

## Eastern North Pacific Hurricane Season of 1990

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### ABSTRACT

The 1990 eastern Pacific hurricane season is summarized. Twenty tropical storms were tracked of which 16 became hurricanes. Hurricanes Hernan and Trudy were among the strongest ever observed in this area. Rachel was the only system to make landfall.

### 1. Introduction

The 1990 eastern North Pacific hurricane season established several tropical cyclone records for this basin and was also marked by several unusually strong hurricanes. There were 20 named tropical cyclones, two below the record, but four more than the long-term average. Sixteen of those named storms, twice the average and four more than the previous record, reached hurricane intensity. Furthermore, Hurricanes Hernan and Trudy were among the strongest ever observed in this area. Alma was the earliest named tropical cyclone for the eastern Pacific. In addition, the eastern Pacific produced four tropical depressions that did not reach tropical storm status. It should be noted that totals for this basin are quite suspect prior to the implementation of improved weather satellites in 1966.

All of this year's storms and hurricanes developed from westward-moving African waves. With the exception of Marie and Polo, these systems developed between 5° and 15°N, east of the longitude of Baja California in the climatologically favored area for cyclogenesis. After their development, most of the tropical cyclones moved on a west to northwest track and dissipated over cool waters without affecting land. Rachel was the only system to make landfall. Five named tropical cyclones moved over or very near Socorro Island located about 450 km south of Cabo San Lucas, Baja California. The 20 named tropical storms and hurricanes, along with their dates, highest sustained winds, and minimum sea-level pressure are listed in Table 1.

### 2. Best tracks

Best tracks for all tropical storms and hurricanes are based on a postanalysis of all available data. A best

track consists of 6-h center positions, maximum 1-min wind speed, and minimum sea-level pressure and includes tropical depression stages.

There are generally no direct measures of storm strength in this region. Intensity estimates are primarily derived from empirical relationships based on cloud characteristics revealed in satellite imagery. These relationships are not exact and intensity values indicated should not be taken as being precisely correct.

The GOES-7 geostationary visible and infrared satellite imagery is the primary data source for tracking cyclones in the eastern Pacific, supplemented by polar-orbiting satellite and sparse ship reports. Figure 1 shows the best-track center positions of this season's 20 tropical storms and hurricanes.

### 3. Verification

The National Hurricane Center issues a 72-h track and intensity forecast every 6 h for the Atlantic and eastern Pacific basins. Forecasts are verified by comparison with a best track including tropical storm and hurricane stage only. Table 2 lists the eastern Pacific official average forecast track error by year since 1978. These errors for 1990 range from 24 km at the 0-h forecast period (initial position) to 371 km at 72 h. The 1990 errors, like 1988 and 1989, are smaller than the 10-yr average ending in 1987. The NHC began issuing forecasts for that basin in 1988. Table 3 lists the official wind speed forecast error for the eastern Pacific since 1988. Wind speed errors in this basin show a negative bias at all forecast periods.

### 4. Individual storms

#### *a. Hurricane Alma, 12–18 May*

Alma was the earliest eastern Pacific tropical storm and hurricane on record. Before this season, the dates of earliest formations were Tropical Storm Alma on 18 May 1984 and Hurricane Adolph on 23 May 1983.

Alma originated from a tropical wave that moved

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TABLE 1. 1990 eastern Pacific hurricane season statistics.

Number	Name	Class*	Dates**	Maximum 1-min wind ( $\text{m s}^{-1}$ )	Minimum sea-level pressure (mb)
1	Alma	H	12–18 May	39	979
2	Boris	H	2–8 June	41	977
3	Cristina	T	8–16 June	28	994
4	Douglas	T	19–23 June	28	992
5	Elida	H	26 June–2 July	36	990
6	Fausto	H	6–12 July	39	979
7	Genevieve	H	10–18 July	46	970
8	Hernan	H	19–31 July	70	928
9	Iselle	H	20–30 July	54	958
10	Julio	H	17–24 August	52	960
11	Kenna	H	21–30 August	39	980
12	Lowell	H	23 August–1 September	34	986
13	Marie	H	7–21 September	62	944
14	Norbert	H	10–19 September	36	983
15	Odile	H	23 September–2 October	64	935
16	Polo	H	28 September–1 October	34	987
17	Rachel	T	27 September–3 October	28	994
18	Simon	T	9–14 October	31	990
19	Trudy	H	16 October–1 November	70	924
20	Vance	H	21–31 October	44	975

\* T: tropical storm, wind speed 17–32  $\text{m s}^{-1}$ . H: hurricane, wind speed 33  $\text{m s}^{-1}$  or higher.

\*\* Dates begin at 0000 UTC and include tropical depression stage.

off the African coast on 29 April. The wave showed very little convective activity until it was located just to the south of Panama. The system became better organized and was upgraded to a tropical depression at 1800 UTC 12 May about 900<sup>1</sup> km south of Acapulco, Mexico. It became Tropical Storm Alma by 0000 UTC 15 May and reached hurricane status by 1200 UTC the same day, with maximum sustained winds of 39  $\text{m s}^{-1}$ . The hurricane then gradually weakened as it moved over cool waters and into a strong shear environment.

#### b. Hurricane Boris, 2–8 June

The second tropical depression of the season formed about 650 km south of Acapulco, Mexico, on 2 June. The depression intensified and became Tropical Storm Boris about 800 km southwest of Manzanillo, Mexico, on the 4th. The system was upgraded to a hurricane the next day with estimated maximum sustained winds of 41  $\text{m s}^{-1}$  and an associated 977-mb central pressure. A weakening process began while Boris was moving over increasingly cooler waters. It dissipated several days later.

A sailboat named the *Azure Dream* reported 36  $\text{m s}^{-1}$  winds and a 982-mb pressure in Boris at 0900 UTC 6 June. Ham radio reports indicated that hurri-

cane force winds in the eyewall ripped the sails off that vessel. Moisture from the remnants of Boris spread over the southwestern United States and contributed to some locally heavy rains. San Diego, which averages 1.5 mm of rain for the month of June, reported 22 mm over a 2-day period. This was the wettest June for San Diego, California, since records began in 1850.

#### c. Tropical Storm Cristina, 8–16 June

Cristina developed from a tropical wave that emerged from the African coast on 23 May, but it was not until 8 June that the system became a tropical depression about 1475 km south of the southern tip of Baja California. Cristina reached tropical storm status on 9 June and peaked with estimated 28  $\text{m s}^{-1}$  winds at 1200 UTC 12 June.

The movement of the storm during the first two days after formation was quite erratic since it was embedded in weak steering currents. Cristina then moved northward over cool waters until it dissipated on the 16th.

#### d. Tropical Storm Douglas, 19–23 June

On 16 June an African wave crossed into the eastern Pacific with an enhanced area of associated cloudiness. The convection organized, and near 0000 UTC on the 19th, a tropical depression formed about 375 km south of Acapulco, Mexico. Twelve hours later, it became Tropical Storm Douglas with estimated 28  $\text{m s}^{-1}$  winds

<sup>1</sup> Specific locations and distances normally refer to the center of the tropical cyclone. It should be noted that tropical cyclones generally cover thousands of square kilometers around that point.

TABLE 2. Official track forecast errors in kilometers by year, eastern Pacific Ocean.

Year	Forecast period (h)					
	0	12	24	36	48	72
1978			154		289	402
1979			159		337	499
1980			150		304	487
1981			185		330	495
1982			145		331	456
1983			159		319	439
1984			165		334	513
1985			158		298	421
1986			187		413	576
1987			158		328	397
1978–1987 average			157		321	469
1988 (cases)	37 (175)	84 (175)	139 (150)	191 (128)	256 (108)	326 (74)
1989 (cases)	28 (215)	80 (215)	152 (182)	232 (150)	304 (119)	439 (77)
1990 (cases)	24 (451)	71 (418)	132 (383)	200 (345)	265 (308)	371 (237)
1988–1990 average	28	76	149	206	272	376

and was heading in a northwesterly direction toward the Mexican state of Jalisco. Tropical storm warnings were issued for portions of that area but the center of the storm never reached the coast. Instead, Douglas began to weaken and turned away from land. The tropical storm dissipated about 225 km south-southeast of the southern tip of Baja California on the 24th. A ship named *Hansa Bremen* reported winds of  $23 \text{ m s}^{-1}$  at 1800 UTC 20 June, not far from the center of the storm.

Fringe effects of Douglas produced copious amounts of rain over Mexico in the states of Guerrero, Michoacan, Colima, Jalisco, and Islas Marias. Manzanillo received 178.1 mm of rain in 36 h and reported a minimum surface pressure of 1003.1 mb at 0600 UTC 22 June. The heavy rains probably caused flash flooding and mud slides in portions of those areas.

#### e. Hurricane Elida, 26 June–2 July

The origin of this storm can be traced back to a tropical wave that moved from Africa on 10 June.

However, it was not until the 26th that the system became a tropical depression in the eastern Pacific. It was upgraded to a tropical storm that day and to a hurricane at 0000 UTC on the 28th. Elida moved directly over Socorro Island, which reported  $36 \text{ m s}^{-1}$  winds at 0600 UTC on the 28th and a 990-mb minimum pressure at 0800 UTC on the same day. A total of 94.4 mm of rainfall was reported there as well as some glass breakage. The ship *Marine Reliance*, located about 150 km north-northwest of the center, reported  $21 \text{ m s}^{-1}$  winds and 1003.0-mb pressure at 2200 UTC on the 26th. The ship *Dole Ecuador*, located a little less than 550 km east-northeast of the center, reported a  $19 \text{ m s}^{-1}$  wind at 0000 UTC on the 27th. Some of Elida's outer rainbands were located over mountainous sections of southwestern Mexico, but no reports of flooding or damage were received.

#### f. Hurricane Fausto, 6–12 July

A tropical depression formed about 450 km south-southwest of Acapulco, Mexico, on 6 July and became

TABLE 3. Official wind speed forecast errors in meters per second, eastern Pacific, 1988–1990. Error = forecast – observed.

	Forecast period (h)					
	0	12	24	36	48	72
1990 mean	−0.5	−1.0	−1.6	−2.4	−3.1	−2.8
1990 mean absolute	1.9	3.7	5.8	7.8	9.2	10.6
(Number of cases)	(451)	(416)	(380)	(343)	(306)	(235)
Maximum error	+10	−15	−23	−31	−36	−44
1989 mean	−0.4	−0.9	−1.4	−2.1	−4.5	−5.8
1989 mean absolute	2.3	4.1	6.5	8.8	10.9	10.8
(Number of cases)	(215)	(215)	(182)	(150)	(118)	(77)
1988 mean	−1.1	−1.4	−1.8	−2.3	−3.1	−1.4
1988 mean absolute	1.6	3.3	5.3	6.8	8.3	9.0
(Number of cases)	(170)	(170)	(147)	(126)	(108)	(75)

1990

NUMBER	TYPE	NAME	DATE
1	H	ALMA	MAY 12-18
2	H	BORIS	JUN 2-8
3	T	CRISTINA	JUN 8-16
4	T	DOUGLAS	JUN 19-23
5	H	ELIDA	JUN 26-JUL 2
6	H	FAUSTO	JUL 6-12
7	H	GENEVIEVE	JUL 10-18
8	H	HERNAN	JUL 19-31
9	H	ISELLE	JUL 20-30
10	H	JULIO	AUG 17-24
11	H	KENNA	AUG 21-30
12	H	LOWELL	AUG 23-SEP 1
13	H	MARIE	SEP 7-21
14	H	NORBERT	SEP 10-19
15	H	ODILE	SEP 23-OCT 2
16	H	POLO	SEP 28-OCT 1
17	T	RACHEL	SEP 27-OCT 3
18	T	SIMON	OCT 9-14
19	H	TRUDY	OCT 16-NOV 1
20	H	VANCE	OCT 21-31

..... Tropical depression stage  
 --- Tropical storm stage  
 --- Hurricane stage  
 +++++ Extratropical stage  
 >>>>> Subtropical depression stage  
 >>>>> Subtropical storm stage  
 ●07 Position and date at 0000 UTC  
 ○ Position at 1200 UTC  
 997mb Lowest central pressure in millibars  
 [6] Initial position of cyclone "Number 6"  
 H HURRICANE  
 T TROPICAL STORM  
 ST SUBTROPICAL STORM

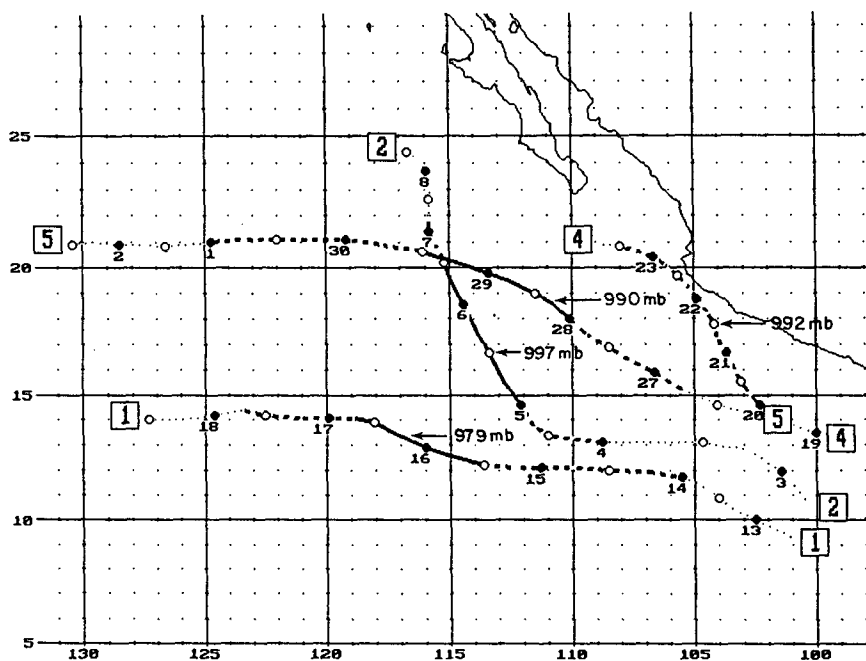


FIG. 1. (a), (b), (c), (d), (e), (f), and (g). Tropical storm and hurricane tracks of 1990.

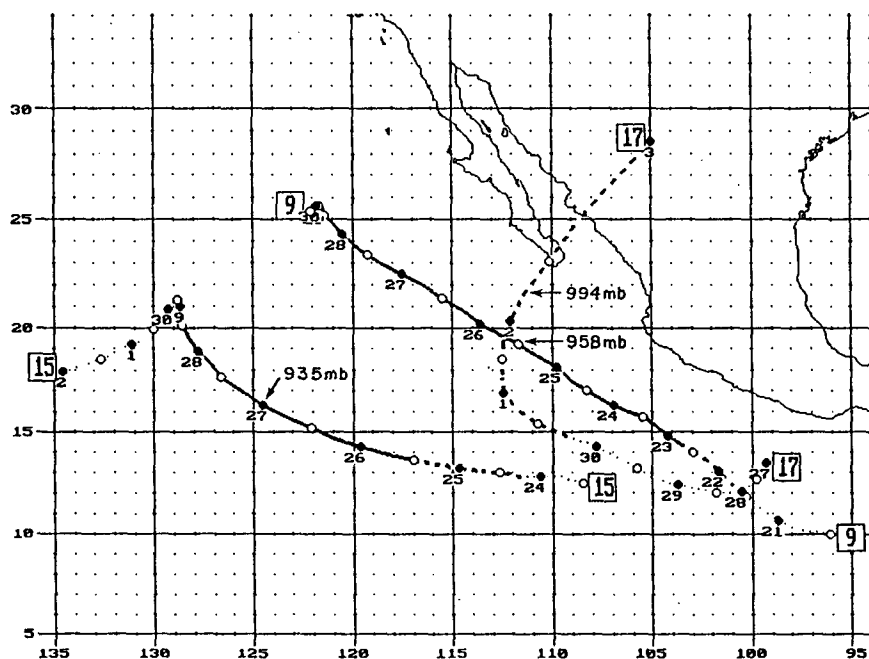
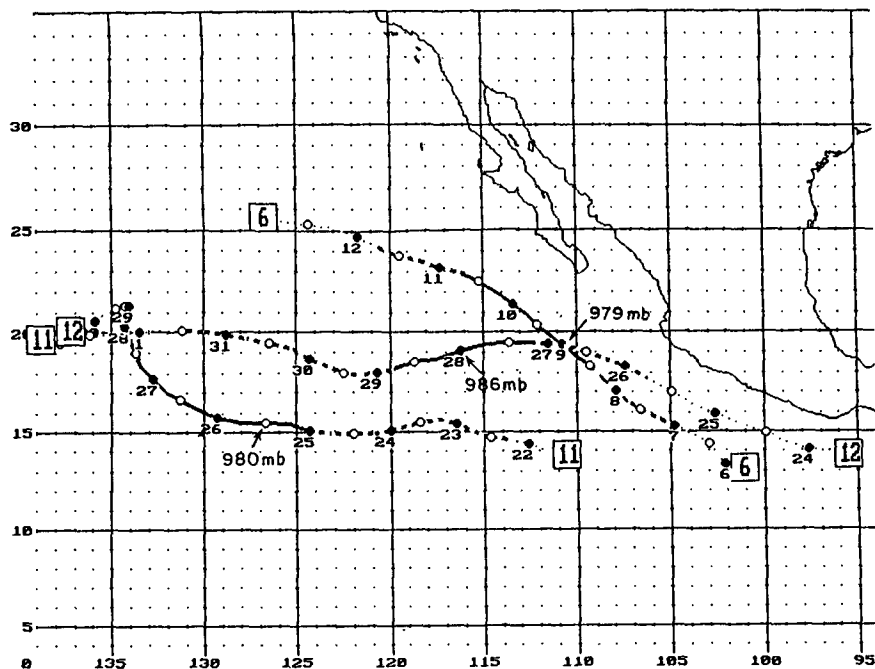


FIG. 1. (Continued)

Tropical Storm Fausto one day later. A weak eye developed and the system was upgraded to a hurricane at 1200 UTC 8 July with estimated  $39 \text{ m s}^{-1}$  winds. Fausto moved near Socorro Island producing 101.6 mm of rain, tropical storm force winds, and a 996.2-mb

pressure at 0000 UTC 9 July. An unnamed vessel reported  $18.5 \text{ m s}^{-1}$  winds about 325 km from the center at 0000 UTC on the 8th. Another ship, the *Nedlloyd van Lindschoten*, observed southwesterly winds of  $18 \text{ m s}^{-1}$  at 0000 UTC on the 9th.

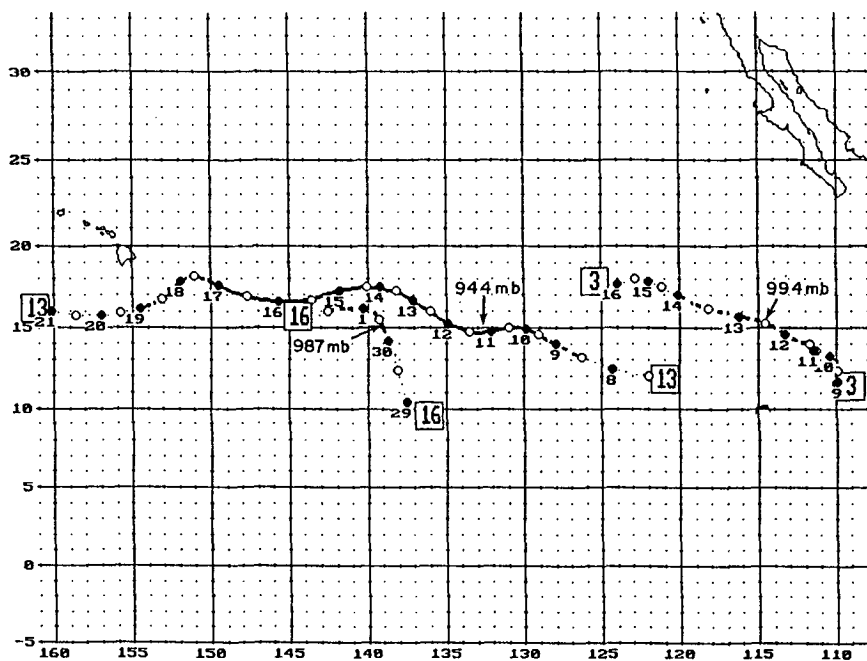
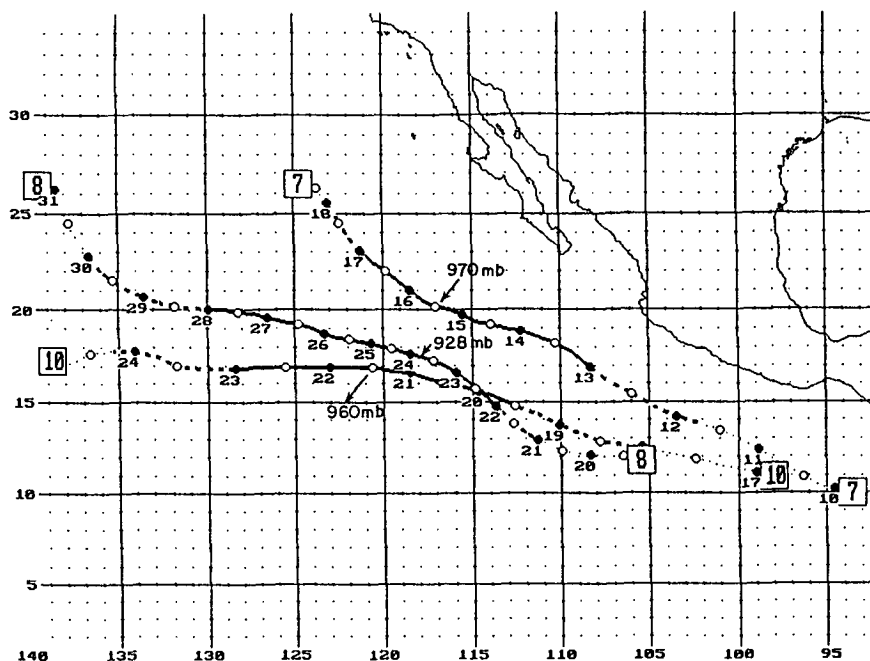


FIG. 1. (Continued)

Fausto was downgraded to a tropical storm about 650 km west of Cabo San Lucas, Mexico. It gradually weakened and then dissipated on the 13th over cool waters.

*g. Hurricane Genevieve, 10–18 July*

Genevieve originated from a tropical wave that moved off the African coast on 25 June and was up-

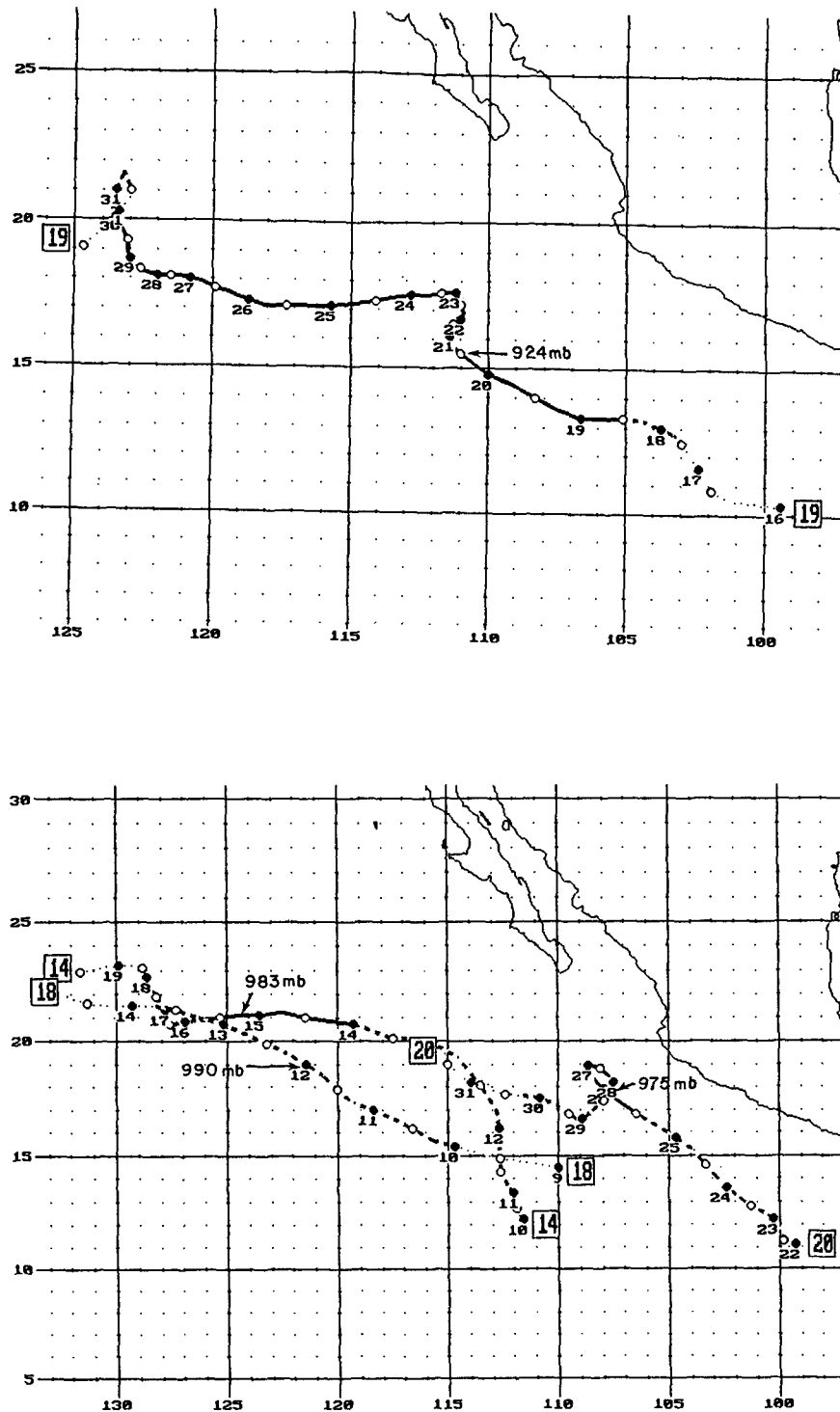


FIG. 1. (Continued)

graded to a tropical depression on 11 July. The depression moved toward the west-northwest and gradually strengthened to a tropical storm on the same day. It reached hurricane status at 0000 UTC 13 July about

675 km south of Cabo San Lucas, Mexico. Genevieve passed very near Socorro Island, which reported a 992.1-mb pressure and tropical storm force winds at 1530 UTC 13 July, prior to equipment failure.

Genevieve strengthened to a  $46 \text{ m s}^{-1}$  wind hurricane with a well-defined eye by 1200 UTC on the 15th. It turned toward the northwest by the 16th and moved into an area of strong shear. The hurricane decreased to a weakening tropical storm in 24 h and became a swirl in the stratocumulus field over cool waters within the next day or two.

#### *h. Hurricane Hernan 19–31 July*

An African wave that appeared as a swirl of clouds in the midtropical Atlantic moved across Central America on 15 July. Convection associated with the wave organized gradually resulting in a tropical depression located about 900 km southwest of Acapulco, Mexico, on the 19th.

Its development was questionable due to the proximity to a trailing depression embedded in a more favorable environment for intensification. Ultimately, both developed. The first became Hernan and the trailing depression became Iselle. Figure 2 shows them both as hurricanes.

Tropical Storm Hernan reached hurricane status at 1800 UTC 21 July and remained in relative close proximity to Iselle for several days. Hurricane Hernan continued strengthening to become one of the strongest hurricanes in recent history in the eastern Pacific. Although no direct measurements were made, highest

intensity estimates from satellite imagery were  $69 \text{ m s}^{-1}$ , with a corresponding minimum central pressure of 928 mb at 1800 UTC 23 July. Those intensity estimates were the same as those made for Hurricane Max of 1987, which was credited as being the strongest hurricane of record in the eastern North Pacific to that date (Cross 1988).

At 1301 UTC 24 July, infrared satellite imagery revealed a concentric eyewall pattern with one eyewall inside a larger eyewall. Concentric eyewalls have been observed on satellite imagery and radar displays in intense hurricanes in the Atlantic, but they are rare. This is the first time that such a phenomenon has been clearly observed on satellite imagery at the NHC for an eastern North Pacific tropical cyclone.

Hernan was a hurricane for just over six days with estimated winds of  $50 \text{ m s}^{-1}$  or higher for four days. It weakened to a tropical depression while moving over cool waters and finally dissipated on the 31st.

#### *i. Hurricane Iselle, 20–30 July*

The African wave that produced Iselle became active several hundred kilometers southeast of Acapulco resulting in a tropical depression near  $10^{\circ}\text{N}$ ,  $96^{\circ}\text{W}$ . In spite of its proximity to Hernan, the depression intensified gradually to storm strength and reached hurricane status at 1800 UTC 22 July. Iselle peaked at 1200 UTC

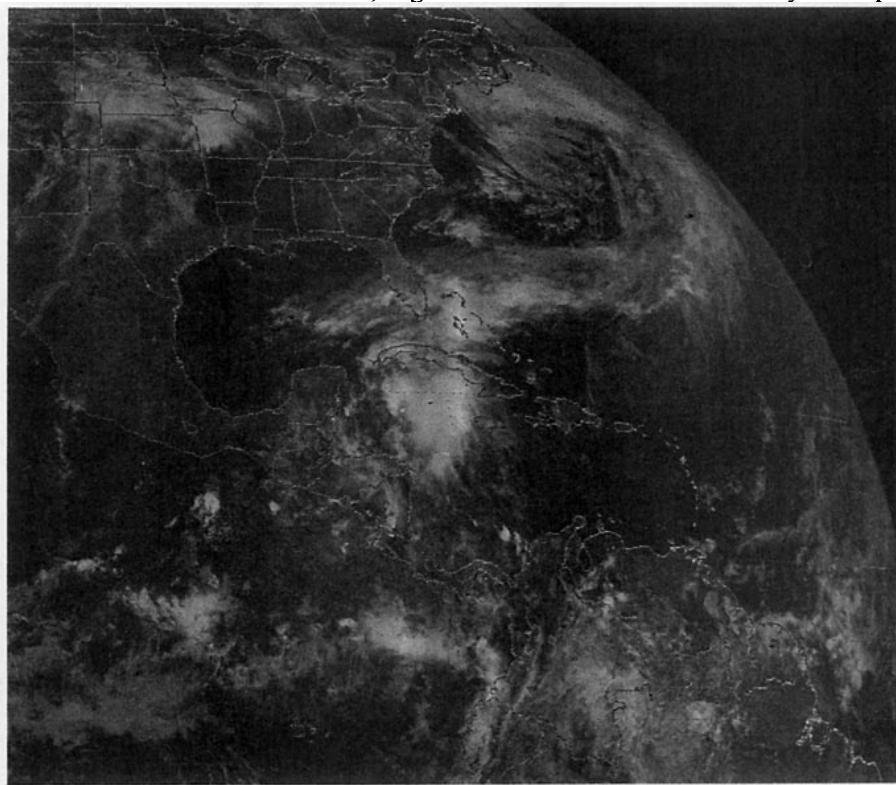


FIG. 2. GOES visible satellite image of Hurricanes Hernan and Iselle at 2001 UTC 23 July 1990.



25 July with estimated  $54 \text{ m s}^{-1}$  winds and an associated minimum pressure of 958 mb. Iselle moved on a general west-northwest track during its entire lifetime, dissipating over cooler waters on the 30th.

Iselle also moved very close to Socorro Island. That island reported a  $31 \text{ m s}^{-1}$  sustained wind, a 992.1-mb pressure, and heavy rain at 1200 UTC 25 July.

*j. Hurricane Julio, 17–24 August*

Julio became a depression on 17 August, about 650 km south of Acapulco, Mexico. Its precursor was a tropical wave that crossed the west coast of Africa on 5 August and was tracked across the Atlantic and Caribbean without distinction.

Julio moved west-northwestward to westward from its inception to its demise on the 24th. Julio became a storm on the 18th and a hurricane on the 19th. It is estimated to have reached maximum intensity at 1200 UTC on the 21st, with  $51 \text{ m s}^{-1}$  winds and a 960-mb surface pressure. It weakened to a storm on the 23d, to a depression on the 24th, and then dissipated in the central tropical Pacific Ocean near  $138^\circ\text{W}$ .

*k. Hurricane Kenna, 21–30 August*

Kenna originated from the same African wave that previously spawned Fran over the eastern Caribbean.

Fran dissipated rapidly, but its remnants were tracked into the eastern Pacific where a tropical depression formed on 21 August. The depression moved westward for the next several days following in the wake of Julio. Kenna reached tropical storm status by 22 August and hurricane strength by the 25th, with an estimated 980-mb pressure and  $39 \text{ m s}^{-1}$  winds. The cyclone turned toward the north over cool waters and gradually dissipated. During the weakening stage, the ship *Gulf Ideal* observed  $18 \text{ m s}^{-1}$  winds near the center of Kenna at 1800 UTC on the 29th.

*l. Hurricane Lowell, 23 August–1 September*

Analysis of satellite imagery indicated that the cloud system associated with an African wave organized into a tropical depression on 23 August. The system moved in a west-northwestward direction and became Tropical Storm Lowell about 350 km to the south-southwest of Puerto Vallarta, Mexico, on the 25th. Lowell turned to a more westward track reaching minimal hurricane strength about 460 km southwest of Cabo San Lucas two days later.

As the deep convection weakened, Lowell was downgraded to a tropical storm on the 28th. The cyclone then resumed a more west-northwestward track and dissipated.

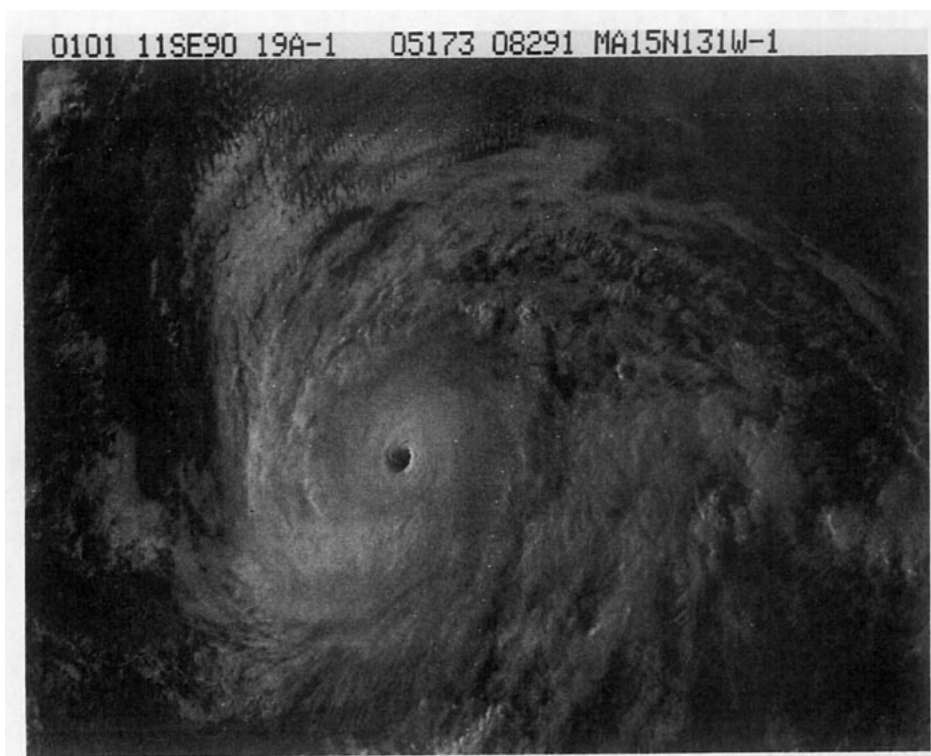


FIG. 3. GOES visible satellite image of Hurricane Marie at 0101 UTC 11 September 1990, shortly prior to Marie's maximum intensity estimate.

*m. Hurricane Marie, 7–21 September*

Convection associated with an African wave increased markedly south of the Gulf of Tehuantepec on 5 September. By the 7th, a tropical depression had formed about 1050 km west-southwest of Clarion Island. That location was somewhat west of where tropical cyclones normally form in the eastern Pacific.

Marie became a tropical storm at 1200 UTC 8 September and strengthened to its estimated peak intensity of  $64 \text{ m s}^{-1}$  at 0300 UTC 11 September. Figure 3 shows Hurricane Marie prior to its maximum intensity estimate. A building ridge to the north kept Marie away from cool waters. Consequently, the hurricane moved west of  $140^\circ\text{W}$  threatening the Hawaiian Islands, where tropical storm warnings were issued. However, the system turned toward the southwest, away from those islands, and dissipated. Marie was the only hurricane to move into the central Pacific from the eastern Pacific this season.

*n. Hurricane Norbert, 10–19 September*

Norbert developed from an African wave. It began as a tropical depression on 10 September about 1225 km south-southwest of Cabo San Lucas, Mexico. The system reached tropical storm status later on the same day but remained poorly organized until the 12th when

Norbert interacted with Tropical Depression Eighteen-E. A Fujiwhara interaction occurred when the two systems were located only about 250 km apart, with the two centers rotating around each other. Finally, the depression was absorbed by Norbert, which then strengthened.

Norbert became a minimal hurricane on the 14th and developed an eye for a short period between 0200 and 0600 UTC on the 15th. An unnamed vessel located about 100 km from the storm's center observed a wind speed of  $25 \text{ m s}^{-1}$ , at 0600 UTC 11 September. Norbert weakened to a tropical depression and then dissipated on the 19th over cool waters.

*o. Hurricane Odile, 23 September–2 October*

Odile was tracked in the eastern Pacific Ocean as an area of disturbed weather triggered by an African wave. A tropical depression developed on 23 September about 1200 km south-southeast of the southern tip of the Baja peninsula. The depression reached tropical storm strength by 0600 UTC on the 24th and became a hurricane by 1200 UTC on the 25th. It is estimated to have reached its peak intensity with  $64 \text{ m s}^{-1}$  sustained winds and a 935-mb central pressure at 0000 UTC on the 27th. Figure 4 shows a visible satellite picture of Odile during the time of its maximum intensity estimate.

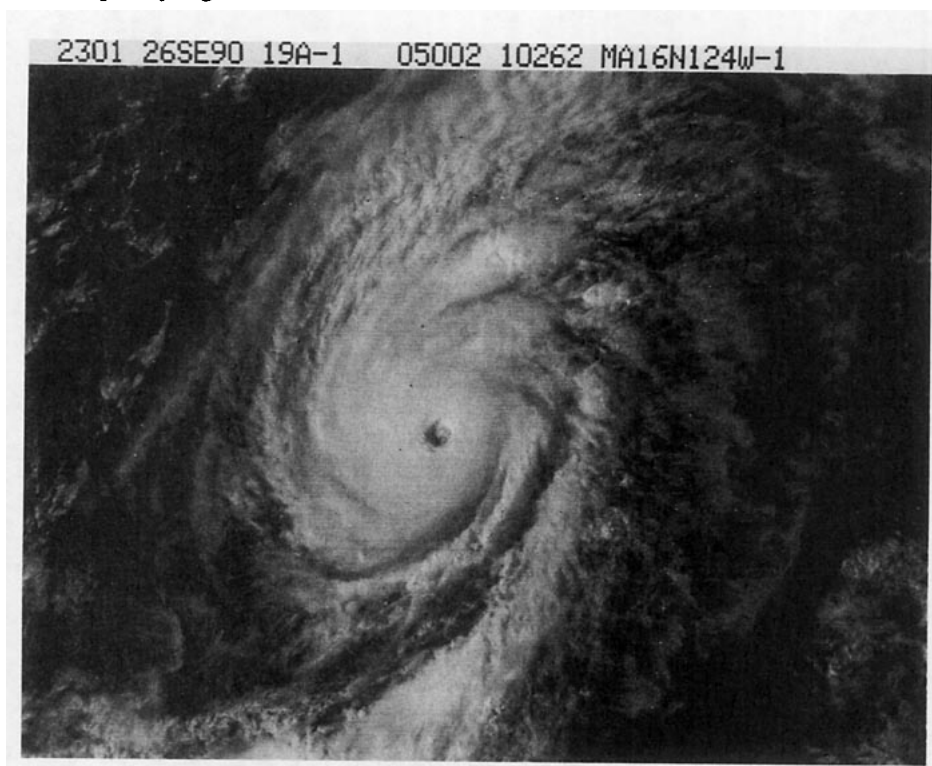


FIG. 4. GOES visible satellite image of Hurricane Odile at 2301 UTC 26 September 1990 during the time of Odile's maximum intensity estimate.

Odile maintained  $64 \text{ m s}^{-1}$  winds for 24 h and then began to weaken, while gradually turning more north-westward in response to a slight weakness in the high pressure ridge. By the 28th, the hurricane was over cool waters and weakened as rapidly as it had earlier intensified. It finally dissipated on 2 October.

*p. Hurricane Polo, 28 September–1 October*

The southern portion of a convectively active African wave, which triggered Isidore in the Atlantic, continued its trek across the Caribbean and showed signs of development over the Bay of Campeche. An Air Force reconnaissance aircraft flying into the system could not locate a circulation center, but an area of deep convection moved onshore along the Mexican coast and then moved westward for the following week.

After several convective outbursts, the system organized into a tropical depression near  $10^{\circ}\text{N}$ ,  $137^{\circ}\text{W}$  at 1800 UTC 28 September and intensified into a minimal hurricane at 0600 UTC 30 September. Once Polo reached hurricane status it was destroyed quickly by strong vertical wind shear.

*q. Tropical Storm Rachel, 27 September–3 October*

Rachel was the only 1990 eastern Pacific tropical cyclone to make landfall. Cloudiness associated with

an African wave became concentrated south of the Gulf of Tehuantepec, resulting in a tropical depression about 375 km south of Acapulco, Mexico, on 27 September. The depression developed into Tropical Storm Rachel at 0600 UTC 30 September, while centered about 925 km southwest of Cabo San Lucas, Mexico. Figure 5 is a visible satellite image of Tropical Storm Rachel.

An upper, low pressure system over California began steering the storm northward. Consequently, tropical storm watches and warnings were issued over a small area of Baja California, south of La Paz. Also, warnings were posted for the Pacific coast of the state of Sinaloa, Mexico, from Los Mochis southward. Rachel curved toward the northeast with increasing forward speed and moved over the southern tip of Baja California at 1200 UTC 2 October. Estimated maximum sustained wind speeds at that time were  $28 \text{ m s}^{-1}$  with a minimum sea-level pressure of 994 mb. The center continued across the Gulf of California and made final landfall on the west coast of Mexico midway between Los Mochis and Culiacan at 1900 UTC 2 October. After moving inland and weakening rapidly, the remnants of Rachel continued to accelerate northeastward across western Texas. The Meteorological Service of Mexico reported a maximum storm-related rainfall of 215.9 mm at San Jose del Cabo near the southern tip of Baja California. The remnants of Rachel contributed to heavy rains and flooding over portions of southwest

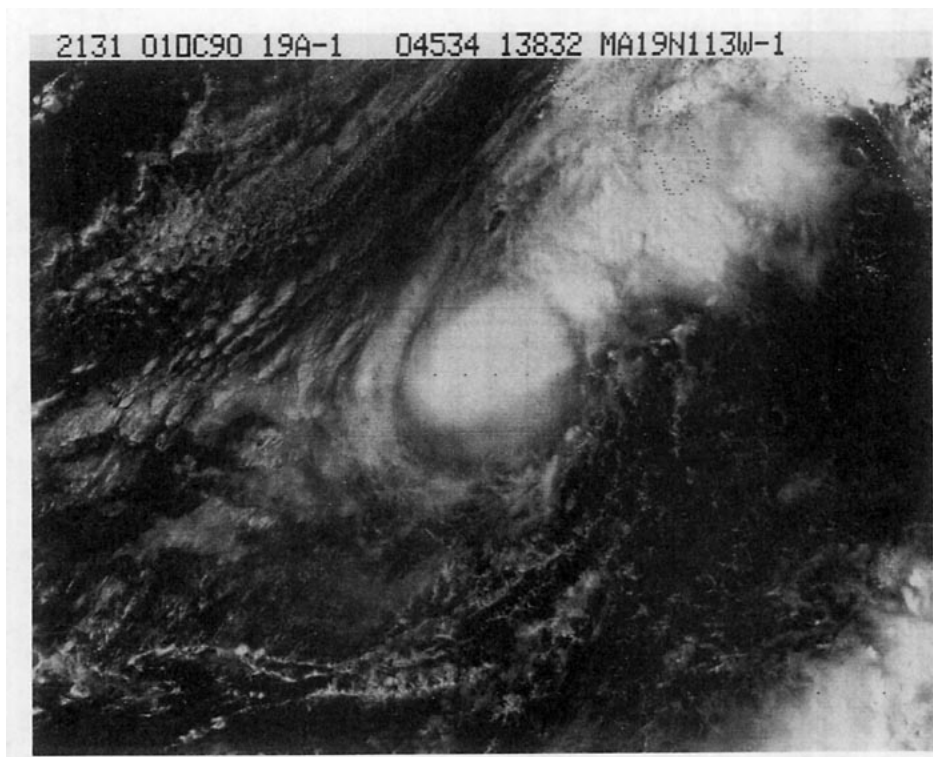


FIG. 5. GOES visible satellite image of Tropical Storm Rachel at 2100 UTC 1 October 1990 heading for Baja California.

Texas, where some roads were covered with water. There were no casualties reported.

*r. Tropical Storm Simon, 9–14 October*

After several days of interaction between an African wave and the intertropical convergence zone, Tropical Depression Twenty-two-E formed about 900 km south of Cabo San Lucas, Mexico, on 9 October. Simon intensified to just below hurricane strength on the 12th. Soon thereafter, the system weakened over cold waters and was downgraded to a tropical depression. It finally dissipated on the 15th.

*s. Hurricane Trudy, 16 October–1 November*

Trudy was a hurricane for 11 days, while traveling a little more than 2200 km over the eastern Pacific. The tropical wave that became Trudy could be identified as early as the 30th of September, near the African coast. However, the wave did not show signs of development until 16 October, when a tropical depression formed several hundred kilometers south of Acapulco, Mexico.

The depression developed rapidly and in less than 36 h, by 1200 UTC 20 September, Trudy was a powerful hurricane with  $69 \text{ m s}^{-1}$  winds and 925-mb minimum sea-level pressure according to satellite estimates.

Trudy was at least as intense as Hurricane Max of 1987 and Hurricane Hernan of this season. Trudy may have been the strongest eastern Pacific hurricane since wind estimates have been available from satellite images. Figure 6 shows Hurricane Trudy during its rapid intensification phase.

An approaching upper-level trough forced Trudy to drift northward, increasing the risk of hurricane conditions to residents of Baja California. The same trough created an unfavorable environment that weakened the hurricane considerably. At that time, dynamically based numerical models forecast Trudy to move northward over Baja California. The trough progressed eastward and was replaced by a ridge, and Trudy resumed a westward motion away from land. The hurricane reintensified, developing an unusually large eye of nearly 90 km in diameter.

Another deep trough approached and pulled the hurricane northward on the 29th, shearing it at the same time. Trudy dissipated at 1800 UTC 1 November but the midlevel moisture was advected northeastward over northern Mexico and the southwestern United States.

Socorro Island reported hurricane force winds for more than 7 h. The winds on that island reached  $54 \text{ m s}^{-1}$  with gusts to  $59 \text{ m s}^{-1}$ , and the surface pressure was 995.3 mb at 0900 UTC 23 October. These reports were received via ham radio. However, these winds

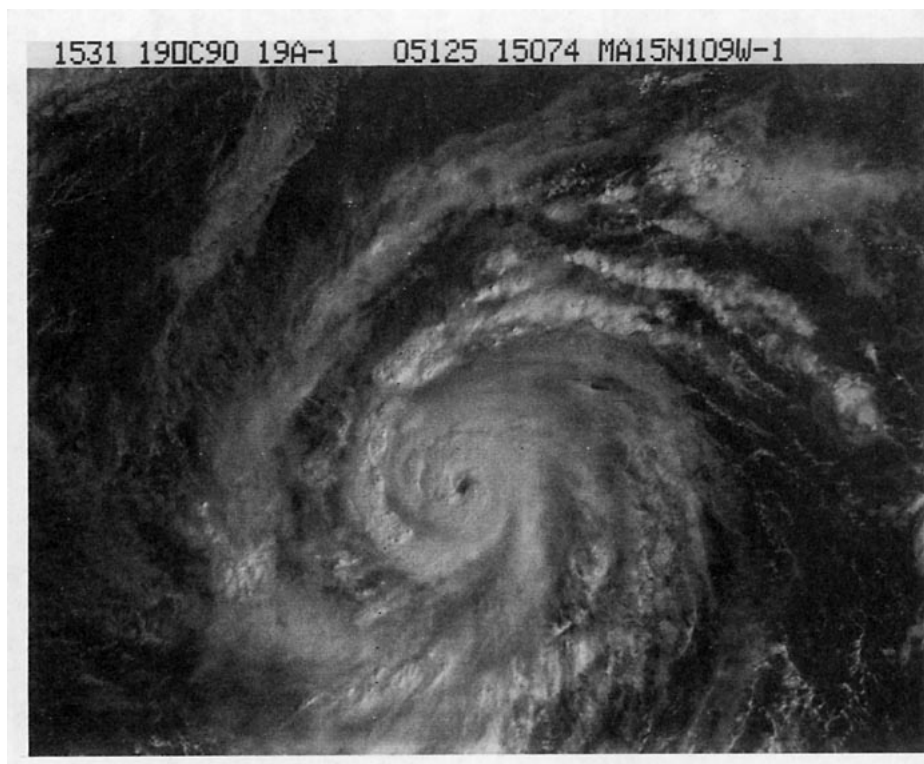


FIG. 6. GOES visible satellite image of Hurricane Trudy at 1531 UTC 19 October 1990 during Trudy's rapid development stage.

occurred when satellite wind estimates were only  $36 \text{ m s}^{-1}$  and the hurricane was located about 150 km south-southwest from that island, so their authenticity is in doubt. The ship *Maple Ace* reported  $23 \text{ m s}^{-1}$ , about 140 km from the center at 1800 UTC on the 18th.

*t. Hurricane Vance, 21–31 October*

A tropical depression formed about 650 km south-southeast of Acapulco on 21 October. The depression moved northwestward parallel to the west coast of Mexico from the 21st through the 26th. It became a tropical storm on 23 October and a hurricane on the 25th. Vance peaked at 1200 UTC on the 26th with maximum sustained winds estimated at  $44 \text{ m s}^{-1}$  and a minimum central pressure estimated at 975 mb.

Vance was centered only 400 km south of the southern tip of Baja California when a ridge of high pressure blocked its forward motion and the center moved in a small loop for two days. Vance began to weaken on the 27th as a result of strong shearing conditions and by being located over waters cooled by upwelling from Trudy a few days earlier and by Vance itself. It dissipated late on the 31st.

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#### REFERENCES

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