TROPICAL REVIEW
September 2001 - December 2001

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Introduction

The Tropical Prediction Center/ National Hurricane Center (TPC/ NHC) became much busier as activity in the Atlantic significantly increased. A total of 20 tropical storms and hurricanes occurred in the Atlantic and eastern Pacific during the summary period. Several non-tropical gale events also affected the TPC high seas forecast areas.

The Tale of the Tellus

Most hurricane seasons bring many encounters between ships and tropical cyclones, and examples of how ship observations aid the TPC in analysis and forecasting. One of the best such examples from the 2001 season was that of the **Tellus** (WRYG) and the storm that became Hurricane Noel.

A non-tropical low formed in the eastern Atlantic late on 1 November near 32°N. 40°W. This system strengthened into a storm center the next day as it drifted northwestward. Convection began to increase near the center on 3 and 4 November, which suggested that the storm might be acquiring tropical characteristics. The **Tellus** began its encounter with the storm at 0000 UTC 5 November (Table 1) as it traveled westward into the now northward-moving circulation. The key observations were at 1200 UTC and 1400 UTC. Figure 1 shows an image of the soon-to-be Noel at 1145 UTC with the 1200 UTC ship observations plotted on it. Note that while **Tellus** was reporting 60 kt and 992.0 hPa from near the center, other nearby ships were reporting 30 kt or less. This indicated the storm had developed a strong inner core characteristic of a tropical cyclone, even though its appearance on satellite images was less than classically tropical. The 1400 UTC observation of 65 kt indicated that the system was at hurricane strength. Subsequent **Tellus** observations helped determine the size of the wind field on the southwest side of the storm.

Table 1. Observations from the Tellus during its encounter with Hurricane Noel, 5-6 November

Date/Time (UTC)	Lat. (^{O}N)	Lon. (^{O}W)	Wind dir/speed (deg/kt)	Pressure (mb)
5/0000	36.9	45.5	100/27	1009.0
5/0600	37.0	47.5	140/35	1001.2
5/1200	**37.0**	**49.5**	**180/60**	**992.0**
5/1400	**37.0**	**50.1**	**240/65**	**994.0**
5/1500	37.0	50.5	240/51	994.2
5/1600	36.9	50.8	250/45	996.2
5/1700	36.9	51.0	270/45	996.9
5/1800	36.8	51.3	270/48	997.8
5/2000	36.8	51.9	290/46	1001.5
5/2100	36.8	52.1	290/45	1002.5
5/2200	36.7	52.5	290/45	1003.6
5/2300	36.7	52.8	290/45	1004.6
6/0000	36.7	53.1	270/45	1006.2
6/0100	36.7	53.4	270/45	1007.5
6/0200	36.6	53.7	270/45	1008.2
6/0300	36.6	54.1	270/40	1009.0
6/0600	36.6	55.2	230/18	1009.2

Based on the observations from the **Tellus** and satellite microwave data indicating the system was warm-core, the TPC/NHC wrote the first advisory on Hurricane Noel at 1500 UTC 5 November (Figure 2). After this time, Noel continued northward and weakened to a tropical storm later that day. It became extratropical about 285 nmi southeast of Cape Race, Newfoundland on 6 November and was soon absorbed into another extratropical low.

The TPC normally requests in its Forecast/Advisories that all ships with 300 nmi of a tropical cyclone send three-hourly observations. Increased observations (three-hourly and hourly) are also useful when a tropical cyclone is first forming regardless of whether it forms from a non-tropical low or a tropical disturbance, or when the observed weather is significantly different than indicated in forecast or analysis products.

The 2002 Hurricane Season

The 2002 hurricane season begins in the eastern Pacific on 15 May and in the Atlantic on 1 June. Both seasons run through 30 November. The names for this season's storms are listed in the table below.

Significant Weather of the Period

A. Tropical Cyclones: Twelve tropical cyclones occurred in the Atlantic basin during the summary period, making this one of the most active September-December periods ever. These included one tropical depression, two tropical storms, and nine hurricanes. Four of the hurricanes reached Category 3 or higher on the Saffir-Simpson Hurricane Scale. The eastern North Pacific basin produced ten tropical cyclones, including one tropical depression, four tropical storms and five hurricanes, with Hurricane Juliette reaching Category 4 status on the Saffir-Simpson scale.

1. Atlantic

Hurricane Erin: Erin formed from a tropical wave on 1 September and quickly became a tropical storm about 660 miles west-southwest of the Cape Verde Islands (Fig. 2). It moved west-northwestward over the next few days, with maximum sustained winds reaching 50 kt on 3 September. After that, westerly wind shear caused the cyclone to weaken to an area of disturbed weather about 400 miles east of the northern Leeward islands on 5 September. The shear then decreased and a new center formed the next day about 475 miles north-northeast of the northern Leeward Islands. The reborn Erin moved north-northwestward and strengthened into a tropical storm on 7 September and to a hurricane on 8 September. It passed about 90 nmi east of Bermuda on the 9 September just before maximum winds peaked at 105 kt (Fig. 3). After a slow recurvature from 11 to 13 September, Erin accelerated northeastward and passed near Cape Race on the 14 September at just below hurricane strength. It became extratropical shortly thereafter.

Several ships encountered Erin, with the most notable observation

Hurricane Names for the 2002 Hurricane Season

Atlantic		Eastern Pacific	
Arthur	Lili	Alma	Marie
Bertha	Marco	Boris	Norbert
Cristobal	Nana	Christina	Odile
Dolly	Omar	Douglas	Polo
Edouard	Paloma	Elida	Rachel
Fay	Rene	Fausto	Simon
Gustav	Sally	Genevieve	Trudy
Hanna	Teddy	Hernan	Vance
Isidore	Vicky	Iselle	Winnie
Josephine	Wilfred	Julio	Xavier
Kyle		Kenna	Yolanda
		Lowell	Zeke

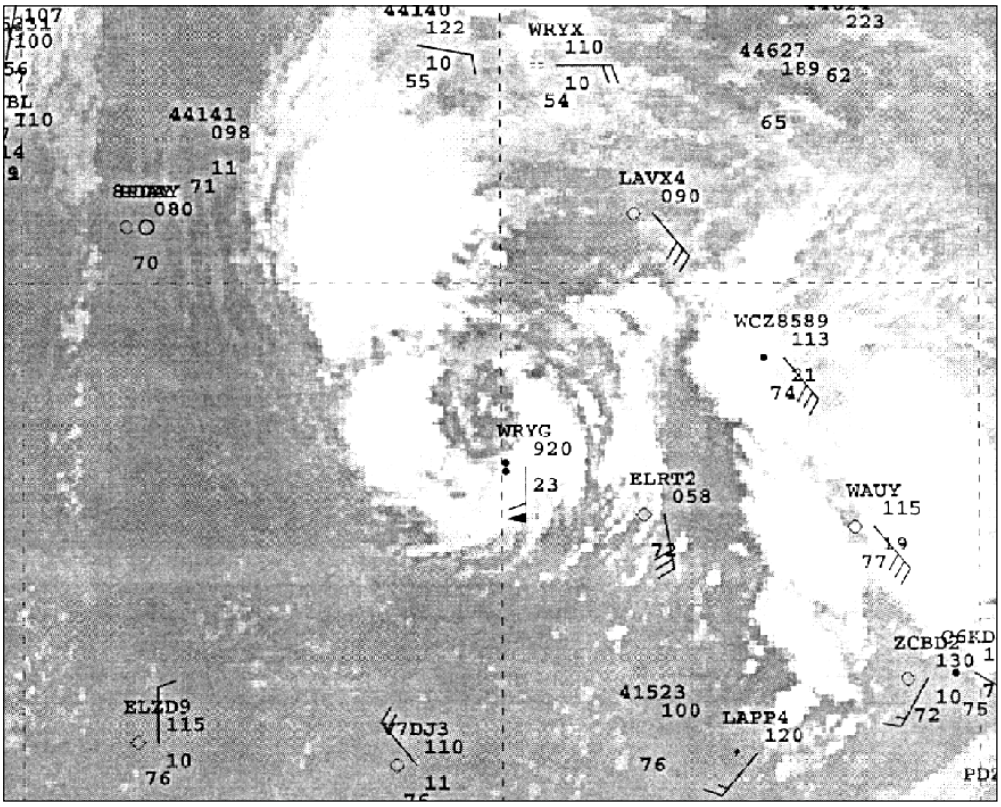

Figure 1. GOES-8 infrared image of hurricane Noel at 1145 UTC 5 November 2001 with 1200 UTC ship observations overlaid on the imagery.

coming from the **Semyonovosk** (UCTR) which reported 48kt winds at 1500 UTC 14 September. Also noteworthy was data from the **Sealand Pride** (WDA367) which intermittently reported tropical storm winds from 1200 UTC on 12 September to 0000 UTC on the 14 September. Other significant ship observations in Erin are included in Table 2.

Erin brought strong winds and heavy rains to portions of southeastern Newfoundland, with Cape Race reporting 46-kt sustained winds and gusts to 58 kt at 0200 UTC 15 September. Bermuda reported a gust to 36 kt. There are no reports of damages or casualties.

Hurricane Felix: A tropical wave developed into a tropical depression on 7 September southwest of the Cape Verde Islands (Fig. 2). Late on 8 September, the westward-moving depression encountered strong shear and weakened to a tropical wave. As the wave continued westward, the shear relaxed enough to allow a new center to form early on 10 September about 1000 miles east of the Lesser Antilles. This made the system the season's fourth topical cyclone to dissipate in the deep tropics and then regenerate. The depression tracked steadily west-northwestward and became Tropical Storm Felix on 11 September. During the next two days Felix turned northwestward and then northward, becoming a hurricane late on 12 September. Maximum winds reached 100 kt as Felix curved northeastward late on 13 September. Slow weakening occurred thereafter. Felix turned eastward on 15 September and continued this motion until it weakened back to a tropical storm on 17 September, at which time it stalled about 350 miles southwest of the Azores. Increasing shear and cooler waters caused Felix to weaken to a depression early on 18 September and to dissipate

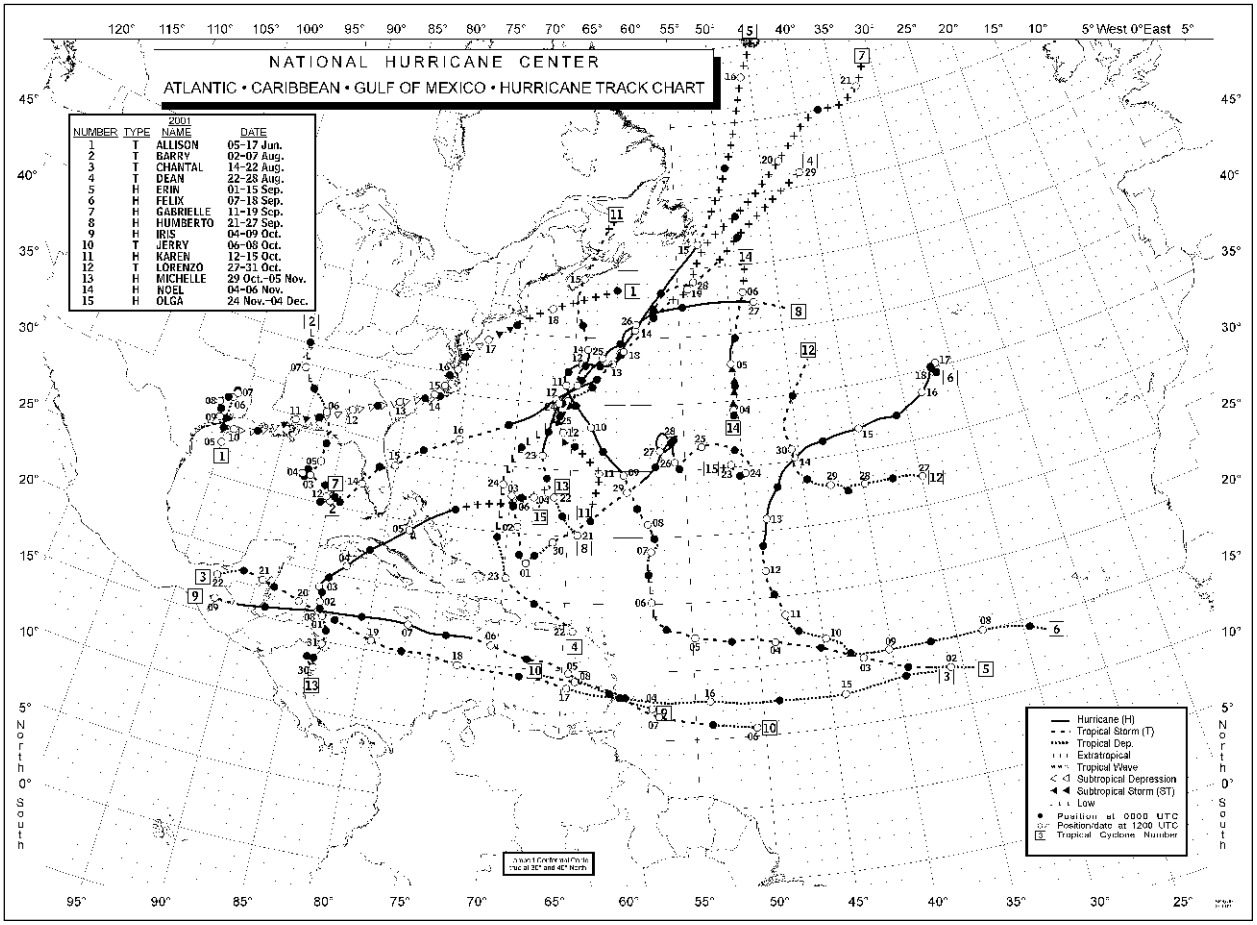

Figure 2 - Atlantic tropical storms and hurricanes of 2001.

later that day about 400 miles southwest of the Azores.

Only a few ships encountered Felix. The **LTC Calvin P. Titus** (KAKG) reported 35 kt winds at 1800 UTC on 16 September, while the **Nariva** (C6PW2) reported 34 kt winds at 1200 UTC on 17 September. There were no reports of damages or casualties.

Hurricane Gabrielle: Gabrielle formed over the southeastern Gulf of Mexico on 11 September from a non-tropical low (Fig. 2). It looped slowly for two days before moving northeastward on 13

Table 2 - Selected ship and buoy observations of 34 kt or greater winds for Hurricane Erin, 1-15 September, 2001.

Date/Time (UTC)	Ship name/ call sign/ buoy ID	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (hPa)
4/0200	Drifting Bouy 41559	17.2	48.9	090/41	1009.0
9/1800	**Irving Primrose/** 8POI	32.5	59.7	140/34	1017.3
9/1800	**Artisgracht/**PCUI	32	65	/35	N/A
13/0000	**Sealand Pride/** WDA367	36.1	60.6	230/43	1004.0
13/0000	**Lykes Navigator/** WGMJ	36.4	65.7	360/34	1010.8
14/0000	**Lykes Navigator/** WGMJ	36	66	/35	N/A
14/1500	**Semyonovosk/** UCTR	43.2	51.7	230/48	1006.0

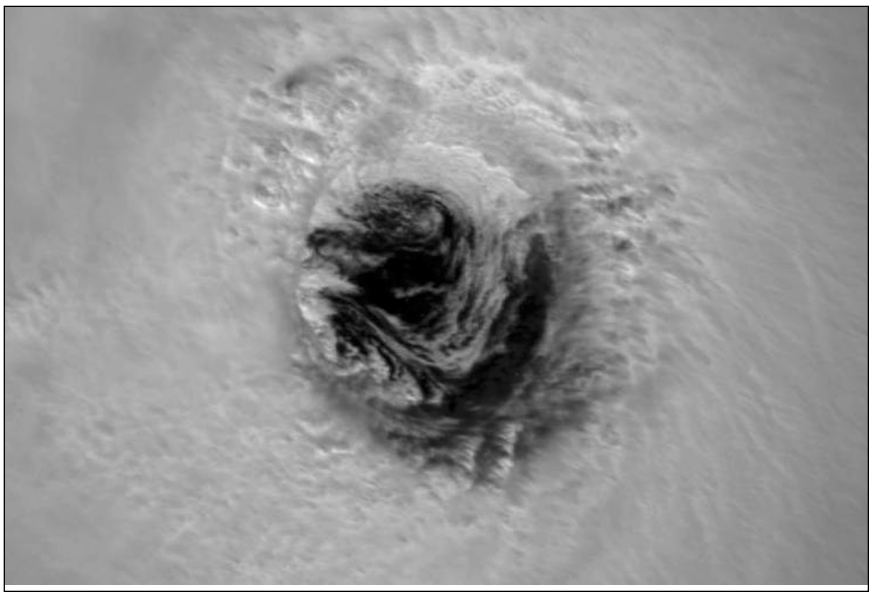

Figure 3 - Close-up of image of Hurricane Erin with winds peaked at 105 kt. Image is MODIS data acquired by direct broadcast from the NASA Terra spacecraft at the Space Science and Engineering Center, University of Wisonsin-Madison.

September as it became a tropical storm. Gabrielle moved inland near Venice, Florida on 14 September as a tropical storm with 60-kt tropical storm winds. After meandering across the Florida Peninsula, the storm moved northeastward into the Atlantic near Cape Canaveral on 15 September. Gabrielle continued northeastward and became a hurricane with 70-kt winds on 17 September while located about 250 miles north of Bermuda. It weakened to a tropical storm on 18 September and became extratropical the next day about 330 miles south of Cape Race.

Even while it was a hurricane, Gabrielle had a large wind field similar to that of an extratropical low. Selected observations from some ships it affected are given in Table 3. The most significant observations were from the **KRPDD** (name unknown) which reported 58-kt winds at 0000 and 1800 UTC 16 September. Additionally, a buoy off the southwest Florida coast reported 44-kt sustained winds with a gust to 85 kt at 1210 UTC on 14 September. At the shore, the Coastal Marine Automated Network (C-MAN) station at St. Augustine, Florida reported 51-kt sustained winds with gusts to 65 kt, while a marine laboratory at New Pass, Florida also reported 51-kt sustained winds.

Gabrielle is blamed for one death and $230 million in damage in the United States.

Table 3. Selected ship and buoy observations of 34 kt or greater winds for Hurricane Gabrielle, 11-19 September, 2001.

Date/Time (UTC)	Ship name/ call sign/ buoy ID	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
13/1200	CZ523	24.0	83.5	170/35	1006.4
13/1800	**Santa Maria**/DCUW	25.3	83.9	160/45	1003.9
14/0600	**El Yunque**/WGJT	29.5	80.0	060/36	1008.0
14/1210	Fl COMPS NA2	27.2	82.9	360/44	N/A
14/1800	**Nedlloyd Holland**/ KRHX	28.1	80.1	180/37	1000.5
15/1800	**Lykes Discoverer**/ WGXO	30.4	80.4	030/40	1003.0
16/0000	**WPGJ**	29.5	80.1	050/37	1006.5
16/0000	**Shanghai Express**/ DGSE	30.5	78.5	360/49	999.0
16/0000	**Lykes Discoverer**/ WGXO	31.4	79.9	010/48	1006.0
16/0000	**Galveston Bay**/ WPKD	32.5	78.7	030/50	1006.8
16/0000	KRPDD	32.7	74.2	080/58	1008.1
16/0600	**P&O Nedlloyd Auckland**/PDHW	32.7	77.7	050/43	1007.0
16/0600	**Transworld Bridge**/ ELJJ5	33.2	77.8	010/44	1009.0
16/1200	KS004	24.9	75.4	280/45	N/A
16/1800	KRPDD	32.8	68.3	140/58	1009.1
16/1800	**Queensland Star**/ MZBM7	34.1	73.1	040/40	1003.1
17/0000	**Sealand Hawaii**/ KIRF	29.3	69.8	200/36	1009.2
17/1800	**Archangelgracht**/ PCTG	34.6	60.6	200/39	1006.9
18/1200	**Chesapeake Bay**/ WMLH	41.4	57.2	100/36	1005.0
18/1200	**Faust**/WRYX	33.2	66.0	260/35	1009.0
18/1800	**Chesapeake Bay**/ WMLH	41.4	59.7	090/35	984.5

Tropical Depression Nine: A tropical wave moving through the Caribbean spawned a tropical depression about 50 nmi north-northwest of San Andres Island on 19 September (Fig. 4). The system moved west-northwestward and made landfall near Puerto Cabezas, Nicaragua early on 20 September. It dissipated over land later that day, and there were no reports of damages or casualties.

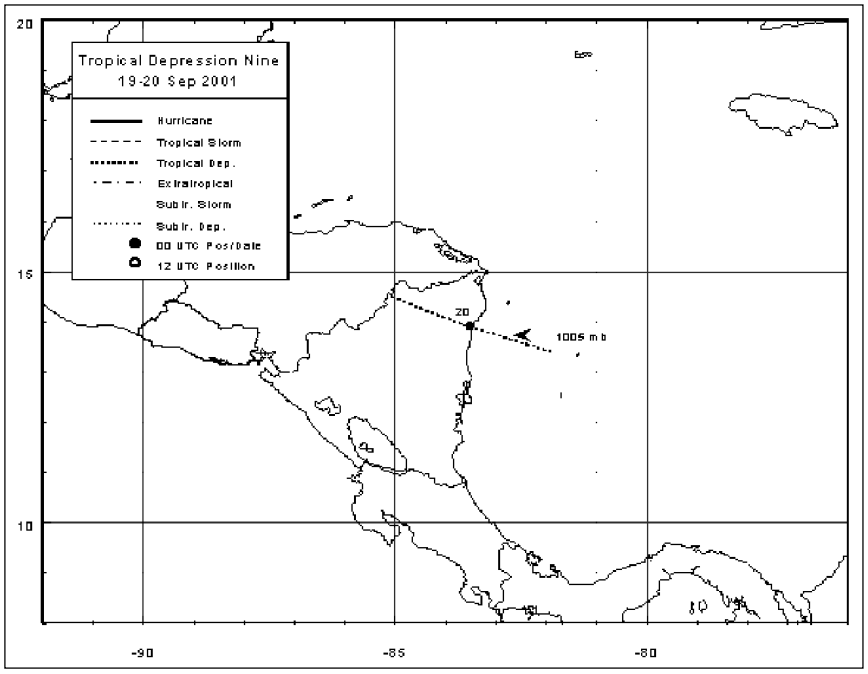

Figure 4 - Best track of Tropical Depression Nine, 19 - 20 September 2001.

Hurricane Humberto: Humberto had an unusual origin in that it formed from a trough extending southwestward from Gabrielle. The cyclone developed on 21 September about 490 miles south of Bermuda (Fig. 2). It moved northwestward and strengthened into a tropical storm on 22 and 23 September. On 23 September Humberto gradually turned northward and became a hurricane, passing about 140 miles west of Bermuda. Winds reached 85 kt early on 24 September, followed by some weakening while Humberto turned northeastward. The cyclone unexpectedly re-intensified on 26 September, and maximum winds reached 90 kt while Humberto was centered about 200 miles south-southeast of Sable Island, Nova Scotia. The hurricane turned eastward and weakened to a tropical storm on 27 September. Humberto became extratropical later that day, and the remnant circulation was eventually absorbed by a larger low over the far north Atlantic.

Ships generally avoided Humberto. The **Sealand Expedition** (WPGJ) and the **Onejskyi** (UCTI) reported 37-kt winds at 1800 UTC 23 September and 1200 UTC 27 September, respectively. Bermuda reported a gust to 37 kt. There were no reports of damages or casualties.

Hurricane Iris: Iris developed from a tropical wave near the Windward Islands on 4 October (Fig. 2). Moving west-northwestward into the Caribbean Sea, it became a tropical storm on 6 October. Iris turned westward and reached hurricane status on 7 October just south of the Barahona Peninsula of the Dominican Republic. The hurricane passed near the southern coast of Jamaica later that day, before rapidly intensifying while crossing the western Caribbean. Maximum winds reached 125 kt just before landfall near Monkey River Town in southern Belize on the evening of 8 October. Iris weakened rapidly after landfall and dissipated over eastern Mexico on 9 October.

Although Iris was a Category 4 hurricane on the Saffir-Simpson scale at landfall, the core was very small with hurricane force winds extending no more than 25 nmi from the center. Tropical-storm force winds generally extended no more than 100 nmi from the center. No ships reported tropical storm winds from Iris. However, a marine tragedy occurred at landfall when the **M/V**

Wave Dancer capsized in harbor near Big Creek, Belize with the loss of 20 lives.

Iris caused severe damage from winds and an 8- to 15-ft storm surge within a 60 nmi wide area of southern Belize. Including those on the **Wave Dancer**, Iris was responsible for 31 deaths, and damage in Belize was estimated at $66 million.

Tropical Storm Jerry: Jerry developed from a tropical wave on 6 October about 540 nmi east-southeast of Barbados (Fig. 2). Moving west-northwestward, it reached tropical storm strength later that day. Jerry moved through the Windward Islands at its maximum intensity of 45-kt winds on 7 and 8 October. The system then became disorganized in the eastern Caribbean Sea and dissipated late on 8 October.

There are no ship reports of tropical-storm-force winds from Jerry. The town of Caravelle on Martinique reported 39 kt sustained winds with gusts to 50 kt on 8 October. There were no reports of damages or casualties.

Hurricane Karen: A frontal system stalled about 200 nmi southeast of Bermuda on 10 October. A low formed on the front early on 11 October, and the low became a strong subtropical storm as it tracked northwestward just southwest of Bermuda early the next day (Fig. 2). The storm turned northward later that day. The cyclone then became better organized, transforming into Tropical Storm Karen early on 13 October and progressing to hurricane status later that day. Karen moved generally northward for the next 2 days, with maximum winds reaching 70 kt early on 14 October. It made landfall in western Nova Scotia on 15 October as a 40-kt tropical storm and became extratropical while moving toward western Newfoundland, where it merged with a large mid-latitude low pressure system.

The **Nordic Empress** (ELJV7) was anchored at Bermuda while the subtropical storm passed and reported 79-kt sustained winds with a gust to 103 kt at the anemometer height of 153 ft. The ship also reported a 991.0 mb pressure. Other ship observations for hurricane Karen are included in Table 4.

Official land observations on Bermuda included 58-kt sustained winds with gusts to 78 kt. There were unofficial reports of sustained winds near 65 kt with gusts to 85 kt. These winds caused tree and power line damage, leaving more than 23,000 people without power and causing the **Norwegian Majesty** to break anchor at the height of the storm. Cape George, Nova Scotia reported 41-kt sustained winds with a gust to 56 kt when Karen made landfall.

Tropical Storm Lorenzo: Lorenzo formed from a non-tropical low in the eastern Atlantic that developed on 26 October. The low became a tropical depression on 27 October about 850 miles southwest of the Azores and moved slowly westward (Fig. 2). Late on 29 October it reached minimal tropical storm strength about 1250 miles west-southwest of the Azores. Lorenzo turned to the northwest and then to the north on 30 October with little change in strength. Accelerating rapidly to the north-northeast early on 31 October, Lorenzo lost tropical characteristics ahead of an approaching cold front about 700

Table 4 - Selected ship observations of 34 kt or greater winds associated with Hurricane Karen, 12-15 October 2001.Best track of Tropical Depression Nine, 19 - 20 September 2001.

Date/Time (UTC)	Ship name/ call sign/ buoy ID	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
11 / 2317	**Nordic Empress/** ELJV7[a,b]	32.3	64.8	111 / 79G103	991.0
12 / 1500	**Zenith/**ELOU5	34.8	71.3	030 / 38	1015.0
13 / 1800	**Taiko/**LAQT4	37.5	66.9	060 / 35	
14 / 1200	**Royal Princess/** GBRP	48.4	62.0	180 / 39	1027.7
15 / 0000	**P&O Nedlloyd Auckland/**PDHW	38.2	61.5	210 / 37	1015.8
15 / 1800	**Royal Princess/** GBRP	42.2	59.9	180 / 37	1017.9

miles west of the Azores. There were no reliable reports of tropical-storm-force winds from Lorenzo, and there were no reports of damages or casualties.

Hurricane Michelle: This classic late-season hurricane started as a broad low associated with a tropical wave in the southwestern Caribbean Sea on 27 October. It developed into a tropical depression on 29 October along the east coast of Nicaragua (Fig. 2). The depression then moved inland and meandered over northeastern Nicaragua for two days. Late on 31 October it moved into the northwestern Caribbean Sea and became Tropical Storm Michelle. The cyclone moved slowly north-northwestward for the next two days as it strengthened into a hurricane. The hurricane turned slowly northward on 3 November (Fig. 5), with an Air Force Reserve Hurricane Hunter aircraft measuring a central pressure of 933 hPa. Michelle turned northeastward on 4 November as maximum winds reached 120 kt. Later that day it hit western Cuba as a Category 4 hurricane on the Saffir-Simpson Hurricane Scale. A weakening Michelle continued northeastward through the Bahamas on 5 November and became extratropical over the southwestern Atlantic on 6 November. The system was absorbed by a cold front late that day.

Several ships encountered the large circulation of Michelle. The most significant observations were from the **Scan Partner** (call sign unknown) and the **ELWU7** (name unknown). The **Scan Partner** passed near the center of Michelle at 0730 UTC 2 November and reported 34-47 kt winds and a 988.0 mb pressure. The **ELWU7** reported 60-kt winds and a 995.0 mb pressure at 1200 UTC on 5 November. Other significant ship and buoy observations are included in Table 5.

Michelle was the strongest hurricane to hit Cuba since 1952 and left a trail of damage and death from Central America to the Bahamas. Cayo Largo, Cuba reported 108-kt sustained winds with gusts to 115 kt, along with a 9- to 10-ft storm surge that reportedly innudated the entire island. Nassau, Bahamas reported a peak gust of 89 kt. Winds of 35 to 45 kt occurred over portions of south Florida. In addition to the main storm surge, above normal tides and battering waves occurred in portions of Cuba, the Bahamas, the Cayman Islands, and south Florida. Seventeen deaths are associated with the hurricane, including 6 in Honduras, 5 in Cuba, 4 in Nicaragua, and 2 in Jamaica. Widespread severe damage occurred across western and central Cuba, with additional damage over portions of Central America, the Cayman Islands, Jamaica, and the Bahamas.

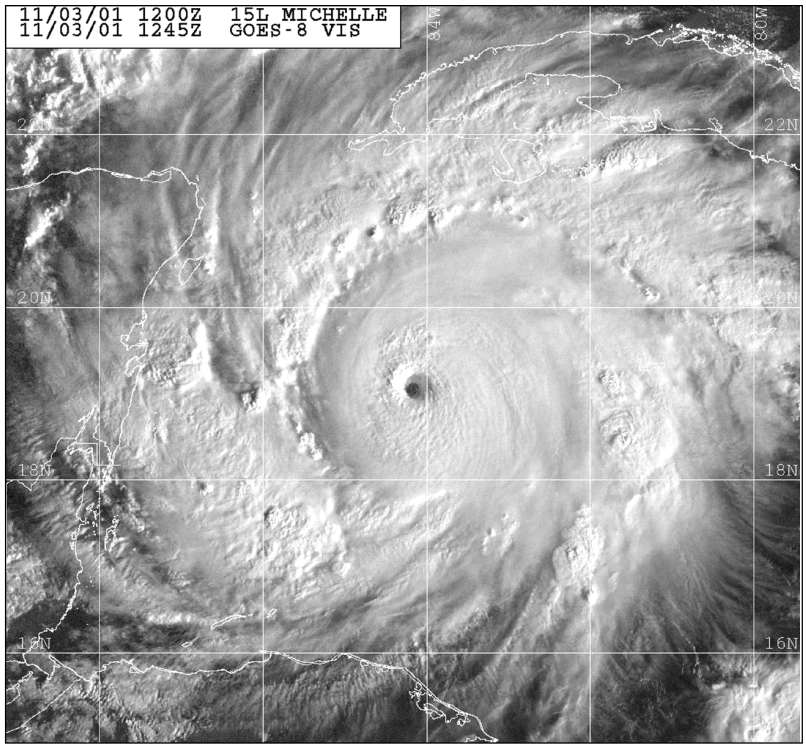

Figure 5 - GOES-8 visible image of Hurricane Michelle at 1245 UTC 3 November. Image courtesy of the Naval Research Laboratory, Monterey, CA.

Table 5 - Selected ship and buoy observations of 34 kt or greater winds for Hurricane Michelle, 29 October - 5 November, 2001.

Date/Time (UTC)	Ship name/ call sign/ buoy ID	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
01/1800	**Jo Cedar**/PFDI	18.2	81.6	100/37	1007.0
02/0730	**Scan Partner**/ (unknown)	17.5	84.1	See Note	988.0
04/0600	C6FN5	24.0	79.3	070/42	1006.0
04/0900	**Star Florida**/ LAVW4	24.2	81.5	060/37	1007.2
04/1500	**Nobel Star**/KRPP	24.1	83.6	050/39	1008.0
04/1800	**Emmagracht**/PDYX	23.6	81.1	080/39	1003.0
04/1800	C6QU3	18.0	81.1	240/34	1004.0
05/1200	ELWU7	25.3	75.9	050/60	995.0
05/1200	**Nedlloyd Van Nes**/ ELVG7	26.7	79.6	050/48	1003.5
05/1900	Drifting Buoy 41651	24.3	75.4	N/A	986.7
06/0200	ELWX5	20.3	68.0	190/38	1006.9
06/0600	**Washington Senator**/DEAZ	29.7	77.3	020/37	1011.8
06/0600	**Liberty Star**/WCBP	23.1	72.5	270/40	1003.2

Hurricane Noel: The story of Noel is found above. A few ships besides the **Tellus** encountered the storm, and their reports are included in Table 6. There were no reports of damages or casualties from Noel.

Hurricane Olga: Olga originated from yet another non-tropical low over the central Atlantic. The low formed on 22 November, and by 24 November it had sufficiently organized convection to be classified a subtropical storm about 780 nmi east-southeast of Bermuda (Fig. 2). The storm moved northwestward to westward for a day or so as it acquired full tropical characteristics. It became a hurricane about 435 nmi east of Bermuda on 26 November. Olga made two loops from 26 to 28 November, during which time maximum winds reached 80 kt. It then moved southwestward, weakening to a tropical storm on 29 November and a depression on 30 November. Olga turned northwestward late on 1 December. It then turned north-northwestward and regained tropical storm strength on 2 November. The cyclone turned eastward on 3 November and again weakened to a depression the next day. It dissipated later that day about 600 nmi east of Nassau.

Olga's extratropical origin resulted in a large wind field which affected many ships. Selected observations are given in Table 7. The most significant reports were from the sailing yacht **Manana Tres** (call sign unknown), which indicated the system had formed a strong inner core, and from the **Liberty Sun** (WCOB), which passed near the center just before Olga became a hurricane.

The only known damage from Olga was to the **Manana Tres**, which reported "lots of damage." Swells generated by Olga affected portions of the U. S. east coast, the Bahamas, and the northeastern Caribbean islands.

2. Eastern Pacific

Hurricane Gil and Tropical Storm Henriette: These two storms developed almost simultaneously and eventually interacted with each other. Gil formed from an area of disturbed weather associated with the southern portion of the tropical wave which spawned Dean in the Atlantic. The disturbance moved westward across Central America

Table 6 - Selected ship or buoy reports with winds of at least 34 kt for Hurricane Noel, 4-6 November 2001.

Date/Time (UTC)	Ship name/ call sign/ buoy ID	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
04/0000	**Grafton**/ZCBO5	31.8	47.1	150/35	1005.5
06/0000	**Polar Argentina**/ ELRT2	36.5	49.4	260/37	1005.0
06/0900	P6038	46.4	48.4	120/35	1010.2
06/1200	Buoy 44145	46.7	48.7	140/46	1008.4

Table 7 - Selected ship reports with winds of at least 34 kt for Hurricane Olga, 24 November - 4 December, 2001.

Date/Time (UTC)	Ship name/ call sign/ buoy ID	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
24/0600	**Irving Primrose/** 8POI	34.2	52.2	040/45	1012.5
24/0900	**Manana Tres**	29.5	51.0		989.0
24/1200	**Liberty Sun**/WCOB	33.1	58.4	350/36	
24/1200	ELWZ7	26.3	54.2	320/43	1009.0
24/1200	**Dorothea Schulte/** LAPP4	32.6	49.1	070/39	1005.0
24/1200	**Irving Primrose/** 8POI	34.2	53.8	040/45	1013.5
25/0900	**Lykes Liberator/** WGXN	37.4	52.7	050/47	1013.5
25/1800	**Liberty Sun**/WCOB	30.8	56.1	360/55	990.0
25/2100	**Liberty Sun**/WCOB	30.1	55.8	340/38	983.5
26/0000	**Liberty Sun**/WCOB	29.7	55.5	270/31	981.4
26/0600	**Liberty Sun**/WCOB	30.1	54.5	275/45	990.0
26/0900	**Liberty Sun**/WCOB	30.4	53.9	170/29	993.0
26/1200	**Liberty Sun**/WCOB	30.7	53.4	160/38	995.0
26/1200	**Safmarine Infanta/** V7CN8	24.1	58.2	320/37	1004.0
26/1500	V7CR4	32.4	55.8	090/39	986.0
26/1800	V7CR4	32.6	56.3	090/39	985.5
29/1800	**Sabina**/HBEB	26.7	62.2	340/34	1001.2
29/1800	**City of Alberni**/8PNI	27.2	65.5	020/35	1008.0

on 24 August, but it did not become a tropical depression until 4 September when it was located about 850 nmi southwest of Cabo San Lucas, Mexico (Fig. 6). On the same day, early morning visible satellite images indicated that another circulation was organized enough to be classified as a tropical depression about 300 nmi west-southwest of Manzanillo, Mexico. This was about 765 nmi east of Gil. Gil reached hurricane intensity with maximum winds of 85 kt on 6 September, while Henriette strengthened to a peak of 55 kt on 7 September. Initially, Gil moved westward but Henriette moved faster and passed to the north of Gil. The two cyclones began to rotate around each other on 7 September. Henriette became absorbed by the circulation of Gil and dissipated on 8 September. However, its remnant disturbance made a counterclockwise loop of Gil over the ensuing 24 hours. Gil's circulation persisted a little bit longer but gradually weakened and dissipated on 9 September about 1150 miles east of the Hawaiian Islands.

The combination of Gil and Henriette created a large area of southwesterly and southerly winds to the east and southeast of the cyclones. The ship **Pacific Highway** reported 40 kt winds and 22 ft seas at 0000 UTC 7 September in this flow while about 205 nmi southeast of the center of Gil.

Tropical Storm Ivo: Ivo first formed about 100 nmi south-southwest of Acapulco on 10 September (Fig. 6). It moved slowly west-northwestward through its lifetime with its circulation hugging the coast. The cyclone became a tropical storm on 11 Septemberand reached a peak intensity of 45 kt on 12 September. It then weakened to a depression on 14 September and dissipated the next day about 300 nmi west of Baja California.

The ship **ZDEB2** (name unknown) reported 37 kt winds at 0600 UTC 12 September, which was the basis for upgrading Ivo to a tropical storm. Although tropical-storm force winds occurred along portions of the coast of Mexico, there were no reports of damages or casualties.

Hurricane Juliette: This large and powerful hurricane was the only eastern Pacific cyclone to make landfall during 2001. Juliette formed from the remnants of Atlantic Tropical Depression Nine, which entered the Pacific on 20 September. The system organized into a depression about 90 nmi south of the coast of Guatemala on 21 September and reached tropical storm strength later that

day (Fig. 6). Juliette moved west-northwestward about 100-200 nmi from the coast of Mexico from 21 to 26 September. It became a hurricane on 23 September and reached a peak intensity of 125 kt on 25 September (Fig. 7). On that date, an Air Force Reserve Hurricane Hunter aircraft measured a central pressure of 923 hPa, the second lowest measured pressure of record in the eastern Pacific. Juliette turned northward and began to weaken on 26 September. It passed just west of Cabo San Lucas as a hurricane with 80 kt winds on 28 September and made landfall on the Baja California peninsula near San Carlos as a tropical storm with 35-kt winds on 30 September. Juliette continued slowly northward as a depression into the Gulf of California and eventually dissipated over the northern portion of the Gulf on 3 October.

The large circulation of Juliette affected several ships. Selected significant observations are shown in Table 8. The most significant observation was from the **Zim Atlantic** (4XFD), which reported 55-kt winds at 0600 UTC 28 September.

Table 8 - Selected ship reports with winds of at least 34 kt for Hurricane Juliette, 23-28 September 2001.

Date/Time (UTC)	Ship name/ call sign/ buoy ID	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
24/0000	**Nedlloyd Raleigh Bay**/PHKG	12.9	108.6	280/39	1007.0
24/0000	**Palmsatr Rose**/ C6JM8	12.7	103.9	270/40	1009.0
26/0000	**Ever Devote**/3FIF8	19.0	104.5	110/40	1007.5
26/0000	**Sealand Comet**/ V7AP3	11.5	107.0	210/34	1005.7
26/1200	CY414	11.4	111.9	240/36	1008.0
26/1200	**Sealand Comet**/ V7AP3	12.5	110.9	220/45	1007.0
27/0600	**Sirius Leader**/H3KF	17.0	110.9	240/36	1005.0
28/0000	**Providence Bay**/ MSTM6	22.9	111.5	030/45	988.3
28/0000	**Zim Atlantic**/4XFD	23.2	111.3	040/53	993.0
28/0600	**Zim Atlantic**/4XFD	22.7	112.7	320/55	997.0
29/1800	**Chiquita Frances**/ ZCBD9	19.9	112.7	270/37	1007.6

On shore, Cabo San Lucas reported sustained winds of 76 kt with a gust to 94 kt at 0000 UTC 30 September. Two deaths are attributed to Juliette: a fisherman near Acapulco whose boat capsized in high seas, and a surfer who drowned near the Baja California coast. According to Mexican news agency reports, Juliette "clobbered' the resort of Cabo San Lucas, isolating it for several days. Flooding in the state of Sonora drove more than 38,000 people from their homes. Moisture from Juliette produced thunderstorms in southern California on 30 September, knocking down trees and power lines across the Coachella Valley.

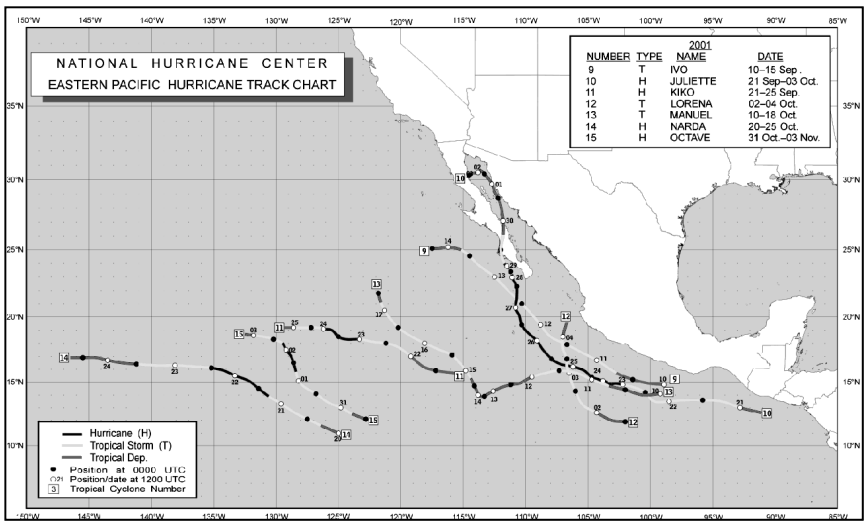

Figure 6 - Eastern North Pacific tropical storms and hurricanes of 2001.

Hurricane Kiko: A portion of the tropical wave that spawned Atlantic Hurricane Felix likely spawned Kiko. The cyclone formed on 21 September about 550 nmi southwest of Cabo San Lucas (Fig. 6). Moving generally west-northwestward to westward, the cyclone became a tropical storm later that day and briefly became a hurricane with 65-kt

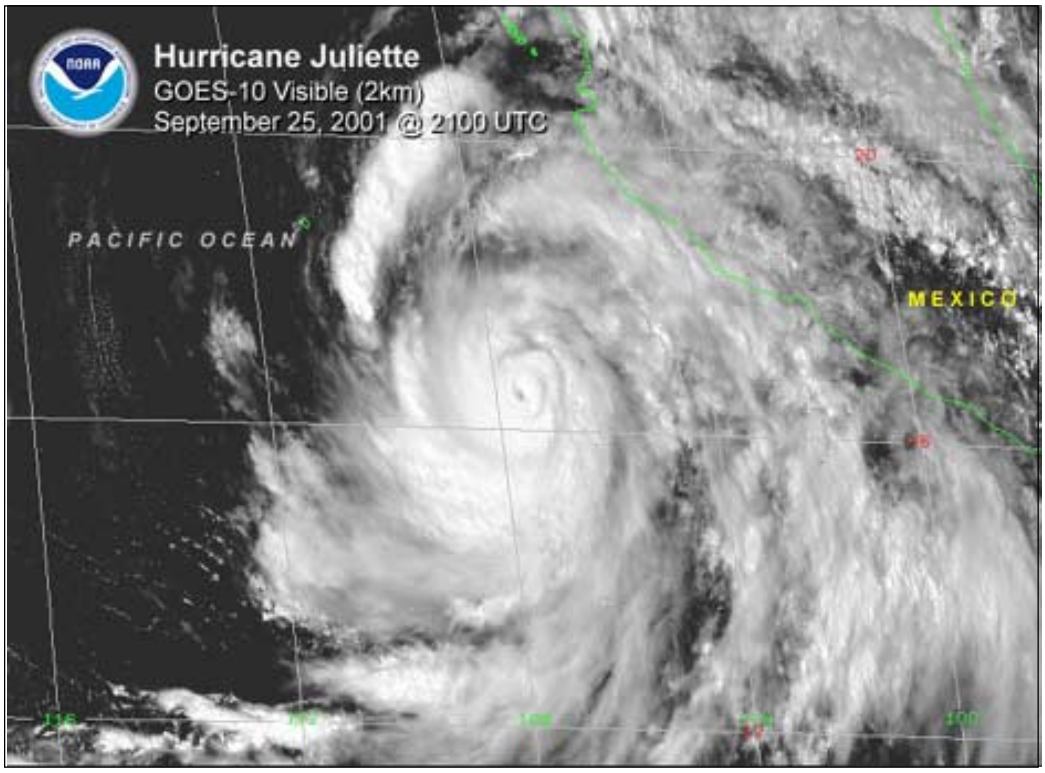

Figure 7 - GOES-10 visible image of Hurricane Juliette near peak intensity at 2100 UTC 25October 2001. Image courtesy of the National Climatic Data.

winds on 23 September. Kiko weakened to a depression on 25 September and degenerated into a low cloud swirl later that day near 19oN. 129oW. There were no reports of damages, casualties, or tropical-storm-force winds.

Tropical Storm Lorena: A tropical wave that crossed into the Pacific on 27 September organized into a tropical depression on 2 October about 300 nmi south of Acapulco, Mexico (Fig. 6). The cyclone moved west-northwestward and became Tropical Storm Lorena later that day. Lorena turned north-northwestward on 3 October as it reached a peak intensity of 50-kt winds. The storm appeared to be a threat to the coast of Mexico at that time; however, strong vertical shear caused rapid weakening, and Lorena became a weak low on 4 October about 120 nmi southwest of Puerto Vallarta, Mexico.

The ship **ELXX7** (name unknown) reported 35-kt winds at 1730 UTC 3 October, while an unidentified ship reported 35-kt winds a half-hour later. There were no reports of damages or casualties.

Tropical Depression Fourteen-E: This short-lived system formed on 3 October about 800 nmi southwest of Cabo San Lucas. Maximum winds reached 30 kt before the system dissipated the next day.

Tropical Storm Manuel: Manuel formed from the remnants of Atlantic Hurricane Iris. While Iris dissipated over Central America on 9 October, a new circulation center formed over the adjacent Pacific. This system became organized into a tropical depression on 10 October about 175 nmi south of Acapulco (Fig. 6). After becoming a tropical storm on 11 October, it moved westward to west-southwestward away from Mexico and weakened to a tropical depression on 12 October. Manuel then turned northwestward and regained tropical storm status on 15 October. It strengthened to its peak intensity of 50 kt on 16 October a little over 520 nmi south-southwest of Cabo San

Lucas. Weakening occurred thereafter, with Manuel becoming a depression again on 17October and dissipating about 660 nmi west-southwest of Cabo San Lucas the next day. There were no reports of damages, casualties, or tropical-storm force winds.

Hurricane Narda: Narda formed about 1150 nmi southwest of Cabo San Lucas on 20 October (Fig. 6). It became a tropical storm later that day and a hurricane with 75 kt winds on 22 October while moving west-northwestward. Narda then turned westward and weakened, becoming a tropical storm on 23 October and a depression on 24 October. Strong vertical wind shear caused the tropical cyclone to dissipate about 520 nmi east-southeast of the Hawaiian Islands on 25 October. There were no reports of damages, casualties, or tropical-storm-force winds.

Hurricane Octave: Octave developed from a large area of disturbed weather about 1000 nmi southwest of Cabo San Lucas on 31 October (Fig. 6). The west-northwestward moving cyclone became a tropical storm later that day and a hurricane on 1 November. Octave turned northwestward and reached a peak intensity of 75 kt on 2 November before weakening to a tropical storm later that day. On 3 November, the system turned westward and weakened to a depression, and it dissipated later that day about 1300 nmi west-southwest of Cabo San Lucas. There were no reports of damages, casualties, or tropical-storm-force winds.

B. Other Significant Events:

1. Atlantic, Caribbean and Gulf of Mexico

West Atlantic Gale 30 September: An early season cold front became stationary on 26 September from the western Atlantic across south central Florida to the Bay of Campeche. Winds increased late on 28 September across the Gulf of Mexico and western Atlantic as a low pressure center formed along the front just north of the Yucatan Peninsula. At 1200 UTC 29 September, a 1005 mb low was analyzed near the Dry Tortugas, Florida. The low moved northeastward across south Florida and by 0000 UTC 30 September was located just east of Palm Beach, Florida. It continued northeastward and produced a brief period of gales off the Georgia and north Florida coasts. The ship **A. V. Kastner** (ZCAM9) reported northeast winds of 35 kt at 0000 UTC 30 September. By 1200 UTC the low center was near 31°N. 70°W., and gales had moved north of 31°N. Since no QuikScat data were available due to the short duration of the event, the ship observations were extremely useful in determining the magnitude of the winds.

Northwest Caribbean Gale 29-31 October: A cold front that moved off the coast of Texas on 25 October reached the northwestern Caribbean on 27 October. The front moved slowly southeast across the Gulf on 26 October, and by 1200 UTC that day, a strong 1037 hPa high was located well northwest of the front over the central United States. Northeast winds increased to 20-25 kt across the northwest Caribbean behind the front. On 28 October, the front was stationary across the northwestern Caribbean while a broad low pressure area (the precursor of Hurricane Michelle) strengthened over the southwestern Caribbean Sea. By 1200 UTC on 29 October, winds increased to gale force from 16°N. to 20°N. between 78°W and 85°W. At that time the ship **Chiquita Schweiz** (C6KD9) reported 34-kt winds and 4-m (13-ft) seas near 18°N. 80°W. Later that day the broad low became a tropical depression (Fig. 2). Gale-force winds were associated with the stationary front located well north of the depression. QuikScat data from just before 0000 UTC 30 October indicated a large area of 30-40 kt winds over the northern Caribbean. The area of gale-force winds spread northeastward, and by 1200 UTC on 30 October covered the entire Caribbean north of 18°N. At that time **Chiquita Schweiz** again observed gale force winds of 40 kt near the Windward Passage. By 1200 UTC 31 October, the high pressure over the eastern United States began to weaken and move northeastward. This weakened the pressure gradient over the northwestern Caribbean and winds decreased below gale force.

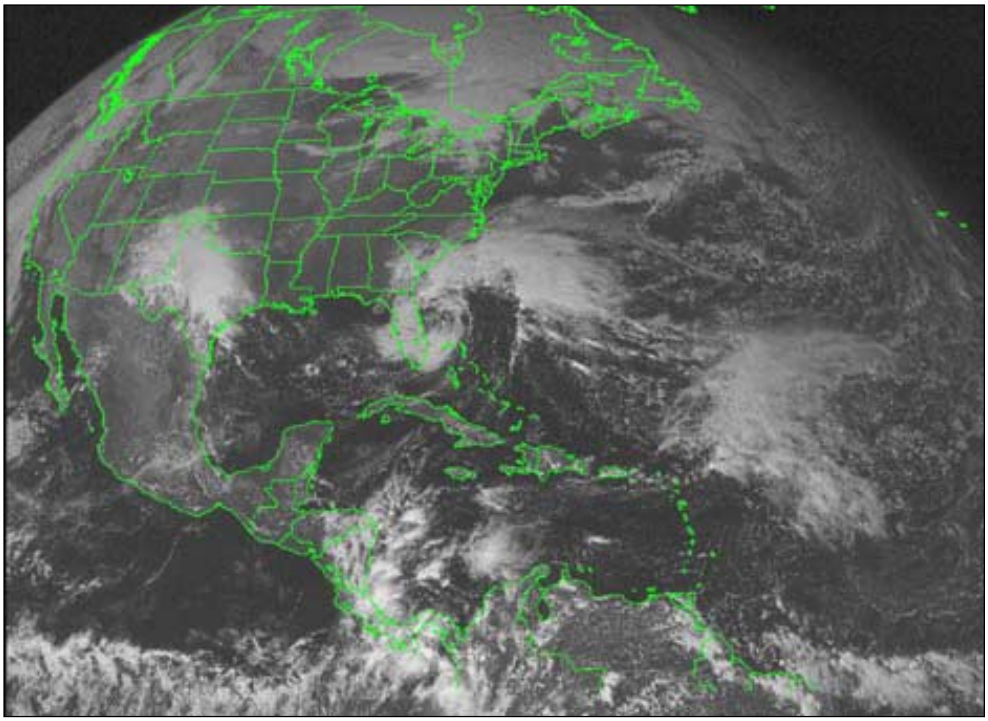

Figure 8 - GOES-8 visible image of western Atlantic gale at 1815 UTC 15 November 2001. Image courtesy of the National Climatic Data Center.

However, winds in that area soon increased with the approach of Michelle.

Central Atlantic Gale 3-4 November: This event was associated with the low that eventually became Hurricane Noel. As the low intensified just north of the TPC high seas forecast area on 2 November, the winds increased to gale force over the area north of 29°N. between 45°W. and 55°W. At 0600 UTC that day the ship **Chiquita Schweiz** again encountered gale force winds of 36 kt near 29°N. 53°W. This helped confirm QuikScat data a short time later. By 1800 UTC that day, the low had strengthened into a storm center near 33°N.44°W. At that time the ships **Chiquita Schweiz, Endurance** (WAUU), and **Grafton** (ZCBO5) observed northeast winds of 35 to 40 kt near 30°N. 50°W. The storm center moved northwestward on 3 November. A QuikScat pass from 2108 UTC that day detected 30-35-kt winds north of 30°N. between 48°W. and 57°W. Gales ended south of 31°N by 1800 UTC on 4 November as the system turned northward.

West Atlantic Gale: 15-16 November: A weakening stationary front extended east to west across the western Atlantic, while a strong high pressure center located along the mid-Atlantic coast produced strong northeast to east winds north of the front. A low started forming on the western end of the front late on 14 November just east of central Florida. The low quickly strengthened and became a 1006 hPa gale center near 28°N. 80°W. at 0600 UTC on 15 November. At 0600 UTC, the **Tellus** and the **Kent Sprint** (VGDX) observed 40-kt winds off the north Florida and Georgia coasts. The ship observations confirmed a 1023 UTC QuikScat pass which showed an area of 30-40-kt easterly winds from 30°N. to 33°N. west of 72°W. At 1200 UTC, the ship **Lykes Discoverer** (WGXO) encountered northeast winds of 37 kt, while an unidentified ship reported 40-kt winds near 31°N. 78.5°W. GOES-8 visible satellite imagery at 1815 UTC 15 November (Fig. 8) showed the well-defined low just off the east-central Florida coast. The gale center drifted northeastward and

weakened while the high pressure center off the mid-Atlantic coast moved east into the central Atlantic. By 0600 UTC on 16 November, gale conditions ended south of 31°N. but continued over the Marine Prediction Center's area north of 31°N. At 1800 UTC, the gale center weakened to a low near 29°N. 76°W., which eventually dissipated northeast of Puerto Rico on 21 November.

Gulf of Mexico Cold Front 29-30 November: A slow-moving cold front moved off the coast of southeast Texas around 0000 UTC 28 November. Early on 29 November, the front accelerated southeastward as stronger high pressure moved southward across the central United States. By 0600 UTC, the front extended from just east of Lake Charles, Louisiana to the southwestern Bay of Campeche. At that time northwesterly gale force winds began over the southwest Gulf of Mexico in the area south of 25°N. west of the cold front. The ship **Koeln Express** (9VBL) observed 37-kt winds at 1200 UTC and 33-kt winds at 1800 UTC in the southwest Bay of Campeche. The short-lived gale event ended at 0000 UTC 30 November.

Central and East Atlantic Gales 17-18 December and 23-26 December: A predominant longwave trough was over the central and east Atlantic during the later half of December. Several fast-moving cold fronts and gale centers moved southeastward, then eastward just

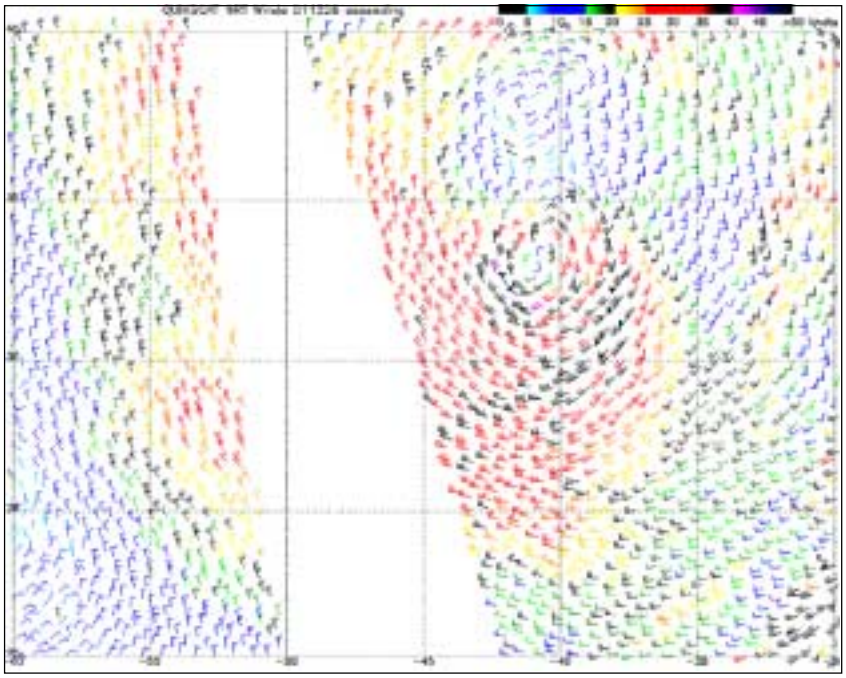

Figure 9 - QuikSCAT data at 0755 UTC 26 December 2001. Image courtesy of the National Environmental Satellite, Data, and Information Service.

north of 31°N., producing periods of gale force winds over the eastern portion of the TPC forecast area. Gales associated with the first system began at 0600 UTC 17 December. Gale conditions and seas of 4.5 to 6 m (15-20 ft) occurred over the TPC forecast area north of 29°N. east of 50°W. At 0600 UTC and 1200 UTC 17 December the ship **Chiquita Nederland** (C6KD6) encountered west to northwest 35 to 40-kt winds near 30°N. 45°W. A day later the ship **Coral Reef** (C6RO6) and the ship **C6RO2** (name unknown) experienced westerly gale force winds of 35-40 kt near 30°N. 45°W. at 0600 UTC and 1200 UTC. By 0000 UTC 19 December, gale conditions ended south of 31°N.; however, swells of 3.5-5.5 m (12-18 ft) continued north of 25°N. east of 55°W. through the rest of that day.

The next cold front began producing gales along 31°N. shortly before 1200 UTC 23 December. At that time this fast-moving front extend through 31°N. 42°W. - 21°N. 55°W. to near Puerto Rico. QuikScat data at 2134 UTC that day showed a large area of 30 to35-kt winds north of 29°N. between 45°W. and 55°W. On 24 December at 0000 UTC, the ship **Licorne Pacifique** (J8CV5) reported northwest winds of 35 kt near 29°N. 53°W. By 0000 UTC on 25 December, the cold front reached from 31°N. 31°W. -19°N. 40°W. to near 15°N. 58°W. At that time gale conditions covered the area

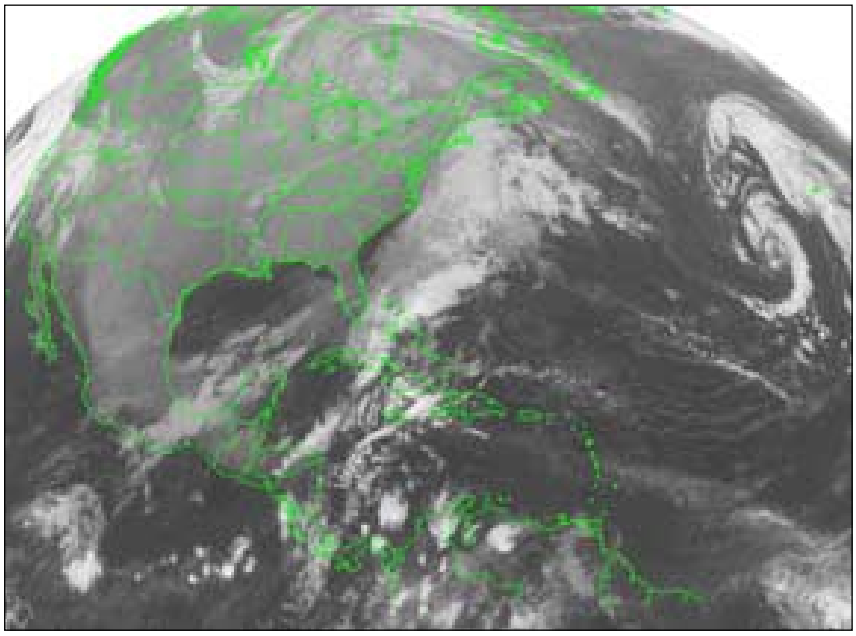

Figure 10 - GOES-8 visible image of eastern Atlantic gale at 1215 UTC 26 December 2001. Image courtesy of the National Climatic Data Center.

north of 27°N. east of 53°W. On 25-26 December a fast-moving storm center moved southeastward and then eastward just north of 31°N. This caused winds to increase 30-40 kt over the TPC forecast area. At 0600 UTC on the 26th, the 988-hPa storm was centered near 33°N. 42°W. At that time the ship **Chiquita Rostock** (ZCBD2) experienced west winds of 40 kt near 29°N. 42°W. QuikScat detected 40 to 50 kt winds just southwest of the storm center and 30 to 40-kt winds south of 31°N. at 0755 UTC that day (Fig. 9). GOES-8 satellite imagery at 1215 UTC 26 December (Fig. 10) clearly detected the well-defined storm. By 0000 UTC on 27 December, the storm weakened and moved northeastward away from the TPC forecast area, and gale conditions moved north of 31°N. However, northwest winds of 25-30 kt and seas of 3.5-5.5 m (12-18 ft) continued north of 25°N. east of 50°W. until 28 December.

2. Eastern Pacific

Six Gulf of Tehuantepec gale events occurred during the period beginning in the middle of October, with the estimated beginning and ending times given in Table 9. These events were documented by QuikScat data or occasionally by reliable ship observations.

The first event occurred between 17-19 October. A strong cold front moved southeastward across the Gulf of Mexico on the 16-17 October, and a 1030 hPa high pressure center moved southward to eastern Texas by 0600 UTC on the 17th. At that time gales began over the Gulf of Tehuantepec. There were no ship observations of gale force winds during the event; however, QuikScat data detected 30 to35-kt winds during the event, which ended at 1200 UTC 19 October.

The second event, beginning at 0600 UTC 28 October, was more prolonged. Two ships reported gale force winds - the **Chiquita Joy** (ZCBC2), which observed north winds of 37 kt at 1800 UTC 28 October and 38 kt at 0000 UTC 29 October, and the **Marine Chemist** (KMCB), which reported 35-kt winds at 0000 UTC on 29 October. Several QuikScat passes during the event showed gales with winds as high as 40 kt at 1232 UTC on 29 October. Subsequent QuikScat passes on 30-31 October showed 30-35 kt winds. The event ended at 1200 UTC 1 November.

The next event began just before 1200 UTC 5 November and was observed by several ships. The ship **Tristan** (SKWI) encountered winds of 37 kt and 38 kt at 1200 and 1800 UTC, respectively. Other ships including the **Saloma** (VRVT2), **Leverkusen Express** (DEHY), **Overseas New Orleans** (WFKW), and the ship **30111** (name unknown) observed winds of 35-40 kt between 1800 UTC on 5 November and 1800 UTC on 6 November. It is unusual to receive so many ships'

Table 9 - Gulf of Tehuantepec Gale Events (October - December 2001).

Event	Beginning	End
1	0600 UTC 17 October	1200 UTC 19 October
2	0600 UTC 28 October	1200 UTC 1 November
3	1030 UTC 5 November	1800 UTC 7 November
4	2230 UTC 10 November	0600 UTC 12 November
5	0000 UTC 10 December	0000 UTC 11 December
6	1030 UTC 20 December	1030 UTC 22 December

observations of gale force winds during a single Tehuantepec event. These observations were very useful, as QuikScat data only detected 30 to35-kt winds. The event ended at 1800 UTC 7 November.

The fourth event began a few days later, just before 0000 UTC 10 November. During the event there were no ship observations of gale force winds; however the ship **Zim Asia** (4XFB) observed 32-kt winds at 0600 UTC on 11 November. Another ship, the **Bosporus Bridge** (3FMV3), encountered 33-kt winds well south of the Gulf of Tehuantepec six hours later. Therefore, it is likely that gale-force winds occurred over the Gulf of Tehuantepec. Winds decreased below gale force at 0600 UTC 12 November.

The next event lasted only 24 hours. Gales began just before 0000 UTC 10 December. High-resolution QuikScat data indicated 35 to 40-kt winds near that time; however, no ship observations of gales were received. The event ended by 0000 UTC 11 December.

The sixth event of the period began just before 1200 UTC 20 December. QuikScat data from 1208 UTC 20 December indicated 35-kt winds over the Gulf. Two subsequent QuikScat passes near 0000 UTC and 1200 UTC on 21 December showed winds of 35-40 kt.

There were no ship observations of gale-force winds during the event, but the ship **Pearl Ace** (VRUN4) observed 30-kt winds at 0600 UTC on 22 December. Gale conditions ended shortly before 1200 UTC that day. ⚓