

ANNUAL SUMMARY

Eastern North Pacific Tropical Cyclones of 1987

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ABSTRACT

A summary of the 1987 season is presented. Included are season statistics, storm tracks and comparisons with activity in recent years.

1. Statistics

The 1987 Eastern North Pacific tropical cyclone season began on 7 June with the formation of tropical storm Adrian and ended on 25 November with the dissipation of tropical depression Twenty-two. Spanning 171 days, the season was 15 days longer than the 1986 season and 8 days longer than the average of the past 11 years.

There were 22 tropical cyclones during the 1987 season, 18 of which were named. This was four fewer than the record 26 tropical cyclones in the 1982 season. The 1987 season was the sixth in a row in which there have been 22 or more tropical cyclones.

All except three of this year's cyclones developed over warm southern waters, moved west-northwest and dissipated over the cold subtropical waters of the eastern Pacific. This was due in part to an especially strong ridge, which extended to the Hawaiian Islands during most of the season.

Table 4 presents statistical data for 1987 tropical storms and hurricanes. The monthly distribution of 1987 tropical cyclone activity is shown in Table 1; and Tables 2, 3 and 5 compare this activity with that of recent years. The 1966–87 period was chosen for comparison due to the excellent satellite coverage over tropical waters since 1966. Prior to that time, some tropical cyclone activity may have gone undetected due to the sparsity of data in the area. Figure 1 shows the tracks of the tropical cyclones and Figs. 2 through 9 are satellite pictures of the nine hurricanes that occurred during the 1987 season.

Eastern Pacific Hurricane Center (EPHC) forecasters issued 397 tropical cyclone advisories during the 1987 season. Advisories were issued four times daily for cyclone positions at 0000, 0600, 1200 and 1800 UTC.

The Central Pacific Hurricane Center (CPHC) in Honolulu, Hawaii, issued additional advisories on two of the 1987 cyclones, Fernanda and Jova, after they moved across 140°W longitude and into the CPHC area of forecast responsibility.

Hurricane Max attained winds of 70 m s^{-1} (135 kt). This is the highest wind estimate recorded for an eastern Pacific hurricane since satellite estimates have been available. The longest lived storm was Hurricane Hilary, which spanned a period of 10 days from tropical depression stage to its final position.

2. Storm effects

Only one of the Eastern North Pacific tropical cyclones moved onshore during the 1987 season, compared to three during the 1986 season. This was Hurricane Eugene, the first hurricane of the season which moved inland near Manzanillo, Mexico on 25 July. Winds were estimated at 44 m s^{-1} . Widespread flooding of this coastal resort city was reported. At least 60 people were left homeless but fortunately, no deaths were reported.

Although Tropical Storm Irwin did not move ashore, an area of intense convection associated with it moved over Acapulco, Mexico on 5 August causing damage worth an estimated 2.1 million dollars. High winds and heavy rains reportedly damaged roads and businesses in that area.

Tropical Storm Pilar, a cyclone which was classified for only 24 hours, moved northward toward Cabo San Lucas, Baja California on 30 September. Even though this storm was very short lived, an observer in Cabo San Lucas measured 182 mm (7.15 in) of precipitation, more than in any storm he had encountered during his 18 years in the area. An area of intense convective activity moved slowly over that area beginning about 1200 UTC on the 30th and lasted until about 0000 UTC 2 October.

The moisture which sheared northeastward from Hurricane Ramon on 11–12 October interacted with

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TABLE 1. Monthly distribution of Eastern North Pacific tropical cyclones, 1987.*

	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Tropical depression	0	2	1	0	0	0	1	0	4
Tropical storms	0	1	4	2	1	1	0	0	9
Hurricanes	0	0	3	2	3	1	0	0	9
Total	0	3	8	4	4	2	1	0	22

* Cyclones are ascribed to the month in which they began.

an upper-level closed low that moved eastward towards extreme southern California. Ramon's moisture contributed to record rainfalls in the area. In and around San Diego, rainfall amounts between 1 and 2 inches were common, and at higher elevations, amounts were no doubt much higher. Near Mt. Palomar, located 30 km northeast of San Diego, California, a brush fire which had raged out of control for more than a week was brought under control by the rainfall. In addition, high winds toppled trees in some areas of San Diego, and some mud slides were reported around Mt. Palomar.

3. Basic data

The National Weather Service Satellite Field Service Station, collocated with the EPHC, provided excellent satellite coverage during the 1987 season. Visual and infrared satellite imagery was available from the GOES

and polar orbiting NOAA satellites. Continuous surveillance was provided by the Digital Weather Processing System (DWIPS), the Electronic Animation System (EAS) and the Satellite Image Display System (SIDS). Detail on satellite imagery was excellent with full disk resolution at 7 km, sector resolution at 4 km, and on request, high resolution sector at 0.9 km. The gridding of satellite imagery was accurate to within a few kilometers due to the stability of the satellites and easily identifiable landmarks. Enhanced BD-curve infrared imagery was especially useful in depicting intensity of storms using cloud-top temperatures. This computer-generated enhancement was developed especially for use with the Dvorak technique of satellite analysis, which in recent years has evolved into the primary tool for estimating cyclonic intensity of tropical cyclones. In addition, the enhanced satellite imagery was useful in locating storm centers at night. (Dvorak 1984).

TABLE 2. Frequency of Eastern North Pacific tropical storms and hurricanes by months and years.*

Year	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1966	0	1	0	4	6	2	0	0	13
1967	0	3	4	4	3	3	0	0	17
1968	0	1	4	8	3	3	0	0	19
1969	0	0	3	2	4	1	0	0	10
1970	1	3	6	4	1	2	1	0	18
1971	1	1	7	4	2	2	1	0	18
1972	1	0	1	6	2	1	1	0	12
1973	0	3	4	1	3	1	0	0	12
1974	1	3	3	6	2	2	0	0	17
1975	0	2	4	5	3	1	1	0	16
1976	0	2	4	4	3	1	0	0	14
1977	1	1	1	1	3	1	0	0	8
1978	1	3	4	6	2	2	0	0	18
1979	0	2	2	2	1	2	1	0	10
1980	0	3	5	2	2	2	0	0	14
1981	1	1	3	4	2	4	0	0	15
1982	1	1	6	5	4	2	0	0	19
1983	1	1	6	3	5	3	1	1	21
1984	2	3	3	4	4	2	0	0	18
1985	0	5	7	4	4	2	0	0	22
1986	1	2	3	5	5	1	0	0	17
1987	0	0	7	4	4	2	0	0	17
Total	12	41	87	88	68	42	6	1	
Average	0.5	1.9	4.0	4.0	3.1	1.9	0.3	0.0	15.7

* Cyclones are ascribed to the month in which they began.

TABLE 3. Number of Eastern North Pacific tropical storms reaching hurricane intensity by months and years.*

Year	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1966	0	1	0	4	2	0	0	0	7
1967	0	1	0	2	1	2	0	0	6
1968	0	0	0	3	2	1	0	0	6
1969	0	0	1	1	1	1	0	0	4
1970	1	0	1	1	0	1	0	0	4
1971	1	1	5	2	2	1	0	0	12
1972	1	0	0	6	1	0	0	0	8
1973	0	1	3	0	2	1	0	0	7
1974	0	2	2	4	2	1	0	0	11
1975	0	1	2	3	1	1	0	0	8
1976	0	2	1	2	3	0	0	0	8
1977	0	0	1	1	1	1	0	0	4
1978	1	2	3	4	1	1	0	0	12
1979	0	1	1	2	1	1	0	0	6
1980	0	2	2	2	1	0	0	0	7
1981	0	1	1	3	1	2	0	0	8
1982	0	0	4	3	3	1	0	0	11
1983	1	1	2	2	3	2	0	1	12
1984	1	3	2	2	4	0	0	0	12
1985	0	2	1	3	3	2	0	0	11
1986	1	1	2	1	3	1	0	0	9
1987	0	0	3	2	3	1	0	0	9
Total	7	22	37	53	41	21	0	1	182
Average	0.3	1.0	1.7	2.4	1.9	1.0	0.0	0.0	8.3

* Cyclones are ascribed to the month in which they began.

Aerial reconnaissance was not required during the 1987 season since none of the cyclones posed a threat to the United States mainland or a U.S. military installation.

4. Forecast verification

Numerically generated forecast tracks for tropical cyclones in the Eastern North Pacific were available from the National Hurricane Center in Miami during the 1987 season. Two new statistical models for the Eastern Pacific became available this season. The new track model, Eastern Pacific Statistical-Synoptic 1987 (EPSS87) replaced the older statistical-synoptic model EPHC77. EPSS87 uses input data from EPCLIPER84 rather than the older EPCLPR model. The synoptic grid is oriented along the axes of bivariate normal ellipses determined by the storm displacements in the 1975-85 developmental data, rather than poleward. This model, developed by Arthur C. Pike of the National Hurricane Center in Miami, Florida, uses tropospheric (1000-100 mb) mass-weighted mean wind components, which help to specify environmental steering better than the 500 mb heights used previously. The second new model EPSHIF is a climatology and persistence regression model used to predict maximum wind speed through 72 hours. It uses first- and second-order terms based on seven primary predictors: day number, initial latitude and longitude, past 12 hour zonal and meridional motion, initial maximum wind,

and past 12 hour change of maximum wind. In addition, an analog model (EPANALOG85), a simulated analog model (EPCLIPER84), a statistical dynamical model (EPHC81) and a barotropic model (EPSANBAR) were used operationally during the 1987 season. Table 6 shows the average operational forecast errors for the 24, 48 and 72 hour positions for the EPHC forecasters and the numerical models.

While the numerical forecasts are independent of each other, the forecasts made by the EPHC forecasters are not independent of the numerical forecasts. The EPHC81 forecasts were run only on 0000 and 1200 UTC input data and were not always available on a timely basis for utilization in operational forecasts made by the EPHC forecasters.

5. Individual hurricanes

a. Hurricane Eugene, 22-26 July

The first storm of the 1987 season to become a hurricane moved into the Pacific from Nicaragua as a disturbance on 20 July. Moving westward in deep easterly flow, the disturbance was upgraded to a tropical depression at 0000 UTC 22 July, centered near 21.7°N, 116.6°W. TD Eight immediately began to veer north northwestward towards a stationary inverted trough centered over central Mexico. It was upgraded to Tropical Storm Eugene at 1800 UTC 22 July. Moving north northwest at 4 m s⁻¹, Eugene reached hurricane

TABLE 4. Eastern North Pacific Tropical Cyclones 1987. All times UTC, latitudes north, longitudes west. HU: hurricane, TS: tropical storm, TD: tropical depression.

Cyclone	Maximum wind					Final position	from		to
	Depression	Storm	Hurricane	Storm	Depression		m s ⁻¹ (kt)		
Adrian	071800	080000			090000	091200	21 (40)	080600	081200
7-9 Jun	11.6-96.3	11.8-97.5			12.2-99.8	13.5-98.6		12.3-98.1	12.8-98.7
TD Two	101800					120000	13 (25)	101800	111800
10-12 Jun	13.5-101.3					200600	15 (30)	190000	14.5-101.6
TD Three	181800					8.9-109.6		051200	191200
18-20 Jun	9.7-104.8					070000	23 (45)	071200	9.5-107.4
TS Beatriz	031200	040600			061200	20.5-129.8		16.5-121.5	051800
3-7 Jul	12.9-115.9	13.8-117.8			19.9-126.9	100600	28 (55)	081200	17.5-122.5
TS Calvin	051800	060600			091200	17.0-122.2		14.8-116.0	081800
5-10 Jul	12.6-101.8	13.1-104.1			15.2-120.3	171200	15 (30)	131800	14.8-117.3
TD Six	130000					14.9-139.7		14.4-118.1	160000
13-17 Jul	13.4-114.8	151200			190600	200000	26 (50)	171200	14.5-131.3
TS Dora	150000	15.8-105.0			21.2-116.0	21.7-116.6		17.9-112.4	171800
15-20 Jul	15.3-102.5	221800			260600	22.0-106.3	44 (85)	250600	18.4-113.0
HU Eugene	220000	12.3-100.7	241200	251800	21.4-105.9	251800*	23 (45)	17.7-104.2	251200
22-26 Jul	11.0-97.0	250600	16.2-103.5	20.0-105.2		12.5-138.9		12.4-137.8	18.5-104.6
TS Fernanda	240600	12.3-136.4				031800	36 (70)	010000	12.5-138.9
24-25 Jul	11.8-131.0	291200	311800	011800	021800	21.6-124.0		19.8-113.3	010600
HU Greg	280000	11.8-101.0	19.1-112.5	21.3-116.7	21.6-120.9	090600	54 (105)	040000	20.4-114.3
28 Jul-3 Aug	11.8-101.0	011200	021200	071200	090000	22.1-123.3		14.6-106.4	041200
HU Hilary	311800	11.7-95.3	12.5-99.3	20.0-119.5	22.1-123.3	090600	28 (55)	061800	15.2-108.4
31 Jul-9 Aug	10.7-92.4	040000			17.2-107.9	17.2-107.9	46 (90)	15.3-99.1	081800
TS Irwin	031800	10.4-90.9	161800	200000*		15.0-140.5		171800	17.2-106.4
3-9 Aug	10.1-90.2	141800	12.4-129.9	15.0-140.5		10.3-126.5	18 (35)	290600	180000
HU Jova	131800	12.6-122.8			300600	10.3-129.2		10.2-121.5	14.4-132.8
13-20 Aug	13.4-119.5	290600				031200	39 (75)	011200	10.3-125.2
TS Knut	281800	10.2-121.5			030600	20.4-118.4		17.4-114.3	011800
28-30 Aug	10.3-118.9	300000	010600	020600	16.9-118.1	20.4-118.4		130600	17.8-115.0
HU Lidia	291200	13.5-104.6	16.9-113.5	18.5-116.4	20.0-118.1	161200	70 (135)	17.4-114.3	140000
30 Aug-3 Sep	12.5-102.6	100000	110600	151800	160600	21.8-123.4		15.1-116.8	17.5-118.6
HU Max	091200	11.1-102.7	11.8-108.4	21.3-121.7	21.7-123.1	201200	34 (65)	171200	171800
9-16 Sep	11.3-100.0	151800	171200	180000	191800	24.2-112.0		220600	20.2113.5
HU Norma	141200	18.2-111.0	19.9-113.4	20.5-113.5	23.8-112.8	261800	52 (100)	14.5-121.8	240600
14-20 Sep	15.4-107.4	201800	211200	251200	260000	17.5-138.7		1010330	16.9-126.4
HU Otis	200000	11.4-120.3	13.2-120.8	17.3-131.0	17.2-134.1	011200	18 (35)	20.0-110.0	010600
20-26 Sep	10.2-119.5	010330			22.9-110.8	120600	62 (120)	090600	22.4-110.9
TS Pilar	301200	20.0-110.0	071200	111800	22.9-110.8	22.0-122.1		15.1-114.4	091800
30 Sep-01 Oct	20.5-110.8	051800	13.7-109.8	21.3-120.8	120000	310600	18 (35)	271800	16.0-116.5
HU Ramon		12.2-104.2			300600	24.1-122.8		11.7-124.4	300000
5-12 Oct	270000	271800			20.7-125.4	14.6-120.5	13 (25)	13.8-121.2	19.9-125.8
TS SELMA	9.5-121.2	11.7-124.4							251800
27-31 Oct	241800								14.6-120.5
TD Twenty-two	13.8-121.2								
24-25 Nov									

* Passed to the Central Pacific Hurricane Center in Honolulu.

TABLE 5. Seasonal Statistics since 1977.

Year	Cyclones	Moved onshore	Passed to CPHC HNL*	Length of season (days)	Storm hours	Hurricane hours	Hurricanes 55 m s^{-1} or greater	Advisories issued
1977	17	0	0	152	343	128	0	193
1978	21	3	5	144	873	840	6	394
1979	13	3	0	172	482	326	4	198
1980	15	0	1	143	476	586	3	470
1981	17	6	2	153	858	432	1	309
1982	26	1	6	160	1044	774	4	509
1983	24	3	3	201	1238	1098	8	580
1984	24	6	3	173	1187	1048	6	585
1985	25	1	5	170	1278	844	7	620
1986	25	3	6	156	927	593	3	431
1987	22	1	1	171	924	630	4	397
Total	228	27	32	1795	9630	7299	46	4686
Average	21	2.5	3.0	161	875	664	4.0	429

* Central Pacific Hurricane Center, Honolulu.

intensity when centered 400 km south southeast of Manzanillo, Mexico. Moving northward Eugene hit the Mexican coast near Manzanillo at 1200 UTC 25 July, (Fig. 2). High winds and heavy rain with extensive flooding were reported in the area. In Manzanillo, at least 60 people were left homeless but there were no reported deaths.

Eugene weakened rapidly over land but kept its organization and moved north northwest out to sea just west of Puerto Vallarta. Eugene dissipated over water at 1200 UTC 26 July, centered near 22°N , 106°W .

b. Hurricane Greg, 28 July–3 August

The next hurricane of the season began as an easterly wave that moved west from Panama on 26 July. It was classified Tropical Depression Ten at 0000 UTC 28 July near 12°N , 101°W and Tropical Storm Greg at 1200 UTC 29 July near 15°N , 104°W . Greg intensified uneventfully while moving northwest over 29°C waters. Greg reached hurricane intensity at 1800 UTC 31 July near 19°N , 113°W , continued as a hurricane for 24 hours, then began to weaken as the sea surface tem-

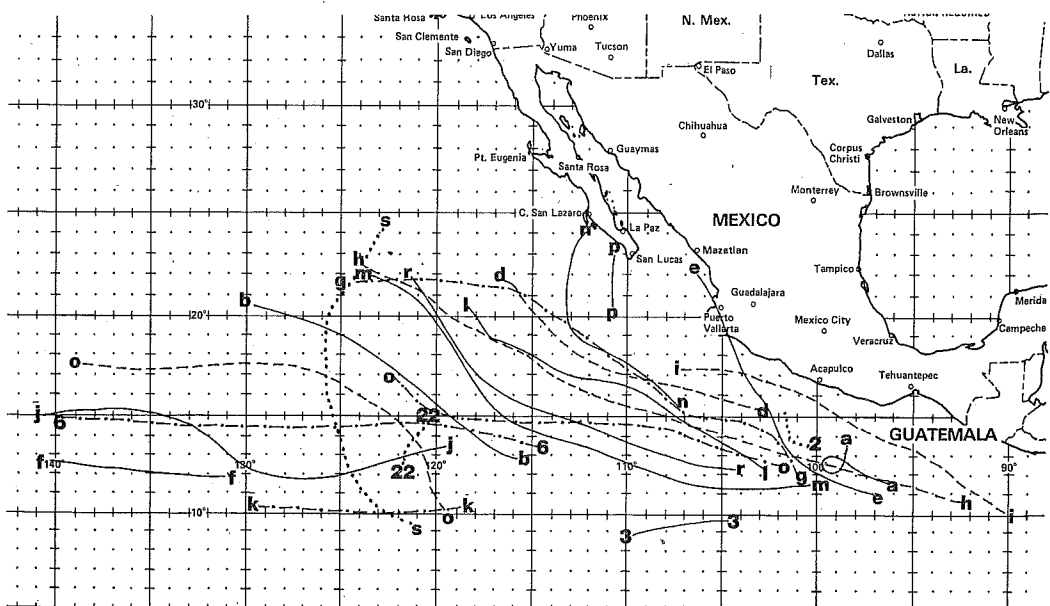


FIG. 1. Tracks of Eastern North Pacific tropical cyclones, 1987. Letters refer to the first letter of each tropical storm.

TABLE 6. 1987 Operational forecast errors.*

	Forecast period (hours)		
	24	48	72
EPHC forecasters	158/236	267/176	397/122
EPANALOG85	169/233	282/176	386/125
EPSS87	148/232	252/174	365/121
CLIPER84	165/236	272/177	385/124
EPHC81	161/102	245/77	385/55

* Average error in kilometers/number of cases.

perature became steadily colder, (Fig. 3). Greg turned west northwest on 1 August due to an east-west oriented ridge running through the southwestern U.S. which intensified and prevented further northward movement. The remnants of Hurricane Greg dissipated over 22°C water at 1800 UTC 3 August near 22°N, 124°W.

c. Hurricane Hilary, 31 July–9 August

Hurricane Hilary formed out of a tropical wave which moved through Central America on 30–31 July beneath a deep layer mean ridge line, which extended

from Oklahoma through southern California to the Hawaiian Islands. This ridge line was responsible for steering this and other hurricanes west-northwest, leading to eventual dissipation over cold water. Convective activity began to increase rapidly after 0000 UTC 31 July, and the first advisory was issued at 1800 UTC 31 July as the cyclone moved west-northwest over 29° to 30°C water. Hilary moved west-northwest at 5–6 m s⁻¹, became a tropical storm at 1200 UTC 1 August, and a hurricane at 1200 UTC 2 August. She reached maximum intensity of 54 m s⁻¹ at 0000 UTC 4 August, (Fig. 4). This was followed by slow, steady weakening until Hilary dissipated over 21°C water at 0600 UTC 9 August.

d. Hurricane Jova, 13–20 August

The 13th tropical cyclone of the season formed in deep easterly flow to the south of the strong deep layer ridge line, which extended from southern Texas through southern Baja California and on to the Hawaiian Islands. The first advisory was issued at 1800 UTC 13 August when the depression was located near 13°N, 120°W. Tropical Depression Thirteen was steered slightly south of west due to the orientation of the ridge, and intensified slowly. It was upgraded to

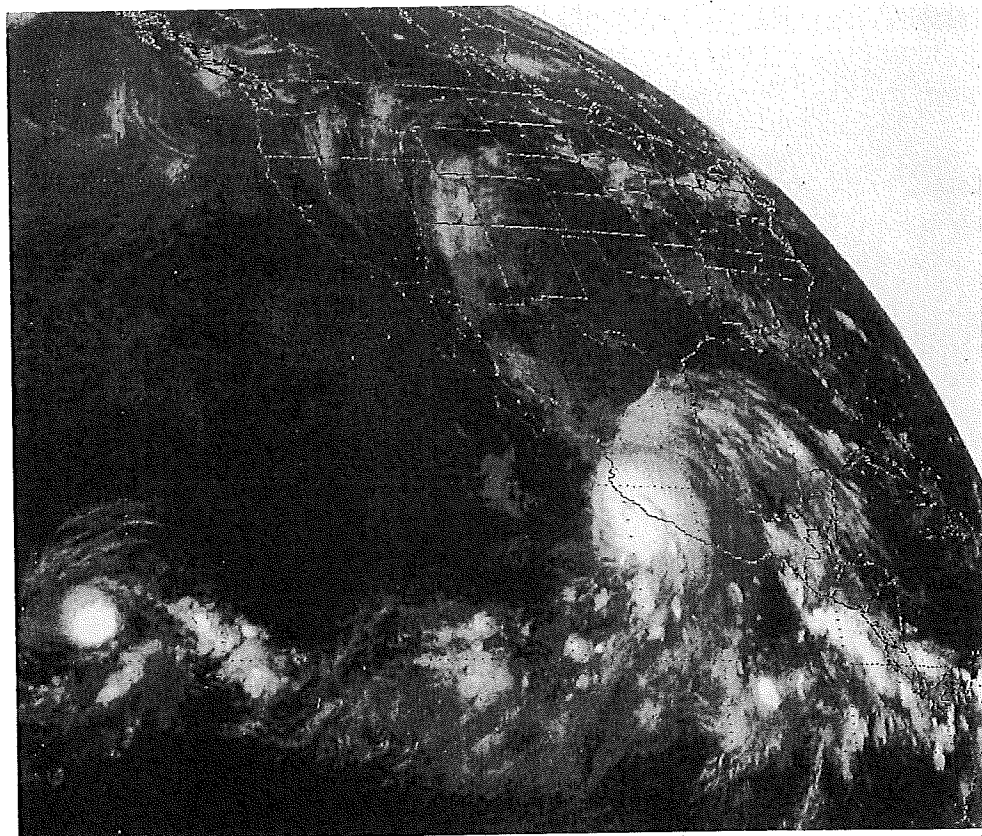


FIG. 2. (Eugene) Infrared satellite photo of Hurricane Eugene nearing the Mexican coast south of Manzanillo.

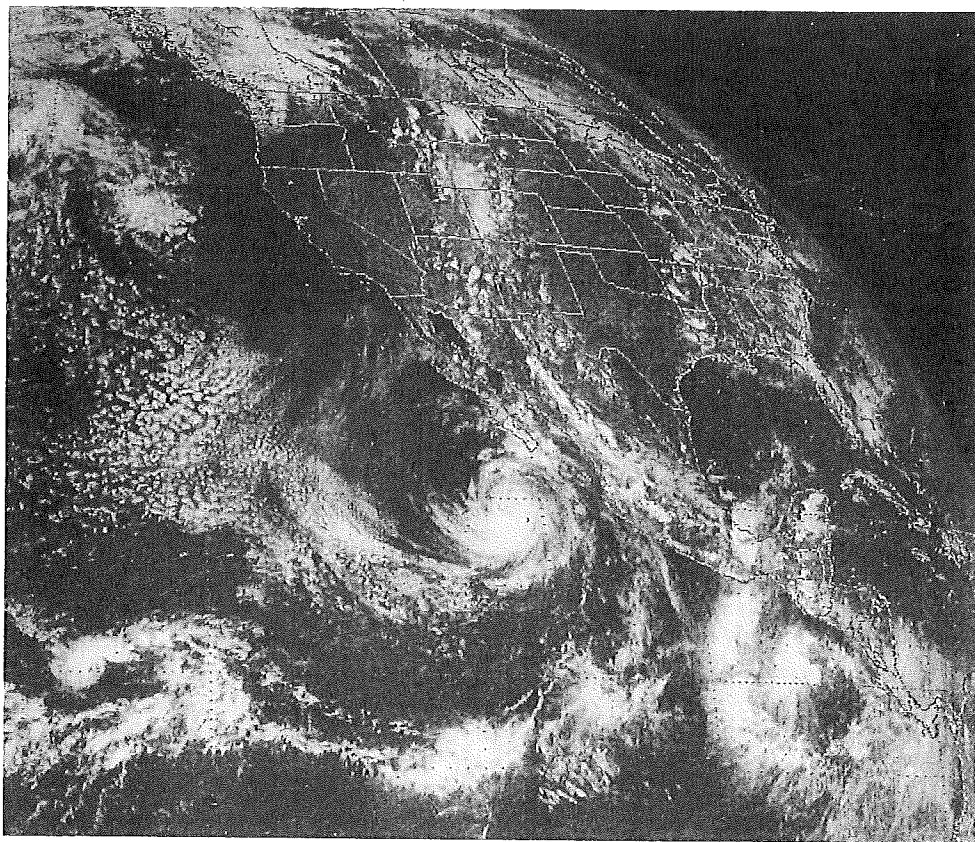


FIG. 3. (Greg) 2045 UTC visible satellite image of Hurricane Greg peaking with 36 M s^{-1} winds. Tropical Depression 14-E (Hilary) is centered near 11°N , 92°W .

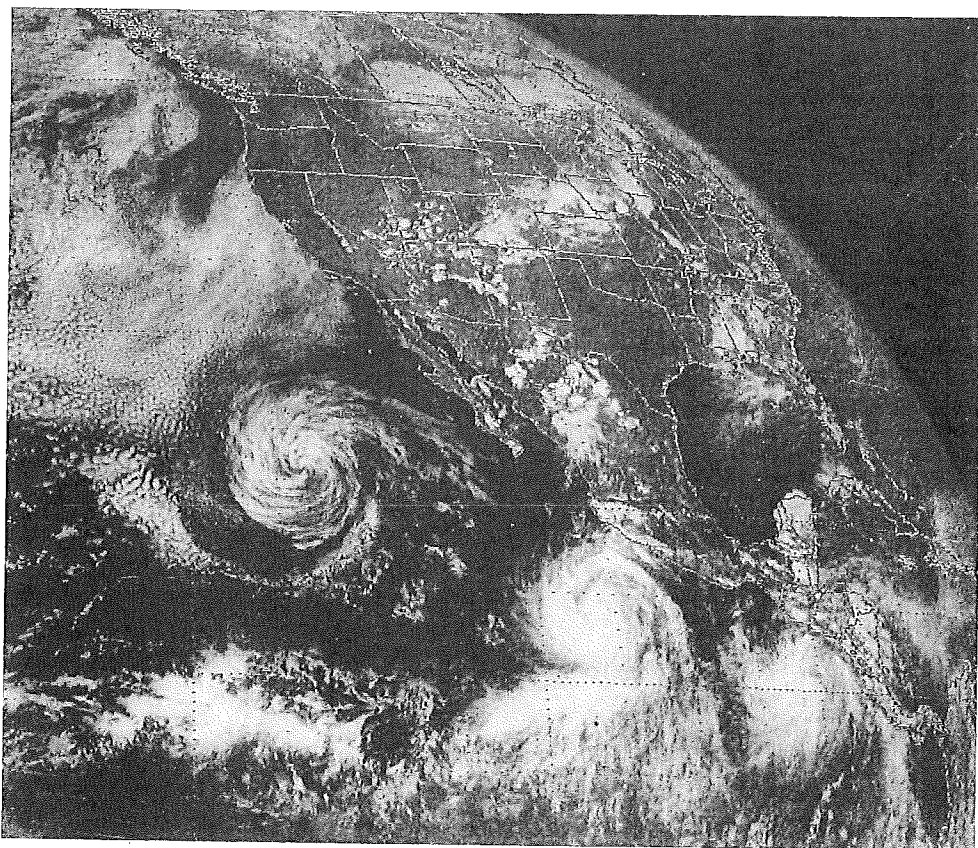


FIG. 4. (Hilary) 2045 UTC visible image of Hurricane Hilary centered near 14.4°N , 105.8°W . Dvorak wind estimate 54 m s^{-1} . Tropical Storm Irwin is centered near 10.2°N , 90.5°W , and the remnants of Hurricane Greg are located west of Cabo San Lucas.

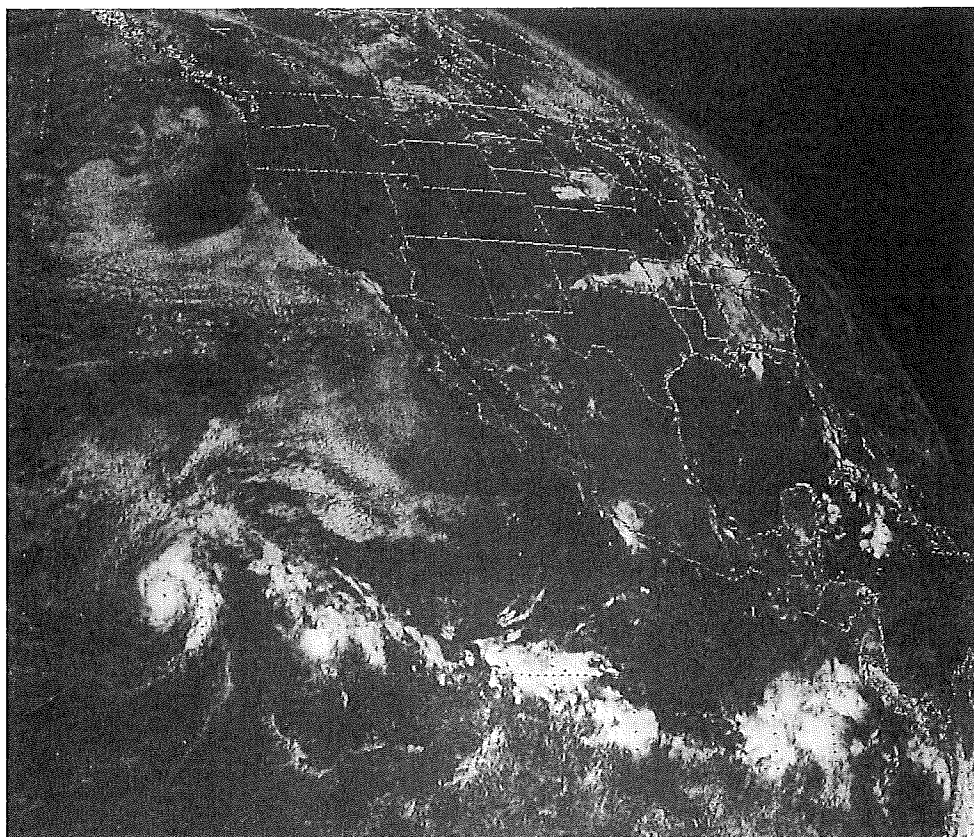


FIG. 5. (Jova) Hurricane Jova centered near 14.4°N , 132.8°W 1745 UTC GOES-6 visible image. Note the strong feeder band in the southeast quadrant.

Tropical Storm Jova at 1200 UTC 14 August and reached hurricane intensity at 1800 UTC 16 August, centered near 12°N , 130°W . Jova then turned west-northwestward. By 1800 UTC 17 August the maximum winds around Jova had reached 46 m s^{-1} , over an area of $26^{\circ}\text{--}27^{\circ}\text{C}$ water, (Fig. 5). This was followed by a turn toward the west along with a moderate weakening trend. Hurricane Jova continued westward and was transferred to the CPHC in Honolulu at 0000 UTC 20 August when centered near 15°N , 140°W . Jova continued moving westward and finally dissipated near 14°N , 155°W on 22 August.

e. Hurricane Lidia, 30 August–3 September

The fifth hurricane of the season began as a tropical wave, which passed into the Pacific from Central America on 28 August. This disturbance moved rapidly westward over the warm waters south of Salina Cruz, Mexico. The first bulletin was issued at 1200 UTC 29 August near 13°N , 103°W , about 550 km southwest of Acapulco. Moving northwest, this depression, Number Fifteen, was upgraded to Tropical Storm Lidia at 0000 UTC 30 August and reached hurricane intensity at 0600 UTC 1 September, (Fig. 6). Just 6 hours

later, according to Dvorak wind estimates, winds around Lidia peaked at 39 m s^{-1} . A fairly rapid weakening trend followed, over increasingly cold water. Lidia dissipated over 25°C water near 20°N , 118°W at 1200 UTC 3 September.

f. Hurricane Max, 9–16 September

On 8 September, a tropical disturbance moved westward from Central America, intensified over the warm waters south of the Gulf of Tehuantepec, and was classified as the 16th tropical depression of the season at 1200 UTC 9 September. The depression was then centered near 11°N , 100°W , about 600 km south of Acapulco, Mexico. This depression intensified rapidly as it moved westward and was named Tropical Storm Max at 0000 UTC 10 September. Thirty hours later Max became a hurricane when centered near 12°N , 109°W . Turning northwest, Max continued to intensify. By 0600 UTC 13 September, the Dvorak satellite wind estimate reached T number 7 or 70 m s^{-1} . This is the highest wind recorded for any Eastern Pacific hurricane since satellite wind speed estimates have been available (Fig. 7). This intensity was maintained for 24 hours. Then Max reached the 26°C water and began

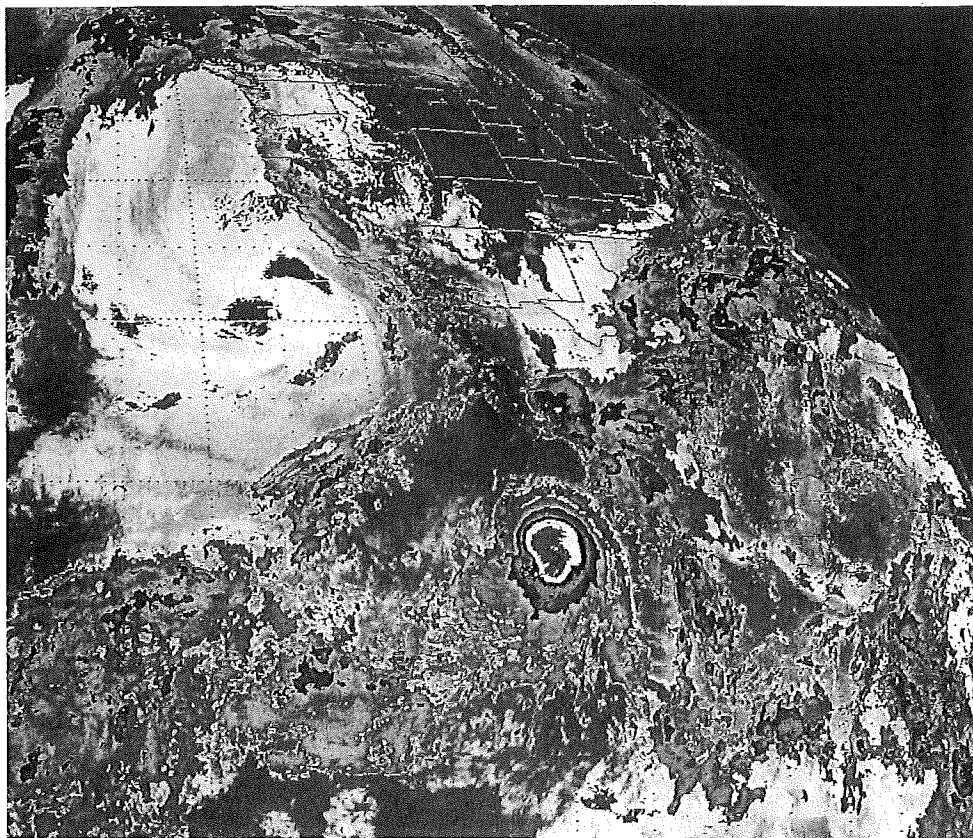


FIG. 6. (Lidia) Enhanced infrared satellite image of Hurricane Lidia in a classic bursting pattern. The coldest cloud tops are near -85°C .



FIG. 7. (Max) Infrared satellite image of Hurricane Max with 70 m s^{-1} winds—the highest wind estimate of any Eastern Pacific Hurricane since satellite wind estimates have been available. A tropical disturbance

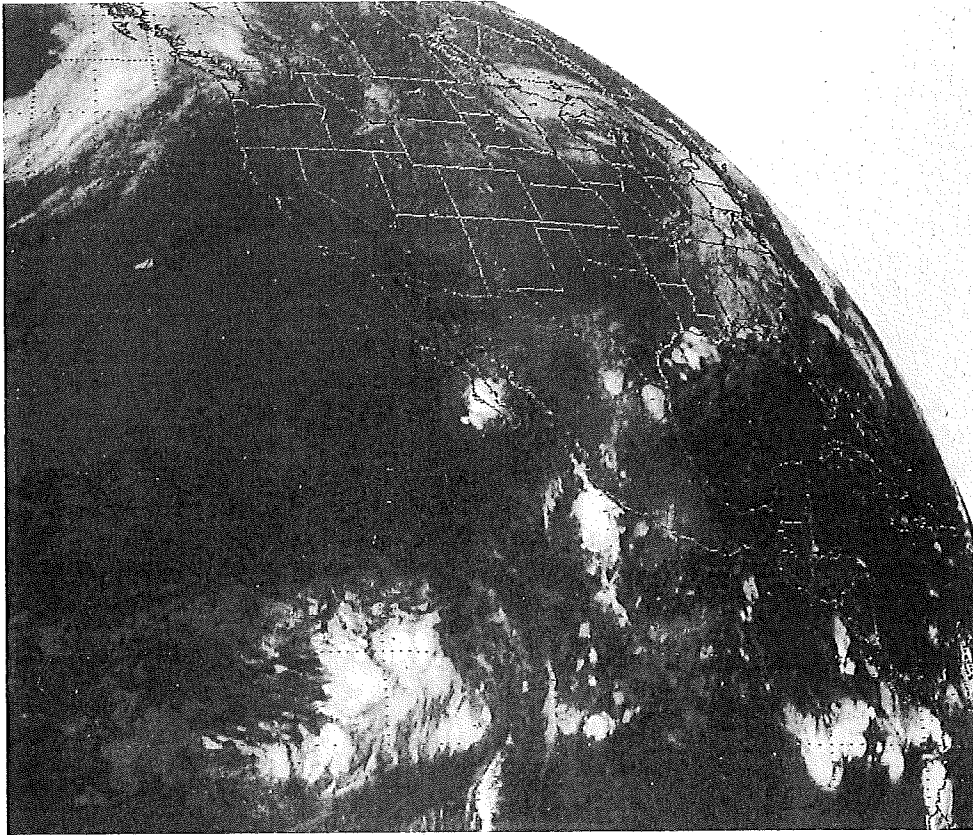


FIG. 8. (Norma) Visible image of Hurricane Norma; a minimal hurricane which maintained hurricane winds for less than 12 hours.

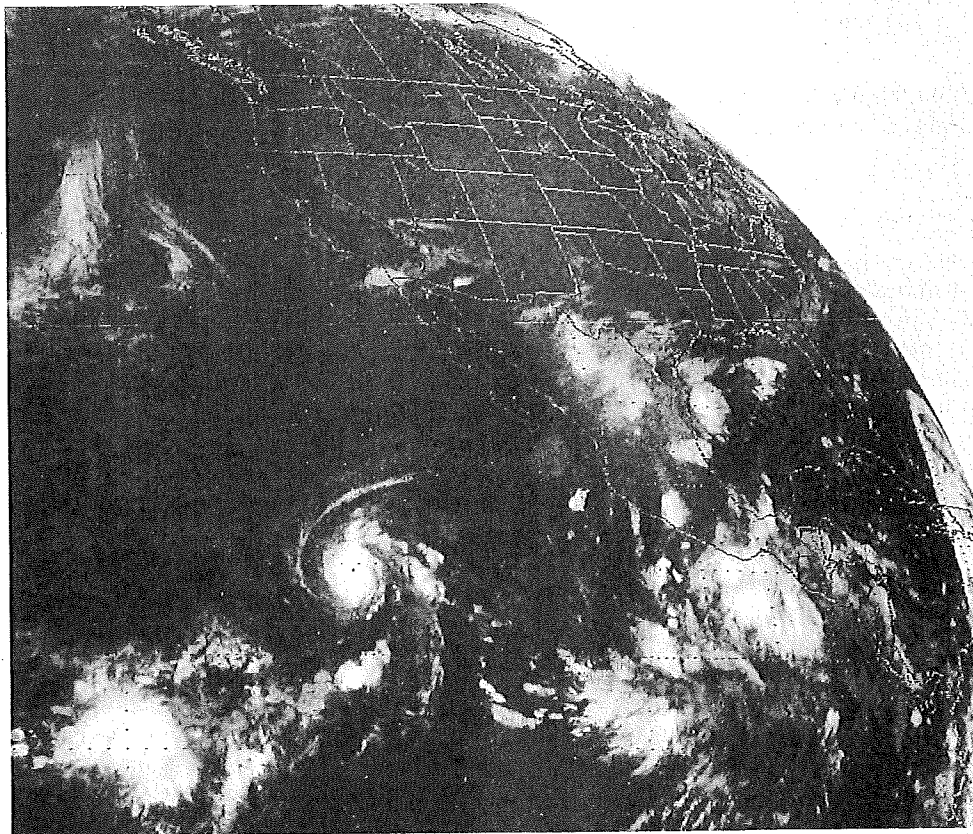


FIG. 9. (Otis) Infrared satellite image of Hurricane Otis with a small but distinct eye.

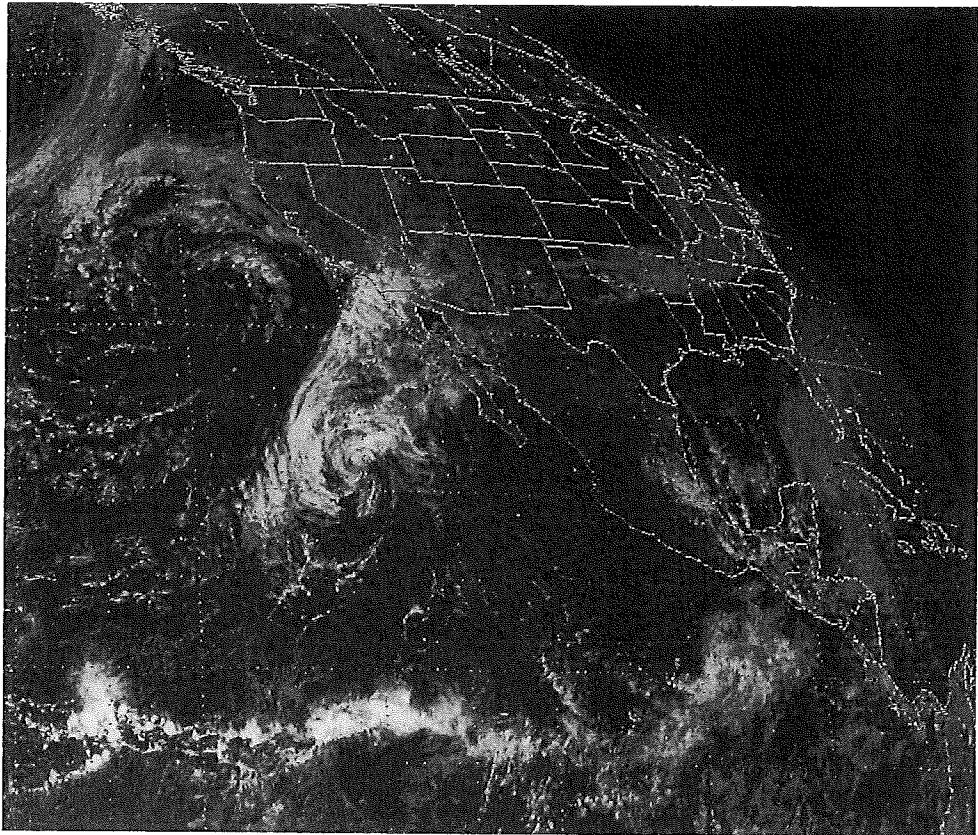


FIG. 10. (Ramon) Visible satellite photo of the remnants of Hurricane Ramon feeding moisture into Southern California. An upper level closed low centered near 33°N , 129°W was moving east at the time.

to weaken rapidly. The final bulletin was issued at 1200 UTC 16 September when Max was centered near 22°N , 123°W .

g. Hurricane Norma, 14–20 September

Hurricane Norma began as a tropical disturbance about 550 km southwest of Acapulco, Mexico on 13 September. This disturbance moved northwest toward a col, centered just west of Cabo San Lucas, Mexico.

The first bulletin was issued at 1200 UTC 14 September. With steady intensification over 28°C water, Tropical Depression Seventeen became a tropical storm at 1800 UTC 15 September, and a hurricane at 1200 UTC 17 September when a small eye became apparent in satellite infrared imagery.

Norma then turned northward at $2\text{--}3\text{ m s}^{-1}$ and passed about 330 km to the west of Cabo San Lucas on 19 September. At that point it appeared that Norma would move inland but instead, the storm stalled off the west coast of Baja California south of Santa Margarita Island and dissipated over 25°C water. This was due in part to a very weak southwesterly steering flow associated with an upperlevel cutoff low that settled over the waters off northern Baja California on 17–18 September. Even though the storm center dissipated

over water, an associated area of intense convection moved inland on 19 September (Fig. 8). The area is sparsely populated and no reports of flooding or damage were received.

h. Hurricane Otis, 20–26 September

The 18th tropical cyclone of the season developed very slowly as a disturbance on the ITCZ. This disturbance moved westward over the waters south of the Gulf of Tehuantepec between 17–19 September. At 0000 UTC 20 September, the disturbance was upgraded to Tropical Depression Nineteen-E. It promptly turned northwestward and intensified rapidly over $28^{\circ}\text{--}29^{\circ}\text{C}$ water. At 1800 UTC 20 September, it was named Tropical Storm Otis, then increased to hurricane intensity just 18 hours later.

As Otis moved westward, the wind speed increased to 52 m s^{-1} by 0600 UTC 22 September and maintained that intensity most of the time during the next $2\frac{1}{2}$ days (Fig. 9). Late on the 24th, Otis began to accelerate westward and weakened over 26°C water. Increasing vertical wind shear ahead of a trough along 150°W further weakened the storm until it dissipated near 17.5°N , 138.7°W at 1800 UTC 26 September.

i. Hurricane Ramon, 5–12 October

On 3–4 October, a tropical disturbance moved into the Pacific south of a large high pressure cell centered in central Mexico. The disturbance became increasingly organized as it moved westward over 28°C water. It was named Tropical Storm Ramon at 1800 UTC 5 October, when centered about 925 km southwest of Acapulco.

Ramon turned west northwest and intensified to hurricane intensity by 1200 UTC 7 October. At 0600 UTC 9 October, Ramon peaked in intensity with 60 m s^{-1} winds. Winds remained above 50 m s^{-1} until 0600 UTC 11 October. Then the storm weakened rapidly as it interacted with a subtropical jetstream and increasingly cold water.

Ramon dissipated at 0600 UTC 12 October, however copious moisture was transported from the storm environment by the subtropical jetstream northeastward into southern California (Fig. 10). This moisture fed a storm center in the westerlies and contributed to record rainfall in extreme southern California.

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