# Atlantic Hurricane Season of 1974

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ABSTRACT

A general overview of the 1974 hurricane season in the North Atlantic is presented together with detailed accounts of individual storms.

## 1. General summary

The relative lull in tropical storm activity that began in the Atlantic in 1970 continued in 1974. Seven tropical cyclones were named during the season, including four hurricanes. The averages for the past 30 years are nine storms including six hurricanes.

Tracks of 1974 North Atlantic tropical and subtropical cyclones are shown in Figs. 1 and 2. A summary of 1974 hurricane statistics is shown in Table 1.

The extensive upper-level westerlies and below normal sea-surface temperatures over large portions of the hurricane-generating areas, which are believed to have been factors inhibiting tropical cyclone development during the past two seasons (Simpson and Hebert, 1973; Hebert and Frank, 1974) were in evidence again, but to a lesser extent. Figures 3 and 4 are charts of the mean vertical shear of the tropospheric horizontal wind (derived by subtracting the 1000 to 600 mb mean from the 600 to 200 mb mean, and from which the strength of the upper westerlies can be inferred), and the mean sea-surface temperature anomalies during the most active part of the hurricane season, 15 August–15 September. Comparison of the 1974 chart with the two previous seasons shows the vertical shear over much of the tropical Atlantic and Caribbean Sea to be less than in 1972 and 1973. In 1974 the 10 kt isotach covers a relatively small area east-northeast of the Leeward Islands, whereas during the 1972 and 1973 seasons it included a much larger area east of the Lesser Antilles as well as most of the Caribbean Sea. Gray (1967) has shown that large vertical shear of the horizontal wind is unfavorable for tropical cyclone development, since the heat released by convection in this situation does not remain in a vertical column to the extent necessary to produce falling surface pressures and the development of a circulation.

In 1974 all the named systems reached tropical storm intensity in areas where the mean vertical shear during 15 August–15 September was less than 10 kt, and less than 5 kt where Alma, Becky, Elaine, Dolly, and Gertrude were named. Gertrude, however, occurred after 15 September, and Alma had its beginning just before 15 August.

Mean sea-surface temperatures, while continuing to be slightly below normal over much of the tropical Atlantic, were nevertheless generally above Palmén's (1948) threshold value for development. All seven 1974 named storms developed in areas where the mid-season sea-surface temperatures exceeded 27°C.

There were 19 hurricane days during the 1974 season compared to an average of 29 days for the past 20 years. A decline in the Atlantic of the number of hurricane days per season since the mid-1960's is indicated on Fig. 5, in which five-year running averages for the past 20 years are shown.

Hurricane Carmen, the only named tropical cyclone to strike the United States in 1974, was the most intense Atlantic Hurricane since Camille of 1969. Thousands of deaths attributed to Hurricane Fifi in Honduras were the result of rainfall-induced flooding. Although becoming a moderately intense hurricane, Becky was a threat only to ships at sea. Gertrude, the final hurricane of the season, acquired hurricane force winds for only a brief period before reaching the Lesser Antilles.

In addition, four systems during the 1974 season were classified as subtropical storms. All had their origins in initially baroclinic zones, exhibiting some tropical characteristics as latent heat played an increasingly greater role in their development. Subtropical storm statistics are shown in Table 2.

There were no tropical storms in June or July. In June the mid-tropospheric circulation was well amplified, with a trough over east-central United States and a ridge over the western Atlantic (Taubensee, 1974a). Neither the positive height anomaly at 700 mb from the Ohio Valley eastward, nor the negative anomaly from Newfoundland into the western Caribbean, shown by Ballenzweig (1958) to be favorable for development in these respective areas, was present in June. In July, the mean features over the eastern United States and the western Atlantic progressed eastward (Wagner, 1974). The mean trough along the east coast of the

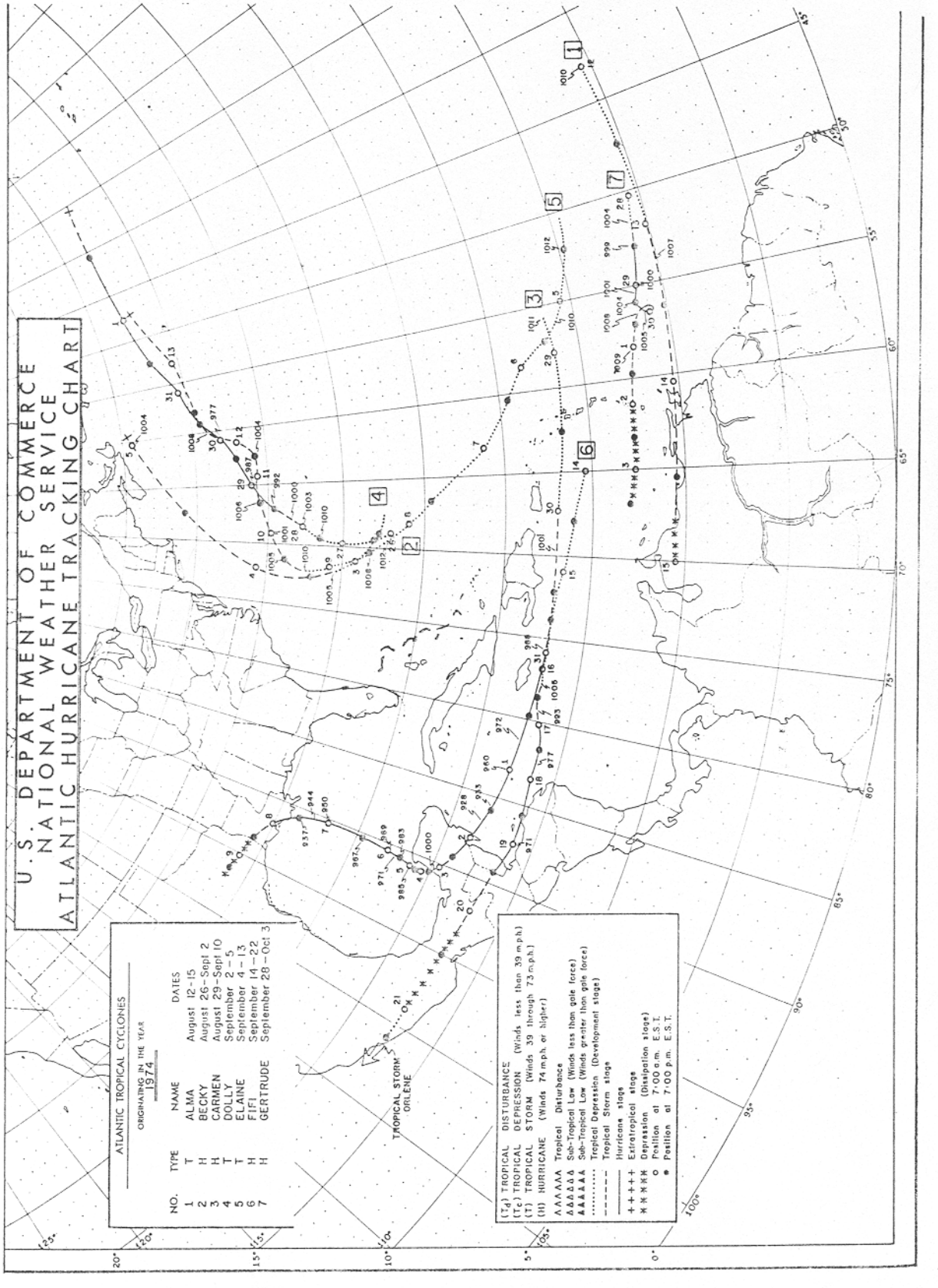


FIG. 1. Tracks of North Atlantic tropical cyclones, 1974.

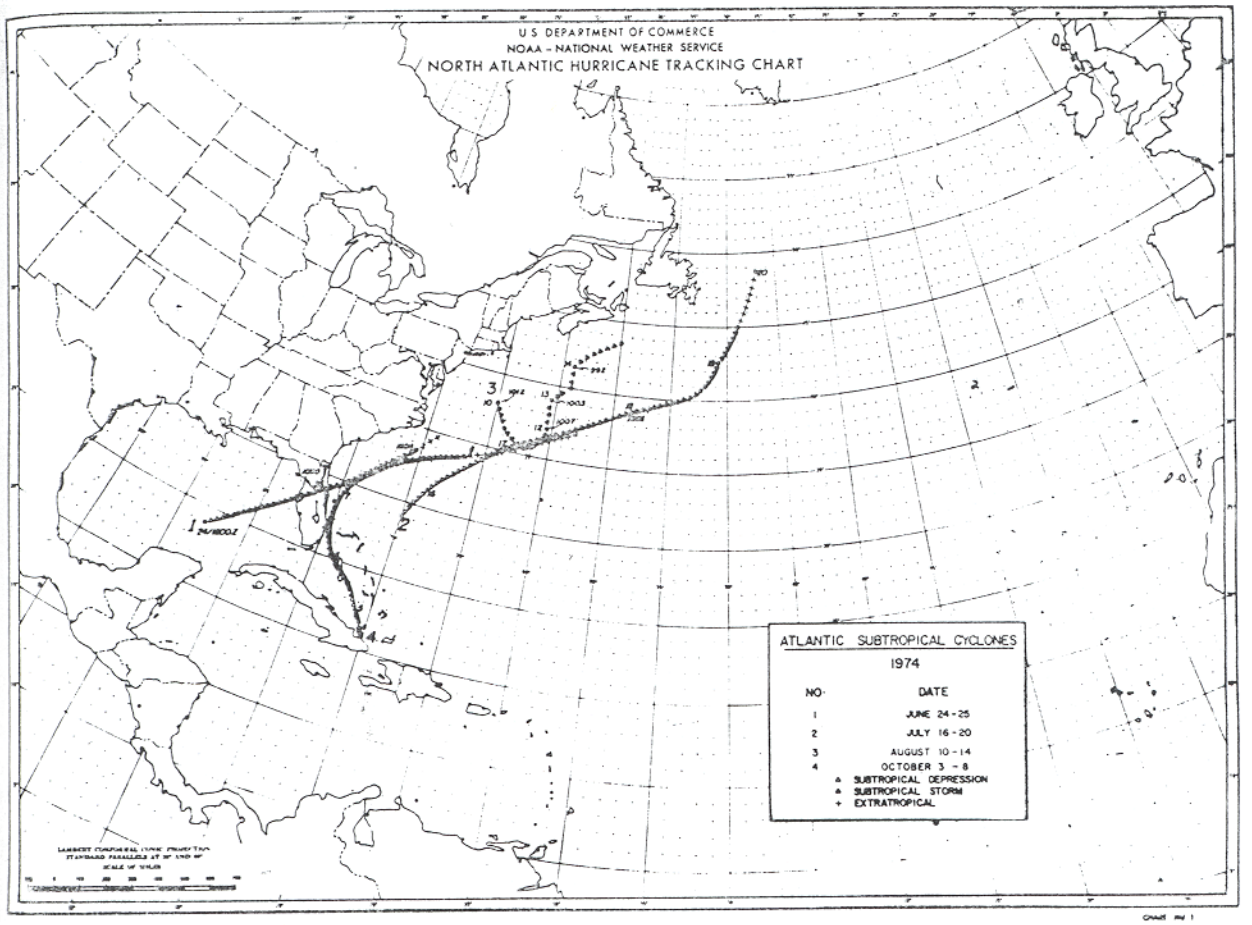


FIG. 2. Tracks of North Atlantic subtropical cyclones, 1974.

United States, considered favorable for development in the western Caribbean, was present but did not extend far enough into the western Caribbean itself.

All of the 1974 tropical storm developments occurred in August and September. In August the July mid-tropospheric ridge over central United States was replaced by a mean trough, and a strong subtropical ridge developed from the Gulf of Mexico eastward over the Atlantic (Dickson, 1974). The 700 mb height anomaly pattern resembled that shown by Ballenzweig to favor development near the Lesser Antilles, in which area Alma and Carmen originated. Once formed, the westward path of these storms in the Caribbean was assured by the presence of the strong subtropical ridge.

Since the aforementioned subtropical ridge held and strengthened somewhat in September (Taubensee, 1974b), hurricanes Fifi and Gertrude maintained westward courses. Strong zonal westerlies north of latitude 35°N caused Becky, Elaine, and Dolly to move northeastward after attaining storm intensity.

TABLE 1. Summary of North Atlantic tropical cyclone statistics, 1974.

| No. | Name | Class | Dates | Maximum sustained winds (kt) | Lowest pressure (mb) | U. S. damage ($ millions) | Deaths |
|---|---|---|---|---|---|---|---|
| 1 | Alma | T | Aug. 12–15 | 55 | 1007 | | Trinidad, 2 |
| 2 | Becky | H | Aug. 26–Sept. 2 | 100 | 977 | | |
| 3 | Carmen | H | Aug. 29–Sept. 10 | 130 | 928 | 150 | U. S., 1 |
| 4 | Dolly | T | Sept. 2–5 | 45 | 1005 | | |
| 5 | Elaine | T | Sept. 4–13 | 60 | 1001 | | |
| 6 | Fifi | H | Sept. 14–22 | 95 | 971 | | *Honduras, |
| 7 | Gertrude | H | Sept. 28–Oct. 3 | 65 | 999 | | 3,000–10,000 |

* The Red Cross has confirmed 3,000 fatalities, other estimates range up to 10,000.

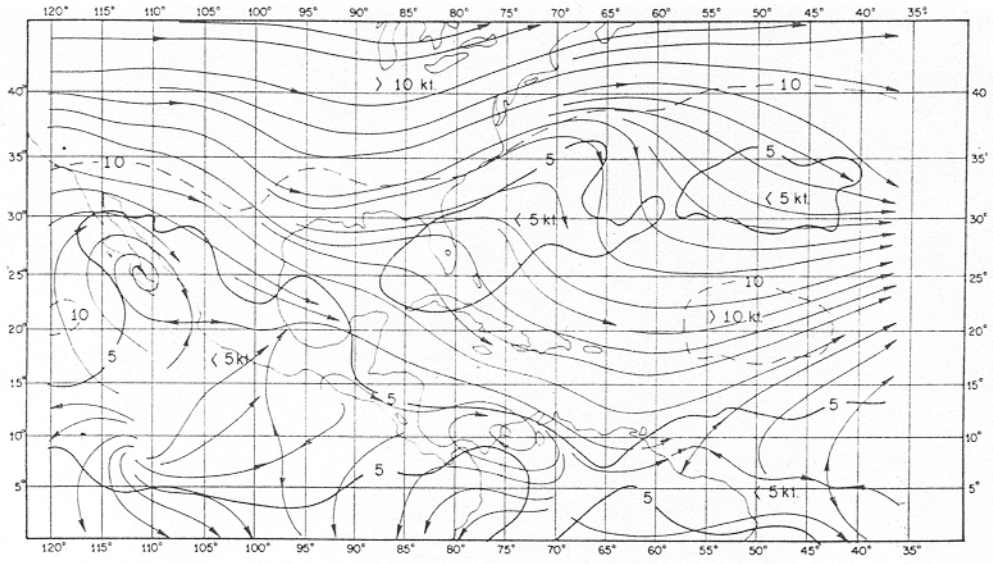


FIG. 3. NHC tropospheric mean vertical shear field (600–200 mb upper mean minus the 1000–600 mb lower mean) for the period 15 August–15 September 1974. Dashed lines are isotachs.

Amplification and strengthening of the mean flow and eastward progression of the trough over the western Atlantic in October (Wagner, 1975) permitted sweeps of cool, dry air into the October hurricane-generating areas, inhibiting development there.

## 2. Individual named storms

### *a. Tropical Storm Alma, 12–15 August*

The initial tropical storm of the season developed unusually far south, forming from a strong ITCZ disturbance in the Eastern Atlantic and reaching tropical storm intensity near 10°N 52°W on 13 August. Only one storm of record, occurring in 1933, crossed Trinidad farther south than did Alma.

The westward course at low latitudes was maintained by the circulation around a strong subtropical ridge located somewhat to the south of its normal August position.

After the storm center moved westward over Trinidad it continued into northern Venezuela, where its circulation was destroyed by the mountainous terrain on 15 August.

The highest wind reported by a land station was 30 kt with gusts to 42 kt at Piarco Airport on Trinidad, while the maximum associated with the storm during

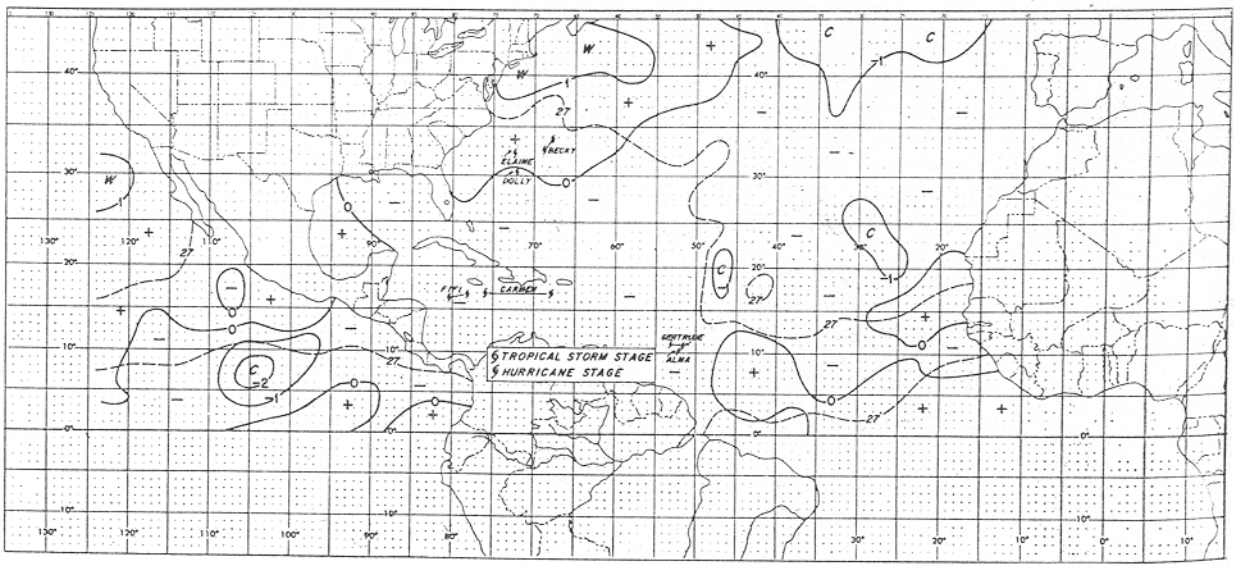


FIG. 4. Sea-surface temperature anomalies (°C) (solid lines) for the period 15 August–15 September 1974. The dashed line is the 27°C isotherm.

its existence was estimated at 55 kt based on aerial reconnaissance reports. The lowest pressure was 1007 mb on 13 August.

There were two fatalities as a direct result of the storm on Trinidad. On the Isla de Magarita off the Venezulean coast, 47 persons perished when a passenger aircraft crashed as the leading edge of the rain shield associated with Alma passed over the island. There were reports of considerable property and crop damage on Trinidad.

*b. Hurricane Becky, 26 August–2 September*

Becky attained tropical storm status west of Bermuda, near 30°N, 68°W, on the morning of 28 August after having acquired a circulation several hundred n mi north of Puerto Rico on the 26th. Hurricane strength was reached on the afternoon of the 28th, followed by further intensification during the next two days as Becky moved slowly northeastward over the open sea and around the periphery of a well-developed surface anticyclone centered just west of the Azores. Maximum strength was observed on the 30th, when reconnaissance reports indicated a minimum central pressure of 977 mb and sustained winds of 100 kt. At this time, 200 mb charts showed a well-developed warm ridge over the hurricane, and satellite loops indicated extensive outflow at the cirrus level.

On 2 September the system lost tropical characteristics after it had accelerated eastward ahead of an approaching frontal trough and merged with a frontal zone northeast of the Azores.

Never a threat to land, Becky was of concern only to shipping, because of its presence astride the main north Atlantic shipping lanes for several days.

*c. Hurricane Carmen, 29 August–10 September*

Carmen was the most severe Atlantic hurricane since Camille of 1969.

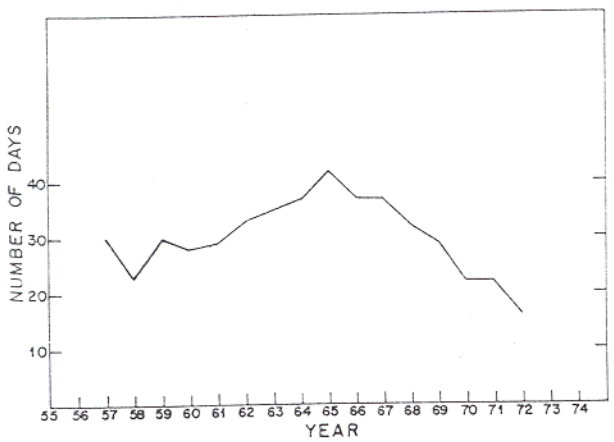


Fig. 5. Five-year running average of North Atlantic hurricane days, 1955–1974.

Table 2. Summary of North Atlantic subtropical cyclone statistics 1974.

| No. | Dates | Maximum sustained winds (kt) | Lowest pressure (mb) |
|---|---|---|---|
| 1 | June 25–27 | 60 | 1000 |
| 2 | July 16–19 | 50 | 1005 |
| 3 | August 10–16 | 50 | 992 |
| 4 | October 3–8 | 50 | 1005 |

The densely populated areas near Carmen's two landfalls were spared by last minute changes in the hurricane's course. First, the hurricane's center veered away from Belize City, Belize, and brushed Chetumal, Mexico, after crossing the coast in a sparsely populated area. After the weakened Carmen crossed the Yucatan peninsula, it regained strength as it moved northward across the Gulf of Mexico. However, the hurricane turned toward the northwest as it reached the Louisiana coast south of New Orleans, sparing that city from considerable damage.

The forerunner of Carmen was an easterly wave which moved off the African coast on 23 August and became a depression centered about 180 n mi east of Guadeloupe on 29 August. It intensified gradually, under a classic outflow pattern produced by a 200 mb anticyclone that moved westward with the hurricane across the Leeward Islands into the eastern Caribbean. The depression deposited up to five inches of rain in the Virgin and Leeward Islands, and over five inches in some sections of Puerto Rico.

Carmen acquired tropical storm strength south of the Mona Passage on 30 August as it moved westward 80 n mi south of Puerto Rico and Hispaniola, and became a minimal hurricane the following day just south of Jamaica. Intensification had not been rapid since the system entered the Caribbean because the low-level inflow pattern was not well established and much of its circulation was over Hispaniola and eastern Cuba.

The center passed a short distance north of Islas del Cisne (Swan Island) on 1 September, where gale force winds were experienced for a period of four hours, and highest sustained winds reached 50 kt, gusting to 60 kt.

Rapid development ensued as the hurricane center approached the Yucatan peninsula on 2 September with most of its circulation over the very warm waters of the northwest Caribbean Sea while a favorable outflow pattern aloft persisted. Sustained winds reached 130 kt and the pressure fell to 928 mb just before landfall as the Belize radar showed the hurricane's course shifting to a more northwesterly direction, sparing the cities of Belize and Corozal. Figure 6 is an example of the excellent presentation on the recently-installed Belize radar as Carmen skirted the city.

The center passed a few n mi north of Chetumal, Mexico, where sustained winds reached 118 kt, accompanied by a minimum pressure of 956 mb. Although

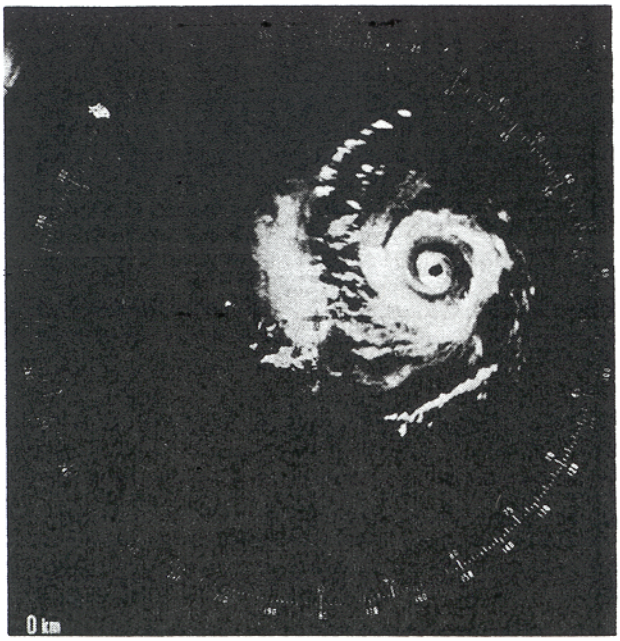


FIG. 6. Radar photograph of Hurricane Carmen from Belize, 0534 GMT 2 September 1974 (courtesy Belize Meteorological Service).

Chetumal likely was under the eye wall of the hurricane, the city was on the storm's weaker side. Winds of 57 kt were reported at San Pedro, Belize, and 87 kt at Corozal.

After moving inland over the Yucatan peninsula, Carmen weakened over land and it was not until 5 September that it regained hurricane strength as it began its northward movement over the Gulf of Mexico in response to surface pressure falls over Texas and rises over Florida and adjacent waters. Reconnaissance reports indicated that sustained winds again reached 130 kt over the northern Gulf of Mexico, while the surface pressure dropped to 937 mb. However, some weakening occurred just before landfall on 8 September as a decrease in echo coverage on land-based radars suggested that cooler, drier air was entering the system. Figure 7 is a photograph of the radar depiction at Slidell, La., at 0545 GMT 8 September, illustrating the absence of echoes in the hurricane's eastern semicircle. Rapid weakening followed landfall on the Louisiana coast. The highest sustained wind measured over Louisiana was 75 kt at Morgan City. Rainfall amounts over land were mostly six inches or less. Reported storm tides ranged up to six feet along the Louisiana coast. Meteorological data associated with the United States landfall of Carmen are shown in Table 3.

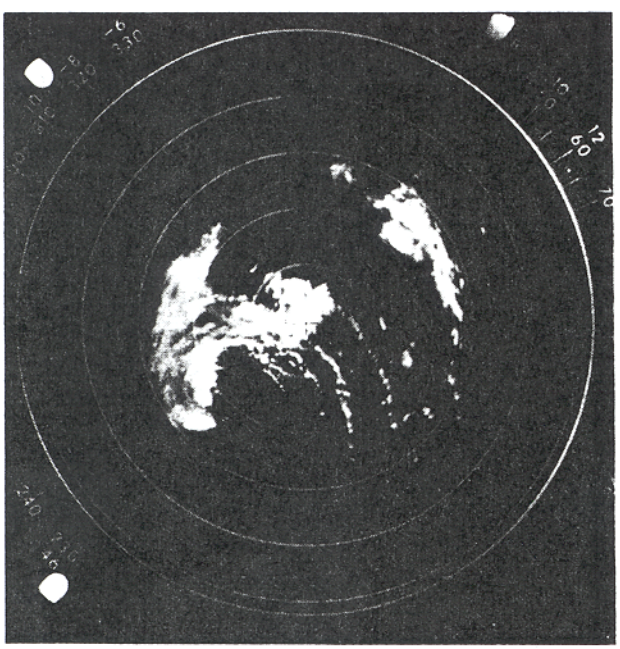

FIG. 7. Radar photograph of Hurricane Carmen from Slidell, La., 0545 GMT 8 September 1974.

Damage caused by Carmen in Puerto Rico was estimated in excess of two million dollars, mainly in flash floods and in a tornado accompanying the developing storm.

In Louisiana crop damage was estimated at 90 million dollars, primarily to sugar cane. Some losses were suffered by offshore oil installations and the shrimp industry. Total damages in Louisiana were about 150 million dollars.

Over 75,000 people, mostly in Louisiana and Mississippi, evacuated low-lying areas ahead of the hurricane.

The only fatality caused directly by Carmen was an electrocution by a fallen power line in Louisiana.

### *d. Tropical Storm Dolly, 2–5 September*

The cloud system that was to evolve into Tropical Storm Dolly was first evident on satellite pictures when it was located 700 n mi east southeast of Bermuda on 30 August. Drifting northwestward for the next few days, the system slowly became better organized and the development of a depression was confirmed on 2 September when a ship reported southwesterly winds south of the developing center. On the following day the storm was named, after a reconnaissance flight reported 45 kt winds and a surface pressure of 1005 mb. Following tropical storm development, Dolly recurved to the northeast around the periphery of the Azores-Bermuda high and ahead of an approaching frontal trough, losing its tropical structure when it merged with the cold front on 5 September. However, the remnants of Dolly, as a frontal wave, produced sustained northerly winds of 33 kt with gusts to 54 kt on Sable Island.

Environmental conditions were not particularly favorable for intensification as a tropical system during the slow transition from depression to a minimal tropical storm, since the system was under a 200 mb trough. However, as the storm moved northward it moved under 200 mb anticyclonic flow. Further tropical de-

TABLE 3. Hurricane Carmen, 29 August–10 September 1974. Meteorological data.

| Station | Date | Pressure (mb) Low | Time (CST) | Wind (kt) Fastest mile | Time (CST) | Gusts | Time (CST) | Tide (ft) Highest MSL | Time (CST) | Rainfall (inches) Storm total | Dates |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Florida | | | | | | | | | | | |
| Pensacola WSO | 7 | 1009 | 1756 | | | 43 | 8/0122 | | | 5.09 | 7–8 |
| Alabama | | | | | | | | | | | |
| Dauphin Island | 7 | 1009 | 1800 | | | SSW 33 | 1800 | | | 5.28 | 7–8 |
| Evergreen | | | | | | | | | | 11.60 | 7–9 |
| Mobile WSO | 7 | 1008 | 1756 | ENE 19 | 1159 | NE 33 | 1404 | 3.5 | 1950 | 7.58 | 7–8 |
| Mississippi | | | | | | | | | | | |
| Bay St. Louis | 8 | 1006 | 0230 | | | SSE 42 | 0235 | 4.6 | 0300 | | |
| Pascagoula | 8 | 1006 | 0330 | | | SE 34 | 0230 | 4.6 | 0300 | | |
| Louisiana | | | | | | | | | | | |
| Alexandria WSO | 8 | 1000 | 0902 | | | E 42 | 1042 | | | 1.59 | 8 |
| Baton Rouge WSO | 8 | 996 | 0349 | NE 28 | 0030 | E 44 | 0323 | | | 0.95 | 7–8 |
| Bayou Boeuf | 8 | | | | | | | 5.1 | 0800 | | |
| Bayou Lafourche | 8 | | | | | | | 5.9 | 0400 | | |
| Boothville WSO | 7 | 1001 | 1930 | | | NE 38 | 0623 | | | 7.81 | 6–7 |
| Cote Blanc Bay | 8 | | | | | | | 4.5 | 0615 | | |
| Grand Isle CG | 7 | 996 | 1845 | 48 | 1900 | 62 | 2025 | 4.0 | | | |
| Lafayette | 8 | | | NE 45 | 0655 | NE 71 | 0655 | | | 3.50 | 7–8 |
| Lake Charles WSO | 8 | 993 | 1154 | | | NNW 44 | 0519 | | | 1.84 | 7–8 |
| Morgan City | 8 | 982 | | | | 75 | | | | | |
| New Orleans WSFO | 8 | 999 | 0200 | | | 49 | | | | 4.00 | 7–8 |
| New Orleans WSMO | 8 | 998 | 0247 | NNE 29 | 7/1732 | NE 45 | 7/2008 | | | 3.64 | 7–8 |
| New Orleans Lakefront Airport | 7 | | | | | NNE 62 | 7/1639 | | | | |
| Shell Beach (Miss. River Outlet) | 8 | | | | | | | 6.0 | | | |
| Vermilion Lock (on Intra-Coastal Waterway) | 8 | | | | | | | 4.0 | | | |
| Wax Lake Outlet (Vermilion Bay) | 8 | | | | | | | 5.3 | 0815 | | |
| Texas | | | | | | | | | | | |
| Galveston WSO | 8 | 1003 | 1700 | NW 28 | 1604 | NW 42 | 1606 | 2.4 | 7/1800 | 0.13 | 8 |
| Port Arthur WSO | 8 | 998 | 1700 | N 24 | 1120 | NW 34 | 1401 | | | 0.38 | 8 |

velopment was halted as cooler air entered the low-level circulation.

*e. Tropical Storm Elaine, 4–13 September.*

The convective cloud pattern that developed into Elaine was traced by satellite pictures from the African coast on 30 August to 600 n mi east of the Leeward Islands on 4 September, where a closed circulation was detected by reconnaissance aircraft.

The storm was named during the late afternoon of 9 September, while centered 225 n mi east southeast of Cape Hatteras, on the basis of wind reports from reconnaissance flights. Thereafter, Elaine moved northeastward, ahead of an approaching frontal trough, losing tropical characteristics as it neared the cold front 350 n mi southeast of Cape Race, Newfoundland, on 13 September. No land areas were threatened by Elaine. Elaine reached storm strength in an area of light vertical shears and under an upper-level anticyclone. As the storm reached higher latitudes, it moved away from the upper anticyclone and under a zone of relatively strong upper westerlies.

The lowest pressure measured in Elaine was 1001 mb on 10 September. Highest sustained winds were estimated to be 60 kt. Some higher winds reported by reconnaissance aircraft are believed to have been transitory and not representative of the strength of the system.

*f. Hurricane Fifi, 14–22 September*

Hurricane Fifi will be remembered chiefly because of the appalling loss of life in Honduras caused by inland flooding of rivers and streams. The influx of moist air from the Caribbean and the Pacific into the hurricane as it skirted the Honduran coast produced torrential rains up to 20 inches or more in the mountains. In addition to drownings, many perished in mud slides as tilled slopes gave way and the avalanche buried all in its path.

The precursor of Fifi moved off the African coast as an organized convective mass on 8 September. Moving steadily across the tropical Atlantic, it became a well-organized tropical depression on the 15th, centered 60 n mi south of Haiti, and a tropical storm on the 16th just south of Jamaica. Strengthening continued and Fifi became a hurricane 250 n mi east of Islas del Cisne (Swan Island) on 17 September. On the next day the hurricane had acquired its maximum sustained

winds of 95 kt. The lowest pressure of 971 mb was observed on the morning of 19 September; however, slight weakening took place prior to landfall on the coast of southern Belize late that afternoon. Rapid weakening to storm and then to depression strength followed landfall.. After crossing Belize and southern Mexico, the system regained strength in the Pacific where it was renamed Orlene. Further strengthening to a hurricane occurred before its final landfall on the west coast of Mexico.

The track of Fifi was controlled by a large high pressure system which persisted over the central Gulf of Mexico throughout the life of the hurricane. Although the 200 mb pattern appeared to become somewhat more favorable as Fifi intensified from depression to hurricane, the upper-level northeasterly flow around the Gulf of Mexico anticyclone inhibited outflow and probably prevented the rapid deepening observed in Carmen and many other hurricanes in the western Caribbean.

Although Honduras received the brunt of Fifi's devastation there were heavy rains in other areas. More than 8 inches fell in two days over southern Jamaica. Heavy rain associated with the hurricane also fell over El Salvador, Guatemala, and southern Belize. Among the highest winds reported at land stations were 115 kt on the island of Guanaja off the north coast of Honduras, 85 kt on Islas del Cisne (Swan Island), and 85 kt with gusts to 100 kt in southern Belize.

The actual number of deaths caused by Fifi may never be determined. Estimates range from 3000 to 10000. The Red Cross has confirmed by actual count the lower figure, which is high enough to place Fifi among the most disastrous hurricanes ever to strike in the western hemisphere.

*g. Hurricane Gertrude, 28 September–3 October*

The seventh and last named storm of the season developed from an Intertropical Convergence Zone disturbance which moved off the African coast on 22 September. By the 26th, satellite pictures showed increasing organization, and a depression had formed by early morning of the 28th. Reconnaissance flights reported hurricane force winds that afternoon.

Gertrude never developed the characteristics of a well organized hurricane. No wall cloud ever formed. The lowest pressure was 999 mb on 28 September. It is concluded that the hurricane force winds observed occurred during short-period accelerations.

Weakening began on the 30th, when satellite pictures showed the low-level circulation center separating from the main convective cloud mass as the storm slowly approached an upper trough and increasing vertical shears. The system was downgraded to a tropical depression on 2 October, just prior to reaching the Windward Islands, and its circulation disappeared over the southeast Caribbean on the following day.

Locally heavy showers, well east of the remnants of Gertrude, continued over the Windward Islands through 4 October.

There are no reports of substantial damage or casualties attributed to Gertrude.

## 3. Subtropical storms

*a. Subtropical storm # 1 24–27 June*

The development of this subtropical storm in the eastern Gulf of Mexico followed by several days the formation of a tropical depression off the Mexican coast near Vera Cruz on 22 June

By the evening of 24 June the convective system associated with the southwestern Gulf of Mexico tropical depression had weakened while convective cloudiness had increased and a new low center had formed in the eastern Gulf of Mexico. The new system moved northeastward at 30–35 kt during the night of 24–25 June and crossed the Florida peninsula during the morning of the 25th. Sustained winds of 30–40 kt, with gusts to 45–55 kt, were reported in the Fort Myers-Naples area as the system approached. Tides 2–4 feet above normal occurred from Everglades City to the Tampa Bay area.

At midday on the 25th, after the storm moved over the Atlantic east of Florida, reconnaissance aircraft and ships found a band of 45–60 kt winds about 150 n mi wide to the east of the storm center. As it moved northeastward during the 25th, the system weakened as it became frontal in character, and became difficult to identify by late evening.

Total rainfall from the storm and the tropical depression, which crossed the coast two days later, amounted to 20 inches in the Tampa Bay area and 10 inches or more over much of west central Florida.

There were three deaths by drowning in Florida. Damages caused by tidal and heavy rainfall flooding has been estimated at $10,000,000 in western Florida.

*b. Subtropical storm # 2, 16–19 July*

Satellite pictures on 15 July suggested that a weak circulation was developing northeast of the Bahamas in an area of convective cloudiness that had been associated with a quasistationary front.

The circulation, as indicated on satellite pictures, became increasingly better organized as it moved northeastward through 18 July; however, the area covered by the circulation remained small through this period and there was no evidence from ship reports that supported satellite-picture evidence of a significant weather disturbance until the ship *Export Adventurer* encountered winds of 47 kt and a pressure of 1006 mb at 2100 GMT 18 July.

The ship's barogram and hourly weather reports between 2000 GMT 18 July and 0400 GMT 19 July

indicated a closed circulation, and that the ship's barometer fell 18 mb in 6 hours.

The low became absorbed in the circulation of a large extratropical low-pressure system off Newfoundland by 20 July, as it continued rapidly northeastward.

*c. Subtropical storm # 3, 10–16 August*

The convective area which evolved into this subtropical storm was associated on 10 August with a wave located 300 n mi southeast of southern New England. The wave had developed along a stationary front extending northeastward from near Cape Hatteras over the North Atlantic.

As the system drifted northeastward, slowly deepening, the air mass along its northern periphery gradually became warmed; 200 mb ridging, and developing light vertical shears, suggested that the low was acquiring some tropical structure.

At 0000 GMT 11 August, ship 4YH reported sustained winds of 40 kt as the low center passed about 200 n mi east of the ship. During the next two days, several ships reported winds in excess of gale force as the low deepened to an estimated 992 mb. The low passed over Cape Race, Newfoundland, on 15 August, after satellite pictures showed the vortex was less well defined; the remaining cloudiness assumed a configuration typical of a frontal band.

*d. Subtropical storm # 4, 3–8 October*

There were indications of a low center forming over extreme eastern Cuba during the afternoon of 3 October as a cold front that had been moving southeastward across eastern Cuba was becoming quasistationary. An extensive area of cloudiness and rain persisted behind the front. A large high pressure cell was centered over the middle Atlantic states, and the strong pressure gradient between the high center and the front was already producing northeasterly winds up to 30 kt over the eastern Gulf of Mexico, the Florida Straits, and over the Bahamas and adjacent waters

By the afternoon of 5 October, as the low center moved into the central Bahamas, a number of ships reported winds in excess of gale force, as did land stations in the Bahamas. Although the storm began to weaken as it moved northeastward away from the Florida coast during the afternoon of 7 October, ships reported winds up to 40 kt on 7–8 October. By the afternoon of 8 October, the weakening storm had merged with a cold front 350 n mi east of Cape Hatteras.

The main effects of the storm on land areas were tidal flooding and some beach erosion along the Florida east coast, caused by the strong and persistent northeast winds, and some local flooding as a result of heavy rainfall. Tides ranged up to three feet above normal along portions of the Florida east coast. Rainfall amounts over a three-day period included 10 inches at Cocoa, 11.5 inches at Deerfield Beach, and 14 inches at Boca Raton.

Total damage along the Florida east coast is estimated at less than one million dollars.

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REFERENCES

Ballenzweig, E. M., 1958: Formation of tropical storms related to anomalies of the long period circulation. National Hurricane Research Report No. 21, U. S. Weather Bureau, 16 pp.

Dickson, R. R., 1974: Weather and circulation of August 1974—Relief from heat and drought in the central United States. *Mon. Wea. Rev.*, **102**, 807–811.

Gray, W. M., 1967: Global view of the origin of tropical disturbance and storms. Atmospheric Science Paper No. 114, Colorado State University, 105 pp.

Hebert, P. J., and N. L. Frank, 1974: Atlantic hurricane season of 1973. *Mon. Wea. Rev.*, **102**, 280–289.

Palmén, E. H., 1948: On the formations and structure of tropical hurricanes. *Geophysica*, **3**, 26–38.

Simpson, R. H., and P. J. Hebert, 1973: Atlantic hurricane season of 1972. *Mon. Wea. Rev.*, **101**, 323–333.

Taubensee, R. E., 1974a: Weather and circulation of June, 1974—Increasing drought in the Southwest. *Mon. Wea. Rev.*, **102**, 662–666.

——, 1974b: Weather and circulation of September, 1974—Record September cold in the central United States. *Mon. Wea. Rev.*, **102**, 871–876.

Wagner, A. J., 1974: Weather and circulation of July, 1974—Heat wave and drought over the middle third of the country. *Mon. Wea. Rev.*, **102**, 736–742.

——, 1975: Weather and circulation of October, 1974—Record early fall cold over the eastern half of the United States. *Mon. Wea. Rev.*, **103**, 78–85.

# Atlantic Tropical Systems of 1974

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ABSTRACT

The 1974 hurricane season produced 96 "tropical systems," of which 25 acquired the closed circulation of a depression. The origin of nearly half of these, 52, was over the continent of Africa. African seedlings initiated five of the seven named Atlantic storms, and disturbances of Atlantic origin spawned 12 of the 17 East Pacific named storms.

## 1. Introduction

Residents within the Atlantic hurricane belt enjoyed another relatively quiet year in 1974 in spite of the horrendous loss of life in Honduras during devastating flash floods along mountain rivers caused by Fifi. Both from the viewpoint of strength and numbers, tropical storm activity in 1974 was below recent long-term averages. Carmen, the only hurricane to affect the United States, collapsed very rapidly as the eye approached the coast and spared southern Lousiana from a major disaster. Hope (1975) attributes the lull in activity to extensive upper-level westerlies and below-normal sea temperatures over large portions of the hurricane-generating areas. This pattern has persisted for the last four years, although Hope was quick to point out that the anomalies this past year were less than in the previous three years.

Another factor believed to be related to storm activity is the number of disturbances or seedlings that develop each year. Do years with greater opportunities produce more named storms? The answer is apparently no. During the past seven years there has been remarkable stability in the annual variation in the number of disturbances. This was true again in 1974, when 96 disturbances provided plenty of opportunities for storm formation. We can only conclude that environmental conditions play a very dominant role in the hurricane formation process.

Three events occurred in 1974 that should have very important impacts on the effectiveness of the hurricane warning service. First, hourly infrared satellite pictures became an operational reality. This new view of the hurricane breeding grounds initially created interpretation problems, but opened exciting avenues for making the satellite pictures more objective. This product enhances cirrus, thus tending to obscure the low-level banding and hamper the interpretation process. However, the field of motion in the upper troposphere is much better defined than on visible pictures, and this offers the possibility of computing such parameters as upper-level outflow.

A second technological achievement was the operational testing of a sophisticated new airborne recording system (AWRS) developed by the Air Force. This system was installed on one of the C-130 aircraft operated by the 53rd Weather Reconnaissance Squadron and a number of successful missions were flown into named storms, including one critical flight into Carmen when the eye was approaching the Louisiana coast. This flight helped us determine that Carmen was rapidly losing strength and changing direction of motion to a northwesterly course away from the populated area of New Orleans. Unfortunately, the Department of Defense has decided to reduce hurricane reconnaissance under the influence of severe budget constraints, and the future of the AWRS package is very much in doubt.

The third event was the successful completion of the field phase of GATE (GARP Atlantic Tropical Experiment) off the west coast of Africa during June, July, and August. Simpson and Simpson, in a report that has been submitted for publication in the GATE series in 1975, have already reported that the dominant cloud form associated with the "inverted V" type disturbance is altocumulus or altostratus rather than stratocumulus as earlier suspected. They also described very successful results with the drop windsonde experiments. Relatively rapid changes in mesoscale circulations were observed, and Zipser is examining one aborted attempt at cyclogenesis. We look forward with great anticipation to the many results that should emerge from studies of the GATE data.

## 2. Census of 1974 tropical systems

The results of the 1974 hurricane season census are tabulated in Table 1 and several categories are summarized in Table 2 and Fig. 1. The philosophy of our counting procedure is described in previous articles, Simpson *et al.* (1968, 1969).

TABLE 1. Summary of the tropical systems in 1974.*

| Dakar passage | Nature | Formed in Atlantic | Nature | Date weakened Atlantic | Barbados passage | Nature | Weakened Caribbean | Formed Caribbean | San Andros passage | Nature | Formed Gulf of Mexico | Formed in N. Atlantic | Atlantic depression, | Atlantic storm | Pacific depression | Pacific storm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 5/3 | Wave | | May 6 | Wave | 5/7 | | | | | | | | | |
| | | 5/13 | ITCZ | | May 14 | ITCZ | | | May 18 | ITCZ | | | #1 | | | |
| May 11 | Wave | | | | May 17 | Wave | 5/18 | | | | | | | | | |
| | | | | | | | | 5/21 | May 22 | ITCZ | | | | | #1 | Aletta |
| May 16 | Wave | | | | May 22 | Wave | | | May 26 | Wave | | | | | | |
| May 21 | Wave | | | | May 28 | Wave | | | May 31 | Wave | | | | | #2 | Blanca |
| May 26 | Wave | | | | May 31 | Wave | 6/1 | | | | | | | | | |
| May 28 | Wave | | | | June 2 | Wave | | | June 4 | Wave | | | | | #3 | Connie |
| May 31 | Wave | | | | June 4 | Wave | 6/5 | | | | | | | | | |
| | | | | | | | | | | | | 6/12 | #2 | | | |
| June 3 | Wave | | | | June 7 | Wave | | | June 10 | Wave | | | | | | |
| June 5 | Wave | | | | June 10 | Wave | | | June 12 | Wave | | | | | #4 | Dolores |
| June 9 | Wave | | | | June 15 | Wave | | | June 18 | Wave | | | #3 | | | |
| June 12 | Wave | | | | June 17 | Wave | 6/18 | | | | | | | | | |
| June 14 | Wave | | | | June 19 | Wave | | | June 22 | Wave | | | | | | |
| June 17 | Wave | | | | June 21 | Wave | 6/22 | | | | | | | | | |
| June 19 | Wave | | | | June 24 | Wave | 6/25 | | | | | | | | | |
| | | | | | | | | | | | 6/25 | | #4 | Subtrop. | | |
| June 21 | Wave | | | | June 26 | Wave | | | June 29 | Wave | | | | | #6 | |
| | | | | | | | | 6/30 | July 1 | Wave | | | | | #7 | |
| June 24 | Wave | | | | June 30 | Wave | | | July 3 | Wave | | | | | | |
| June 28 | Wave | | | | July 4 | Wave | | | July 6 | Wave | | | | | | |
| July 1 | Wave | | | | July 6 | Wave | | | July 9 | Wave | | | | | | |
| | | 7/5 | Wave | | July 8 | Wave | | | July 11 | Wave | | | | | #8 | Francesca |
| July 6 | Wave | | | | July 11 | Wave | | | July 14 | Wave | | | | | | |
| July 8 | Wave | | | 7/10 | | | | | | | | | | | | |
| | | | | | | | | | | | 7/13/5 | | #5 | | | |
| | | | | | | | | | | | | 7/14 | #6 | Subtrop. | | |
| | | | | | | | | 7/16 | July 17 | ITCZ | | | | | | |
| July 11 | Wave | | | | July 16 | Wave | | | July 19 | Wave | | | | | #11 | |
| July 13 | Wave | | | | July 18 | Wave | | | July 21 | Wave | | | | | | |
| July 15 | Wave | | | | July 21 | Wave | | | July 24 | Wave | | | | | | |
| | | 7/18 | ITCZ | 7/21 | | | | | | | | | | | | |
| | | | | | | | | 7/26 | July 27 | ITCZ | | | | | #12 | |
| July 20 | Wave | | | | July 26 | Wave | | | July 29 | Wave | | | | | | |
| July 22 | Wave | | | | July 28 | Wave | | | July 30 | Wave | | | | | | |
| July 28 | Wave | | | | Aug. 2 | Wave | 8/3 | | | | | | | | | |
| July 31 | Dep. | | | | Aug. 4 | Wave | | | Aug. 7 | Wave | | | #7 | | | |
| | | | | | | | | 8/2 | Aug. 2 | ITCZ | | | | | | |
| | | | | | | | | 8/9 | Aug. 10 | ITCZ | | | | | | |
| Aug. 4 | Wave | | | | Aug. 10 | Wave | | | Aug. 13 | Wave | | | | | #14 | Ione |
| Aug. 7 | Wave | | | | Aug. 12 | Wave | 8/13 | | | | | | | | | |
| | | 8/10 | ITCZ | | Aug. 14 | Alma | | | Aug. 16 | Wave | | | #8 | Alma | #15 | Joyce |
| | | | | | Aug. 17 | Wave | | | Aug. 19 | Wave | | | | | #18 | Maggie |
| Aug. 11 | Wave | | | | Aug. 20 | Wave | 8/21 | | | | | | | | | |
| Aug. 13 | Wave | | | | Aug. 21 | ITCZ | | | Aug. 24 | Wave | | | | | | |
| | | 8/20 | ITCZ | | | | | | | | | 8/10 | #9 | Subtrop. | | |
| | | | | | | | | | | | | 8/13 | #10 | | | |
| | | | | | | | | | | | | 8/14 | #11 | | | |
| | | | | | | | | | | | 8/24 | | #12 | | | |

TABLE 1. (*Continued*)

| Dakar passage | Nature | Formed in Atlantic | Nature | Date weakened Atlantic | Barbados passage | Nature | Weakened Carib-bean | Formed Carib-bean | San Andros passage | Nature | Formed Gulf of Mexico | Formed in N. Atlantic | Atlantic depres-sion | Atlantic storm | Pacific depres-sion | Pacific storm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aug. 15 | Wave | | | | Aug. 23 | Wave | | | Aug. 26 | Wave | | | #13 | Becky | | |
| Aug. 18 | Wave | | | 8/20 | | | | | | | | | | | | |
| Aug. 20 | Wave | | | | Aug. 26 | Wave | 8/28 | | | | | | | | | |
| Aug. 23 | Wave | | | | Aug. 29 | Dep. | | | Sept. 1 | Carmen | | | #14 | Carmen | | |
| Aug. 27 | Wave | | | | Sept. 2 | Wave | | | Sept. 5 | Wave | | | | | | |
| | | | | | | | | | | | | 9/1 | #15 | Dolly | | |
| Aug. 30 | Wave | | | | Sept. 6 | Dep. | | | Sept. 9 | Wave | | | #16 | Elaine | | |
| Sept. 2 | Dep. | | | | Sept. 8 | Dep. | | | Sept. 11 | Wave | | | #17 | | | |
| | | | | | | | | 9/6 | Sept. 6 | ITCZ | | | | | #19 | Norma |
| | | | | | | | | 9/7 | Sept. 8 | ITCZ | | | | | | |
| Sept. 6 | Wave | | | 9/10 | | | | | | | | | | | | |
| | | | | | | | | 9/13 | Sept. 14 | ITCZ | | | | | | |
| Sept. 9 | Wave | | | | Sept. 14 | Wave | | | Sept. 17 | Fifi | | | #18 | Fifi | #20 | Orlene |
| | | 9/14 | Wave | | Sept. 16 | Wave | 9/17 | | | | | | | | | |
| | | | | | | | | | | | | 9/18 | #19 | | | |
| | | 9/12 | ITCZ | 9/14 | | | | | | | | | | | | |
| | | 9/17 | ITCZ | | Sept. 18 | ITCZ | | | Sept. 21 | Wave | | | | | | |
| Sept. 13 | Wave | | | | Sept. 19 | Wave | | | Sept. 23 | Wave | | | #20 | | | |
| | | 9/21 | ITCZ | | Sept. 22 | ITCZ | | | Sept. 25 | Wave | | | | | | |
| | | 9/21 | Wave | | Sept. 24 | Wave | | | Sept. 28 | Wave | | | | | #21 | |
| Sept. 17 | Wave | | | | Sept. 27 | Wave | | | Oct. 1 | Wave | | | | | #22 | Patricia |
| Sept. 20 | Wave | | | 9/22 | | | | | | | | | | | | |
| Sept. 22 | ITCZ | | | | Oct. 2 | Gertrude | 10/3 | | | | | | #21 | Gertrude | | |
| | | 10/2 | Wave | | Oct. 4 | Wave | | | Oct. 8 | Wave | | | | | #23 | |
| Sept. 25 | Wave | | | | Oct. 6 | Wave | | | Oct. 10 | Wave | | | | | #24 | Rosalie |
| Sept. 28 | Wave | | | 10/1 | | | | | | | | | | | | |
| Oct. 2 | Wave | | | 10/5 | | | | | | | | | | | | |
| | | | | | | | | | | | | 10/4 | #22 | Subtrop. | | |
| Oct. 4 | Wave | | | | Oct. 13 | Wave | | | Oct. 16 | Wave | | | | | | |
| | | | | | | | | 10/16 | Oct. 18 | Wave | | | | | | |
| | | | | | | | | | | | | 10/14 | #23 | | | |
| | | 10/14 | Wave | | Oct. 16 | Wave | | | Oct. 20 | Wave | | | | | #25 | |
| Oct. 7 | Wave | | | | Oct. 18 | Wave | | | Oct. 23 | Wave | | | | | | |
| Oct. 13 | Wave | | | | Oct. 22 | Wave | | | Oct. 26 | Wave | | | | | | |
| Oct. 19 | Wave | | | 10/21 | | | | | | | | | | | | |
| | | 10/18 | ITCZ | 10/22 | | | | | | | | | | | | |
| | | | | | | | | 10/29 | Oct. 30 | Wave | | | | | | |
| | | | | | | | | | | | | 10/30 | #24 | | | |
| | | 10/26 | Wave | | Oct. 28 | Wave | 10/29 | | | | | | | | | |
| | | 10/29 | Wave | | Oct. 30 | Wave | 10/31 | | | | | | | | | |
| | | 10/26 | ITCZ | 11/2 | | | | | | | | | | | | |
| | | 11/4 | ITCZ | | Nov. 7 | ITCZ | 11/8 | | | | | | | | | |
| Nov. 7 | Wave | | | 11/13 | | | | | | | | | | | | |
| Nov. 10 | Wave | | | 11/11 | | | | | | | | | | | | |
| | | 11/4 | Wave | | Nov. 11 | Wave | 11/13 | | | | | 11/10 | #25 | | | |

* "Dep." indicates depression.

TABLE 2. Summary of 1974 tropical systems according to type and geographical area of formation. The numbers in parentheses indicate systems that were counted in a weaker stage.

| | Africa | Tropical Atlantic | Subtropical Atlantic | Caribbean | Gulf of Mexico | Total |
|---|---|---|---|---|---|---|
| Waves | 49 | 9 | 0 | 3 | 0 | 61 |
| ITCZ | 1 | 10 | 0 | 8 | 0 | 19 |
| Depression | 2 | (2) | 11 (2) | (4) | 3 (1) | 16 (9) |
| Named storms | | (2) | (3) | (2) | | (7) |
| | 52 | 19 (4) | 11 (5) | 11 (6) | 3 (1) | 96 (16) |

Table 1 describes the history of the 96 systems, giving the dates when they passed three key stations: Dakar, Senegal; Barbados; and San Andres Island. The table also lists the spawning date of seedlings that formed and weakened along the intertropical convergence zone (ITCZ) in the Atlantic, and the dates of formation of subtropical cyclones over the Gulf of Mexico and the Atlantic north of latitude 20°N. The Atlantic and eastern Pacific storms that were initiated by Atlantic seedlings are listed in the last four columns.

Table 2 summarizes the systems according to type and geographical area of formation. The numbers in parentheses indicate systems that were counted in a weaker stage of development. For example, the two storms (Carmen and Fifi) and the four depressions that formed in the Caribbean were initiated by five African waves and one Caribbean ITCZ disturbance. Once again we see that nearly half of the systems were wave perturbations in the trades whose origin was over Africa. This observation has been true every year we have completed the survey and stresses the importance of Africa as a seed-bed for Atlantic disturbances.

Figure 1 tabulates the total number of systems passing Dakar, Barbados, and San Andres Island as well as the number that maintained their identity while traversing the Atlantic and Caribbean. Statistics are also presented on the seedlings that developed within four geographical areas; the Gulf of Mexico, the Caribbean Sea, and the subtropical and tropical Atlantic, where latitude 20°N has been used as a dividing line. Of the 52 African systems, 43 were tracked to the Caribbean and 32 all the way to the Pacific Ocean. Over the tropical Atlantic, 19 disturbances formed with 15 eventually passing through the Antilles. Another four were identified along the ITCZ and followed for at least 48 hours before dissipating. A total of 58 systems crossed the Antilles (43 from Africa plus 15 that formed in the Atlantic), of which 41 maintained their identity while traversing the Caribbean. The 11 disturbances that formed over the Caribbean added to the number from the Antilles resulted in 52 seedlings entering Central America.

One unusual aspect of the 1974 season was the early appearance of a well-defined African wave that moved by Dakar on May 11th. This is the earliest we have been able to track an African system across the Atlantic in seven years of study. The first African system of the season does not generally occur until late May or early June when the easterly subtropical jet becomes established across tropical Africa in the upper troposphere.

The depression tracks for the months May through November are shown in Fig. 2. The first depression of the season formed over the northwestern Caribbean Sea on May 19th and was initiated by a disturbance that originated along the ITCZ east of Trinidad.

Four of the depressions strengthened and were classified as subtropical storms. The tracks of the subtropical storms are presented by Hope (1975) along with a brief description of their history. Simpson and Pelissier (1971) initiated the first attempt to define and identify what have now come to be known as subtropical storms. Essentially, these are systems of baroclinic origin that initiate widespread convection and possess surface winds in excess of gale force. If the convection becomes concentrated, the system can quickly acquire the warm core characteristics of a tropical storm. They usually develop over subtropical waters either along a low-level baroclinic zone or are initiated by a downward strengthening of an upper-tropospheric cold low. It is not always easy to properly identify a storm as belonging to this category because conventional data and reconnaissance flights are sparse. Prior to the satellite era, many of these would probably have been named, and it is important to consider this fact when discussing the decrease in named storms noted in the last four years.

Two of the subtropical storms were noteworthy because of the damage inflicted upon Florida. Heavy rains associated with the June storm caused very serious flooding around Tampa Bay and damage estimated at 10 million dollars. Widespread beach erosion occurred

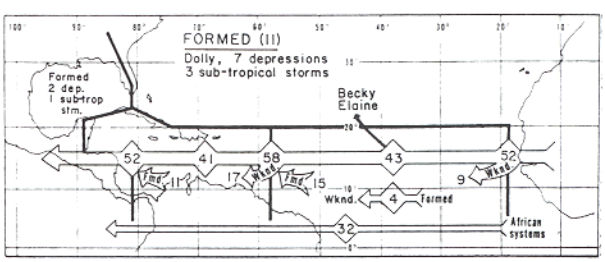


FIG. 1. Summary of tropical disturbances that passed three key stations (Dakar, Barbados, and San Andres) in 1974 and those maintaining their identity while crossing the Atlantic and Caribbean.

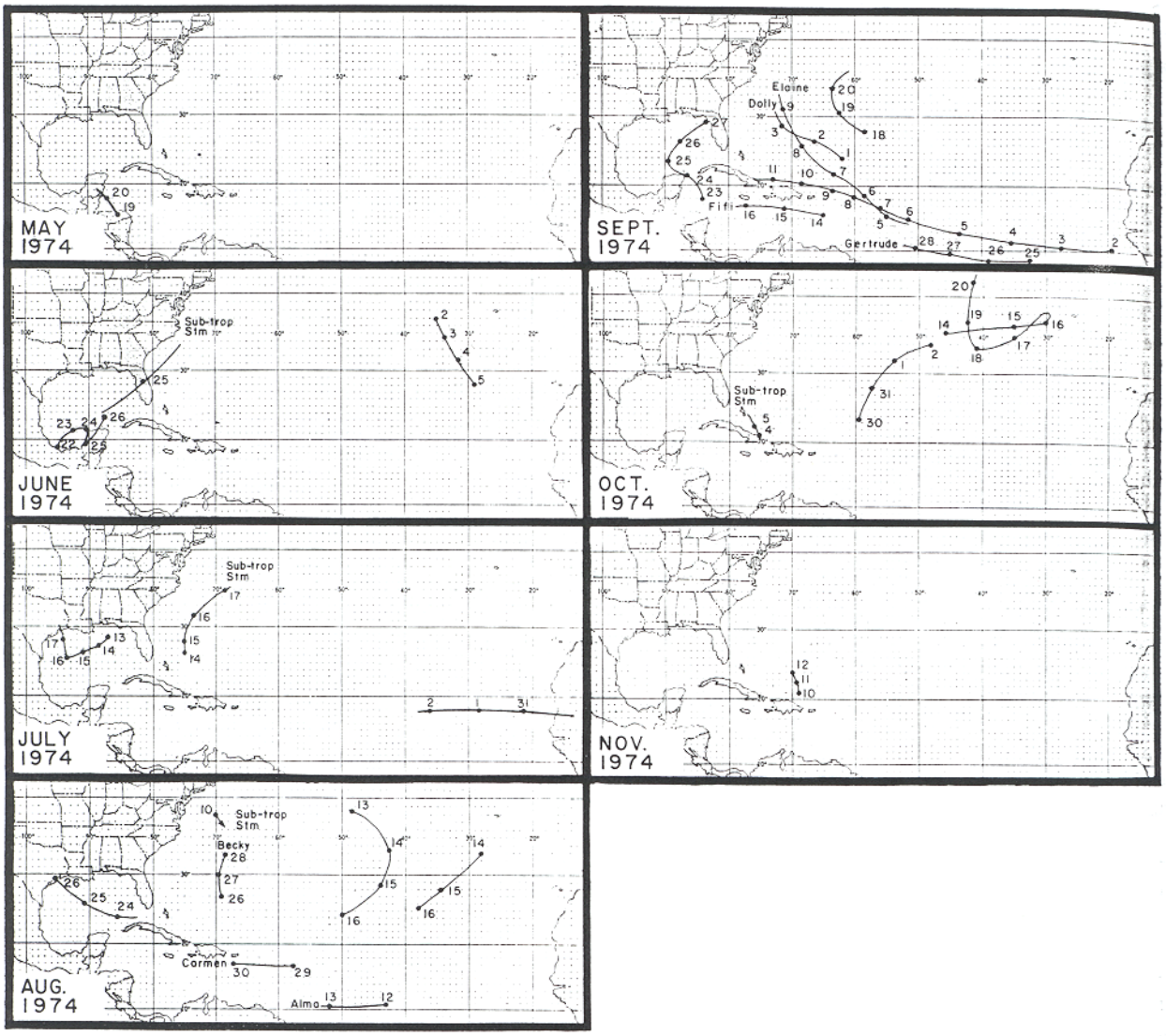


FIG. 2. Tracks of depressions in 1974.

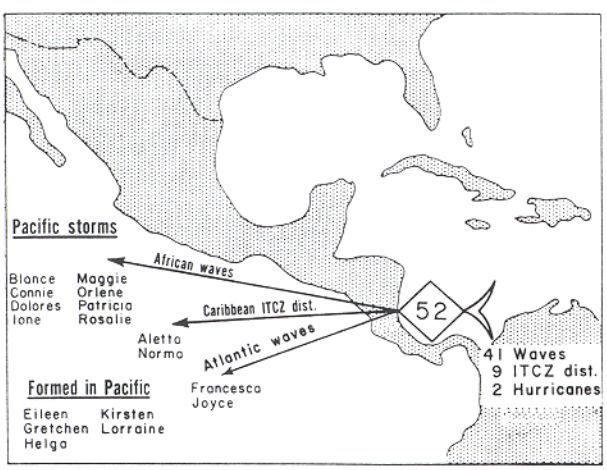


FIG. 3. Summary of the type of seedlings that initiated Pacific storms in 1974.

along the east coast during the October storm. Sections of some coastal roads were washed out, sea-walls eroded, and beach front structures undermined with total damage estimated less than one million dollars.

Two of the depressions gave us some anxious moments before moving inland and weakening. Satellite pictures indicated the depression that moved over northeast Texas on August 26th was strengthening and becoming better organized. If the system had remained over water another day, it might have become a named storm.

A second near miss occurred in September when a bright convective area developed as the depression approached Cedar Key, Fla. Winds in excess of gale force occurred in heavier squalls, and public bulletins were issued specifying the threat of tropical storm formation.

Another depression threatened the Virgin Islands and Puerto Rico in early September. This system eventually weakened over Cuba, partially under the influence of an

TABLE 3. Results of 1974 compared with the previous six years.

| | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 6-year average | 1974 |
|---|---|---|---|---|---|---|---|---|
| Total systems (all types) | 107 | 105 | 85 | 103 | 113 | 95 | 101 | 96 |
| Dakar systems | 57 | 58 | 54 | 56 | 57 | 56 | 56 | 52 |
| Barbados systems | 59 | 44 | 53 | 56 | 56 | 58 | 54 | 58 |
| San Andres systems | 40 | 43 | 45 | 58 | 49 | 54 | 48 | 52 |
| Depressions | 19 | 28 | 24 | 23 | 24 | 24 | 24 | 25 |
| Named storms | 7 | 13 | 7 | 12 | 4 | 7 | 8 | 7 |

upper-tropospheric trough. This system was one of two depressions that emerged from Africa and was tracked across the entire Atlantic.

As a point of interest, an observation that may not be insignificant is the fact that very few depressions have come out of Africa during the recent lull in storm activity. This year there were only two while in the latter part of the sixties, when storm activity was normal, many of the African systems were well-defined depressions when they moved into the Atlantic. So, while there has been little yearly variation in the number of African systems, those of the last four years have not been as well organized from the viewpoint of circulation.

Figure 3 summarizes the source of Eastern Pacific named storms. As we have observed in earlier years, nearly three-fourths of the storms were initiated by seedlings whose origin was on the Atlantic side of Central America, and half (8 of 17) were triggered by African disturbances. Two of the storms developed from the remains of Atlantic storms—Alma became Joyce, and Fifi, Orlene.

### 3. Comparison with other years

Table 3 compares the tropical systems in 1974 with averages determined over the previous six years within several categories. The total number of systems in 1974 was slightly less than the previous six-year average. However, the year-by-year variations may not be significant because of the uncertainty in our counting system. Disturbances that have very poor cloud definition are difficult to track across the Atlantic, and there is a certain amount of noise in the counting procedure.

One of the most remarkable results of our work is the consistency in the yearly number of African systems. This can be seen in Table 3, which shows that the annual variation over the last 7 years has been less than 5%. Apparently the environmental conditions that are so important for intensification to storm strength have very little control over the number of seedlings developing within the heart of the tropics. There is much greater variation in the number of seedlings forming over the subtropical latitudes, where the influence of the baroclinic westerlies is directly felt.

One parameter that we are finding very useful in evaluating the character of a hurricane season is the nature of seedlings that initiate the depressions and named storms. The results for the past eight years are shown in Table 4. The seedlings have been grouped under two main categories. African systems and disturbances that form primarily along the ITCZ have been listed under the tropical category. The second category of seedlings includes those forming over the subtropics from baroclinic sources either in the upper or lower troposphere. These are frequently referred to as subtropical cyclones and become subtropical storms if winds acquire gale strength.

The story of the 1974 hurricane season is well summarized in Table 4, in which we see that over half of the depressions (13) were initiated by baroclinic seedlings. In the table, the 1974 results can be compared with the averages for the past eight years; however, a more meaningful comparison can be made by dividing the past eight years into two four-year periods. The years from 1967 to 1970 were characterized by normal storm activity, while a lull has been observed during the period 1971 to 1974. This is not nearly as evident from the named storm statistics as with the summary for depressions. Even though there is little difference in

TABLE 4. Summary of the type of seedling that initiated Atlantic named storms and depressions during 1974 compared with annual averages from previous years.

| Year | Tropical | | Baroclinic | | Totals |
|---|---|---|---|---|---|
| | African systems | Disturbance | Upper troposphere | Lower troposphere | |
| | Named storms | | | | |
| 1974 | 5 | 1 | 1 | 0 | 7 |
| Average 1967–1973 | 4.0 | 2.0 | 1.0 | 1.0 | 8.0 |
| Average 1967–1970 | 4.2 | 2.8 | 1.0 | 0.8 | 8.8 |
| Average 1971–1974 | 3.8 | 1.2 | 1.5 | 1.2 | 7.8 |
| | Depressions | | | | |
| 1974 | 9 | 3 | 2 | 11 | 25 |
| Average 1967–1973 | 10.5 | 4.0 | 4.5 | 6.0 | 25.0 |
| Average 1967–1970 | 12.8 | 5.0 | 3.2 | 4.5 | 25.5 |
| Average 1971–1974 | 7.8 | 2.8 | 4.7 | 8.7 | 24.0 |

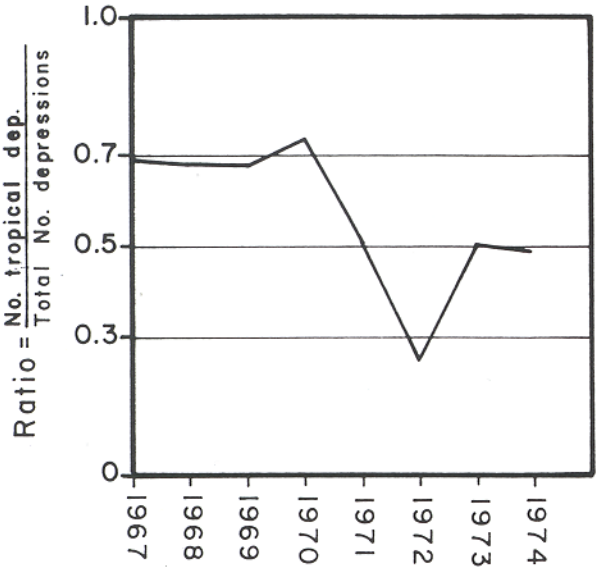


FIG. 4. Ratio of the number of tropical depressions to the total number of depressions, 1967 to 1974.

the total number of depressions, there is a very significant difference in the character of the disturbances that initiated the depressions. During the four-year normal period, two-thirds to three-fourths of the depressions were spawned by tropical-type seedlings, and subtropical cyclones were not very common. But during the last four years over half of the depressions were initiated by baroclinic disturbances, and subtropical storms were much more frequent. The character of the season is directly related to the amount of activity in the subtropical latitudes.

The statistics shown in Table 4 suggest that a very good indicator of the character of a hurricane season is the simple ratio of the number of tropical depressions to the total number of depressions. A curve of this index is shown in Fig. 4. Low values of this ratio indicate a high number of baroclinic depressions, and we have observed this to be generally associated with anomalous baroclinic conditions over the tropics. The low values for the past four years with a minimum in 1972 are consistent with the current lull in storm activity.

## REFERENCES

Hope, John R., 1975: Atlantic hurricane season of 1974. *Mon. Wea. Rev.*, **103**, 285–293.

Simpson, R. H., and J. M. Pelissier, 1971: Atlantic hurricane season of 1970. *Mon. Wea. Rev.*, **99**, 269–277.

——, Neil L. Frank, David Shideler, and H. M. Johnson, 1968: Atlantic tropical disturbance of 1967. *Mon. Wea. Rev.*, **96**, 251–259.

——, ——, ——, and ——, 1969: Atlantic tropical disturbances of 1968. *Mon. Wea. Rev.*, **97**, 240–255.