APPENDIX III

RSMC MIAMI 2002 ATLANTIC AND EASTERN NORTH PACIFIC HURRICANE SEASON SUMMARY

ATLANTIC

There were twelve named tropical cyclones in the Atlantic basin in 2002, of which four became hurricanes. Two of these became major hurricanes – Category Three or higher on the Saffir-Simpson Hurricane Scale (111 m.p.h. or higher). Even though the number of named storms in 2002 was above the long-term average (ten), the number of hurricanes was below average (long-term average is six). Another measure of seasonal activity, the "accumulated cyclone energy", which is the sum of the squares of the maximum wind speeds every six hours, also indicates below normal activity, because there were many weak and short-lived tropical cyclones in 2002. There were also two tropical depressions that did not become storms.

Eight named tropical cyclones formed in September, making it the busiest calendar month on record in the Atlantic. It is interesting that the first 2002 Atlantic hurricane did not develop until September 11th, the latest date for such an occurrence since the beginning of the reconnaissance aircraft era, 1944.

Eight tropical cyclones made direct hits in the United States. Lili was the first U.S. hurricane landfall since Irene in 1999. Tropical cyclones caused 18 deaths overall. Total damage in the United States was about 1.2 billion dollars, mostly from Lili and Isidore. There was extensive damage from Isidore in western Cuba and Mexico's Yucatan Peninsula. Just eleven days after Isidore hit extreme western Cuba, Lili struck the same area and produced even greater destruction. Lili also caused extensive flood damage in Jamaica.

Tropical Storm Arthur originated along a frontal trough in the eastern Gulf of Mexico on July 9th. The developing system spread heavy rain across portions of north Florida, Georgia, and South Carolina, before becoming a tropical depression near the North Carolina coast on the 14th. Arthur accelerated northeastward and reached its highest intensity of 60 m.p.h. on the 16th while centered about 400 miles south of Nova Scotia. Arthur moved over eastern Newfoundland on the next day as it became extratropical, producing gale force winds and about one inch of rain there.

Tropical Storm Bertha also formed along a frontal trough in the Gulf of Mexico, just east of the mouth of the Mississippi River on August 4th. The cyclone quickly became a tropical storm and moved west-northwestward over southeastern Louisiana by early on the 5th with 40-m.p.h. sustained winds. After weakening to a depression, Bertha's center moved southwestward, back over the Gulf of Mexico, and then moved inland over south Texas on the 9th. Rainfall totaled 5 to 10 inches over portions of Louisiana and Mississippi and Bertha caused one death, a drowning in high surf in the Florida panhandle near Perdido Key State Park.

Tropical Storm Cristobal formed about 175 miles off the coast of South Carolina on August 5th, within the same trough that produced Bertha. Winds reached a maximum of 50 m.p.h. while the tropical storm meandered southward and eastward for a few days. Cristobal was absorbed into a frontal zone and quickly dissipated on the 9th.

Tropical Storm Dolly was the first storm of the season to originate from a tropical wave, becoming a tropical cyclone on August 29th at a low latitude in the far eastern Atlantic Ocean.

Initially moving west-northwestward, Dolly gradually turned northward over the next five days as it moved into a weakness in the Atlantic subtropical high pressure ridge. Winds reached 60 m.p.h. on the 30th. However, strong shear weakened the system to a remnant low on the 4th several hundred miles northeast of the Leeward Islands.

Tropical Storm Edouard formed on September 1 from a non-tropical disturbance about 140 miles east of Daytona Beach Florida. The system made a clockwise loop off the northeast Florida coast, and then headed toward Florida. Edouard attained a peak intensity of 65 m.p.h. for a short time on the 3rd, but strong upper-level winds quickly caused weakening. The cyclone was barely of tropical storm intensity when it made landfall near Ormond Beach, Florida on the evening of September 4. It crossed north-central Florida as a weak depression and then dissipated over the northeastern Gulf of Mexico on the 6th, when its remnants were entrained into the large circulation of Tropical Storm Fay centered off the Texas coast. Edouard caused some flooding due to locally heavy rains over north-central Florida. There are no reported casualties and damage is believed to be minor.

Tropical Storm Fay had its origins in a broad low pressure system over the western Gulf of Mexico. Reports from an Air Force Hurricane Hunter aircraft investigating the area on September 5th suggested that a tropical depression had developed about 110 miles southeast of Galveston, Texas. The depression quickly strengthened into a tropical storm, and Fay reached its peak intensity of 60 m.p.h. on the 6th. After moving slowly and erratically, Fay headed toward the Texas coast. The storm made landfall on the morning of the 7th near Port O'Connor with 60-m.p.h. winds. After landfall, Fay weakened to a remnant low that meandered across southern Texas and northeastern Mexico for several days, producing copious rains until the low finally dissipated late on the 10th near Monterrey, Mexico. There were no reports of casualties or estimates of damage.

Hurricane Gustav initially formed as a subtropical depression on September 8th about 550 miles south-southeast of Cape Hatteras, North Carolina. The cyclone moved northwestward and soon became a subtropical storm. Gustav turned northward and made the transition to a tropical storm before the center passed just east of Cape Hatteras on the 10th. It then turned northeastward into the Atlantic and strengthened into the first hurricane of the season. Maximum winds reached 100 m.p.h. before Gustav made landfall in eastern Nova Scotia as a hurricane with 90 m.p.h. winds early on the 12th. The system became extratropical later that day near western Newfoundland. The Cape Hatteras Coast Guard station reported a wind gust of 78 m.p.h., and wind gusts to hurricane force were also reported in Nova Scotia. There was one death directly attributed to Gustav: a swimmer at Myrtle Beach, South Carolina suffered injuries from high surf and died two days later. Damage in North Carolina is estimated at about $100,000. In Nova Scotia, some docks were damaged and trees were blown down.

Tropical Storm Hanna formed in the Gulf of Mexico from the interaction of a tropical wave, an upper-level low, and a surface trough. Air Force reconnaissance aircraft observations indicate that a tropical depression developed late on September 11 about 290 miles south of Pensacola, Florida. The system became a tropical storm early on the next day. After moving slowly and erratically for a couple of days, Hanna turned northward toward the northern Gulf coast, ahead of an approaching mid-level trough. With maximum winds near 60 m.p.h., the storm center passed over the southeastern tip of Louisiana early on the 14th and made a second landfall near the Alabama-Mississippi border later that morning. Hanna dissipated near the Georgia-Alabama border on the 15th, but its remnants produced heavy rains across Georgia and the

Carolinas. Sustained winds of 54 m.p.h. were recorded at Pensacola and a gust to 68 m.p.h. was measured at Pensacola Beach. There were numerous reports across the southeastern states of storm-total rainfall accumulations of between 5 and 10 inches. The highest reported storm total, 15.56 inches, was from Donalsonville, Georgia. Three deaths in the Florida panhandle are attributed to rip currents generated by Hanna. The total damage, mainly agricultural losses, is estimated at $20 million.

Hurricane Isidore developed from a tropical wave to a tropical depression just east of Trinidad on September 14th, but degenerated back to a wave over the eastern Caribbean Sea on the next day. The system again became a depression to the south of Jamaica on the 17th and strengthened into a tropical storm early on the 18th. Isidore just missed Jamaica, then moved west-northwestward across the Cayman Islands, and strengthened into a hurricane. Its maximum winds reached 105 m.p.h. while it passed near the Isle of Youth, Cuba, and Isidore hit the western tip of mainland Cuba with 85 m.p.h. winds on the 20th. After departing Cuba, the hurricane moved over the Gulf of Mexico, and strengthened to 125 m.p.h. while Isidore headed toward the Yucatan Peninsula. The eye of the hurricane made landfall near Puerto Telchac on the north coast of Yucatan on the 22nd . For 24 to 36 hours, Isidore meandered over northern Yucatan and weakened. It then moved northward over the Gulf of Mexico and made landfall early on the 26th, just west of Grand Isle, Louisiana, with maximum winds near 65 m.p.h. Weakening over land, Isidore moved across the southeastern states, producing torrential rains. Isidore became an extratropical cyclone over Pennsylvania on the 27th, and was then absorbed into a frontal zone.

Isidore caused four deaths. One was a rip current drowning in Louisiana, another was a storm surge drowning in Mississippi, a third was caused by a tree falling on a car in eastern Mississippi, and a fourth death resulted from a car being driven into 10 feet of water in Clarksville, Tennessee. Very heavy rains caused damage in Jamaica. Isidore caused major damage to the Yucatan Peninsula and western Cuba. In the United States, the total damage due to Isidore is estimated to be $330 million, mainly in Louisiana.

Tropical Storm Josephine formed along a decaying frontal zone several hundred miles east of Bermuda on September 17. The tropical cyclone moved slowly north-northwestward to northward for about a day and strengthened to a tropical storm very early on the 18th. Soon thereafter, Josephine accelerated northeastward in the flow ahead of a deep-layer mid-latitude trough. The system lost its tropical characteristics and merged with a larger extratropical low and frontal system on the 19th.

Hurricane Kyle had a life span of 22 days, the third longest on record for an Atlantic tropical cyclone, exceeded only by Ginger of 1971 and Inga of 1969. It developed from a non-tropical low about 820 miles east-southeast of Bermuda on September 20th. Kyle moved erratically, but generally westward until October 11th, when the storm turned northward and northeastward and made landfall on the South Carolina and North Carolina coasts with winds to 45 m.p.h. Associated tornadoes caused over $2 million dollars damage in North Carolina. Kyle merged with a cold front the next day. During its long track, Kyle strengthened (or re-strengthened) to a tropical storm on four different occasions, and it became a hurricane over open water, from September 25th to 28th, with winds reaching 85 mph.

Hurricane Lili's track began on September 21st, when a depression formed in the central tropical Atlantic. Lili swept across the Windward Islands on the 23rd as a developing tropical storm and left four dead in St. Vincent from mud slides. Weakening back to an open wave in the central Caribbean Sea, Lili again became a tropical storm on the 27th. The storm took a slow jog around the north coast of Jamaica from the 28th to 30th and dumped heavy rains there, and to a lesser extent, over southern Haiti and eastern Cuba. Lili hit western Cuba on October 1st with winds to 105 m.p.h..

Lili moved to the central Gulf of Mexico where winds quickly strengthened to 145 m.p.h, Category Four intensity on the Saffir-Simpson Hurricane Scale. But the wind speed decreased almost as fast as it had increased. Lili made landfall with sustained winds of 90 m.p.h. on the coast of Louisiana to the south of Intracoastal City on the 3rd. Weakening over land, Lili merged with an extratropical low over the east-central United States on the 4th.

In addition to four deaths in the Windward Islands, four also died in Jamaica, where flood waters swept them away. Flood damage in Jamaica was compounded by earlier heavy rain from Hurricane Isidore. There were news reports of wind damage at Cayman Brac in the northeastern Cayman Islands. Lili cut a swath of destruction across extreme western Cuba. There was a death in the province of Pinar del Rio. In Louisiana, there was a trail of muck and misery from widespread wind and flood damage. The total U.S. property damage estimate is 860 million dollars.

Lili's eyewall passed over NOAA data buoy 42001 in the central Gulf of Mexico on October 2nd. The buoy measured a ten-minute mean wind speed of 113 m.p.h., which is the highest sustained wind speed ever recorded by a NOAA buoy.

2002 Atlantic Tropical Storms and Hurricanes

Name	***Class****	***Dates****	***Max. winds (m.p.h)***	***Min. pressure (mb)***	***Direct deaths***	***U.S. damage ($ millions)***
Arthur	*Tropical Storm*	*July 14-16*	*60*	*997*		
Bertha	*Tropical Storm*	*Aug. 4-9*	*40*	*1007*	*1*	
Cristobal	*Tropical Storm*	*Aug. 5-8*	*50*	*999*		
Dolly	*Tropical Storm*	*Aug. 29-Sep. 4*	*60*	*997*		
Edouard	*Tropical Storm*	*Sep. 1-6*	*65*	*1002*		
Fay	*Tropical Storm*	*Sep. 5-8*	*60*	*998*		
Gustav	*Hurricane*	*Sep. 8-12*	*100*	*960*	*1*	*0.1*
Hanna	*Tropical Storm*	*Sep. 12-15*	*60*	*1001*	*3*	*20*
Isidore	*Hurricane*	*Sep. 14-27*	*125*	*934*	*4*	*330*
Josephine	*Tropical Storm*	*Sep. 17-19*	*40*	*1009*		
Kyle	*Hurricane*	*Sep.20-Oct. 12*	*85*	*980*		*2.5*
Lili	*Hurricane*	*Sep. 21-Oct 4*	*145*	*938*	*9*	*860*

***** Tropical Storm: wind speed of 39-73 m.p.h. Hurricane: wind speed of 74 m.p.h or higher.***
*****Dates begin at 0000 UTC and include tropical depression stage(wind speed less than 39 m.p.h)***

EASTERN NORTH PACIFIC

Tropical cyclone activity in the eastern North Pacific hurricane basin was below average in the year 2002. There were twelve cyclones of at least tropical storm strength, and of these, six became hurricanes. In an average season, there are fifteen named storms and nine hurricanes. Although the total of six hurricanes was below normal, there were five Amajor@ hurricanes, one above the long-term average of four (a major hurricane has maximum 1-min average winds greater than 110 m.p.h., corresponding to category three or higher on the Saffir-Simpson Hurricane Scale). Overall activity was fairly evenly distributed over the nominal 15 May - 30 November season, with tropical cyclones forming in each month. Kenna was the strongest hurricane of the season, with 165 m.p.h. peak winds. In addition to the twelve named tropical cyclones in 2002, there were four depressions that did not reach tropical storm strength.

Eastern North Pacific tropical cyclones were directly responsible for 4 deaths in 2002; these resulted from Hurricane Kenna, which made landfall north of Puerto Vallarta Mexico near San Blas in late October. Tropical Storm Julio also made landfall in Mexico, and rains from Tropical Storm Boris caused damage even though the center of Boris remained offshore.

In the individual cyclone summaries below, all dates and times are based on Universal Coordinated Time (UTC).

Hurricane Alma

Alma originated from a tropical wave that moved across the west coast of Africa on 8 May. The system developed into a tropical depression on 24 May about 560 miles south-southeast of Manzanillo, Mexico. The depression moved slowly westward and strengthened into a tropical storm two days later. Alma turned west-northwestward and intensified, becoming a hurricane on 28 May about 785 miles southwest of Manzanillo. Alma began moving northwestward around the western periphery of a subtropical ridge centered over Mexico. Steady intensification continued for the next two days as the hurricane turned northward, and Alma reached its peak intensity of 115 m.p.h. on 30 May. Alma then began to weaken as it started moving over cooler water and encountered southwesterly wind shear. The cyclone weakened to a tropical storm on 31 May and stalled as its deep convection diminished. The cyclone weakened to a depression and then dissipated on 1 June about 520 miles southwest of Cabo San Lucas.

Tropical Storm Boris

Boris developed from the interaction of an Atlantic tropical wave with a broad and persistent eastern North Pacific disturbance southwest of Acapulco, Mexico. The system became a tropical depression on 8 June about 175 miles west-southwest of Acapulco. The depression reached tropical storm status, as well as its peak intensity of 60 m.p.h., on the following day. Boris moved little on 9 June and began to weaken. On 10 June, Boris drifted to the northeast and then east, and weakened back to a depression when it was located about 115 miles south-southeast of Manzanillo. Boris degenerated to a non-convective remnant low on 11 June. The remnant low then moved southeastward and dissipated the following day.

The National Meteorological Service of Mexico reported maximum storm total rains of 6.43 inches in Michoacan and 5.13 inches in Jalisco. There were media reports that several homes in unspecified locations along the Mexican coast were damaged due to heavy rains from Boris. There are no known reports of casualties.

Tropical Storm Cristina

Cristina originated from an area of disturbed weather that was first identified near Panama on 6 July. The system became a tropical depression on the morning of 9 July about 345 miles south of Acapulco, and after becoming a depression, moved just north of due west for the next three days. Despite a hostile environment, the depression strengthened to a tropical storm on 12 July. Cristina began to turn toward the north-northwest and slowly strengthened, reaching its peak intensity of 65 m.p.h. on 14 July. Shortly thereafter, Cristina weakened and turned to the west-northwest. By 16 July, Cristina had degenerated to a non-convective remnant low moving westward over colder water about 865 miles west-southwest of Cabo San Lucas.

Hurricane Douglas

The tropical depression that became Douglas formed about 460 miles south of Manzanillo on 20 July and became a tropical storm later that day. After moving in a generally northwestward direction, Douglas turned toward the west late on 21 July and strengthened into a hurricane. It reached its peak intensity of 105 m.p.h. on 22 July while located about 750 miles south-southeast of Cabo San Lucas. Douglas moved west-northwestward and gradually weakened over the next two days. Douglas degenerated into a remnant low about 1180 miles east of Hawaii on 26 July.

Hurricane Elida

Elida was the first category 5 hurricane of the season, forming from a tropical wave that moved westward across the coast of Africa on 13 July. A tropical depression formed from the wave on 23 July about 350 miles south-southeast of Puerto Escondido, Mexico. The cyclone strengthened very rapidly as it moved westward, becoming a tropical storm on 23 July and a hurricane less than 18 h after becoming a storm. Elida turned west-northwestward on 24 July while continuing to deepen rapidly, and reached its peak intensity of 160 m.p.h. on 25 July. The hurricane moved west-northwestward for the next two days, during which time the cyclone weakened back to a tropical storm. Elida weakened to a depression on 29 July, and then became a non-convective remnant low the next day. The low dissipated late on 31 July about 535 miles west of Los Angeles, California. While high swells from Elida likely affected portions of the coast of

Mexico, the high winds and heavy rains stayed well offshore, and there were no reports of damage or casualties.

Hurricane Fausto

The weather system that became Fausto could be tracked from Africa nearly to Alaska. Fausto developed from a tropical wave that crossed the west-African coast on 11 August. Ten days later the system became a tropical depression about 460 miles south-southwest of Manzanillo. The depression initially moved westward and strengthened, becoming a tropical storm on 22 August. Fausto turned to the west-northwest and steadily strengthened, becoming a hurricane later that day when it was about 650 miles south-southwest of Cabo San Lucas. Steady strengthening continued, with Fausto reaching its peak intensity of 145 m.p.h. on 24 August. By 25 August a weakening trend began, and Fausto became a tropical storm again the following day. Fausto=s large circulation was slow to spin down; winds did not fall below tropical storm strength until 28 August, shortly after Fausto crossed 140E W longitude and entered the central Pacific hurricane basin. Fausto became a remnant low later that day.

The remnant low continued on a westward track, passing about 495 miles north of the Hawaiian Islands on 30 August. During the day the surface circulation passed underneath an upper-level low and redeveloped deep convection, and with this redevelopment Fausto became a tropical depression again. Fausto moved to the west-northwest on 31 August, strengthened, and became a tropical storm on 1 September. The next day, Fausto turned north and accelerated ahead of a mid-latitude frontal system, becoming absorbed by an extratropical low early on 3 September about 690 miles south of the Aleutian Islands.

Tropical Storm Genevieve

A depression formed from a tropical wave on 26 August about 575 miles south of Cabo San Lucas, and became a tropical storm one day later. Genevieve was approaching hurricane strength on 28 August, with maximum winds of 70 m.p.h., when it turned to the northwest and passed over cooler waters. Genevieve degenerated to a non-convective remnant low about 1105 miles west-northwest of Cabo San Lucas on 1 September.

Hurricane Hernan

Hernan was the second of the season=s three category five hurricanes. Its development may have been related to a weak tropical wave that crossed the African coast on 16 August. The disturbance developed into a tropical depression on 30 August about 390 miles south-southeast of Manzanillo. Moving west-northwestward for five days and northwestward thereafter until dissipation, Hernan had an uncomplicated life cycle. After genesis, the cyclone strengthened steadily, with maximum winds reaching 160 m.p.h. on 1 September, an increase of 125 m.p.h. in 54 hours. This was followed by a steady decay stage. By 6 September Hernan degenerated to a remnant low about 900 miles west of Cabo San Lucas. The remnant low drifted southwestward until it dissipated on 9 September.

The center of Hernan passed about 105 miles to the south of Socorro Island on 1 September, when the intensity was near its maximum value. No reports were received from the island regarding conditions experienced there.

Tropical Storm Iselle

The tropical wave that spawned Iselle crossed the west coast of Africa on 31 August, and on 15 September the system became a tropical depression about 310 miles south of Manzanillo. The depression moved west-northwestward and strengthened into a tropical storm on 16 September. Iselle moved northwestward for the next 3 days and gradually strengthened, eventually reaching a peak intensity of 70 m.p.h. late on 17 September. Shortly thereafter, Iselle made a sharp turn to the northeast. Vertical wind shear increased and Iselle rapidly weakened, becoming a tropical depression on 19 September, when it was located about 90 miles southwest of Puerto Cortes, Mexico. Early on 20 September, Iselle degenerated into a non-convective low, and the circulation dissipated later that day.

A sustained wind of 45 m.p.h. was observed in Manzanillo late on 15 September. Iselle briefly produced locally heavy rainfall across the southern third of the Baja California peninsula on 19 September, but rainfall totals appeared to be generally less than 2 inches. There were no reports of damage or casualties.

Tropical Storm Julio

Tropical Storm Julio, one of two land-falling tropical cyclones in 2002, formed from a persistent area of monsoon-like disturbed weather near the west coast of Mexico. The system gradually became better organized and developed into a tropical depression on 25 September about 200 miles southwest of Acapulco. The depression moved northward and strengthened. It became a tropical storm near midday, then reached its maximum intensity of 45 m.p.h. prior to landfall on the Mexican coast just west-northwest of Lazaro Cardenas early on 26 September. A subsequent northwestward motion took the center over the mountains of southwestern Mexico, where the system dissipated north of Manzanillo.

A sustained wind of 40 m.p.h., with a gust to 50 m.p.h., was observed in Zihuatanejo. Julio caused locally heavy rains and gusty winds over portions of the southern coast of Mexico, and there were media reports of damage to homes from flash flooding. There were no reports of casualties.

Hurricane Kenna

Kenna developed from a disturbance that moved westward across Central America and entered the eastern North Pacific basin on 19 October. The system became a tropical depression on 22 October about 375 miles south of Acapulco, moved westward, and quickly reached tropical storm strength. Kenna became a hurricane about 460 miles south of Cabo Corrientes, Mexico, late on 23 October. Kenna continued to strengthen the next day, while its heading turned to the northwest and then north late in the day as its forward speed slowed. Late on 24 October, roughly 24 hours after reaching hurricane strength, reports from a reconnaissance aircraft indicated that Kenna=s winds had reached 160 m.p.h. and its minimum pressure had fallen to 917 mb.

The flow ahead of a large mid- to upper-level trough west of Baja California turned Kenna to the northeast beginning late on 24 October. As Kenna began to accelerate toward the coast of Mexico, the cyclone intensified slightly and early the next day reached its peak intensity of 165 m.p.h. with a minimum pressure of 913 mb. At this time Kenna was only about 145 miles west-southwest of Cabo Corrientes. Kenna continued to accelerate, and although the hurricane was still over warm waters, it began to weaken under increasing shear associated with the upper trough. By midday 25 October the minimum pressure had risen to near 940 mb. Despite the sharp increase in pressure, Kenna's convective activity increased in the hours just prior to landfall, and a reconnaissance aircraft reported extremely severe turbulence that was among the most intense ever experienced by the flight crew. Kenna made landfall near San Blas, Mexico with winds estimated to be near 140 m.p.h. at 1630 UTC. Only an unnamed hurricane in 1959 and Madeline in 1976 are known to have been stronger at the time of landfall than Kenna. Kenna continued moving northeastward and weakened very rapidly inland over the mountains of Mexico; by early on 26 October it was a minimal tropical storm, and the circulation dissipated a few hours later. The remnants of Kenna moved into the northwestern Gulf of Mexico later that day, and enhanced rainfall in the southeastern United States.

There were very few surface observations from the landfall of Kenna. At Tepic, Nayarit (located about 15 miles inland) the peak measured wind was 87 m.p.h., with a storm total rainfall of 3.35 inches. At Islas Marias, about 40 miles to the left of the track of Kenna, 1.38 inches of rain was recorded. The maximum rain totals reported from the states of Colima and Nayarit were

9.84 inches and 4.72 inches, respectively. The Meteorological Service of Mexico estimates that the storm surge in San Blas was as high as 16 feet. Storm surge also affected Puerto Vallarta, but no measurements are available. There were reports of 10-ft waves rushing inland from the bay.

Mexican authorities report four deaths from Kenna. All but roughly 200 or so of the 9000 residents of San Blas evacuated the village, likely accounting for the relatively low number of casualties. There were media reports of over100 injuries in San Blas and Puerto Vallarta from flying glass and other debris. In Puerto Vallarta, storm surge was primarily responsible for the estimated $5 million of damage, largely to hotels. There are no monetary estimates of damage in San Blas; however, media reports indicated that 80 to 90% of the homes were damaged or destroyed. Large commercial shrimp boats were dragged up to 300 yards from their docks.

Tropical Storm Lowell

Lowell originated from a westward-moving disturbance that crossed Central America and entered the eastern North Pacific basin on 12 October. On 22 October the system became a tropical depression about 1590 miles southwest of Cabo San Lucas. After briefly drifting north, the depression turned to the west and strengthened to a tropical storm with winds of 45 m.p.h. the following day. At that point southwesterly vertical wind shear caused Lowell to weaken back to a depression on 24 October. Lowell crossed 140E W longitude and entered into the central Pacific hurricane basin on 26 October. On 27 October as the vertical wind shear lessened, Lowell regained tropical storm strength. Lowell reached its peak intensity of 50 m.p.h. on 28 October about 805 miles east-southeast of the Hawaiian Islands. Lowell then turned to the west-southwest and began to weaken, becoming a tropical depression again on 29 October, and dissipating two days later.

Table 1. 2002 Eastern North Pacific hurricane season statistics.

No.	Name	Class [a]	Dates [b]	Maximum 1-min wind (m.p.h.)	Minimum sea level pressure (mb)	Direct deaths
1	Alma	H	24 May - 1 June	115	960	
2	Boris	TS	8 - 11 June	60	997	
3	Cristina	TS	9 - 16 July	65	994	
4	Douglas	H	20 - 26 July	105	970	
5	Elida	H	23 - 30 July	160	921	
6	Fausto	H	21 Aug. - 3 Sept.	145	936	
7	Genevieve	TS	26 Aug. - 1 Sept.	70	989	
8	Hernan	H	30 Aug. - 6 Sept.	160	921	
9	Iselle	TS	15 - 20 September	70	990	
10	Julio	TS	25 - 26 September	45	1000	
11	Kenna	H	22 - 26 October	165	913	4
12	Lowell	TS	22 - 31 October	50[c]	1002	

[a] T - tropical storm, wind speed 34-63 m.p.h. (17-32 m s^{-1}); H - hurricane, wind speed 64 m.p.h. (33 m s^{-1}) or higher.

[b] Dates begin at 0000 UTC and include tropical and subtropical depression stages but exclude extratropical stage.

[c] Lowell=s peak intensity was attained west of 140E W Longitude, in the central Pacific hurricane basin.

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(p. 11 to 15 - tracks)

APPENDIX IV

SUMMARY REPORTS ON THE 2002 HURRICANE SEASON PROVIDED BY MEMBER COUNTRIES

(Available in English only)

2002 HURRICANE SEASON SUMMARY

(Submitted by Antigua and Barbuda)

The “normal” hurricane season generates nine (9) Tropical Storms, six (6) of which develop into hurricanes and of these six hurricanes, two (2) will develop further into intense hurricanes, i.e. category 3, 4, 5 (Gray et al.).

This year (2002) there were twelve (12) storms, four (4) of which developed into hurricanes and of these hurricanes, two (2) developed into intense hurricanes.

Antigua and Barbuda were not affected by any Tropical Depression, Tropical Storms, or Hurricanes during the 2002 Hurricane Season.

2002 HURRICANE SEASON REVIEW

(Submitted by The Bahamas)

The 2002 cyclone season was a quiet one for The Bahamas and the Turks and Caicos Islands. However, moderate to heavy rainfall associated with Tropical Depression number fourteen affected The Bahamas from 14th through 16th October 2002.

Tropical Depression number fourteen developed from a broad low-pressure area off the northeast coast of Honduras on 14th October 2002. The system moved along a northeast track and merged with a cold front off the southern coast of Central Cuba on 16th October 2002.

At midnight on Monday, 14th October 2002, The Bahamas Department of Meteorology issued a tropical storm watch for the islands of the Northwest Bahamas. Six hours later, at 6:00 a.m. on 15th October 2002, this tropical storm watch was extended to include the islands of the Central Bahamas. The watch was upgraded to a tropical storm warning at midnight on 15th October 2002. All warnings for The Bahamas were discontinued at 5:30 p.m. EDT on 16th October 2002 after the tropical depression merged with the cold front and lost its tropical characteristics.

Rainfall amounts recorded at three sites in The Bahamas are shown in the table below:

Site location	**Rainfall amount (inches**
Nassau International Airport, New Providence	2.94
Freeport International Airport, Grand Bahama	2.10
Duncan Town, Ragged Island	0.87

(Available in English only)

2002 HURRICANE SEASON – THE BARBADIAN EXPERIENCE

(Submitted by Barbados)

(hard copy only)

REPORTS OF HURRICANES, TROPICAL STORMS, TROPICAL DISTURBANCES AND RELATED FLOODING DURING 2002

(Submitted by the British Caribbean Territories)

(hard copy only)

(Available in English only)

2002 TROPICAL CYCLONE SEASON SUMMARY

(Submitted by Canada)

(hard copy only)

(Disponible en español solamente)

INFORME SOBRE HURACANES, TORMENTAS TROPICALES, PERTURBACIONES TROPICALES E INUNDACIONES ASOCIADAS CON ESOS FENÓMENOS DURANTE 2002

(Presentado por Colombia)

(hard copy only)

TROPICAL CYLCONES THAT AFFECTED COSTA RICA IN 2002

(Submitted by Costa Rica)

The tropical disturbance which formed on 16 September, which later developed into tropical storm Isidore, was the only cyclone to affect Costa Rica (during the year).

It caused floods and landslides and forced the evacuation of those in the province of Guanacaste - western part of the country - but did not cause any loss of lives.

The Instituto Meteorológico Nacional (IMN) issued meteorological alert information related to this system from 16 to 23 September 2002.

REPORTS OF HURRICANES, TROPICAL STORMS, TROPICAL DISTURBANCES AND RELATED FLOODING DURING 2002

(Submitted by Cuba)

INTRODUCTION

1. Hurricane Season 2002 had among its main features two hurricanes that crossed Cuba, Isidore and Lili, affecting the same area with very similar tracks and only 11 days between the first and the second. There was no new record in this aspect, for back in 1886 another two hurricanes crossed Cuba with an interval on only 5 days. The most recent case of two consecutive hurricanes affecting the same area in Cuba occurred in 1948, when two category 3 hurricanes hit the western part of Cuba within an interval of 15 days. Notwithstanding these precedents, there was no other case of consecutive hurricanes in history with such similarity in their tracks.

2. Hurricane Season 2002 showed again that the Atlantic basin hurricane activity lies within a period of high activity that began in 1995. This fact is observed with great concern, for Cuba have been affected by several hurricanes since that year, in contrast with the poor activity recorded in the 70s, 80s and the first half of the 90s. In just less than a year Cuba was hit by three hurricanes, Michelle in November 2001, as well as Isidore and Lili in September 20 and October 1st 2002.

HURACÁN ISIDORE

3. Isidore formed from Tropical Depression 10, on September 14th, 110 kilometers East of Trinidad, Southern Leeward Islands. The Depression headed West and West-Northwest, crossing over the island of Trinidad in the afternoon, and over the Northwestern coast of Venezuela during the night. No closed circulation was found by a reconnaissance plane on September 15 in the morning; therefore, the Depression was then downgraded to a Tropical Wave, but upgraded again to a Depression two days later, when the system was located over the Central Caribbean South of the Eastern tip of Jamaica. It headed Northwestward, and continued its intensification process to become Tropical Storm Isidore on the 18th.

4. Isidore reached hurricane status on the 19th, and had category 2 strength on the 20th, when it was located south and very near the Isle of Youth, Cuba.

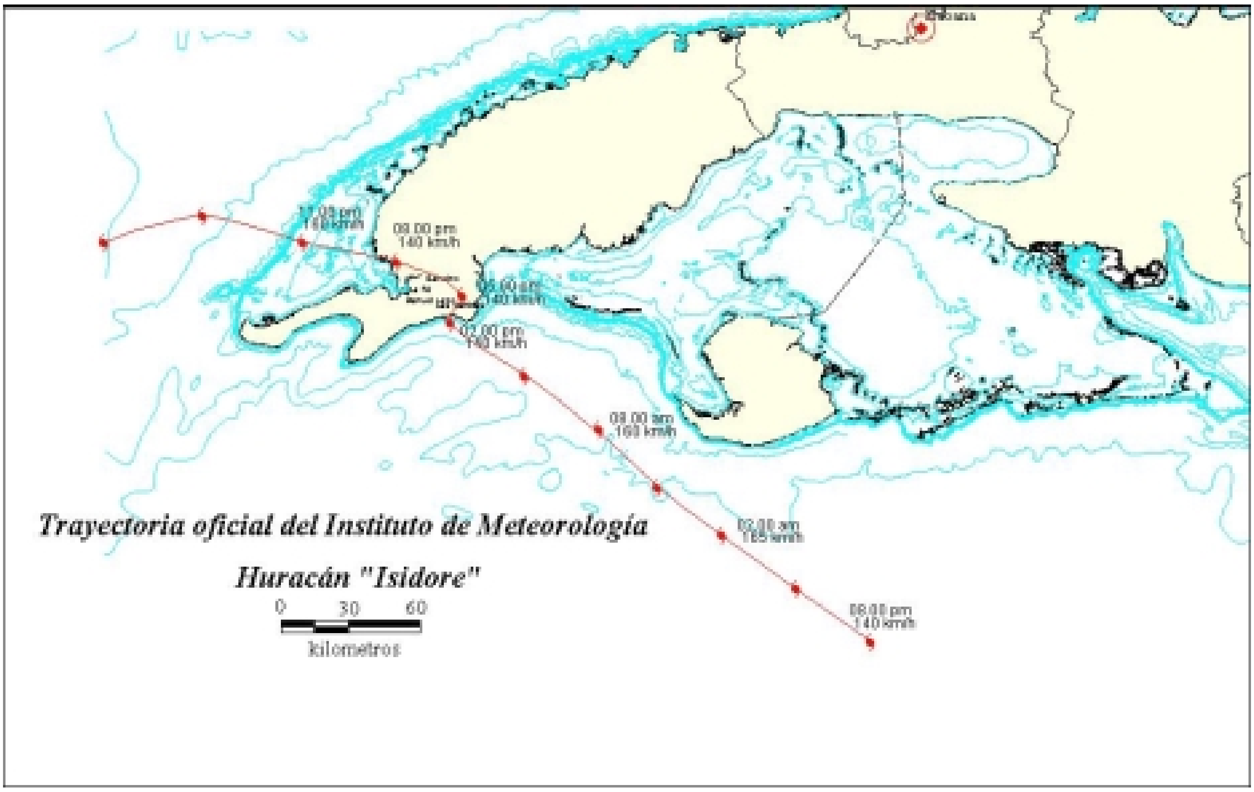

Fig. 1 Track of “Isidore” across the Cuban archipelago.

5. A portion of Isidore’s track over Cuba is shown in figure 1. The closest approach to the Isle of Youth took place during the morning, 28 km away of Cabo Pepe, moving between the West and Westnorthwest at 11 km/h. Highest winds were decreasing as it moved near and over Cuba. They were near 160 km/h when Isidore was crossing west of the isle of Youth, while central pressure reported by an aircraft (at 11:01 UTC) was 966 hPa. Landfall in Cuba occurred near 2 PM (18UTC) at a point West and near Cabo Francés, Western tip of Pinar del Río. The central pressure at that moment was 964 hPa; however, highest winds decreased to 140 km/h, that is, a Category 1 hurricane. A small turn to the Northeast occurred right after landfall, heading toward the Westnorthwest afterwards (at 5:00 PM, 21:00 UTC). The track of Isidore over this area was very slow, at only 5 km/h. Isidore’s center went off to sea around 9 PM (01:00 UTC, Sept 21st), near Punta de Abalos.

6. Highest sustained winds (estimated) as well as highest gusts recorded during Isidore are shown in table 1. The main 24 h rainfall totals are shown in table 2.

7. Isidore was a hurricane of great extension. Feeding bands expanded over Cuba, and this caused impressive rain totals in distant provinces, mainly in Sancti-Spiritus. The eye was 30 km in diameter, so the calm area roughly extended 15 km at each side of the track. The calm was observed in Las Martinas during 20 minutes (at 2:30 PM,18:30 UTC), and lasted for 15 minutes in El Cayuco, while had a one hour duration in Ciudad Sandino, Pinar del Rio, as well as in Santa Fe, Isle of Youth.

Table 1. Maximum Sustained 1-minute winds (estimated) in km/h and highest gusts reported by some Cuban stations during Isidore, September 20th, 2002.

No. Estación	Localidad	Viento máximo sostenido (km/h)	Racha máxima registrada (km/h)
78310	Cabo de San Antonio	78	105
78313	Isabel Rubio	115	138
78314	San Juan y Martínez	78	108
78315	Pinar del Río	99	117
78316	La Palma	57	98
78317	Paso Real de San Diego	80	92
78309	Cuba – Francia	92	133
78321	La Fé	115	134
78324	Punta del Este	106	133

Table 2. Highest 24 hour rainfall totals due to the influence of hurricane Isidore, September 19 to 23.

Localidad y Provincia	Día	mm/24 horas
Punta del Este	19	177.8
La Fé	20	166.6
Punta del Este	20	206.3
Nueva Gerona	20	183.1
Paso Real de San Diego, Pinar del Río	20	154.7
Isabel Rubio, Pinar del Río	20	346.2
San Juan y Martínez, Pinar del Río	20	281.3
Pinar del Río	20	248.3
Guasimal, Sancti Spíritus	20	364.0
Tunas de Zaza, Sancti Spíritus	20	346.5
Mapos, Sancti Spíritus	20	211.3
Pilón, Granma	20	175.0
Punta del Este, Isla de la Juventud	21	144.0
Cabo de San Antonio, Pinar del Río	21	134.9
Playa Girón, Matanzas	21	134.8
Topes de Collantes, Sancti Spíritus	21	222.2
Trinidad, Sancti Spíritus	21	169.1
Iznaga, Sancti Spíritus	21	135.8
Quivicán, La Habana	22	158.0
La Salud, La Habana	22	151.0
Izanga, Sancti Spíritus	22	139.9
Condado, Sancti Spíritus	22	136.0
Júcaro, Ciego de Avila	22	153.0
Sanguily, Ciego de Avila	22	204.0
Paso Real de San Diego, Pinar del Río	23	120.6
Nueva Gerona, Isla de la Juventud	23	147.1
La Fé, Isla de la Juventud	23	122.8
Batabanó, La Habana	23	146.0
Güira de Melena, La Habana	23	118.3
Santiago de las Vegas, Ciudad de La Habana	23	107.3
Sanguily, Ciego de Avila	23	204.0
Júcaro, Ciego de Avila	23	152.7

HURRICANE LILI

8. Isidore was moving away from Cuba when Tropical Depression 13 was forming 1615 km East of Barbados on September 21st afternoon. The new Tropical Depression was located South of the Atlantic Subtropical ridge, moving Westward over warm waters along an upper level favorable environment for development. There was little change in intensity on the 22nd, but it was better organized on the 23rd, when the Depression was upgraded to Tropical Store Lili, located South of Barbados. Deep convection had developed North of the center, with a clear high level outflow, when Lili entered the Eastern Caribbean.

9. Lili was near hurricane strength on the morning of September 24th, , but the low level circulation became elongated by the afternoon due to a moderate shear induced by an upper level low over Venezuela. A reconnaissance aircraft was not able to find a surface circulation center that evening, but 24 hours later the system became better organized, being upgraded to Tropical Depression again.

10. The intensification trend continued and the system was upgraded to Tropical Storm Lili on 28th in the morning, crossing near the Northern coast of Jamaica on Sept. 29th . Lili reached Hurricane strength on the morning of Sept. 30th, South of Cuba.

11. Numerous and heavy rainfall occurred in Cuba due to the crossing of Lili South of the island from Sept. 28 to 30. They were especially heavy in the provinces of Granma, Santiago de Cuba and the Isle of Youth.

12. Hurricane Lili crossed near Carapachibey, Southwestern coast of the Isle of Youth, at 6:30 AM (10:30 UTC), moving Northwestward at 18 km/h. Lili had an elliptical eye, 37–22 km wide, highest winds were 140 km/h, and lowest surface pressure 970 hPa.

13. Lili's track over Cuban archipielago is shown in Figure 2. The center of the hurricane headed Hawai from the Isle of Youth arounf 8:30 AM (12:30 UTC), increasing its strenght and translation speed. Landfall in Cuba occurred at midday, by a point between Playa Bailén and Playa de Galafre, western section of Pinar del Río.

14. A reconnaissance aircraft found a 102 knots (189 km/h) flight level wind in Lili's eyewall over Pinar del Río at 1:05 PM (17:05 UTC). This gives a surface estimated value of 160 km/h, corresponding with a Category 2 hurricane. The surface met station at Isabel Rubio registered a lowest pressure reading of 971.4 hPa at 12:50 PM (16:50 UTC). Lili crossed Pinar del Río with a fast Northwesterly track, at an average forward speed of 33 km/h. The hurricane emerged offshore between Dimas and Arroyos de Mantua near 2:00 PM (18:00 UTC).

15. A 1.8 meter storm surge, of brief duration because of Lili's fast movement, was reported in the Southern coast of Pinar del Río. The sea came 1.5 km inland at Cortes pushed by Southwesterly winds.

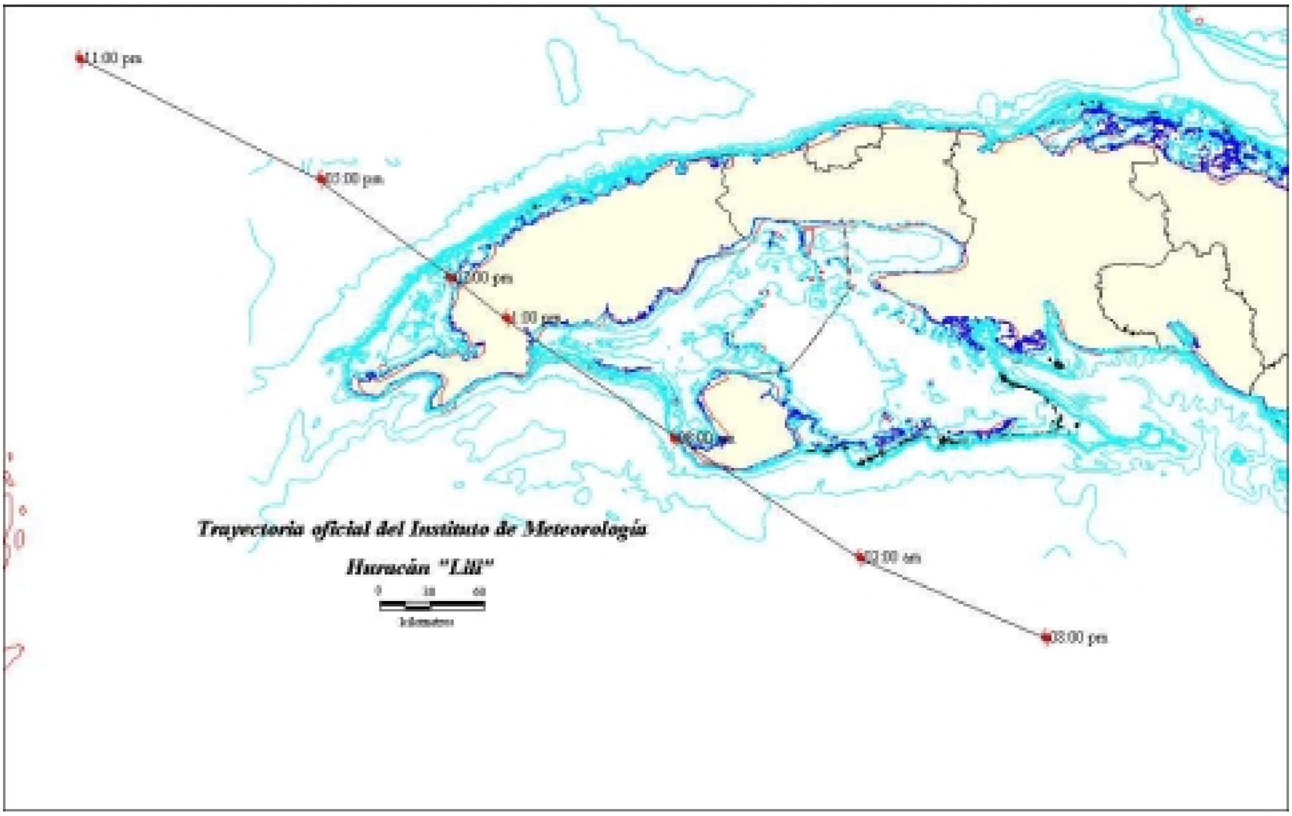

Fig. 2 Track of "Lili" across the Cuban archipelago.

Table 3. Maximum Sustained 1 minute Winds (estimated) in km/h and highest gusts reported by Cuban stations in Lili, on October 1st, 2002.

Station No.	Location	Maximum Sustained Winds (km/h)	Highest Gust (km/h)
78310	Cabo de San Antonio	75	85
78313	Isabel Rubio	92	116
78314	San Juan y Martínez	154	164
78315	Pinar del Río	126	140
78316	La Palma	57	98
78317	Paso Real de San Diego	94	108
78318	Bahía Honda	80	101
78309	Cuba – Francia	146	182
78321	La Fé	147	184
78324	Punta del Este	138	173
--	Nueva Gerona	128	160

Table 4. Highest amounts of 24 hour rainfall due to the influence of hurricane Lili, September 29th-October 1st.

Location and Province	Day	mm/24 hours
Pilón, Granma	29	157.5
San Ramón, Granma	29	149.7
CAI Bartolomé Masó, Granma	29	107.6
Matías, Santiago de Cuba	29	113.0
Gran Piedra, Santiago de Cuba	29	108.1
Matías, Santiago de Cuba	30	168.0
Cruce de los Baños, Santiago de Cuba	30	117.0
La Victoria, Isla de la Juventud	30	152.2
Hotel Colony, Isla de la Juventud	30	123.6
La Fé, Isla de la Juventud	30	116.1
Punta del Este, Isla de la Juventud	30	106.1
Viñales, Pinar del Río	1	339.5
Río Seco, Pinar del Río	1	276.1
Presa El Punto, Pinar del Río	1	241.2
Puerto Esperanza, Pinar del Río	1	221.0
Presa El Jíbaro, Pinar del Río	1	224.0
San Cayetano, Pinar del Río	1	208.5
Pilotos, Pinar del Río	1	203.5
Juraguá, Cienfuegos	1	258.6
Yaguaramas, Cienfuegos	1	189.0
Horquitas, Cienfuegos	1	167.8
Abreus, Cienfuegos	1	161.0

DAMAGE ASSESSMENT RELATED TO HURRICANES ISIDORE AND LILI IN CUBA

16. Lili hit the Isle of Youth and the province of Pinar del Río, the same area affected by Isidore just 11 days before. The area had been left without electricity because of Isidore, but restoration tasks had not been finished yet when Lili appeared on the scene. Therefore, special cautionary measures had to be taken, such as messages through loudspeakers installed on cars and the use of battery radios to warn the population. The forecast and warning system worked very well before, during and after both hurricanes. There were no casualties in Isidore and just one man was dead in Lili.

17. Material losses related to Isidore and Lili in Cuba were estimated in 713 million US dollars. Affected houses were 92,291 in Pinar del Río province and the Isle of Youth, of which 17,481 were totally destroyed. 2,767 electricity poles fell down, as well as 1,700 telephone poles. Agriculture, as well as installations of social and economical value, suffered devastating damages. The greatest damage occurred in tobacco infrastructure. 14,000 curing houses existed before both hurricanes. Isidore and Lili left 6 600 totally destroyed and another 4,400 affected.

SUMMARY OF THE IMPACTS OF THE 2002 HURRICANE SEASON

(Submitted by the Dominican Republic)

1. Based on its impacts, the 2002 hurricane season can be considered to be fairly inactive in the Dominican Republic. Of the 45 tropical waves that formed, the majority were most convectively active to the south of 15°N, therefore no significant impact on the Dominican Republic was sustained, except for three of these waves which caused flooding.

2. From 26 to 28 September, convective activity from the Tropical Storm *Lili* which, at its closest, passed some 250 km to the south of the coast of the Dominican Republic, caused torrential rain, electrical storms and occasional gusts of wind that entailed suspending aeronautical activities for low level aircraft.

3. Strong breakers were formed, causing damage to the coastline and also abnormal swells hindered marine navigation to and from the southwestern coast of the country.

Station	Precipitation (mm)		
SEPTEMBER	26	27	28
Punta Cana	10.3	14.5	7.9
San R. del Yuma	70.7	9.0	7.2
S. de la Mar	10.4	1.6	56.3
San Cristóbal	2.0	40.0	16.3
Loyola (S.C.)	7.0	15.3	29.5
Las Américas	6.6	17.8	58.1
Herrera	5.3	1.6	19.8
Santo Domingo	2.7	14.3	39.8
Bayaguana	3.0	14.8	25.3
Los Llanos	9.0	30.0	29.9
S.P. de Macorís	2.1	41.6	18.1
Baní	19.4	16.4	14.2
Barahona	22.3	17.6	22.0
Polo	11.4	60.3	30.4
Oviedo	9.7	8.9	7.9

The following table shows the dates and impacts of the tropical waves on the Dominican Republic:

Date	Rivers that burst their banks	Region	Average accumulated rainfall (mm)	Impacts
24-25 May (tropical wave)	Isabela, Haina, Isa-Mana y Boruga	Southeast	136.5 Accumulated maximum 83.3 (Polo)	Bridges destroyed, tens of families evacuated, millions of dollars' worth of damage to agriculture
28 to 31 May (associated with a trough from 28 May to 3 June)	Arroyos Los Chivos, Palomino	Central and Southeast	37.1 Accumulated maximum 120.3 (Barahona)	Barios neighbourhood and area flooded, hundreds of families evacuated
31 May to 3 June	--	National District	90.4 Maximum 43.8 Día 03	Urban flooding landslides in neighbourhoods and on motorways. Some flights from AILA were suspended. A plane went off the runway without causing any passenger injury.
3-5 June	--	Northwest, Southeast and settlements in the central mountain range	Southeast 102.9 Accumulated maximum 196.1 Bayaguana Northwest 141.7 3 June Santiago Rodriguez	Urban flooding and landslides. 70% of the settlement of San Pedro de Macoris was flooded and water levels were up to 3 m high. Thousands of families were made homeless.
22-24 July (tropical wave)	--	Southeast	28.7 Accumulated maximum 69.9 Herrera	Strong electrical storms, gusts of wind and heavy rain
16 September (tropical wave)	--	Metropolitan Santo Domingo	103.3	Heavy rain, gusts of wind, some landslides

REPORT ON HURRICANE ACTIVITY IN EL SALVADOR IN 2002

(Submitted by the National Territorial Studies Service, National Meteorological Service, El Salvador)

May

Tropical waves moving from the east were observed on the 15th, 18th, 21st, 25th and 29th. This had a direct and indirect influence on our country, producing moderate to heavy rains that were sometimes scattered and sometimes widespread.

Finally, from 31 May to 2 June a storm arrived, produced mainly by a low pressure centre at the surface and the lower troposphere. At 9 a.m. local time it was located at 18°N and 82°W, and was expected to go north. This system produced a broad depression over the Central American region, leaving up to 148.9 mm of precipitation in 24 hours in Llopango and similar or lesser amounts at other weather stations. The situation led the National Emergency Committee to declare at first a green alert, and later a yellow alert.

August

- At the end of the month a tropical wave and cyclonic circulation south of the coast gave rise to a storm that produced 103.5 mm of precipitation in Sensuntepeque, Cabañas Department, and 113 mm in Los Naranjos, Sonsonate Department.

September

- September was an especially active month for the generation of tropical cyclones in the Atlantic basin, as eight appeared. Nonetheless, only hurricanes Isidore and Lili threatened Central America.

- The first half of the month was influenced by the entry of tropical waves and moist ocean air from the south-west.

- Later, and as a result of the scenario created by Isidore (a trough arriving from the Pacific), from the 18th to the 26th there was a break in the easterlies.

- There was a substantial increase in the cloud fields because of a predominating south-easterly flow over the country.

- From the 21st, Tropical Storm Lili was accompanied by two troughs, one extending south and another going toward the Pacific near Central America.

October

From the climatological standpoint, October includes the end of the stormy season and the beginning of a transition to dry weather. Hurricane Lili, which moved over the Caribbean and the Yucatan Peninsula, was the main atmospheric characteristic of the month.

- For the first three days of the month this system brought about cyclonic circulation patterns in the lower atmosphere and anticyclones in the upper layers above our country.
At low levels, the easterly flow was constant in the region until the 25th. At high altitudes, a short wave trough arrived from Mexico, crossed Central America on the 20th and 21st, later broke up and moved toward El Salvador on the 25th.

- As from that date a low altitude low pressure system was located in the Pacific Ocean to the west of Costa Rica, extending a trough toward Guatemala, covering the Central American coast, with anticyclonic circulation at higher altitudes. A cyclone, at the level of 200 hPa, advanced from the Caribbean Sea through Costa Rica on the 29th and reached El Salvador on the 30th before moving on towards Guatemala and Mexico on the 31st.

REPORT ON THE SYSTEMATIC TREATMENT OF HURRICANE ISIDORE

(Submitted by the National Territorial Studies Service, National Meteorological Service, Meteorological Forecasting Centre (CPM), El Salvador)

Before the event

What needed to be done? Product expectations.

Advise the population living in high-risk areas. Inform the Centre for Hydrological Forecasts (CPH) of the increasing possibility of persistent rains. Monitoring of the hurricane and its impact.

How was it done? Key indicators.

A written article for the media. Special bulletins were issued. Technical discussions were held between forecasters of the Meteorological Forecasting Centre (CPM) and CPH. Integrated work was done by the different directorates of the National Territorial Studies Service (SNET).

What was the result? and/or means of verification

Greater attention on the part of the population to information issued by CPM. Greater attention of the National Emergency Committee (COEN). Increased information flow between CPM and CPH. Interest for internal users in issued products.

Why was that the result? Efficiency, effectiveness, relevance and coherence analysis.

The report could not be posted on the Internet at the end of the week. The experience of the forecasters was decisive in this type of situation. Appropriate monitoring and analysis for issuing special bulletins.

What measure was taken? Corrective actions and/or measures to ensure success

Request access to the Internet for bulletins, forecasts and perspectives for CPM staff. Count telephone calls for the media. Register visits by the media. Extend the grid of maps (longitude) for the detection of systems.

During the event

What needed to be done? Product expectations

Keep the population informed of the system's classification. Provide information on the risks of rains.

How was it done? Key indicators

SUMMARY OF THE 2002 HURRICANE SEASON IN THE FRENCH WEST INDIES (Martinique, Guadeloupe, St Barthelemy and St Martin)

(Submitted by France)

A very very quiet 2002 season for all the French West Indies Islands. Only tropical storm Lili and DT10 had some light effects on our islands as their centres passed away in the southern part of the archipelago. No significant damage has been reported.

1. Passage of DT10 in the southern part of the small West Indies

Heavy rain in Guadeloupe associated with DT10 (which becomes later Isidore) on 13th and 14th of September 2002. Rains up to 100 mm have been reported. Notice that light rain has been reported in Martinique which was though closer to the center.

2. TS Lili

No watches for Lili which threatened at the beginning our islands. Light rain in Martinique and Guadeloupe but 10 mn mean wind up to 40 KT and guts up to 50 KT in Martinique. Seas up to 3.5 m (H1/3) and max. height around 5 m at our coastal buoys.

(Disponible en español solamente)

INFORME SOBRE LA TEMPORADA DE HURACANES DEL 2002

(Presentado por Guatemala)

(hard copy only)

(Available in English only)

REPORT ON THE 2002 HURRICANE SEASON

(Submitted by Jamaica)

(hard copy only)

(Disponible en español solamente)

INFORME SOBRE LA TEMPORADA DE CICLONES E INUNDACIONES ASOCIADAS A ESOS FENÓMENOS DURANTE EL AÑO 2002

(Presentado por Mexico)

(hard copy only)

COUNTRY REPORT 2002

(Submitted by the USA)

1. Eight tropical cyclones made direct hits in the United States. Lili was the first U.S. hurricane landfall since Irene in 1999. In the United Sates, tropical cyclones caused 9 direct deaths. The total damage was about 1.2 billion dollars, mostly from Lili and Isidore. Tropical Storm Arthur produced heavy rains in northern Florida, Georgia and South Carolina during its formative stage.

2. **Bertha** formed along a frontal trough in the Gulf of Mexico, just east of the mouth of the Mississippi River on August 4th. The cyclone quickly became a tropical storm and moved west-northwestward over southeastern Louisiana by early on the 5th with 40-m.p.h. sustained winds. After weakening to a depression, Bertha's center moved southwestward, back over the Gulf of Mexico, and then moved inland over south Texas on the 9th. Rainfall totaled 5 to 10 inches over portions of Louisiana and Mississippi and Bertha caused one death, a drowning in high surf in the Florida panhandle near Perdido Key State Park.

3. **Edouard** formed on September 1 from a non-tropical disturbance about 140 miles east of Daytona Beach Florida. The system made a clockwise loop off the northeast Florida coast, and then headed toward Florida. Edouard attained a peak intensity of 65 m.p.h. for a short time on the 3rd, but strong upper-level winds quickly caused weakening. The cyclone was barely of tropical storm intensity when it made landfall near Ormond Beach, Florida on the evening of September 4. It crossed north-central Florida as a weak depression and then dissipated over the northeastern Gulf of Mexico on the 6th, when its remnants were entrained into the large circulation of Tropical Storm Fay centered off the Texas coast. Edouard caused some flooding due to locally heavy rains over north-central Florida. There are no reported casualties and damage is believed to be minor.

4. **Fay** had its origins in a broad low pressure system over the western Gulf of Mexico. Reports from an Air Force Hurricane Hunter aircraft investigating the area on September 5th suggested that a tropical depression had developed about 110 miles southeast of Galveston, Texas. The depression quickly strengthened into a tropical storm, and Fay reached its peak intensity of 60 m.p.h. on the 6th. After moving slowly and erratically, Fay headed toward the Texas coast. The storm made landfall on the morning of the 7th near Port O'Connor with 60-m.p.h. winds. After landfall, Fay weakened to a remnant low that meandered across southern Texas and northeastern Mexico for several days, producing copious rains until the low finally dissipated late on the 10th near Monterrey, Mexico. There were no reports of casualties or estimates of damage.

5. **Gustav** initially formed as a subtropical depression on September 8th about 550 miles south-southeast of Cape Hatteras, North Carolina. The cyclone moved northwestward and soon became a subtropical storm. Gustav turned northward and made the transition to a tropical storm before the center passed just east of Cape Hatteras on the 10th. It then turned northeastward into the Atlantic and strengthened into the first hurricane of the season. Maximum winds reached 100 m.p.h. before Gustav made landfall in eastern Nova Scotia as a hurricane with 90 m.p.h. winds early on the 12th. The system became extratropical later that day near western Newfoundland. The Cape Hatteras Coast Guard station reported a wind gust of 78 m.p.h., and wind gusts to hurricane force were also reported in Nova Scotia. There was one death directly attributed to Gustav: a swimmer at Myrtle Beach, South Carolina suffered injuries from high surf and died two days later. Damage in North Carolina is estimated at about $100,000. In Nova Scotia, some docks were damaged and trees were blown down.

6. **Hanna** formed in the Gulf of Mexico from the interaction of a tropical wave, an upper-level low, and a surface trough. Air Force reconnaissance aircraft observations indicate that a tropical depression developed late on September 11 about 290 miles south of Pensacola, Florida. The system became a tropical storm early on the next day. After moving slowly and erratically for a couple of days, Hanna turned northward toward the northern Gulf coast, ahead of an approaching mid-level trough. With maximum winds near 60 m.p.h., the storm center passed over the southeastern tip of Louisiana early on the 14^{th} and made a second landfall near the Alabama-Mississippi border later that morning. Hanna dissipated near the Georgia-Alabama border on the 15^{th}, but its remnants produced heavy rains across Georgia and the Carolinas. Sustained winds of 54 m.p.h. were recorded at Pensacola and a gust to 68 m.p.h. was measured at Pensacola Beach. There were numerous reports across the southeastern states of storm-total rainfall accumulations of between 5 and 10 inches. The highest reported storm total, 15.56 inches, was from Donalsonville, Georgia. Three deaths in the Florida panhandle are attributed to rip currents generated by Hanna. The total damage, mainly agricultural losses, is estimated at $20 million.

7. **Isidore** meandered over northern Yucatan and weakened. It then moved northward over the Gulf of Mexico and made landfall as a tropical storm early on the 26th, just west of Grand Isle, Louisiana, with maximum winds near 65 m.p.h. Weakening over land, Isidore moved across the southeastern states, producing torrential rains. Isidore became an extratropical cyclone over Pennsylvania on the 27^{th}, and was then absorbed into a frontal zone.

8. Isidore caused four deaths. One was a rip current drowning in Louisiana, another was a storm surge drowning in Mississippi, a third was caused by a tree falling on a car in eastern Mississippi, and a fourth death resulted from a car being driven into 10 feet of water in Clarksville, Tennessee. Very heavy rains caused damage in Jamaica. Isidore caused major damage to the Yucatan Peninsula and western Cuba. In the United States, the total damage due to Isidore is estimated to be $330 million, mainly in Louisiana.

9. **Kyle** had a life span of 22 days, the third longest on record for an Atlantic tropical cyclone, exceeded only by Ginger of 1971 and Inga of 1969. It developed from a non-tropical low about 820 miles east-southeast of Bermuda on September 20^{th}. Kyle moved erratically, but generally westward until October 11^{th}, when the storm turned northward and northeastward and made landfall on the South Carolina and North Carolina coasts with winds to 45 m.p.h. Associated tornadoes caused over $2 million dollars damage in North Carolina. Kyle merged with a cold front the next day. During its long track, Kyle strengthened (or re-strengthened) to a tropical storm on four different occasions, and it became a hurricane over open water, from September 25^{th} to 28^{th}, with winds reaching 85 mph.

10. **Lili's** moved across the Caribbean Sea and reached the central Gulf of Mexico where winds quickly strengthened to 145 m.p.h, Category Four intensity on the Saffir-Simpson Hurricane Scale. But the wind speed decreased almost as fast as it had increased. Lili made landfall with sustained winds of 90 m.p.h. on the coast of Louisiana to the south of Intracoastal City on the 3^{rd}. Lili was the first U.S. hurricane landfall since Irene in 1999. Weakening over land, Lili merged with an extratropical low over the east-central United States on the 4^{th}. In Louisiana, there was a trail of muck and misery from widespread wind and flood damage. The total U.S. property damage estimate is 860 million dollars.

11. Lili's eyewall passed over NOAA data buoy 42001 in the central Gulf of Mexico on October 2nd. The buoy measured a ten-minute mean wind speed of 113 m.p.h., which is the highest sustained wind speed ever recorded by a NOAA buoy.

2002 Atlantic Tropical Cyclones affecting the United States

Name	***Class****	*Dates***	*Max. winds (m.p.h)*	*Min. pressure (mb)*	*U.S. Direct deaths*	*U.S. damage ($ millions)*
Bertha	*Tropical Storm*	*Aug. 4-9*	*40*	*1007*	*1*	
Edouard	*Tropical Storm*	*Sep. 1-6*	*65*	*1002*		
Fay	*Tropical Storm*	*Sep. 5-8*	*60*	*998*		
Gustav	*Hurricane*	*Sep. 8-12*	*100*	*960*	*1*	*0.1*
Hanna	*Tropical Storm*	*Sep. 12-15*	*60*	*1001*	*3*	*20*
Isidore	*Hurricane*	*Sep. 14-27*	*125*	*934*	*4*	*330*
Kyle	*Hurricane*	*Sep.20-Oct. 12*	*85*	*980*		*2.5*
Lili	*Hurricane*	*Sep. 21-Oct 4*	*145*	*938*		*860*

***** *Tropical Storm: wind speed of 39-73 m.p.h. Hurricane: wind speed of 74 m.p.h or higher.***
*****Dates begin at 0000 UTC and include tropical depression stage(wind speed less than 39 m.p.h)***

APPENDIX V

RA IV HURRICANE COMMITTEE'S TECHNICAL PLAN AND ITS IMPLEMENTATION PROGRAMME

I. **METEOROLOGICAL COMPONENT**

II.

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
1.1 DEVELOPMENT OF METEOROLOGICAL SERVICES									
1.1.1	Development and provision of adequate staff and equipment to enable the national Meteorological Services in the area to meet their responsibilities in the provision of hurricane warning services						Members	National and external assistance	
1.1.2	Full implementation of the observing, telecommunication and data-processing systems of the World Weather Watch in the hurricane area						Members	National and external assistance	With advice of WMO, where needed
1.2 METEOROLOGICAL OBSERVING SYSTEM									
1.2.1	Manned surface stations								
1.2.1.1	Assignment of the highest priority to the removal of deficiencies in the synoptic observation programmes at 0000 and 0600 UTC at stations of the RA IV regional basic synoptic network lying in the area between latitudes 5°N and 35°N, and between longitudes 50°W and 140°W*						Members	National	

*During 2003-2004 items with an asterisk to be given priority attention

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
1.2.1.2	Investigation of the possibilities of establishing simple stations which may be operated by volunteers and would supply hourly observations of direction and measured wind speed and atmospheric pressure only during periods (hours) that a hurricane is within about 200 km of the stations						Members with large land masses	National	Such stations could suitably be placed where stations of the WWW network are more than 200 km apart. * Weather stations will continue to be provided to radio amateur operators in the Caribbean.
1.2.1.3	Introduction of the practice of requesting stations along the shore to provide observations additional to those in the regular programme during hurricane periods, in particular when required by the RA IV Hurricane Operational Plan*						Members	National	
1.2.1.4	Expand the synoptic observation network of the RAIV in the area between latitudes 5ºN and 35º and longitude 50ºW and 140ºW.						Members	National	

Implementation note: 1.2.1.2 - 60 stations have been provided to amateur radio operators in parts of the Caribbean in 2001 and this support will continue.

* During 2003-2004 items with an asterisk to be given priority attention

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
1.2.2	Upper-air stations								
1.2.2.1	Establishment of the following upper-air stations:								
	Guatemala	—	—	—	—	—	Guatemala	) National and external assistance	
	80400 Isla de Aves - radiosonde*		—	—			Venezuela	) National and external assistance	
	Upgrade of ART upper-air stations at Barbados, Belize and Grand Cayman	—	—					) National and external assistance	
	Maintenance and replacement of hydrogen generators	—	—	—	—	—	Bahamas	USA. Resources have been identified to replace 6 generators,	
1.2.2.2	Implementation of two radiowind observations per day at all radiowind stations throughout the hurricane season*	—	—	—	—	—	Members concerned	National and external assistance	
1.2.2.3	Maintaining two radiowind observations per day whenever a named hurricane is within 1,000 km of the station, until the requirements of paragraph 1.2.2.2 above can be accomplished*	—	—	—	—	—	Members	National	

* During 2003-2004 items with an asterisk to be given priority attention

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I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
1.2.2.4	Implementation of the upper-air observations required at 0000 GMT under the World Weather Watch plan to enable a sufficient coverage during night hours						Members concerned	National and external assistance	
1.2.3	Ships' weather reports								
1.2.3.1	Continuation of efforts to recruit ships for participation in the WMO Voluntary Observing Ship Scheme, in particular by :								
	• Recruiting selected and supplementary ships plying the tropics*						Members	National	
	• Designating Port Meteorological Officers*						Members	National	
1.2.3.2	Improvement of liaison between Meteorological Services and Coastal Radio Stations and arrangements for specific requests for ships' reports from any area of current hurricane activity even if such reports have to be transmitted in plain language*						Members operating coastal radio stations	National	

* During 2003-2004 items with an asterisk to be given priority attention

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
1.2.4	Automatic weather stations								
1.2.4.1	Exploration of the possibility of installing automatic reporting devices at stations with insufficient staff for operation throughout the 24 hours; such stations might then be operated during daylight hours as manned stations and during night-time as unattended automatic stations, possibly with a reduced observing programme	———	———	———	———	———	Members concerned	National and external assistance	
1.2.4.2	Exploration of the possibility of installing automatic weather stations at locations which may be considered critical for the hurricane warning system for operation at least during the hurricane season	———	———	———	———	———	Members concerned	National and external assistance	

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
1.2.4.3	Establishment of automatic weather stations at the following locations: Bahamas (3) Barbuda Dominica Dominican Republic (5) Panama Cuba (5) St. Lucia (4) Trinidad and Tobago (6) Belice Mexico (10)						Bahamas Antigua Dom. Rep. Jamaica Cuba St. Lucia Trinidad and Tobago Belize	National & USA France National National and external assistance	The USA requested that countries planning to install automatic weather stations which use the GOES satellite for collection consult early with NOAA concerning details of the station configuration and transmission code formats which should be in WMO formats if possible

The Dominican Repubic has installed 44 AWS and Mexico 64.

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
1.2.5	Radar stations								
1.2.5.1	Promotion of the establishment and operation of a sub-regional network of 10 cm/5.6 cm wavelength radar stations, including replacement of unserviceable radars* • Replacement of radars in Barbados, Belize, Trinidad & Tobago • Replacement of radar in Bermuda • Establishment of radar in Bahamas						Barbados,Belize Trinidad&Tobag Bermuda Bahamas	National and European Union	Being implemented
1.2.5.2	Establishment and operation of 10 cm/5.6 cm wavelength radar stations at the following locations or nearby: • The north coast of Colombia between 73° and 75°W longitude • On the Central American coast (within longitudes 82° and 92°W and latitudes 10° and 16°N) either in Central America						Colombia Costa Rica, Nicaragua, Honduras, El Salvador and Guatemala.	)))) National and) external) assistance))	

* During 2003-2004 items with an asterisk to be given priority attention

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2002	2003	2004	2005	2006			
1.2.5.3	Speedy availability of 10 cm/5.6 cm radar information, and particularly eye-fixes, to all other countries in the hurricane area in accordance with the Hurricane Operational Plan for Region IV*						Members operating 10 cm/5.6 cm radar stations	National	
1.2.5.4	Development of pictorial radar information sharing programme including composites among all RA IV countries in the hurricane area in accordance with the Hurricane Operational Plan*						France	USA and France	
1.2.6	Air reconnaissance flights								
1.2.6.1	Provision of aircraft reconnaissance when required in accordance with the Hurricane Operational Plan for Region IV and dissemination of the information obtained to all concerned*, whenever this activity is not in violation of the sovereignty of the countries concerned.						USA	National	

Implementation Note:

Mexico is upgrading several their radars with Doppler capability

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* During 2003-2004 items with an asterisk to be given priority attention

1.2.5.4 The Netherlands Antilles is developing a regional website to host radar images.

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
1.2.7	Meteorological satellite systems								
1.2.7.1	Maintaining and operating the LRIT stations for the reception of cloud pictures from GOES and near-polar-orbiting satellites, including any modified or new equipment necessary for the reception of information from the TIROS-N series of satellites*						Members	National	
1.2.7.2	Installation and operation of direct read-out satellite reception facilities, in view of their great utility in hurricane tracking and forecasting*						Members able to do so	National and external assistance	
1.2.8	Storm surges								
1.2.8.1	Establishment of a network of tide-gauge stations in coastal areas where storm surges are likely to occur						Members able to do so	National	

* During 2003-2004 items with an asterisk to be given priority attention

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
1.3 METEOROLOGICAL TELECOMMUNICATION SYSTEMS									
1.3.1	National telecommunication networks								
1.3.1.1	Provision of suitable telecommunication facilities for the collection at NMCs of all observational data from stations in the regional basic synoptic network in accordance with the requirements of the WWW (i.e. 95% of reports to reach the collecting centre within 15 minutes of the observing station's filing time)*						Members	National and external assistance	Take urgent action
1.3.2	Special hurricane telecommunication arrangements								
1.3.2.1	Implementation, where necessary, of communication links to enable direct contact between warning centres to permit direct communication between forecasters						Members	National	Use of systems such as VSAT is recommended
1.3.2.2	Implementation, where necessary, of national and international communication links for distribution of warnings and advisories						Members	National and external assistance	

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
1.3.3	Regional telecommunication network								
1.3.3.1	Upgrade telecommunication systems in accordance with the RA IV Regional Meteorological Telecommunication Plan,*						Members	SIDS Project US, France and VCP	

1.3.2 **CDERA is developing a Model National Telecommunications Plan and training course. Sixteen States will be provided with telecommunication packages under a Japanese funded Search and Rescue Project.**

* During 2003-2004 items with an asterisk to be given priority attention

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
1.4 HURRICANE AND STORM SURGE SIMULATION, FORECASTING AND WARNING									
1.4.1	Storm surge project								
1.4.1.1	Cooperation in activities to be undertaken on storm surges as a project of the WMO Tropical Cyclone Programme in the Hurricane Committee area*						Members	National and external assistance including TCDC	With advice of WMO
	• develop storm surge maps and undertake hazard assessment activities*						Members		Digitized format ; Resolution 0.1 to 1.0 nautical mile
	• ~~undertake bathymetric and~~ topographic data collection for vulnerable areas*						Members		
	• CIMH is developing storm surge hazard maps for CMO members*						CIMH		
	• Bahamas increasing its maps using SLOSH						Bahamas		

CDERA will be using storm surge catalogues to assess potential flood vulnerability and mitigation options for two urban areas in an IDB funded project. Climate change vulnerability assessments will be used to develop response scenarios.

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* During 2003-2004 items with an asterisk to be given priority attention

II. HYDROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
2.1 SUPPORT TO HYDROLOGICAL SERVICES AND FACILITIES									
2.1.1	Strengthening the national Hydrological Services and, in particular, improvement of the hydrological observing networks and data transmission and processing facilities**						Members concerned	National and external assistance	**This would include promoting the use of quantitative precipitation information from precipitation forecasts, surface radar networks and satellites, as considered in the meteorological component of the Technical Plan
2.1.2	Establishment and development of national and/or sub-regional hydrological workshops to repair and maintain hydrological instruments, and promotion of the establishment of sub-regional facilities for the calibration of these instruments						Members concerned	National and external assistance	

St. Vincent and the Grenadines will receive assistance to purchase and install stream gauges under the CADM project. Support will also be provided to CIMH to calibrate, install and maintain this equipment.

III. HYDROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
2.2 HYDROLOGICAL FORECASTING									
2.2.1	Establishment, improvement and/or expansion of hydrological forecasting (including flash floods) and warning systems in flood-prone areas, and in particular: (a) The countries indicated to be invited to consider the establishment/ expansion of systems in the: • ATRATO, CESAR and SINU basins • YAQUE DEL SUR river basin • YAQUE DEL NORTE river basin • RIO GRANDE DE SAN MIGUEL river basins • OSTUA, COYALATE, POCOCHINO and MOTAGUA river basins • International river, RIO GRANDE (RIO BRAVO) river basin • VIEJO,COCO and TUMA river basins • RIO HONDO, international river • RIO PARRITA						Colombia)) Dominican) Republic El Salvador and Honduras Guatemala Mexico) Nicaragua) Mexico/) Belize Costa Rica	National	

Barbados and St. Vincent and the Grenadines will be assisted in the development of an Integrated Flood Management Programme. Dominica and Trinidad and Tobago will be assisted in the establishment of a community level early flood warning system. (CDERA)

II. HYDROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
2.2.1 (cont'd)	Establishment, improvement and/or expansion of hydrological forecasting (including flash floods) and warning systems in flood-prone areas, and in particular:								A flash flood warning system will be installed in 2003 and 2004 in Central America with support of the USA.
	(b) Establishment of flash flood warning systems in flood-prone areas;						Members concerned	National	
	(c) Promote the use of hydrological models to forecast the behaviour of rainfall and run-off characteristics, paying special attention to the use of radar and satellite information.						Members concerned	National	
2.3 BASIC SUPPORTING STUDIES AND MAPS									
2.3.1	Determination of flood-prone areas; compilation of an inventory of existing hydrological observing, transmission and processing facilities in these areas; and determination of requirements for related meteorological services						Members concerned	National and external assistance	For these studies, use should be made insofar as possible, of previous experience of Member countries of the Committee
2.3.2	Implementation of hydrometeorological and rainfall-runoff studies (including depth-area duration-frequency analyses of rainfall) for use in planning and design						Members concerned	National and external assistance	

2.3 **CDERA will undertake activities in this component in Barbados, St. Vincent and the Grenadines and Trinidad and Tobago.**

II. HYDROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
2.3.3	Carry out surverys as soon as possible, immediately following flood events for the purpose of delineating the limits of flooding. The survey could include if possible aerial photography						Members concerned	National	
2.3.4	Preparation of flood risk maps in flood-prone areas for their use in: (a) Planning and undertaking preventive measures and preparations for flood mitigation; (b) Long-term planning covering land use						Members concerned	National	Members sharing basins encouraged to standardize the scales of these maps
2.3.5	Assessment of quantitative precipitation information from precipitation forecast, satellite, radar and raingauge networks for flood forecasting						Members concerned	National and external assistance including TCDC	
2.3.6	Initiation of research studies and operational data collection for analysis and forecasting of combined effects of storm surge and river flooding phenomena** ** WMO Operation Hydrology Report No. 30 "Hydrological Aspects of Combined Effects of Storm Surges and Heavy Rainfall on River Flow" (**WMO Sec to replace with an IWTC initiative)**						Members	National and external assistance	For these studies, use should be made, insofar as possible, of previous experience of Member countries of the Committee

II. HYDROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
2.3.7	Basic studies on the vulnerability of the monitoring networks to damage caused by tropical storms, taking into account also the problems which might be generated when stations become inoperative, both with regard to the interruption of the available historical series and to the provision of observations and data of subsequent events						Interested Members	National and TCDC	
2.3.8	Basic studies on the intensity and spatial variability of rainfall produced by all tropical storms during the tropical cyclone season, as well as on the optimal density of the recording rainfall network required						Interested Members	National and TCDC	
2.3.9	Preparation of flood-risk maps of zones susceptible to flooding caused by tropical storms, separating floods resulting from local rains from those resulting from rainfall in the headwaters of the basins						Interested Members		
2.3.10	Basic studies on the problems of operation of reservoirs when their basins are affected by rainfall produced by tropical storms and decisions to be made with respect to the water impounded						Interested Members	National and TCDC	
2.3.11	Initiation of a GIS-based database to be used by all countries of the region						Interested Members	National and TCDC	

II. HYDROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
2.3.12	Establishment of a regional project to generalize the hydrological impact knowledge of tropical storms and hurricanes						Interested Members	National and TCDC	
2.4 TRANSFER OF HYDROLOGICAL TECHNOLOGY									
2.4.1	Attention to the availability through HOMS of components and sequences containing hydrological technology suitable for the hydrological component of the technical plan*						Members	National and TCDC	With advice of WMO
2.4.2	Undertaking a promotional effort among Member countries, so that they may develop HOMS components reflecting in particular experiences in regions affected by tropical storms; the Committee to encourage the inclusion of the components in the <u>HOMS Reference Manual</u>						Hurricane Committee in cooperation with its Members	National and TCDC	

* These HOMS components include instrumentation and hydrological models for monitoring and forecasting the floods caused by all tropical storms during the tropical cyclone season. HOMS components also relate to flood damage estimation extent of flooding and flood-plain mapping.

III. DISASTER REDUCTION AND PREPAREDNESS

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
3.1 DISASTER REDUCTION									
3.1.1	Drawing the attention of national authorities of the principal role of meteorological and hydrological factors in carrying out vulnerability analyses in the fields of physical and urban planning, land-use zoning, public works and building codes						Members	National, regional and international	
3.1.2	Promote public awareness of the hurricane risk and the associated risks prior to each hurricane season						Members	National, regional and international	
3.1.3	Participate actively in appropriate conferences related to natural hazard mitigation						Members	National, regional and international	
3.1.4	Participate actively in the preparation and on-going review of the national disaster prevention and preparedness plans						Members	National	
3.1.5	Cooperate with all national and regional agencies in their annual pre-hurricane season exercises. Where these do not exist meteorological services should promote their implementation						Members	National and regional	

CDERA has an Annual Press Conference on June 1st . It facilitates media training and conducts a biennial Preparedness Audit.

III. DISASTER REDUCTION AND PREPAREDNESS

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
3.1.6	Promote good relationship with the media and make full use of their services to disseminate information prior to and during the hurricane season						Members	National, regional and international	
3.1.7	Arranging for the early transmission of forecasts of hurricanes and flooding to the central coordinating agency responsible for the organization of protective and relief measures, and to similar coordinating agencies at regional level, to allow the timely dissemination of warning by such agencies						Members	National and regional	
3.1.8	Participate in ensuring that official advisory statements concerning forecasts, warnings, precautionary actions or relief measures are only to be made by authorised persons and to be disseminated without alteration						Members	National, regional and international	
3.1.9	Advising on and contributing to training programmes to support preparedness programes to include disaster administrators, disaster control executives and rescue/relief groups and workers in all counter-disaster authorities and agencies						Members	National, regional and international	

III. DISASTER REDUCTION AND PREPAREDNESS

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
3.2 REVIEWS AND TEST EXERCISES									
3.2.1	Participating in periodic reviews of both disaster prevention and disaster preparedness plans to ensure that they are active and up to date						Members	National and external assistance	With advice of OCHA/IFRC/ CDERA
3.2.2	Conducting of periodic staff checks and test exercises to test the adequacy of disaster preparedness plans, preferably on a progressive annual basis prior to the expected seasonal onset of natural disaster threats but also, in respect of plans to meet sudden impact disasters, on an occasional no-warning basis						Members	National	

IV. TRAINING COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
4.1 TRAINING OF METEOROLOGICAL PERSONNEL									
4.1.1	Assessment of current and expected future needs for the training of specialized staff to man their warning systems at all levels under the following headings: (a) Those capable of being met through training facilities already available in Member countries* (b) Those for which assistance from external sources is needed* Take appropriate steps to organize such training programmes*						Members Members Members	National National National and external assistance	 With advice of WMO
4.1.2	Support as appropriate and make full use of the training facilities offered at the WMO Regional Meteorological Training Centres at the CIMH, Barbados, and the University of Costa Rica, San José, as well as at the Tropical Desks in Washington and Montreal						Members	National and external assistance	

* During 2003-2004 items with an asterisk to be given priority attention

IV. **TRAINING COMPONENT**

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
4.1.3	Arrangements for short courses of approximately 2 to 3 weeks duration on topics related to storm rainfall estimation and to hurricane forecasting to be organized at the RSMC Miami Hurricane Center and the Regional Meteorological Training Centres at the CIMH and the University of Costa Rica*						Regional centres	Regional, national and external assistance	These events should be conducted in English and Spanish.
4.1.4	Arrangements for periodic seminars or workshops on specific topics of particular interest for hurricane prediction and warning purposes, priority being given in the first instance to operational techniques for the interpretation and use of NWP products, satellite and radar data and to storm surge prediction						Members, Hurricane Committee	National and external assistance	
4.1.5	Arrangements for exchange working visits of Staff between operational and training centres						Members, training centres	National and external assistance, regional projects, TCDC	

* WMO/TD-No. 975 (TCP-42) "Estimating the Amount of Rainfall Associated with Tropical Cyclones Using Satellite Techniques " was published in October 1999.

IV. TRAINING COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
4.2 TRAINING OF HYDROLOGICAL PERSONNEL									
4.2.1	Assessment of current staff availability and capabilities and future needs for training hydrologists in specific subjects concerning hydrological forecasting and warning and of hydrological technicians, to promote and take appropriate steps to organize and disseminate information on training courses, workshops and seminars, and in particular to support the following: (a) The establishment of a sub-regional centre in the Central American Isthmus for hydrological technicians' training; (b) The training of operational hydrological personnel at the sub-regional (training) centre in the Caribbean; (c) The organization of a course for training in tropical cyclone hydrology and flood forecasting.						Members concerned	National and external assistance	
	Courses and workshops on hydrological forecasting techniques or data acquisition, processing and analysis						USA or other Members concerned	National and external assistance	
4.2.2	Arrangements for exchange working visits of staff between national hydrology and flood forecasting centres and regional hydrological training centres						Members, training centres	National and external assistance, regional projects, TCDC	

V. RESEARCH COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2003	2004	2005	2006	2007			
5.1 RESEARCH									
5.1.1	Making readily available information on research activities carried out in Member countries to other Members of the Committee*	___	___	___	___	___	Members	National	*WMO, when requested, to facilitate the exchange of information on these activities as well as on sources of data available for research
5.1.2	Formulation of proposals for consideration by the Committee for joint research activities to avoid duplication of effort and to make the best use of available resources and skills	___	___	___	___	___	Members	National	
5.1.3	Arrangements for exchange visits of staff between national research centres	___	___	___	___	___	Members	National and external assistance, regional projects, TCDC	

* During 2003-2004 items with an asterisk to be given priority attention.

APPENDIX VI

(Presentation by USA, hard copy only)