Eastern North Pacific Hurricane Season of 1992

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ABSTRACT

The National Hurricane Center tracked a record-breaking 27 tropical cyclones in the eastern North Pacific Ocean during 1992. Of the 27, 24 became tropical storms (also a record) and 14 became hurricanes. These records are based on data starting in 1966, which is when routine satellite surveillance began. Four hurricanes affected mainland Mexico.

1. Introduction

There were 27 tropical cyclones in the eastern North Pacific Ocean during 1992. Twenty-four reached tropical storm strength and 14 of these became hurricanes. The other three tropical cyclones remained tropical depressions. In comparison, on average, there have been 16 tropical storms per year in the eastern North Pacific, of which 9 have become hurricanes. The eastern North Pacific Ocean basin is defined as the area north of the equator and extending westward from the west coasts of North and Central America to 140°W longitude.

The 27 tropical cyclones and 24 tropical storms are record totals, breaking the previous records of 26 tropical cyclones in 1982 and 22 tropical storms in 1985. The record number of hurricanes is 16 in the year 1990. The annual statistics are based on data starting in 1966, which is when routine weather satellite surveillance began. Data from the *GOES-7* geostationary satellite provided most of the information about 1992's tropical cyclones. A limited set of observations from ships and land sites mainly near the west coast of Mexico supplemented the satellite data. A research aircraft flown by the National Oceanic and Atmospheric Administration provided additional information about Hurricane Tina.

Figure 1 shows the tracks taken by the 1992 tropical cyclones and indicates where these systems were located at tropical depression, tropical storm, and hurricane intensity. These "best-track" data, along with a complete "preliminary report" on each tropical cyclone, are listed in the Diagnostic Report of the National Hurricane Center (NHC). The Annual Hurricane Diskette Data Tabulation is also a source of best-track data.[1] Best-track data contains center positions, maximum 1-min surface wind speed, and minimum central sea level pressure every 6 h for the duration of the tropical cyclone.

Nearly all of the cyclones formed within 1000 km of the southwest coast of Mexico between 10° and 15°N, to the south or southeast of the region of high pressure that dominates the summertime weather pattern over northern Mexico and the adjacent waters of the subtropical eastern North Pacific Ocean. The steering currents associated with that pattern drove most of the 1992 tropical cyclones on a course that was similar to the climatological movement of about 6 m s^{-1} toward the west-northwest. The tracks of nearly all of the tropical cyclones ended by 25°N, where the ocean waters become too cold to support tropical cyclones.

Table 1 lists the formation and dissipation dates, estimated maximum surface wind speed, and estimated minimum sea level pressure for each of the tropical cyclones. Eight hurricanes reached category 3 or higher status on the Saffir–Simpson hurricane scale (SSHS) (Simpson 1974) with estimated sustained (1 min) wind speeds of at least 50 m s^{-1}. Tina was the most powerful hurricane for this year with maximum sustained wind speeds estimated at 67 m s^{-1}. Figure 2a shows Tina's track, and Fig. 3 shows a visible satellite image of Tina near its time of maximum intensity.

Hurricane Tina is now the longest lasting tropical cyclone in the North Pacific Ocean. Tina lasted 24 days, 4 more days than Hurricane Fico in the eastern and central North Pacific in 1978 and about 2 more days than Typhoon Rita in 1972.

Tropical cyclones originating in the eastern North Pacific Ocean in 1992 were responsible for six deaths in

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[1] Both the Diagnostic Report and the Diskette Data Tabulation are available from the National Climatic Data Center, Federal Building, Asheville, NC 28801.

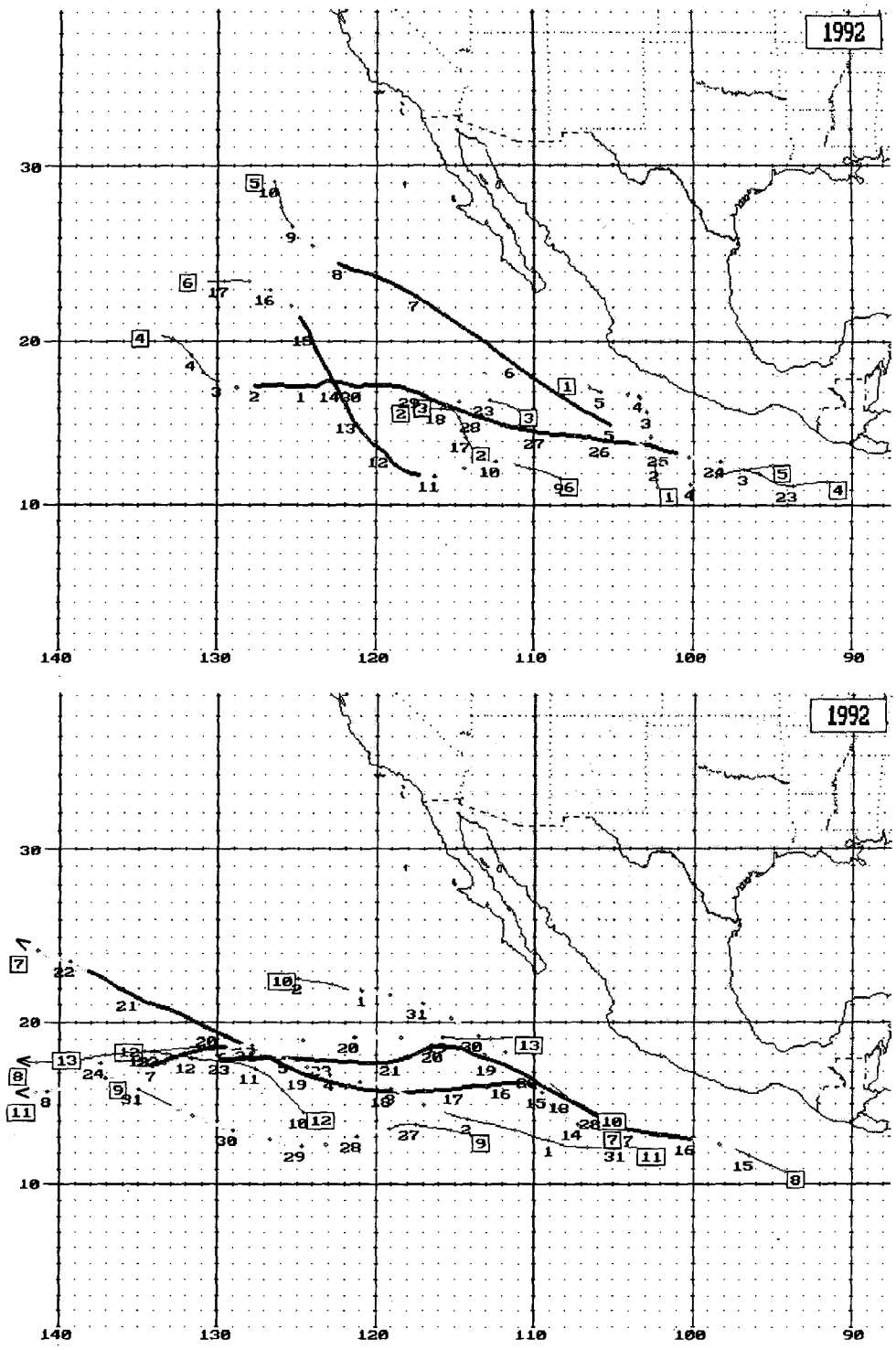
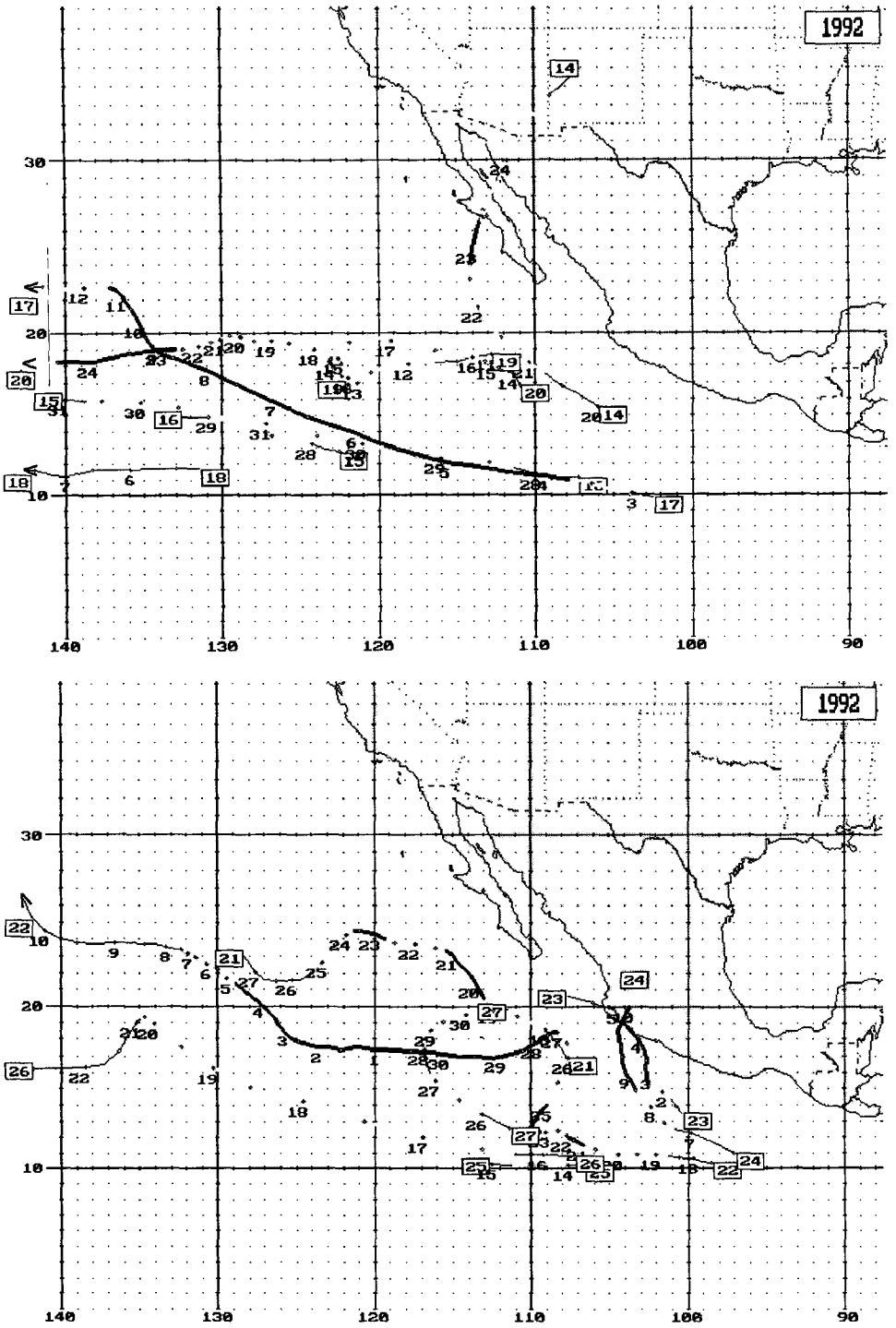


FIG. 1. Tropical cyclone tracks for 1992. The numbers in the squares are the tropical cyclone identifying numbers used in Table 1. The broad black lines indicate the hurricanes; the gray lines indicate the tropical storms, and the thin lines indicate the tropical depressions. Dates are placed alongside the 0000 UTC position of the tropical cyclone center. An arrow indicates that the tropical cyclone continued westward across 140°W into the central North Pacific Ocean basin.



Mexico, and five other people were reported missing near the southwest coast of Mexico. In addition, Tropical Depression Eighteen-E became central Pacific Hurricane Iniki (Fig. 2), which killed three people in Hawaii. Two other people were reported missing there. Iniki was a category 3 hurricane on the SSHS at landfall on the south coast of Kauai, with a central pressure of 945 mb and an estimated maximum sustained wind speed of 59 m s^{-1}. Iniki is the costliest hurricane in Hawaiian history, with a total damage estimate of $1.8 billion.

TABLE 1. Eastern North Pacific 1992 hurricane season statistics.

Tropical cyclone number	Name	Class*	Dates**	Maximum 1-min wind ($m\ s^{-1}$)	Lowest pressure (mb)
1	Agatha	T	1–5 June	31	990
2	Two-E	TD	16–18 June	15	1009
3	Blas	T	22–24 June	18	1004
4	Celia	H	22 June–4 July	64	935
5	Darby	H	2–10 July	54	968
6	Estelle	H	9–17 July	62	943
7	Frank	H	13–23 July	64	935
8	Georgette	H	14–27 July	49	964
9	Howard	T	26–30 July	28	992
10	Isis	T	28 July–2 August	28	992
11	Javier	H	30 July–12 August	36	985
12	Twelve-E	TD	10–12 August	15	1006
13	Kay	T	18–22 August	23	1002
14	Lester	H	20–24 August	39	977
15	Madeline	T	27–31 August	23	999
16	Newton	T	28 August–1 September	23	999
17	Orlene	H	2–14 September	64	934
18	Eighteen-E	TD	5–13 September (became Iniki on 8 September)		
19	Paine	H	11–16 September	33	987
20	Roslyn	H	13–30 September	44	975
21	Seymour	H	17–27 September	36	980
22	Tina	H	17 September–11 October	67	932
23	Virgil	H	1–5 October	59	948
24	Winifred	H	6–9 October	51	960
25	Xavier	T	13–14 October	21	1003
26	Yolanda	T	15–22 October	28	993
27	Zeke	T	24–30 October	23	1000

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

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

2. Tropical cyclones affecting the North American mainland

Three tropical cyclones (Lester, Virgil, and Winifred) came ashore in Mexico, and a fourth (Darby) battered the southwest coast of Mexico even though its center remained at sea. Figure 2 shows the tracks of these systems in detail. This section describes the development of these hurricanes and their impact on land.

a. Hurricane Darby, 2–10 July

Darby formed from a westward-moving tropical wave that emerged from the northwest coast of Africa on 19 June. The wave moved across the Atlantic and Caribbean without developing further. Balboa, Panama rawinsonde data indicated that the wave entered the eastern North Pacific on 29 June. Convective activity associated with the wave then became better organized. Satellite "classifications" (Dvorak 1984) for this system began on 2 July, and by 1200 UTC the system had become a tropical depression while centered about 375 km south of the Gulf of Tehuantepec (Fig. 2b).

Satellite images then showed increased convective banding and suggested that the depression strengthened to become Tropical Storm Darby while located about 550 km south-southeast of Acapulco on 3 July. The storm turned from a west-southwest heading toward the west-northwest, and accelerated on 4 July. For about 48 h, Darby continued on a generally west-northwestward to northwestward course at the fast pace of up to 10 $m\ s^{-1}$.

Upper-level outflow became more distinct, and Darby reached hurricane status about 450 km south of Manzanillo, Mexico, at 0000 UTC 5 July. By this time, the circulation associated with the cyclone had expanded and outer rainbands had begun to affect the coastal areas of Mexico from near Acapulco to Puerto Vallarta. Manzanillo reported 20 $m\ s^{-1}$ sustained winds early on 5 July.

Observations from Socorro Island, Mexico, included a surface pressure of 974.5 mb and estimated sustained winds of 51 $m\ s^{-1}$ with gusts to 57 $m\ s^{-1}$ in association with the hurricane's center passing just south of the island late on 5 July. Satellite imagery showed the eye becoming even better defined the following day, and Darby is estimated to have reached its minimum pressure of 968 mb and maximum sustained winds of 54 $m\ s^{-1}$ at 0600 UTC 6 July.

Darby began weakening when it moved over the cooler waters that lie to the northwest of Socorro Island. However, Darby's rapid forward motion allowed the cyclone to reach nearly 25°N before weakening to below hurricane strength. This is farther north than any other July hurricane on record in the eastern North Pacific. Deep convection diminished considerably by 7 July, and the cyclone was downgraded to a tropical storm on 8 July, and to a tropical depression on 9 July. The depression turned more toward the north and lost tropical characteristics by 0000 UTC 10 July.

The low-level remnants of Darby slowly moved to just offshore of the Southern California coast by 14 July, bringing rare humid weather and occasional showers to Southern California for a few days. Although precipitation totals were light (generally less than 13 mm in 24 h), several daily rainfall records were broken in Southern California. In addition, waves to 2 m occurred along the south-facing beaches of Southern California.

Highest rainfall amounts were reported from Mexico on 3 July. The largest total on that day was 146 mm from Acapulco, and several totals of near 100 mm were reported elsewhere in the Mexican state of Guerrero.

A newspaper in Mexico, *Excelsior,* reported three people killed in Acapulco due to flooding attributed to Darby. In addition, the newspaper reported four fishermen missing and 180 small shops damaged near the Acapulco city port. The rainfall and damage in the Acapulco area occurred over 550 km north of the center of the cyclone, during the early stages of cyclone development.

The *Oasis,* a 21-m pleasure boat, was abandoned near San Benedicto Island, just north of Socorro Island, on 5 July after it experienced wind speeds estimated by the boat's captain at 49 m s^{-1}. All seven persons on board were rescued.

Although the cyclone center remained well offshore of mainland Mexico, the large size of the circulation prompted the Government of Mexico to issue a tropical storm warning for the extreme southern tip of Baja California south of La Paz on 5 July. No tropical storm–force wind reports were received from the peninsula but several ships just off the extreme southern tip of the peninsula did report such winds.

The cloud cover associated with Darby forced the landing of the NASA space shuttle *Columbia,* scheduled for Edwards Air Force Base in California, to be postponed and changed to the Kennedy Space Center in Florida.

b. Hurricane Lester, 20–24 August

A weak tropical wave crossed the coast of Africa early on 7 August and remained poorly defined during its passage across the tropical Atlantic Ocean and the eastern Caribbean Sea. It appeared to split over the central Caribbean Sea with the northern portion dissipating over Cuba on 15 August and the southern portion continuing westward across Central America. The associated convection increased when the wave entered the eastern Pacific on 16 August, and the system slowly became organized over the next four days. It became a depression on 20 August, while centered about 450 km southwest of Manzanillo, Mexico.

The depression moved toward the northwest and strengthened to become Tropical Storm Lester within 24 h (Fig. 2b). It then passed directly over Socorro Island late on 20 August. (Observations from Socorro Island for this period were not available.)

Lester continued to slowly strengthen. At 1800 UTC 21 August, a ship with call sign *8JPX* (name unknown) reported 22 m s^{-1} winds 275 km northeast of the center, and a ship identified as *JBCN* (name unknown) reported 19 m s^{-1} winds about 375 km east-northeast of the center. The Government of Mexico issued a tropical storm warning and later a hurricane warning for a portion of Baja California. A tropical storm warning was also issued for mainland Mexico from Cabo Tepopa southward to Los Mochis.

By early on 22 August, the ridge to the north of Lester weakened in response to a trough approaching the west coast of the United States. The steering flow directed Lester toward the north. Later that day, Lester reached hurricane strength about 400 km west of La Paz, Baja California (Fig. 4), and a banding-type eye appeared on satellite pictures. The major trough along the west coast of the United States then became quasi-stationary. Lester gradually turned toward the northeast and made landfall as a tropical storm, first near Punta Abreojos, Baja California, at 1000 UTC 23 August, and then near Isla Tiburon, Mexico, only 2 h later.

Satellite imagery and surface observations suggest that Lester probably was a minimal tropical storm as far inland as Tucson, Arizona, and dissipated in central New Mexico. This was the first time since Katrina in 1967 that an eastern Pacific tropical cyclone retained at least tropical storm intensity upon reaching the United States.

Rainfall totals of up to 220 mm were reported from the states of Baja California and Sonora, Mexico.

Lester left more than 5000 people homeless in Mexico. Several small communities were destroyed west of the city of Hermosillo and on the highway that leads from there to San Diego. Lester also caused minor flooding in California, Colorado, and Utah. There were no reports of deaths.

c. Hurricane Virgil, 1–5 October

Virgil was a small hurricane that made landfall on the west coast of Mexico about midway between Lazaro Cardenas and Manzanillo (Fig. 2c).

A westward-moving tropical wave noted on sounding data at Dakar, Senegal, on 13 September may have been the precursor to Virgil. When the

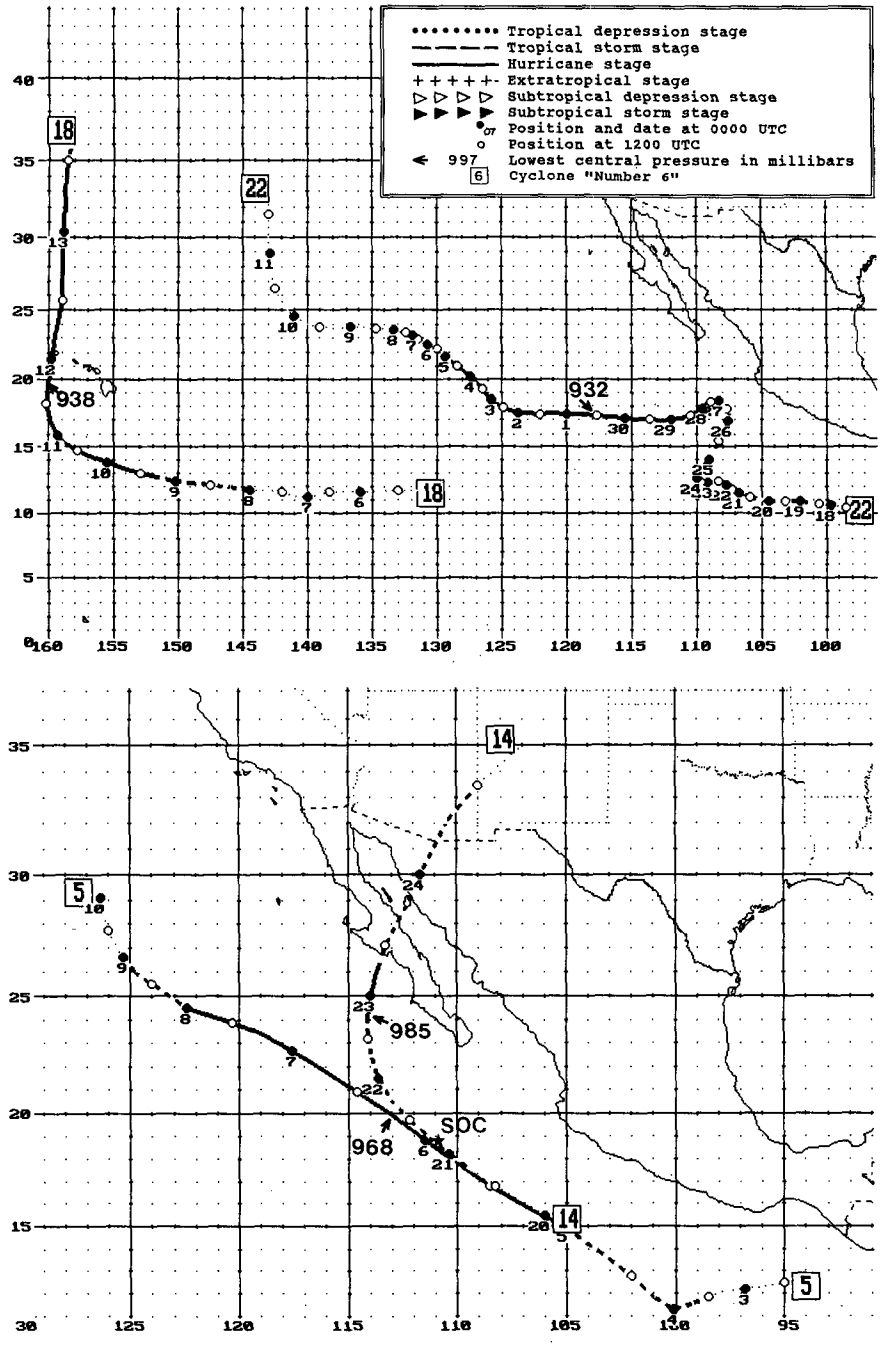


FIG. 2. Tropical cyclone tracks of (a) Hurricanes Iniki (Tropical Depression Eighteen-E) and Tina, (b) Hurricanes Darby and Lester, and (c) Hurricanes Virgil and Winifred; the numbers in the squares identify the tropical cyclones, with corresponding information provided by Table 1. ZLO indicates Manzanillo and SOC indicates Socorro Island.

wave moved over the Lesser Antilles on 20 August, the associated deep convection increased but was relatively disorganized. Subsequently, deep convection became widely suppressed when the wave crossed the Caribbean Sea. The wave's passage over Panama on 25 September was marked by a distinct lower-tropospheric wind shift at Balboa. Convection increased but remained rather unorganized until the wave neared 100°W on 30 September. On that date, a curved band pattern became evident on satellite images. Tropical depression stage was reached on 1 October.

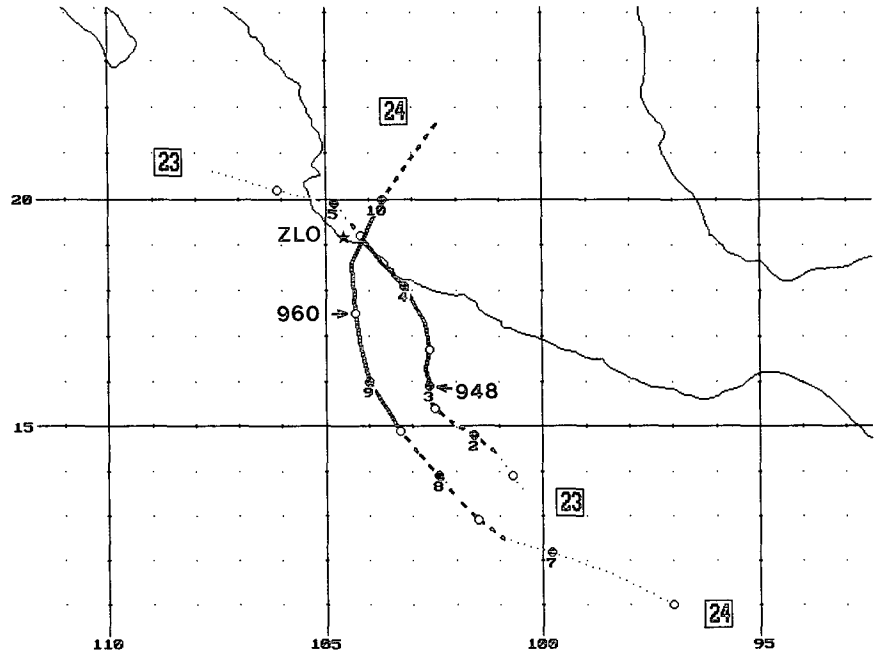


FIG. 2. (*Continued*)

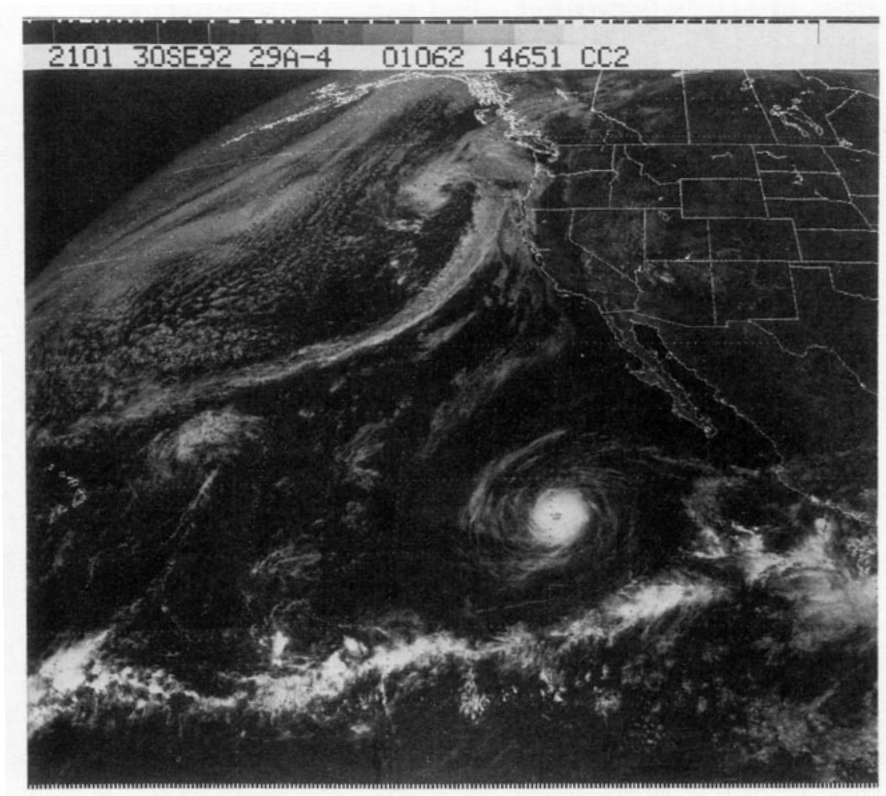


FIG. 3. GOES visible image of Hurricane Tina at 2101 UTC 30 September 1992, near time of Tina's peak intensity.

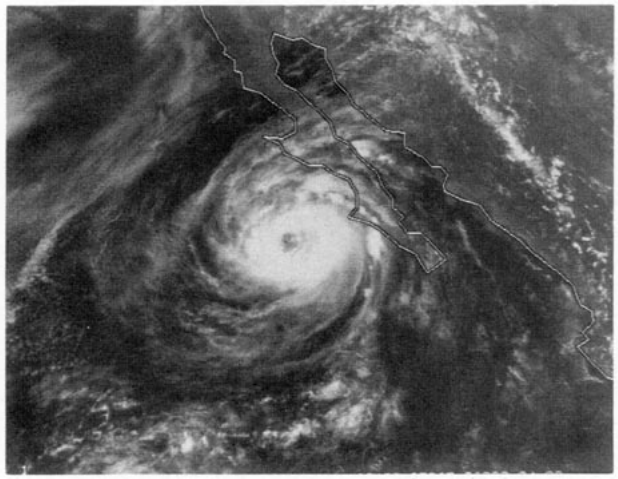


FIG. 4. GOES visible image at 1801 UTC 22 August 1992 showing Hurricane Lester, near its peak intensity, approaching Baja California, Mexico.

A weak vertical wind shear and warm ocean waters helped the depression strengthen. By 1800 UTC 1 October, the depression became Tropical Storm Virgil. On 2 October, it intensified markedly. A distinct eye appeared on infrared satellite images at 1300 UTC indicating that Virgil had reached hurricane intensity. Up to that time, Virgil had been moving slowly to the northwest. Its track then turned temporarily to the north-northwest but soon became northward. These course changes were brought about by the evolution of a mid- to upper-tropospheric trough centered several hundred kilometers to the northwest of Virgil. Virgil continued to strengthen after turning northward and is estimated to have reached its peak intensity of about 59 m s^{-1} at 0000 UTC 3 October (Fig. 5). A nearby ship of unknown name reported sustained winds of 30 m s^{-1} at that time.

Virgil's eye became less distinct and was generally not discernible on satellite images when the hurricane neared the coast. The hurricane turned to the north-northwest just before making landfall midway between Lazaro Cardenas and Manzanillo at 0300 UTC 4 October. Maximum winds at landfall were estimated to be 49 m s^{-1}.

Virgil weakened rapidly over land. By the time that the center of the cyclone passed just north of Manzanillo, Virgil was down to tropical depression strength. On 5 October, Virgil moved back over the Pacific in the vicinity of Cabo Corrientes and only a small, weak low-level circulation remained. Strong upper-level westerly winds prevented regeneration. The system

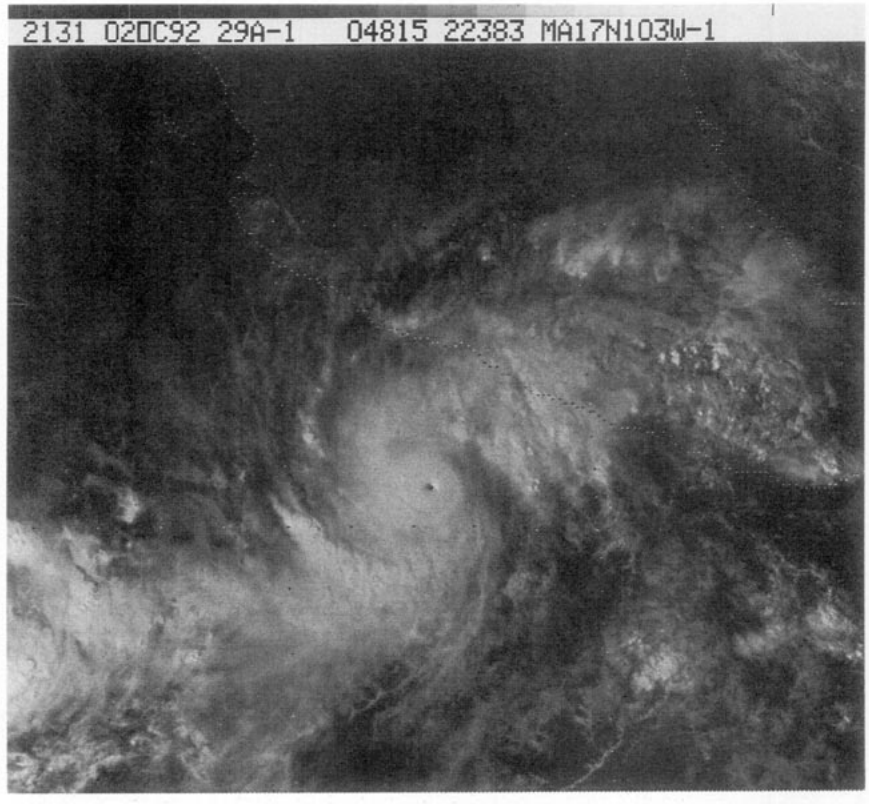


FIG. 5. GOES visible image at 2131 UTC 2 October 1992 showing Hurricane Virgil, near its peak intensity, approaching the southwest coast of Mexico.

TABLE 2. Average 1992 official track forecast errors (km) for the eastern North Pacific basin. Tropical depression stage is not included. For comparison, the average 1988–91 official errors are also given.

	Forecast period (h)				
	12	24	36	48	72
1992	72	135	206	272	402
(No. of cases)	(524)	(508)	(485)	(456)	(382)
1988–91 average	74	135	200	265	371
1992 departure from 1988–91 average	−2%	0%	+3%	+3%	+8%
1992 maximum error	504	743	906	925	1629

dissipated several hundred kilometers southeast of the southern tip of Baja California on 5 October.

A number of reports of heavy rainfall associated with Virgil were received from Mexico. For the 24-h period of 3 October, the largest total was 255 mm at Presa La Villita, Michoacan.

Based on reports from the government of Mexico, the main impact of Virgil appears to have been flooding and/or mud slides caused by the heavy rainfall. One person was reported missing in the state of Colima. Three persons were reported injured in the state of Guerrero. More than 1000 homes were reported damaged in the states of Guerrero, Michoacan, and Colima. Approximately 7400 acres of farmland were damaged in those states. In the state of Guerrero, there were reports of 500 homes flooded due to the overflow of the Atoyac River, which prompted the evacuation of 2500 persons from that area. In the state of Michoacan, the passenger train Purepecha was reportedly derailed about 45 km north of Lazaro Cardenas after floods washed out the roadbed.

d. Hurricane Winifred, 6–10 October

Satellite imagery indicated that thunderstorms increased within a broad area of disturbed weather in the vicinity of Panama on 1 October. The activity moved west-northwestward over the following several days while slowly becoming better organized. The deep convection became concentrated and a tropical depression formed from this system on 6 October about 750 km south-southeast of Acapulco, Mexico (Fig. 2c). The cyclone moved toward the west-northwest near 8 m s^{-1} and became Tropical Storm Winifred while located about 550 km south of Zihuatanejo, Mexico, at 0600 UTC 7 October. Satellite imagery showed increased convective banding at this time. The storm gradually turned toward the northwest, and the forward motion slowed to 4 m s^{-1}.

Winifred reached hurricane status about 500 km south-southeast of Manzanillo, Mexico, at 1200 UTC 8 October. Convective banding increased and an eye appeared in satellite imagery. By this time, outer rainbands were affecting the coastal areas of southwest Mexico. It is estimated that the hurricane deepened to a minimum central pressure of 960 mb and maximum sustained winds reached 51 m s^{-1} near 1200 UTC 9 October while Virgil was centered about 185 km south of Manzanillo. By then, the steering flow had become more southerly as the hurricane approached an upper-level trough to the northwest.

The hurricane turned toward the north-northeast just prior to landfall and its forward speed increased to about 7 m s^{-1}. The center is estimated to have made landfall about 30 km east-southeast of Manzanillo at 2030 UTC 9 October, which is within the hurricane warning area, as issued by the Government of Mexico, along the coastline from Lazaro Cardenas to Cabo Corrientes. The eye was not identifiable during the last few hours prior to the center crossing the coast, likely indicating some weakening due to the circulation interacting with the mountains of Mexico. At the time of landfall the estimated minimum pressure was 975 mb with maximum sustained winds of near 44 m s^{-1}.

Winifred continued inland on a northeast track and weakened quickly over mountainous terrain. A pressure of 983 mb near the time of landfall was recorded on a barograph trace at the Mexican Meteorological Service office in Manzanillo. An observer at that office estimated wind gusts to 49 m s^{-1}. Sustained winds of

TABLE 3. Average 1992 official wind speed forecast errors (m s^{-1}) for the eastern North Pacific basin. Tropical depression stage is not included. For comparison, the average 1988–91 official errors are also given. Error is forecast minus observed.

	Forecast period (h)				
	12	24	36	48	72
1992 mean	−0.4	−0.3	−0.5	−0.5	+0.3
1992 mean absolute	3.5	5.7	7.2	8.2	9.8
(No. of cases)	(524)	(507)	(482)	(437)	(377)
1988–91 mean	−0.8	−1.2	−1.9	−2.7	−2.9
1988–91 mean absolute	3.6	5.9	7.8	9.4	10.6
1992 departure from 1988–91 mean absolute	−3%	−3%	−8%	−12%	−8%
Maximum absolute error	28.3	38.6	38.6	43.7	33.4

18 m s^{-1} were reported from Colima, Mexico, for several hours prior to landfall on 9 October.

Several rainfall amounts of up to 100 mm were reported from observing sites in the states of Colima and Michoacan from 0600 UTC 9 October to 0600 UTC 10 October. Total storm rainfall was probably higher because rainfall is believed to have occurred both before and after this time period.

Three deaths have been reported due to flooding in association with Winifred. Most of the damage occurred in the states of Colima and Michoacan. The Governor of Colima estimated damage associated with Winifred at more than $5 million. Electricity was knocked out and water systems were made inoperable in portions of Colima. Damage occurred to hotels, restaurants, and houses. About 1500 homes and several roads were damaged. Extensive flooding occurred on the road connecting Lazaro Cardenas with Ixtapa and Zihuatanejo. About 200 000 acres of farmland were reportedly damaged. The hardest hit crops were plantains and corn.

3. Statistics on forecast accuracy

The NHC issues track and intensity forecasts, every 6 h, for all tropical cyclones in the eastern North Pacific basin (and in the Atlantic basin). These forecasts are for the periods 12, 24, 36, 48, and 72 h and are evaluated using the best-track dataset derived from NHC's postanalysis of all available track and intensity data information.

The average official track forecast errors for the eastern North Pacific in 1992 are listed in Table 2, along with the previous 4-yr averages [The NHC began forecasting tropical cyclones in the eastern North Pacific basin, east of 140°W, in 1988. The National Weather Service (NWS) Forecast Office in Redwood City, California, held this responsibility prior to 1988. Tropical cyclones between 140°W and 180° longitude are the responsibility of the NWS office in Honolulu, Hawaii.] The track errors for 1992 are generally within a few percent of the 1988–91 averages except at the 72-h forecast period where the errors are 8% larger.

Official maximum 1-min wind speed forecast errors are given in Table 3. The average bias (mean error) is slightly negative at 12–48 h and slightly positive at 72 h. The 1988–91 biases are negative and considerably larger than 1992 at all forecast periods. The absolute values of the 1992 wind speed forecast errors are somewhat smaller than the 1988–91 absolute errors at all time periods.

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