Atlantic Tropical Systems of 1973

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ABSTRACT

The 1973 hurricane season featured 95 "tropical systems" of which 24 acquired the closed circulation of a depression. Atlantic "seedlings" were responsible for the seven named storms in the Atlantic and seven of the twelve East Pacific storms. Fifty-six of the systems originated over Africa.

1. Introduction

The lull in storm activity that has been evident over the Atlantic during the past several years continued in 1973. There was no serious threat to the United States, and Ellen was the only hurricane to acquire significant strength. Hebert and Frank (1974) discussed several factors that contributed to this inactivity. Upper tropospheric westerlies over the Caribbean remained stronger than normal in response to a well defined mid-Atlantic upper trough. Water temperatures over the Atlantic from Africa to the Antilles were slightly below normal. However, it is important to note that the magnitude of these anomalies was generally less than in 1972, which was the quietest season in over 40 years. The development of Ellen and Christine over the tropical eastern Atlantic gave evidence that the tropical Atlantic may be returning to normal.

Intuition suggests that the number of storms should be related to the number of "seedlings." Years with greater opportunities should produce an abundance of storms. However, our statistics over the past several years have not confirmed our intuition. On the contrary, we are finding remarkable stability in the number of seedlings that develop over the tropical Atlantic and Caribbean each year. The minor year-to-year variations in the total number of seedlings is largely related to developments over the subtropical latitudes, and storm formation depends primarily on environmental conditions. During the past three years the tropical Atlantic has been characterized by numerous seedlings, baroclinic environmental conditions, and few storms.

2. Census of 1973 tropical systems

The results of the 1973 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 describes the history of the 95 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 Atlantic north of latitude 20N. The Atlantic and eastern Pacific storms that were initiated by Atlantic seedlings are listed in the last two 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 depressions and two storms (Ellen and Christine) were spawned by tropical waves whose origin was in Africa. Once again we see that over 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.

Fig. 1 tabulates the total number of systems passing Dakar, Barbados, and San Andres Island as well as the number that maintained their identity while transversing 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 20N has been used as a dividing line. Of the 56 African systems, 51 were tracked to the Caribbean and 39 all the way to the Pacific Ocean. Over the tropical Atlantic, 13 disturbances formed with seven eventually passing through the Antilles. Another six were identified along the ITCZ and followed for at least 48 hours before dissipating. A total of 58 systems crossed the Antilles (51 from Africa plus 7 that formed in the Atlantic), of which 43 maintained their identity while transversing the Caribbean. The 11 disturbances that formed over the Caribbean added to the number

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TABLE 1. Summary of the tropical systems in 1973.*

Dakar passage	Nature	Formed in Atlantic	Nature	Weakened in Atlantic	Barbados passage	Nature	Weakened in Caribbean	Formed Caribbean	San Andres passage	Nature	Formed in N. Atlantic	Atlantic Storm	Pacific Storm
											4/18	Dep.	
											4/24	Dep.	
April 30	Wave				May 5	Wave			May 8	Wave			
May 4	Wave				May 5	Wave			May 13	Wave			
		5/07	ITC	5/09							5/02	Dep.	
											5/11	Dep.	
May 10	Wave				May 16	Wave			May 19	Wave			
May 13	Wave				May 18	Wave			May 21	Wave			
May 16	Wave				May 24	Wave			May 27	Wave			
May 18	Wave				May 26	Wave	5/27						
May 22	Wave			5/25									
May 26	Wave				June 1	Wave			June 3	Wave			
May 28	Wave				June 5	Wave			June 8	Wave			
		5/31	ITC	6/02									
May 31	Wave				June 7	Wave			June 10	Wave			
June 02	Wave				June 9	Wave			June 12	Wave			
June 05	Wave				June 11	Wave			June 14	Wave			
June 08	Wave				June 13	Wave			June 15	Wave			
											6/08	Dep.	
								6/17	June 18	ITC			Bernice
June 12	Wave				June 17	Wave			June 20	Wave			
June 14	Wave				June 21	Wave			June 24	Wave			
June 17	Wave				June 24	Wave			June 27	Wave			
		6/20	ITC	6/22									
June 21	Wave				June 27	Wave	6/28						
June 23	Wave			6/25									
											6/24	Dep.	
								7/01	July 02	ITC			
June 27	Wave				July 04	Wave			July 07	Wave			
June 29	Wave			7/01									
July 02	Wave				July 08	Wave			July 11	Wave			Dep.
July 04	Wave				July 10	Wave	7/11						
											7/01	Alice	
July 07	Wave				July 13	Wave			July 16	Wave			
											7/09	Dep.	
July 09	Wave				July 15	Wave			July 18	Wave			Emily
								7/19	July 20	ITC			
		7/20	ITC	7/25									
								7/21	July 22	Dep.		Dep.	Florence
July 15	Wave				July 20	Wave			July 24	Wave			
July 17	Wave		Dep.		July 23	Wave			July 26	Wave			Glenda
								7/27	July 28	ITC			
July 21	Wave				July 27	Wave			July 31	Wave			
July 24	Wave			7/28									
											7/30	Alfa	
July 27	Wave				Aug. 01	Wave			Aug. 04	Wave			
		8/04			Aug. 04	Wave			Aug. 08	Wave			
July 31	Wave				Aug. 08	Wave			Aug. 12	Wave			Dep.
Aug. 06	Wave				Aug. 10	Wave			Aug. 14				
Aug. 08	Wave				Aug. 11	Wave	8/13						

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TABLE 1 (*continued*).

Dakar passage	Nature	Formed in Atlantic	Nature	Weakened in Atlantic	Barbados passage	Nature	Weakened in Caribbean	Formed Caribbean	San Andres passage	Nature	Formed in N. Atlantic	Atlantic Storm	Pacific Storm
Aug. 09	Dep.				Aug. 14	Wave			Aug. 16	Wave		Brenda	Dep.
Aug. 10	Wave				Aug. 16	Wave	8/17						
Aug. 12	Wave				Aug. 19	Wave			Aug. 22	Wave			
		8/20			Aug. 21	Wave			Aug. 24	Wave			Dep.
Aug. 19	Wave				Aug. 24	Wave			Aug. 27	Wave			Heather
		8/27			Aug. 28	Wave	8/29						
								8/27	Aug. 29	Wave		Delia	
Aug. 23	Wave				Aug. 31	Wave			Sept. 09	Wave			
Aug. 26	Dep.				Sept. 03	Storm	9/06					Christine	
Aug. 31	Wave				Sept. 06	Wave	9/07						
		8/30	ITC	9/01									
Sept. 03	Wave			9/05									
								9/07	Sept. 08	ITC			
Sept. 04	Wave				Sept. 09	Wave			Sept. 11	Wave			
								9/12	Sept. 13	ITC			
		9/10			Sept. 12	Wave			Sept. 15	Wave			Jennifer
Sept. 08	Wave				Sept. 14	Wave			Sept. 17	Wave			Irah
Sept. 10	Wave				Sept. 16	Wave			Sept. 19	Wave			
Sept. 13	Wave				Sept. 20	Wave			Sept. 23	Wave		Ellen	Katherine
		9/20			Sept. 23	Wave			Sept. 26	Wave			
								9/26	Sept. 27	ITC			Dep.
								Dep.				Dep.	
											9/09	Dep.	
Sept. 18	Wave				Sept. 25	Wave			Sept. 29	Wave			Lillian
Sept. 21	Wave				Sept. 27	Wave			Oct. 01	Wave			
Sept. 23	Wave				Sept. 29	Wave			Oct. 03	Wave			Dep.
											9/24	Dep.	
Sept. 26	Wave				Oct. 02	Wave			Oct. 05	Wave			Dep.
		10/03			Oct. 05	Wave	10/06						Dep.
Sept. 30	Wave				Oct. 08	Wave			Oct. 11	Wave			
Oct. 03	Wave				Oct. 10	Wave			Oct. 14	Wave		Gilda	
											10/08	Bravo/Fran	
											10/10	Dep.	
Oct. 07	Wave				Oct. 16	Wave	10/18						
Oct. 12	Wave				Oct. 18	Wave	10/19						
Oct. 15	Wave				Oct. 21	Wave			Oct. 26	Wave			
Oct. 18	Wave				Oct. 28	Wave	10/29						
								10/27	Oct. 28	ITC			
Oct. 25	Wave				Nov. 04	Wave	11/05						
											10/26	Dep.	
Oct. 30	Wave				Nov. 06	Wave	11/07						
		11/08			Nov. 09	ITC	11/10						
		11/07	ITC	11/13									
								11/17	Nov. 17	Dep.			

* "Dep." indicates depression.

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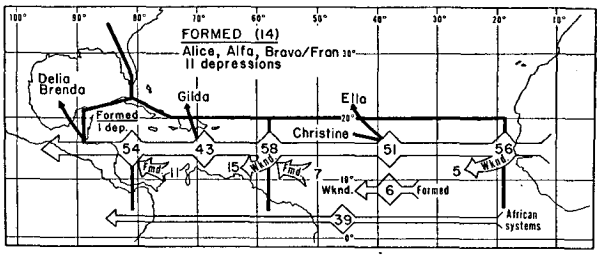

FIG. 1. Summary of the tropical systems that passed three key stations (Dakar, Barbados, and San Andres) in 1973 and those maintaining their identity while crossing the Atlantic and Caribbean.

TABLE 2. Summary of 1973 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	Sub-tropical Atlantic	Carib-bean	Gulf of Mexico	Total
Waves	54	6	0	0	0	60
ITCZ	0	7	0	8	0	15
Depressions	2	(2)	14	3(2)	1	20(4)
Named storms	0	(2)	(2)	(2)	(1)	(7)
	56	13(4)	14(2)	11(4)	1(1)	95(11)

from the Antilles resulted in 54 seedlings entering Central America.

The depression tracks for the months April through November are shown in Fig. 2. The first four depressions of the year (two in April and two in May) were associated with the remains of old polar fronts and never acquired tropical characteristics. Three of the depressions warranted special consideration. During the past several years baroclinic depressions have been designated as subtropical storms and identified by letters of the phonetic alphabet if winds strengthen to gale force. In August, an upper tropospheric cold low penetrated downward to the surface between Hatteras and Bermuda and was designated Alfa when winds reached gale force off the mid-Atlantic coast. This system weakened before making landfall in Maine and produced no deaths or damages. A second sub-

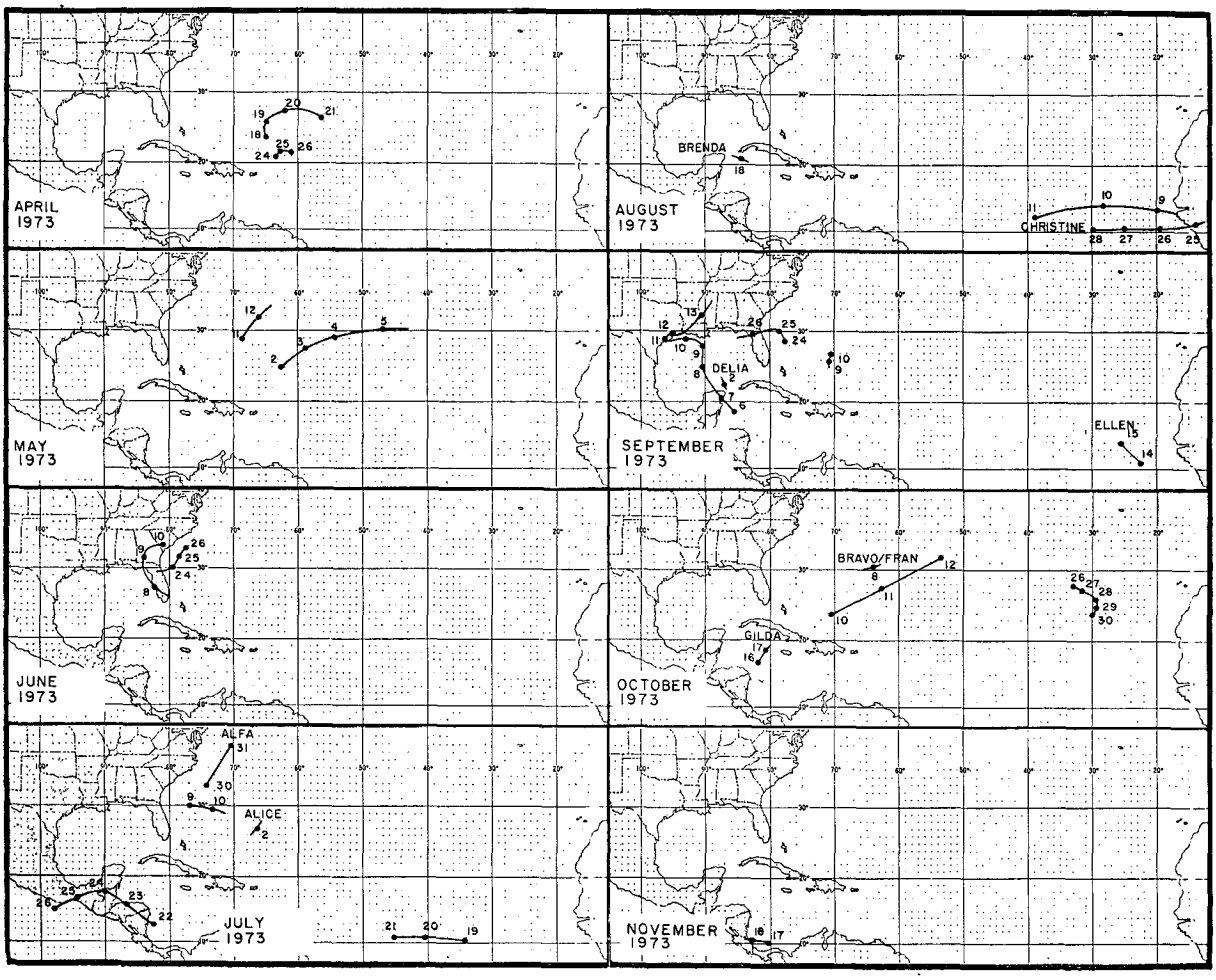

FIG. 2. Tracks of depressions in 1973.

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tropical storm, Bravo, was spawned by a low level baroclinic zone southeast of Bermuda in October; Bravo later acquired a warm core and was redesignated Hurricane Fran. This type of transformation is fairly common and has been observed several times in the last four years.

A rare development sequence gave birth to a third subtropical storm in late October which was never phonetically designated in the interest of maintaining simplicity in our public warnings. Gilda formed over the northwest Caribbean, drifted northward across Cuba and lost tropical characteristics north of the Bahamas as winds decreased to less than gale force. The central pressure began falling again on 24 October as the remains of Gilda assumed the features of a large, severe subtropical cyclone.

Perhaps the most noteworthy depression of the year was one that developed near Swan Island in September as Delia lashed the northwest Gulf of Mexico. This depression moved towards the northwest and lingered on the Texas coast near Galveston for three days. This system produced 15 inches of rainfall over coastal regions of southeast Texas that had been saturated five days earlier by rains associated with Delia. The rainfall associated with this depression raised the crop losses associated with Delia to 15 million dollars.

Fig. 3 summarizes the source of eastern Pacific storms and hurricanes. Three-fourths of the storms were initiated by seedlings whose origin was on the Atlantic side of Central America, and half of the storms were triggered by African disturbances. Three of the storms formed along the Pacific ITCZ.

3. Comparison with other years

Table 3 compares the tropical systems in 1973 with averages determined over the previous five years within several categories. The total number of systems in 1973 was slightly less than the five years average. The year

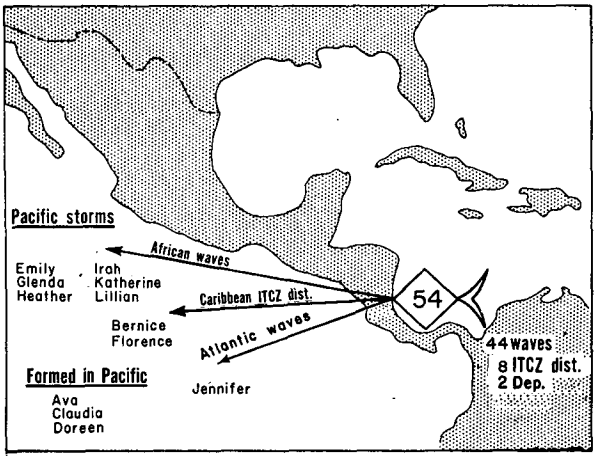

FIG. 3. Summary of the type of seedlings that initiated Pacific storms in 1973.

TABLE 3. Five-year summary of tropical systems within several categories compared with the results for 1972.

	1968	1969	1970	1971	1972	5-year average	1973
Total systems, all types	107	105	85	103	113	103	95
Dakar systems	57	58	54	56	57	56	56
Barbados systems	59	44	53	56	56	54	58
San Andres systems	40	43	45	58	49	47	54
Depressions	19	28	24	23	24	24	24
Named storms	7	13	7	12	4	9	7

to year variation seen in the first row of Table 3 is partly real and partly a consequence of our counting procedure. Years featuring strong systems may produce seasonal totals that will be less than years with weak disturbances because of the uncertainty in maintaining the continuity of weak systems. For example, when a weak disturbance emerges from Africa, it is generally associated with a poorly organized cloud pattern and the trans-Atlantic track is difficult to determine. In this case our rules would show the African system dissipating over the Atlantic. Later on if there is evidence of a system moving through the Antilles we would indicate a second development even though we realize this could be the African disturbance, and the counting scheme would register two systems. If the system had been strong it would have been counted as one and the systems in 1973 tended to be strong. A measure of this can be seen in the percentage of African systems tracked to the Caribbean and Pacific. Fig. 1 shows that 39 African systems were tracked to the Pacific. This is the highest number we have seen in our six years of experience.

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 annual variation over the last 6 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 evaluation of the character of a hurricane season is the nature of seedlings initiating the depressions and named storms. The results for the past seven 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.

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The story of the 1973 hurricane season is well summarized in Table 4. Half of the depressions were initiated by the tropical type seedlings and half by baroclinic seedlings. If we disregard 1972, which was a very anomalous year, we see that during the prior five-year period approximately 75% of both the named storms and depressions were spawned by tropical type seedlings and 25% by baroclinic seedlings. If the statistics for the period from 1967 to 1971 are related to long-term values, then 1973 was also anomalous in that a greater percentage of the depressions formed over subtropical waters. The statistics shown in this table suggest that a very good indicator of the tropical character of a hurricane season is the simple ratio of the number of tropical depressions to the number of baroclinic 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 is generally associated with anomalous baroclinic conditions over the tropics. The low values for the past three years with a minimum in 1972 are consistent with the lull observed in storm activity.

TABLE 4. Summary of the type of seedling that initiated Atlantic named storms and depressions during the years 1967 through 1972 compared with the results for 1973.

Year	Tropical		Baroclinic		Totals
	African systems	Disturbances	Upper troposphere	Lower troposphere	
		Named Storms			
1967	4	3	0	1	8
1968	2	3	1	1	7
1969	7	3	2	1	13
1970	4	2	1	0	7
1971	6	1	4	2	13
1972	1	0	1	2	4
6-year average	4	2	1.5	1	8.5
1973	3	3	0	1	7
		Depressions			
1967	15	5	4	5	29
1968	8	5	3	3	19
1969	11	8	3	6	28
1970	17	2	3	4	26
1971	11	1	7	4	23
1972	6	0	6	12	24
6-year average	11	3.5	5	5.5	25
1973	5	7	4	8	24

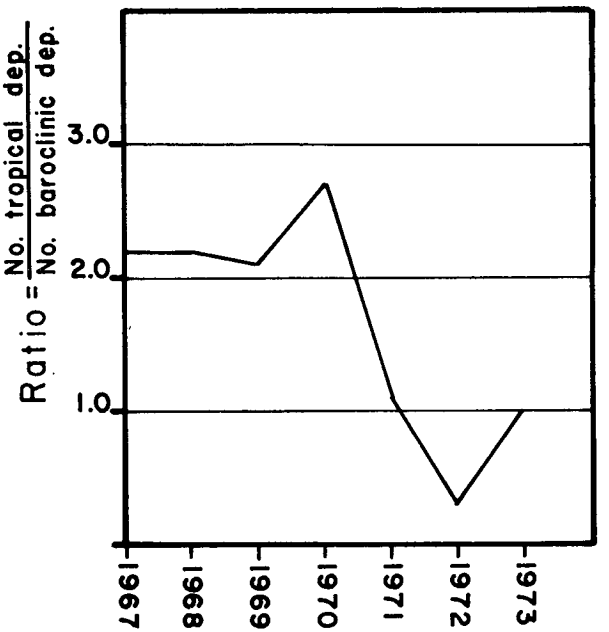

FIG. 4. Time graph of the ratio of the number of "tropical-type" depressions to the number of "baroclinic-type" depressions.

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