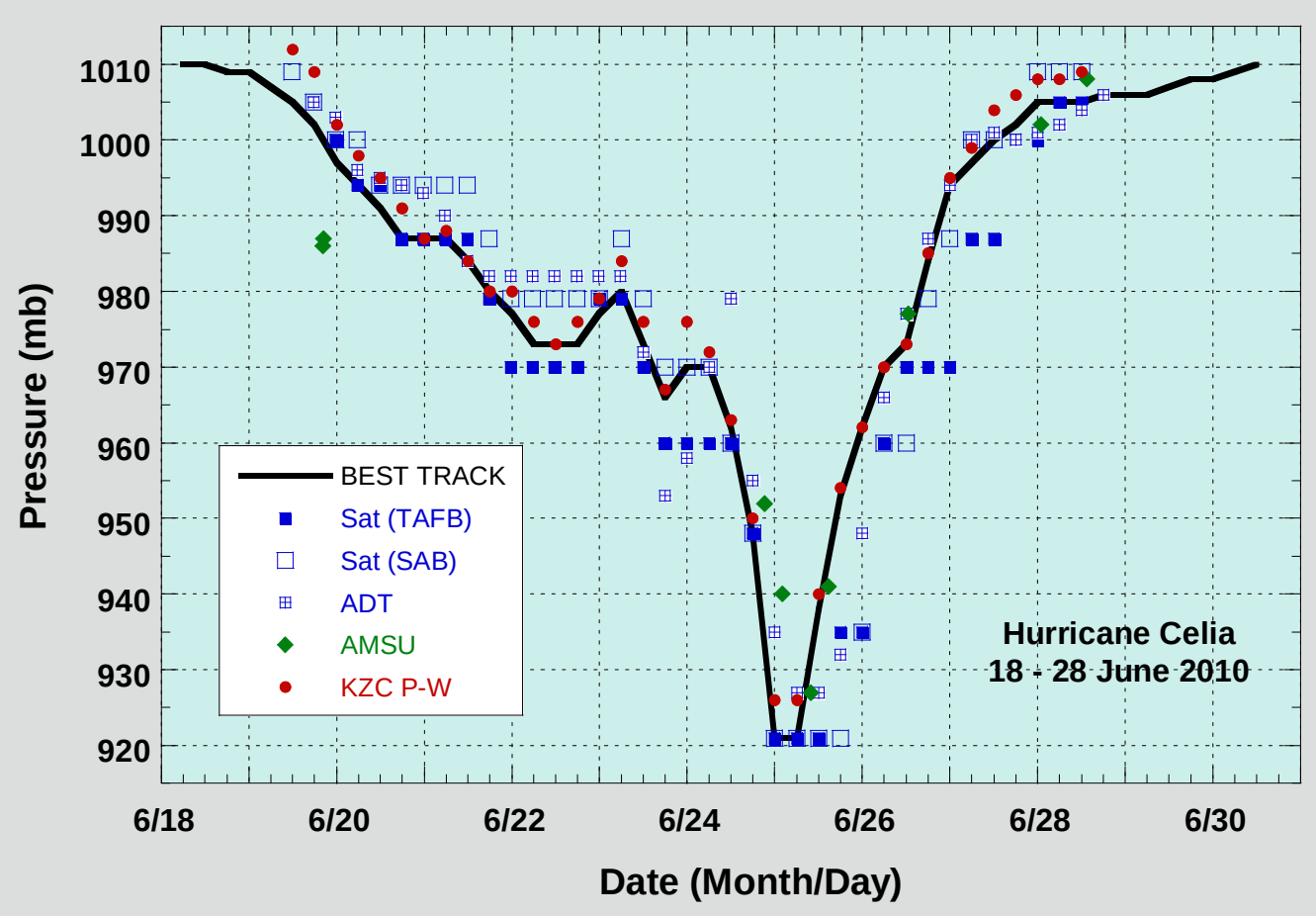


Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Celia, 18-28 June, 2010. Advanced Dvorak Technique estimates represent linear averages over a three-hour period centered on the nominal observation time. Dashed vertical lines correspond to 0000 UTC. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship.