Eastern North Pacific Hurricane Season of 1991

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ABSTRACT

The 1991 eastern North Pacific hurricane season is summarized. The season comprised 16 tropical cyclones, consisting of 10 hurricanes, 4 tropical storms, and 2 tropical depressions.

1. Introduction

The 1991 hurricane season in the eastern North Pacific Ocean appears undistinguished at first glance (e.g., Fig. 1). A total of 16 tropical cyclones developed, featuring 10 hurricanes, 4 tropical storms, and 2 tropical depressions. These totals are close to the climatological averages established using the 1966–91 period of routine weather satellite surveillance. The amount of activity also represents a marked decrease from 1990, when 16 hurricanes formed, a season record high.

Nevertheless, 1991 had its share of peculiarities. The season began earlier than all others in the satellite era, except 1990. The season also ended late with the first hurricane in the last quarter century to form in November. On the other hand, the month of July, often the most active in this hurricane basin, was relatively quiet. In fact, only two tropical cyclones (four below normal) formed that month. The decrease in activity during July 1991 was likely related to the presence of an anomalous circulation aloft associated with a series of transitory large-scale disturbances at mid- and upper levels identified unusually far to the south over the tropical eastern North Pacific Ocean. A notable absence of activity from mid-August until mid-September was also characterized by a flow pattern associated with recurrent troughing near and southwest of the Baja peninsula.

None of the tropical storms or hurricanes made landfall on the mainland. One of this season’s two tropical depressions (named Five-E), however, was close to tropical-storm strength when its center came ashore near Salina Cruz, Mexico, on the last day of June. The depression caused the year’s lone fatality and most significant damage (to 118 homes), as well as 500 injuries, with 2 people reportedly missing. Rainfall totals as large as 235 mm in 24 h accompanied the depression over southern Mexico. Three other systems (Delores, Ignacio, and Marty) threatened the coast, prompting the government of Mexico to issue tropical-storm or hurricane warnings or watches. The remaining 40 injuries during this season came when the center of Tropical Storm Ignacio passed just offshore of Lazaro Cardenas, Mexico, during mid-September. Public advisories were issued on four additional systems to highlight the threat of rain-induced floods and mudslides over Mexico.

Several tropical cyclones grew into especially long-lived and intense overwater systems. In fact, Hurricane Kevin endured as a hurricane for 12 days to the east of 140°W, establishing a new record for longevity of a hurricane in the eastern Pacific. Kevin was one of five major hurricanes (sustained surface winds of 50 m s⁻¹ or greater) this year.

Satellite images suggest that most, if not all, of the tropical cyclones formed from tropical waves first detected near the west coast of Africa. The importance of tropical waves is supported by valuable aircraft observations made during the Tropical Experiment in Mexico (TEXMEX), an intensive research program on tropical cyclone formation in the eastern North Pacific.

2. Best tracks

Tropical cyclone best tracks consist of a center position and two measures of intensity (the maximum 1-min sustained surface wind speed and the minimum sea level pressure). The parameters are estimates at 6-h intervals. They are based on a postanalysis of data conducted by the National Hurricane Center (NHC). The primary data sources for the postanalysis are the NHC Tropical Satellite Analysis and Forecast Unit,

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**FIG. 1. (Continued)**

- Tropical depression stage
- Tropical storm stage
- Hurricane stage
- Extratropical stage
- Subtropical depression stage
- Subtropical storm stage

**NUMBER** | **TYPE** | **NAME** | **DATE**
--- | --- | --- | ---
9 | T | IGNAZIO | SEP 16-19
10 | H | JIMENA | SEP 20-OCT 2
11 | H | KEVIN | SEP 25-OCT 12
12 | H | LINDA | OCT 3-11
13 | H | MARTY | OCT 7-10
14 | H | NORA | NOV 7-12

997 mb Lowest central pressure in millibars

**ST** TROPICAL STORM

**H** HURRICANE

**6** Cyclone "Number 6"
the Synoptic Analysis Branch of the National Environmental Satellite Data and Information Service, and the Air Force Global Weather Central. These centers provided to the NHC real-time estimates of position and intensity by applying the Dvorak (1984) tropical cyclone analysis technique to imagery from the Geostationary Operational Environmental Satellite GOES-7 and polar-orbiting satellites.

In 1991 the estimates derived from satellite imagery were supplemented by the TEXMEX data, by flight-level data from a NOAA research aircraft investigating Hurricane Jimena, and by a few surface observations. Figure 1 shows the best tracks for this year’s tropical storms and hurricanes. Table 1 provides additional information about these systems.

3. Verification

The NHC began operational forecasting of eastern North Pacific tropical cyclones in 1988. Every 6 h the NHC issues tropical cyclone track and intensity forecasts for periods extending to 72 h. The forecasts are evaluated with respect to best-track data.

Table 2 lists the position forecast errors for the 1991 season. The position errors for this year are slightly smaller than the NHC errors averaged over the years 1988–90. Wind-speed forecast errors in 1991 are comparable to the errors during 1988–90 (Table 3).

4. Tropical cyclone summaries

a. Tropical Storm Andres, 16–20 May

The first tropical cyclone of 1991 progressed through a somewhat unusual evolution. It formed earlier in the hurricane season (on 16 May) than any other eastern North Pacific tropical cyclone, except for 1990 Hurricane Alma (12 May). Moreover, the formation occurred along about 122°W, well west of the region that more often favors development. The tropical cyclone moved very little, slowly tracing out a small cyclonic loop.

The depression became Tropical Storm Andres early on 17 May. Andres reached its peak intensity later that day, with an estimated minimum sea level pressure of 994 mb and maximum sustained wind speed of 28 m s⁻¹. After about 24 h, Andres began weakening. The weakening and eventual dissipation resulted from vertical wind shear, which increased in association with changes occurring in a 200-mb anticyclone centered south of Baja California.

b. Tropical Storm Blanca, 14–22 June

The year’s second tropical cyclone formed nearly a month after the first system, late on 14 June, several hundred kilometers south of Acapulco, Mexico. The depression developed from an area of convection accompanying a tropical wave.

The tropical cyclone moved generally toward the west-northwest, initially through an area of easterly shear that was strong enough to delay significant strengthening of the cyclone. Nevertheless, by the 17th, the shear temporarily relaxed and the depression intensified into Tropical Storm Blanca. The tropical storm reached its maximum intensity of 28 m s⁻¹ winds and 994-mb pressure early on 20 June. Blanca apparently had a rather compact circulation, as deduced from observations made aboard the ship Chevron Arizona. That ship reported winds of only 10 m s⁻¹ at a time when it was within 100 km of Blanca’s center.

Blanca’s low-level circulation center became essentially cloud-free late on the 20th when strong winds aloft removed mid- and upper-level clouds from the surrounding area. The wind shear and Blanca’s passage

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**Table 1. Eastern North Pacific hurricane season statistics for 1991.**

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Class*</th>
<th>Dates**</th>
<th>Maximum 1-min wind (m s⁻¹)</th>
<th>Minimum sea level pressure (mb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Andres</td>
<td>T</td>
<td>16–20 May</td>
<td>28</td>
<td>994</td>
</tr>
<tr>
<td>2</td>
<td>Blanca</td>
<td>T</td>
<td>14–22 June</td>
<td>28</td>
<td>994</td>
</tr>
<tr>
<td>3</td>
<td>Carlos</td>
<td>H</td>
<td>16–27 June</td>
<td>54</td>
<td>955</td>
</tr>
<tr>
<td>4</td>
<td>Delores</td>
<td>H</td>
<td>22–28 June</td>
<td>39</td>
<td>979</td>
</tr>
<tr>
<td>5</td>
<td>Enrique</td>
<td>H</td>
<td>15–21 July</td>
<td>33</td>
<td>987</td>
</tr>
<tr>
<td>6</td>
<td>Feda</td>
<td>H</td>
<td>29 July–2 August</td>
<td>54</td>
<td>959</td>
</tr>
<tr>
<td>7</td>
<td>Guillermo</td>
<td>H</td>
<td>4–10 August</td>
<td>36</td>
<td>983</td>
</tr>
<tr>
<td>8</td>
<td>Hilda</td>
<td>T</td>
<td>8–14 August</td>
<td>28</td>
<td>992</td>
</tr>
<tr>
<td>9</td>
<td>Ignacio</td>
<td>T</td>
<td>16–19 September</td>
<td>28</td>
<td>994</td>
</tr>
<tr>
<td>10</td>
<td>Jimena</td>
<td>H</td>
<td>20 September–2 October</td>
<td>59</td>
<td>945</td>
</tr>
<tr>
<td>11</td>
<td>Kevin</td>
<td>H</td>
<td>25 September–12 October</td>
<td>64</td>
<td>935</td>
</tr>
<tr>
<td>12</td>
<td>Linda</td>
<td>H</td>
<td>3–13 October</td>
<td>54</td>
<td>957</td>
</tr>
<tr>
<td>13</td>
<td>Marty</td>
<td>H</td>
<td>7–18 October</td>
<td>36</td>
<td>979</td>
</tr>
<tr>
<td>14</td>
<td>Nora</td>
<td>H</td>
<td>7–12 November</td>
<td>46</td>
<td>970</td>
</tr>
</tbody>
</table>

* T: tropical storm, wind speed 17–32 m s⁻¹; H: hurricane, wind speed 33 ms⁻¹ or higher.
** Dates begin at 0000 UTC and include tropical-depression stage.
over progressively lower sea surface temperatures led to gradual weakening and dissipation of the system.

c. Hurricane Carlos, 16–27 June

Carlos formed from a tropical wave that crossed Central America to the eastern Pacific Ocean on 14 June. The wave and its shower activity soon became better organized, and, by 16 June, it had developed into a tropical depression. Intensification followed, and the depression strengthened to become Hurricane Carlos on 18 June.

After weakening briefly, Carlos’s strengthening resumed and the hurricane reached its peak intensity of 54 m s⁻¹ winds and minimum pressure of 955 mb on 24 June (Fig. 2). During that period a strong high developed to the north of Carlos, and the steering flow around the high temporarily forced the tropical cyclone to the west-southwest.

After 24 June Carlos experienced strong wind shear and moved over cooler waters. These conditions led to Carlos’s dissipation by late on the 27th.

d. Hurricane Delores, 22–28 June

Satellite imagery indicated that cloudiness associated with a tropical wave first showed signs of circulating cyclonically over the eastern Pacific Ocean on 22 June, several days after the wave had crossed Central America. The system became a tropical depression on the 22d when centered about 850 km south-southeast of Manzanillo, Mexico.

Over the next two days, the depression moved northward at about 3 m s⁻¹ toward the coast of Mexico. A tropical-storm warning was issued, and a hurricane watch was later issued from Ixtapa to Manzanillo. Delores reached hurricane strength on 25 June while at its closest point of approach to the coast, about 150 km offshore from Manzanillo. Although several ships near Delores reported tropical-storm-force winds, the center of the hurricane is believed to have remained far enough offshore that the strongest winds did not affect the mainland. Satellite imagery suggested, however, that periods of heavy rain occurred over the coastal states of Mexico, from Oaxaca northwestward to Jalisco, between 23 and 26 June.

Delores turned toward the west-northwest, accelerated away from the coast, and reached its peak intensity of 39 m s⁻¹ and 979 mb on the 25–26 June. That motion eventually brought the tropical cyclone over colder water, leading to a gradual decrease in the amount of deep convection. Delores then slowed as it continued to weaken. On the 28th satellite images and surface observations from Socorro Island indicated that Delores was dissipating near that island. Nevertheless, remnants of Delores persisted for several more days.

e. Hurricane Enrique, 15–21 July

Satellite observations and data from the TEXMEX aircraft suggest that Enrique formed from a tropical wave. On 14 July the wave was centered about 1000

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Table 2. Official track forecast errors in kilometers by year, eastern North Pacific Ocean. Number of cases in parentheses.

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>12</th>
<th>24</th>
<th>36</th>
<th>48</th>
<th>72</th>
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<td>154</td>
<td></td>
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<td>1980</td>
<td>150</td>
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<td>1982</td>
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<td>1983</td>
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<tr>
<td>1987</td>
<td>157</td>
<td></td>
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<td></td>
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<tr>
<td>1978–87 average</td>
<td>156</td>
<td>route</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1988</td>
<td>37 (175)</td>
<td>83 (175)</td>
<td>139 (150)</td>
<td>191 (128)</td>
<td>256 (108)</td>
<td>326 (74)</td>
</tr>
<tr>
<td>1989</td>
<td>28 (215)</td>
<td>80 (215)</td>
<td>152 (182)</td>
<td>232 (150)</td>
<td>304 (119)</td>
<td>439 (77)</td>
</tr>
<tr>
<td>1990</td>
<td>24 (451)</td>
<td>70 (418)</td>
<td>131 (383)</td>
<td>200 (345)</td>
<td>265 (308)</td>
<td>370 (237)</td>
</tr>
<tr>
<td>1988–90 average</td>
<td>28</td>
<td>76</td>
<td>139</td>
<td>206</td>
<td>272</td>
<td>376</td>
</tr>
<tr>
<td>1991</td>
<td>24 (345)</td>
<td>69 (305)</td>
<td>126 (281)</td>
<td>183 (257)</td>
<td>246 (232)</td>
<td>361 (182)</td>
</tr>
<tr>
<td>1988–91 average</td>
<td>27</td>
<td>74</td>
<td>135</td>
<td>200</td>
<td>264</td>
<td>371</td>
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</tbody>
</table>

Table 3. Official wind-speed forecast errors in meters per second, eastern North Pacific. Error = forecast – observed.

<table>
<thead>
<tr>
<th>Forecast period (h)</th>
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<th>24</th>
<th>36</th>
<th>48</th>
<th>72</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988–90 mean</td>
<td>-0.6</td>
<td>-1.1</td>
<td>-1.6</td>
<td>-2.3</td>
<td>-3.4</td>
<td>-3.2</td>
</tr>
<tr>
<td>1988–90 mean (absolute)</td>
<td>1.9</td>
<td>3.7</td>
<td>5.9</td>
<td>7.8</td>
<td>9.4</td>
<td>10.3</td>
</tr>
<tr>
<td>Number of cases</td>
<td>836</td>
<td>801</td>
<td>709</td>
<td>619</td>
<td>532</td>
<td>387</td>
</tr>
<tr>
<td>1991 mean</td>
<td>-0.5</td>
<td>0.0</td>
<td>-0.3</td>
<td>-0.8</td>
<td>-1.2</td>
<td>-2.4</td>
</tr>
<tr>
<td>1991 mean (absolute)</td>
<td>1.4</td>
<td>3.3</td>
<td>5.9</td>
<td>7.9</td>
<td>9.3</td>
<td>11.2</td>
</tr>
<tr>
<td>Number of cases</td>
<td>345</td>
<td>305</td>
<td>281</td>
<td>257</td>
<td>232</td>
<td>182</td>
</tr>
<tr>
<td>Maximum error</td>
<td>-10</td>
<td>+15</td>
<td>-26</td>
<td>+31</td>
<td>-28</td>
<td>-33</td>
</tr>
<tr>
<td>1988–91 mean</td>
<td>-0.6</td>
<td>-0.8</td>
<td>-1.2</td>
<td>-1.9</td>
<td>-2.7</td>
<td>-2.9</td>
</tr>
<tr>
<td>1988–91 mean (absolute)</td>
<td>1.8</td>
<td>3.6</td>
<td>5.9</td>
<td>7.8</td>
<td>9.3</td>
<td>10.6</td>
</tr>
<tr>
<td>Number of cases</td>
<td>1181</td>
<td>1106</td>
<td>990</td>
<td>876</td>
<td>746</td>
<td>569</td>
</tr>
</tbody>
</table>
km south-southwest of Acapulco and contained a well-defined midlevel vortex (see Fig. 3a) periodically accompanied by deep convection. Although flight data did not show a corresponding low-level circulation center that day, the midlevel vortex is believed to be the same system that became a tropical depression one day later.

The depression intensified quickly and became Tropical Storm Enrique early on the 16th. Satellite pictures showed that Enrique had an eye just fleetingly, indicating that the tropical cyclone may have been a hurricane for a few hours early on 17 June. Maximum intensity was estimated at 33 m s\(^{-1}\) and 987 mb.

Enrique initially moved generally toward the northwest. By midday on the 17th, it began to be sheared by a strong southwesterly flow aloft associated with one of the series of upper-level troughs noted unusually far to the south over the eastern North Pacific Ocean during July. The shearing quickly exposed Enrique’s low-level cloud center and led to a slower westward forward motion. The NHC downgraded the cyclone to tropical-depression status on the 19th.

The next day, Enrique became the year’s first tropical cyclone to cross 140°W into the Central Pacific Hurricane Center’s (CPHC) area of responsibility. CPHC analyses (Chun et al. 1992) indicate that although Enrique weakened by late on 21 July, the system did not completely dissipate then. Instead, it remained identifiable on satellite imagery as a disturbance that for nearly a week moved toward the northwest. By the 27th the remnants were almost 1500 km north of Hawaii and about to turn toward the west-southwest. On that new course the system crossed Midway Island without significant effect on 31 July. The system passed the International Date Line and entered the U.S. Joint Typhoon Warning Center (JTWC) forecast area on 1 August.

Enrique proved resilient as well as long lived. The JTWC analyses show that Enrique regenerated to tropical-storm strength early on 1 August in the vicinity of 31°N, 175°E. Over the following 36 h the tropical cyclone turned toward the north and accelerated to about 13 m s\(^{-1}\). On that track, Enrique weakened on moving into an environment of colder water and stronger vertical wind shear. Final dissipation occurred 1–2 August around 35°N, 172°E.

Enrique’s lengthy track made it the first system since Georgette in 1986 to have been a tropical cyclone in the eastern, central, and then western North Pacific Ocean.
FIG. 3. Flight-level winds from research aircraft. Plots produced in a storm-relative coordinate system, but show ground-relative winds. Flag for 25.7 m s$^{-1}$ (50 kt), full barb for 5.1 m s$^{-1}$ (10 kt), and half-barb for 2.6 m s$^{-1}$ (5 kt). Data in (a)–(c) from TExMEX, during formative stages of tropical cyclones. (a) Measured winds (squares) and analysis scheme winds (asterisks) in Enrique, at 700 mb near 0400 UTC 14 July. (b) Measured winds at 950 mb (solid squares) and 700 mb (open squares) in Fefa, near 0300 UTC 30 July 1991. (c) Streamlines and isolachs (m s$^{-1}$) during Guillermo, at 970 mb near 1200 UTC 5 August. (d) Measured 850-mb winds in Jimena near 2000 UTC 23 September. Figures provided by Sam Houston and Peter Black of the NOAA/Atlantic Oceanographic and Meteorological Laboratory (AOML)/Hurricane Research Division (HRD).
f. Hurricane Fefá, 29 July–8 August

The tropical wave phase of Fefá was especially well observed. The wave emerged from the northwest coast of Africa on 17 July, accompanied by large 24-h pressure falls along the west coast of Africa and a marked low- to midlevel wind shift in the Dakar rawinsonde data. The wave moved across the Atlantic Ocean and Caribbean Sea from 17 to 25 July without development, but with its passage across Barbados and Trinidad clearly detected in wind shifts analyzed in upper-air data. Balboa rawinsonde data indicated that the wave emerged over the eastern Pacific Ocean on 25 July.

Cloudiness near the wave became better organized by the 28th. Data from a TEXMEX aircraft indicated that a 700-mb cyclonic circulation center was present within the wave early the next day, but evidence of a low-level center was lacking at that time. Nevertheless, the system became a tropical depression late on the 29th. The surface circulation probably in association with the 700-mb center previously identified.

The depression intensified quickly to become Tropical Storm Fefá. Flight-level data on 29–30 July showed a broad area of 18 to 26 m s⁻¹ winds at low levels. Interestingly, the 950-mb center was displaced about 55 km to the northwest of the center of a 700-mb vortex detected about 45 min earlier (Fig. 3b).

Fefá reached hurricane strength on 31 July. Satellite imagery showed strong upper-level outflow and an eye on 1 August. The hurricane reached its maximum wind speed of 54 m s⁻¹ and minimum pressure of 959 mb early on 2 August.

Throughout its lifetime Fefá moved toward the west or west-northwest. When the hurricane crossed 140°W on 5 August, operational responsibility for the system was passed to the CPHC. CPHC analyses indicate that Fefá had weakened to a depression when it overspread the Hawaiian Islands with unsettled weather (Chun et al. 1992). Squalls with wind gusts to tropical-storm strength, high surf, and localized flash flooding occurred on the island of Hawaii. Fefá weakened and then dissipated on 8 August in a strongly sheared environment near the Hawaiian Islands.

g. Hurricane Guillermo, 4–10 August

The tropical wave that produced Guillermo was investigated over the western Gulf of Tehuantepec on 3 August by a TEXMEX aircraft. Although a midlevel circulation center was identified on that flight, a surface center was not detected. Satellite imagery suggested, however, that the system became a tropical depression early the next day about 600 km south of Acapulco.

The depression generally moved toward the west-northwest or parallel to and about 375 km offshore of the southwest coast of Mexico. It gradually intensified in the presence of easterly shear and reached tropical-storm strength late on the 4th. Based on reports from a TEXMEX aircraft (e.g., Fig. 3c), Guillermo was upgraded to a hurricane on 5 August. The aircraft data included a surface wind estimate of 33 m s⁻¹ and a calculated central pressure of 993 mb. A 39 m s⁻¹ gust was encountered at a flight level of about 400 m.

Guillermo strengthened only slightly more during the following day and a half. Satellite imagery showed a bursting-type pattern of deep convection over the center of Guillermo during that period. Guillermo’s maximum intensity was estimated at 36 m s⁻¹ and 983 mb. The system turned toward the west-southwest, weakened, and then appeared on satellite images as a swirl in the stratocumulus clouds during its final days.

h. Tropical Storm Hilda, 8–14 August

Hilda strengthened from a tropical wave to a tropical depression early on 8 August when centered a few hundred kilometers south-southwest of Acapulco. Later that day, a TEXMEX aircraft investigated the depression and found a well-defined closed cyclonic circulation with wind speeds up to 12 m s⁻¹ at a flight level of about 1500 m.

The system strengthened and became Tropical Storm Hilda on the 9th. Hilda’s estimated peak intensity, 28 m s⁻¹ sustained winds and 992-mb central pressure, was reached two days later.

The storm moved mainly toward the northwest. While a persistent northwestward track occasionally occurs in the latter part of the season, such a motion is quite unusual for early to mid-August. In this instance, the cyclone was steered by the flow associated with yet another large-scale trough over the eastern North Pacific. On that track Hilda eventually moved over quite cool water to the west of the Baja peninsula. Although the storm then weakened, this process was prolonged and dissipation was not complete until the cyclone had moved unusually far to the north, nearly reaching southern California. The slow deterioration may have been due to Hilda having a rather broad circulation.

Public advisories were issued. They cautioned against locally heavy rain over portions of Baja California and the southwestern United States. Tropical-storm conditions occurred as far north as Guadalupe Island and some rain was reported northward into California.

i. Tropical Storm Ignacio, 16–19 September

Tropical Storm Ignacio formed in a broad area of convection located to the east of a quasi-stationary midlevel trough axis anchored along about 115°W. The area of disturbed weather became a tropical depression on 16 September when centered about 375 km southwest of Acapulco.

The tropical cyclone’s forward motion was slow, along a small clockwise loop. This track was somewhat unexpected. The forecast problem was ultimately traced to a lack of rawinsonde data near Ignacio.

Ignacio was centered about 45 km offshore and was near its peak intensity, 28 m s⁻¹ and 994 mb, late on
the 17th. The surface pressure fell to (or slightly below) 1004.7 mb at Zihuatenejo and 1006.1 mb at Manzanillo. Tropical-storm warnings were posted for the subsequently affected portion of southwest Mexico, and public advisories emphasized the possibility of heavy rain and associated damage to several coastal and adjacent states. The few surface observing sites in the area experienced many hours of rain, some locally heavy, from midday on the 16th to early on the 18th.

Ignacio caused 40 injuries. Although no serious damage was reported, street flooding was noted in Acapulco by the U.S. Consular Agent in that city.

Several ships reported tropical-storm-force winds. The OMI Willameite had the highest surface wind of the event, 21 m s\(^{-1}\).

Ignacio weakened quickly on 18 September, perhaps from the combined effects of the storm's close proximity to land and persistence over waters likely cooled by upwelling. Strong winds (10–15 m s\(^{-1}\)) aloft, shearing Ignacio from the southwest, probably contributed to the weakening as well. Ignacio was downgraded to a depression and dissipated on the 19th. The remnants of the depression, identified on satellite imagery as occasional flare-ups of convection, moved west-southwest for the next two days.

\textit{j. Hurricane Jimena, 20 September–2 October}

A tropical wave from which Jimena likely originated exited the coast of Africa on 5 September as a fairly active-looking system. While over the eastern Atlantic Ocean the wave formed Tropical Storm Danny.

The southern part of the wave continued westward and crossed Central America on the 14th and 15th of the month. The system developed into a tropical depression on the 20th and then into Tropical Storm Jimena a day later. Jimena moved toward the northwest, then the west, and strengthened rapidly. It became a hurricane on 22 September. Upper-level outflow became distinct and a banding-type eye developed.

Satellite imagery and flight-level data from a NOAA research aircraft (Fig. 3d) suggest that Jimena reached, and then generally maintained, its maximum wind speed of \(59 \text{ m s}^{-1}\) and minimum pressure of 945 mb between 1200 and 1800 UTC 24 September. This made Jimena the first of two Saffir–Simpson category 4 hurricanes in the eastern North Pacific Ocean this year. Only minor weakening followed during the next few days and Jimena still had a well-defined eye and winds of about \(46 \text{ m s}^{-1}\) on the 28th.

Jimena turned toward the northwest on 29 Septem-

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{image}
\caption{GOES visible satellite image at 2101 UTC 30 September 1991 showing, from left to right, Tropical Storm Jimena, Hurricane Kevin, and a tropical disturbance that developed into Hurricane Linda.}
\end{figure}
ber. That motion brought the hurricane into an area of lower sea surface temperatures and relatively strong southwesterly winds aloft. Jimena weakened quickly in that environment and, by late on the 30th, the circulation center was devoid of deep convection. This left a low-level cloud swirl that gradually dissipated.

k. Hurricane Kevin, 25 September–12 October

Hurricane Kevin provided two highlights. Not only was it the most enduring eastern Pacific hurricane on record, but it was also the season's strongest hurricane with Saffir-Simpson category 4 winds estimated at 64 m s⁻¹ and a minimum pressure of 935 mb.

Kevin formed from a tropical wave that moved into the eastern Pacific Ocean on 21 September. The convection became better organized on the 23rd and 24th, and the system progressed quickly through the tropical-depression stage to become Tropical Storm Kevin on 25 September. Convective banding and upper-level outflow grew more distinct on the 26th, and Kevin became a hurricane that day.

Several ships reported tropical-storm-force winds on the 26th and 27th. The highest surface wind associated with Kevin reported by a ship was 23 m s⁻¹. The season's lowest-pressure report received from a ship (the Sedco-BP471) was 1001.9 mb, also associated with Kevin.

Kevin strengthened from 27 to 29 September. Satellite imagery initially showed intermittent glimpses of an eye, followed by a well-defined eye (Figs. 4 and 5) that persisted for several days. Kevin reached its peak intensity on 1 October.

Kevin began moving toward the west-southwest in response to the steering current associated with a strengthening high pressure system to the northwest of the hurricane. This course was maintained for several days. During that period Kevin's winds decreased to 39 m s⁻¹. A more northerly track resumed by 6 October. The hurricane then reintensified and, by the 8th, Kevin regained 51 m s⁻¹ winds.

Kevin crossed 140°W on 9 October, entering the CPHC area of responsibility. During the next few days, Kevin weakened and then lost its tropical characteristics over the cool waters that lie well to the northeast of Hawaii.

l. Hurricane Linda, 3–13 October

The tropical wave that produced Hurricane Linda crossed Central America to the eastern Pacific Ocean on 25 September. Although convection flared up on
the 30th, the system did not develop into a tropical depression until 3 October.

The system initially moved toward the northwest until steering currents weakened. Linda then drifted toward the north and then the north-northeast from the 3d through the 5th. Linda intensified over that period. It reached hurricane strength early on the 5th and attained its estimated maximum winds of 54 m s\(^{-1}\) and minimum pressure of 957 mb late that day.

Linda's course turned toward the west-northwest by 7 October. The system weakened when it moved over a patch of water that had been cooled by upwelling associated with Hurricane Kevin's passage a few days earlier. Even so, the hurricane caused 36 m s\(^{-1}\) sustained winds at Socorro Island. That was the strongest wind report received from a surface site in 1991.

Strong upper-level winds sheared the deep convection near Linda's center by late on 9 October. Only low clouds remained and Linda weakened to a depression a day later. Although deep convection periodically appeared over the next few days, the system dissipated on 13 October.

\textit{m. Hurricane Marty, 7–18 October}

Convection associated with a tropical wave became rapidly concentrated on 6 October, just west of the Pacific coast of Central America. By the 8th, the weather system had passed through the tropical-depression stage and become Tropical Storm Marty. Marty continued intensifying through 11 October. On several occasions, satellite imagery showed a transitory eye in Marty's clouds, and, on the 10th Marty became a hurricane. Marty's minimum central pressure of 979 mb and maximum wind speed of 36 m s\(^{-1}\) occurred late on the 11th.

The track of Marty until 12 October was west-northwest or parallel to and about 200 km offshore of the southwestern Mexican coastline. Satellite images showed intense convection near the coast, and several ships just offshore reported tropical-storm conditions during that period. The Texaco Georgia encountered 26 m s\(^{-1}\) winds on 10 October. This was the strongest wind reported to the NHC from a ship in the tropical eastern North Pacific Ocean during this hurricane season. Winds of 21 m s\(^{-1}\) and swells of 6 m were observed aboard the Chesapeake Bay during Marty.

Tropical-storm warnings were issued for the mainland from Acapulco to Manzanillo. There were no reports of tropical-storm-force winds from the widely spaced surface stations in southwest Mexico. The NHC also advised that sections of the mainland might experience heavy rain and floods.

The steering current around an upper trough over

\begin{figure}[h]
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\includegraphics[width=\textwidth]{image.png}
\caption{GOES visible image at 2201 UTC 9 November 1991 showing Hurricane Nora near its peak intensity.}
\end{figure}
the western United States influenced Marty's course from the 11th through the 14th. The hurricane initially took a turn toward the north. When the influence of the trough decreased, Marty turned abruptly toward the west-southwest. On this course Marty weakened as it passed over waters cooled just several days earlier by upwelling in Hurricanes Kevin and Linda. Although areas of deep convection occasionally developed for a few days near Marty's center, the tropical cyclone continued to gradually weaken and then it dissipated.

**n. Hurricane Nora, 7–12 November**

Nora formed from a tropical wave that contained an area of well-organized convection during its transit from the southwest Caribbean Sea across Central America to the eastern Pacific Ocean. The system reached tropical-depression status about five days later, on 7 November. It intensified to become Tropical Storm Nora on the 8th and Hurricane Nora on the 9th.

The track of Nora was toward the northwest from the 7th through the 10th, with a temporary curve toward the west on the 8th. The changes of track were due to the flow field around a strengthening ridge of high pressure to the north of the tropical cyclone.

The hurricane reached its peak intensity with estimated wind speeds of 46 m s\(^{-1}\) and a central pressure of 970 mb early on 10 November (Fig. 6). By late the next day, Nora began to weaken rapidly when a strong large-scale trough approached the hurricane from the west and formed a cutoff low just west of the Baja peninsula. The low created an environment of westerly vertical wind shear over Nora that caused the weakening. This flow also caused the forward motion of Nora to abruptly change to the northeast. Nora's low-level cloud circulation pattern became completely exposed on the 11th. Convection occasionally reappeared near the circulation center until late on the 12th.

Public advisories were issued on the 12th. They indicated that the states of Sinaloa and Nayarit, Mexico, might experience floods from an approaching, rather large area of Nora's deep convection. The convection did move inland, in contrast to Nora's surface circulation center, which dissipated offshore.

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**REFERENCES**
