Atlantic Tropical Systems of 1974

NEIL L. FRANK

National Hurricane Center, National Weather Service, NOAA, Miami, Fla. 33124

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 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
		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. 11	Wave				Aug. 17	Wave			Aug. 19	Wave					#18	Maggie
Aug. 13	Wave				Aug. 20	Wave	8/21									
		8/20	ITCZ		Aug. 21	ITCZ			Aug. 24	Wave						
												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

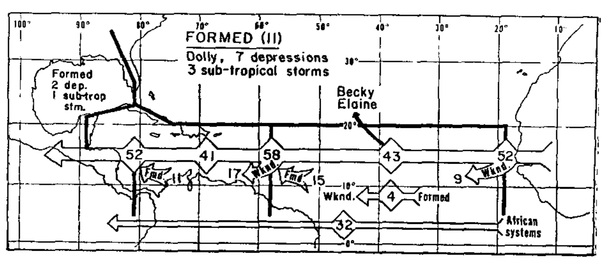

Fig. 1. Summary of tropical disturbances that passed three key stations (Dakar, Barbados, and San Andres) in 1974 and those maintaining their identity while crossing the Atlantic and Caribbean.

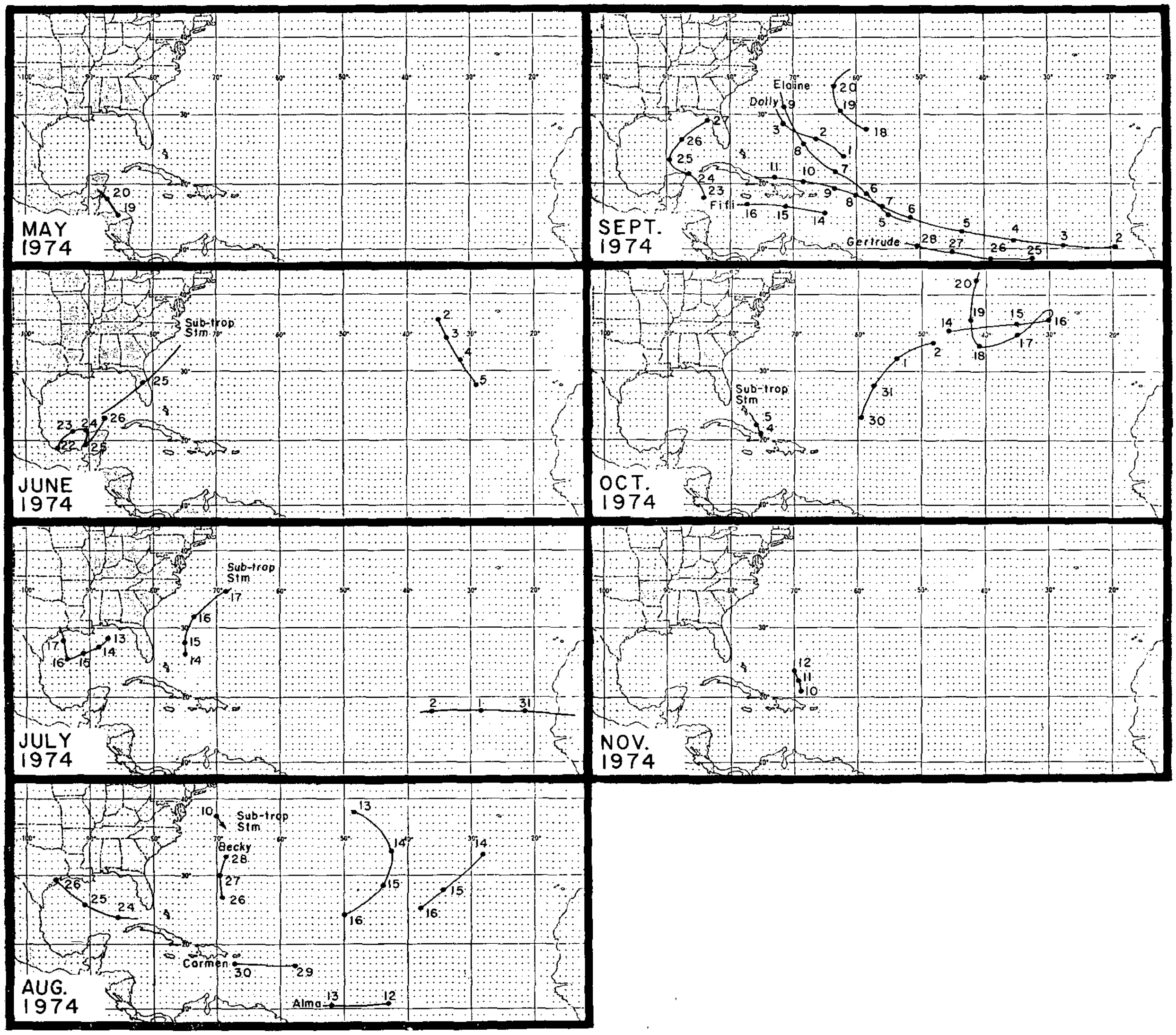

FIG. 2. Tracks of depressions in 1974.

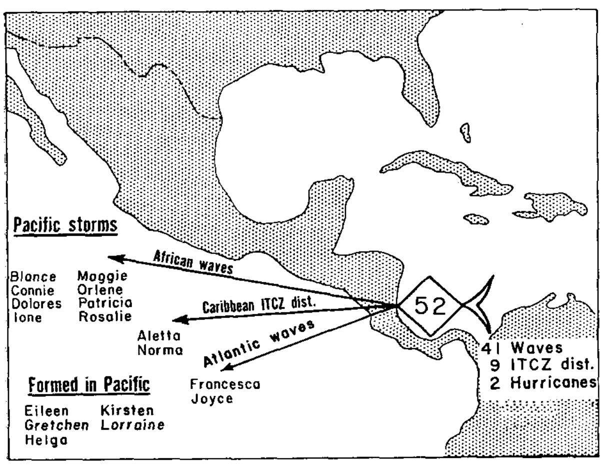

FIG. 3. Summary of the type of seedlings that initiated Pacific storms in 1974.

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 African systems	Tropical Disturbance	Baroclinic Upper troposphere	Baroclinic Lower troposphere	Totals
		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

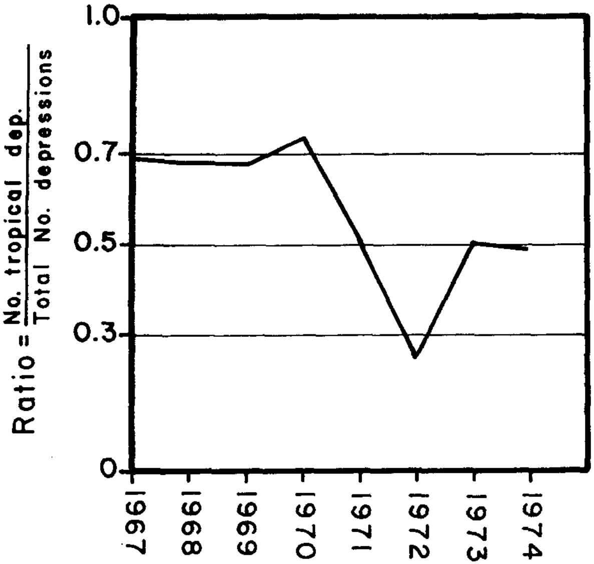

FIG. 4. Ratio of the number of tropical depressions to the total number of depressions, 1967 to 1974.

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.