WORLD METEOROLOGICAL ORGANIZATION

RA IV HURRICANE COMMITTEE

FINAL REPORT

OF THE

TWENTY-SIXTH SESSION

MIAMI BEACH, FLORIDA, USA
28 APRIL TO 3 MAY 2004

GENERAL SUMMARY OF THE WORK OF THE SESSION

1. ORGANIZATION OF THE SESSION (Agenda item 1)

1.1 Opening of the session (agenda item 1.1)

1.1.1 At the kind invitation of the Government of the United States, the twenty-sixth session of the RA IV Hurricane Committee (RA IV/HC-26) was held at the Deauville Beach Resort, in Miami Beach, Florida, from 28 April to 3 May 2004. The opening ceremony commenced at 0815 hours on Wednesday, 28 April 2004.

1.1.2 Retired Brigadier General David L. Johnson, Assistant Administrator, NOAA's National Weather Service, opened the RA IV/HC-26 with the presentation, "Teamwork Gets it Done". General Johnson emphasized the importance of regional partnerships relating to data acquisition and processing, numerical modeling, warning operations, information dissemination and response for the success of the hurricane warning program. Additionally, General Johnson outlined the Region's recent accomplishments including the 5-day forecast, improved track forecasts and the transition of projects from research to operations via the Joint Hurricane testbed. Future projects for improved observations and storm surge models were also mentioned. General Johnson concluded by summarizing the many innovative ways RA IV Members work together and encouraged future cooperation and collaboration.

1.1.3 On behalf of Mr Michel Jarraud, Secretary-General of WMO, Ms Nanette Lomarda, the WMO Secretariat representative, welcomed the participants and expressed the appreciation of WMO to the Government of the United States for the kind invitation to host the annual session of the Committee. She stated that the Secretary-General had emphasized his close interest in the important work being done by the RA IV Hurricane Committee aimed at the prevention of loss of life and reduction of damage to property due to tropical cyclones and its associated hazards and looks forward to even more substantial contributions and activities from its Members. Ms Lomarda then urged the Committee to formulate new strategies to further enhance its work and attain its humanitarian goals.

1.1.4 Mr Arthur Dania (Netherlands Antilles and Aruba), President of RA IV, in his opening remarks, expressed his appreciation on the level of participation of all the Members of RA IV in the work and activities of the Committee. In particular, he expressed his appreciation for the attendance of the new Director of NOAA's National Weather Service, Retired Brigadier General David L. Johnson at the opening of the session. Mr Dania stressed the crucial importance of the work and activities of the Committee in the protection of life and property. Furthermore, he stressed the important role the Committee has played over the years in the enhancement of the standard of development of all the NMHSs of RA IV. In this connection, he mentioned several important milestones reached by the Committee. In particular, he mentioned the Committee's achievements regarding the Regional Meteorological Telecommunication Network, the development of an excellent operational plan, the many training events, the Regional Maintenance Project, the Regional Internet Project and several other important projects. He expressed thanks to WMO, to the Government of the United States and all the other countries which supported these projects over the years.

1.1.5 The Chairman of the Hurricane Committee, Mr Max Mayfield (USA), welcomed all participants and stated that he looks forward to a fruitful session with the active participation of all those attending this year's session. He concluded by formally declaring the session open.

1.1.6 The session was attended by 51 participants, including those from 26 Members of WMO and observers from seven private, regional and international organizations. The list of participants with the capacities in which they attended is given in Appendix I.

1.2 Adoption of the agenda (agenda item 1.2*)*

The Committee adopted the agenda for the session as given in Appendix II.

1.3 Working arrangements for the session (agenda item 1.3)

The Committee decided on its working hours and the arrangements for the session.

2. REPORT OF THE CHAIRMAN OF THE COMMITTEE (Agenda item 2)

2.1 The Chairman reported to the Committee that RSMC Miami – Hurricane Center continued to assist the RA IV Members in the coordination of watches and warnings during the tropical cyclone events of 2003. RMSC Miami began issuing five-day hurricane forecasts this year, extending the three-day forecasts issued since 1964. The RSMC Miami is responsible for tropical and subtropical cyclone advisories for the North Atlantic Ocean, the Caribbean Sea, Gulf of Mexico and the North Pacific Ocean eastward from 140°W.

2.2 The Committee was informed that one meteorologist from Mexico (Itzel Lopez Ortiz) was part of the RSMC Miami attachment in 2003. Ms Lopez was helpful in improving hurricane warning and coordination in the Region while gaining valuable training in hurricane forecasting. This programme has been successful and the chairman hopes to have a continued participation of meteorologists from the Region during the 2004 hurricane season. RSMC Miami and WMO had already asked WMO RA IV Permanent Representatives for potential candidates for the 2004 season.

2.3 Three meteorologists from the Mexican Air Force were stationed at the RSMC Miami during 2003. They provided assistance to the Hurricane Warning Program primarily by helping to coordinate timely clearances that allowed hurricane surveillance and reconnaissance flights over Mexico during potential land falling tropical cyclone events.

2.4 The 2004 RA IV Hurricane Forecasting and Warning workshop took place from 13 to 24 April and was conducted in English and Spanish as requested in previous Hurricane Committee meetings. The Meeting recalled that the 2003 RA IV Workshop on Hurricane Forecasting and Warning was conducted in English only. The Chairman strongly feels that offering this as a bilingual workshop is important to the Region's hurricane programme.

2.5 The Caribbean Hurricane Awareness Tour (CHAT) took place during 15 to 21 March 2004 and consisted of a U.S. Air Force C-130 (J-model) hurricane hunter plane visiting Tampico, Mexico, Dominica, Martinique and Guadeloupe (France) and both Ponce and San Juan, Puerto Rico. The CHAT was very successful in conveying the hurricane problem to communities at high risk and in promoting the team effort involved in the hurricane programme. The CHAT enhanced the visibility of the individual country weather forecasting and emergency management offices. Over 15,000 people toured the plane. A Hurricane Awareness Tour (HAT) took place along the U.S. east coast during 4 to 9 May 2003 and another HAT is expected to take place along the U.S. coast of the Gulf of Mexico from 17 to 21 May 2004.

2.6 Reconnaissance aircraft have continued to play an important role in monitoring the track and intensity of tropical cyclones. U.S. Air Force Reconnaissance Hurricane flights are providing very useful meteorological data. The cooperation by all parties involved is fully appreciated.

2.7 Radar imagery received operationally via the internet from Cuba and Mexico was again extremely useful to the RSMC Miami during the 2003 season. Other countries with similar facilities are encouraged to provide their radar data.

2.8 As part of the United States Weather Research Program (USWRP), the Joint Hurricane Testbed (JHT) is a mechanism for evaluating research projects with the goal of transitioning successful projects into operations.

2.9 The American Meteorological Society (AMS) 26th Conference on Hurricanes and Tropical Meteorology will take place in Miami Beach, Florida from 3 to 7 May 2004. Dr Lixion Avila (USA) continues as a member of the AMS Tropical Committee and is the chairperson of this year's Conference. The Chairman is pleased that the 2004 WMO RA IV Hurricane Committee meeting is being held in conjunction with the AMS Tropical Conference, as was requested by the Members during last year's Hurricane Committee meeting in Mexico City.

2.10 The next International Workshop on Tropical Cyclones (IWTC-VI) is scheduled to take place in Costa Rica in 2006. The dates are yet to be determined. Dr Avila continues to represent RA IV in the International Committee.

2.11 Given the visibility of the recent tropical cyclone that struck Brazil, WMO invited a representative from Brazil to attend the 26th session of the RA IV Hurricane Committee. The representative participated actively in the discussions. The Chairman suggested that Brazil be represented at future WMO sponsored training course on hurricanes.

In addition to the Chairman's report:

2.12 The Committee highlighted the success of the 2003 Hurricane Awareness Tour and strongly endorsed the continuation of these tours as a method to enhance the visibility of the individual country weather forecasting and emergency management offices.

2.13 The representative of WMO's Commission on Atmospheric Sciences (CAS) emphasized that it is very important that the operational forecaster group be well represented at the IWTC-VI scheduled in 2006. He stressed that it is equally important that those attending the international workshop be identified as early as possible to enable the International Committee to assign them to the different working groups.

2.14 The Committee felt that since the IWTC-VI will be held in Region IV, this would mean the expenses that would be incurred to support the participation of forecasters from Hurricane Committee Members will be less compared to IWTC-V. It therefore requested that WMO provide funding support for the participation of a larger number of forecasters from the Region at the IWTC-VI. It also urged the NMHSs to ensure that only appropriate personnel who would be able to make a meaningful contribution to the IWTC, be nominated to attend.

2.15 The President of RA IV informed the Committee that he had sent out a letter on the 1st of April 2004 to Committee Members requesting nominations of bilingual operational forecasters for attachment at the RSMC Miami - Hurricane Center for at least four weeks during the 2004 hurricane season. He strongly urged Members to send in their nominations well before the 15 May 2004 deadline (see 2.2 above).

3. COORDINATION WITHIN THE WMO TROPICAL CYCLONE PROGRAMME (Agenda item 3)

3.1 The Committee was informed that the TCP had engaged the services of Systems Engineering Australia Pty. Ltd. in July 2003 to undertake reviews and assessments that would lead to suitable conversion factors between the WMO 10-minute average wind and 1-minute, 2-minute and 3-minute "sustained" winds. The technical report from this study will be subsequently included in the updated edition of the Global Guide to Tropical Cyclone Forecasting and the Operational Plans/Manual of the five tropical cyclone regional bodies.

3.2 The Committee urged Members to make full use of recently published technical reports in the TCP series, such as the updated brochure "*Specialized Centres Provide Up-to-Date Tropical Cyclone, Hurricane, Typhoon Advisories*" (WMO/TD-No. 1045) (TCP-44) and the "*Annual Summary of Global Tropical Cyclone Season 2002*" (WMO/TD-No. 1194) (TCP-49).

3.3 The Committee was informed that arrangements had been made to organize an expert meeting on the implementation of TCP sub-project no. 23: *Combined effects of storm surges/wind waves and river floods in low-lying areas* in Brisbane, Australia from 6 to 7 July 2004 and that an expert meeting on the formulation of TCP Sub-project No. 24: Establishment of a tropical cyclone forecaster Web Site would be held from 8 to 9 July 2004 also in Brisbane. The Committee noted that the two sub-projects would involve the participation of all five tropical cyclone regional bodies.

3.4 The Committee was pleased to learn of the successful completion of the RA IV Workshop on Hurricane Forecasting and Warning and Public Weather Services, organized by NOAA in cooperation with WMO at the RSMC Miami - Hurricane Center, from 13 to 24 April this year. It was attended by 24 participants that included six female meteorologists from the Region. This was conducted in English and in Spanish. The Committee strongly endorsed that future workshops also be bilingual.

3.5 The Committee was informed that the TCP had, as was proposed by the ESCAP/WMO Typhoon Committee, engaged the services of a consultant from the Philippines to undertake a study on the economic and societal impacts of tropical cyclones on the Philippines. The report, to be finished by the end of this year, will serve as a prototype for subsequent studies that will be conducted in the four remaining tropical cyclone regional bodies. This study is being undertaken in connection with TCP sub-project No. 25: *Study on the economic and societal impacts of tropical cyclones* that was endorsed by the Fourteenth World Meteorological Congress (Cg-XIV, Geneva, 2003).

3.6 On the issue of climate change and tropical cyclone aspects, the Committee was informed by the representative of CAS that IWTC-V (Cairns, December 2002) had concluded that the statement prepared by a committee of prominent scientists headed by Professor Ann Henderson-Sellers that was published in the Bulletin of the American Meteorological Society (1999) remains the latest official statement from the meteorological community on the issue and that an updated statement is currently under preparation. The 1999 statement is also available at:

http://www.bom.gov.au/bmrc/meso/New/Gallery/People/Greg_Holland/TC_ClimChange/tropical.htm

3.7 The Committee noted with appreciation the strong support of Cg-XIV regarding the need for its annual sessions and of the annual workshops on hurricane tracking and forecasting at the RSMC Miami-Hurricane Center. In this regard, the Committee requested the Secretary-General of WMO to ensure that appropriate funding and support be allocated for the organization of these two important annual events.

4. REVIEW OF THE PAST HURRICANE SEASON (Agenda item 4)

4.1 Summary of the past season (agenda item 4.1)

4.1.1 A report of the 2003 hurricane season in the Atlantic basin and in the eastern North Pacific was presented to the Committee by Dr Lixion Avila of RSMC Miami - Hurricane Center.

RSMC Miami 2003 Atlantic Hurricane Season Summary

4.1.2 There were 16 named tropical cyclones in the Atlantic basin in 2003, of which seven became hurricanes. There have been six seasons with 16 or more named tropical cyclones in the 118 seasons since 1886, so 2003 ranks in the upper five percentile of seasonal number of named tropical cyclones. Seven hurricanes are close to the long-term average value of six, but both Fabian and Isabel were exceptionally long-lived and intense. Also, Fabian, Isabel, and Kate were major hurricanes (category three or higher on the Saffir-Simpson Hurricane Scale).

RSMC Miami 2003 Eastern Pacific Hurricane Season Summary

4.1.3 There were sixteen named tropical cyclones in the Eastern North Pacific basin in 2003, of which seven became hurricanes. These totals compare to long-term averages of sixteen named tropical cyclones and nine hurricanes. There were no major hurricanes (category three or higher on the Saffir-Simpson Hurricane Scale) during the 2003 season. This is the first time this has occurred since 1977 and is well below the long-term average of four major hurricanes. The first hurricane, Ignacio, did not form until 24 August. This is the latest observed first hurricane of record in the basin since reliable satellite observations began in 1966.

4.1.4 The report on the 2003 hurricane season provided by RSMC Miami-Hurricane Center is given in Appendix III.

4.2 Reports on hurricanes, tropical storms, tropical disturbances and related flooding during 2003 (agenda item 4.2)

4.2.1 The Committee was informed by the representative of USA that two hurricanes made landfall in the United States in 2003. Claudette struck Texas near Matagorda Island as a category-one hurricane and category-two Isabel made landfall on the Outer Banks of North Carolina. Isabel brought hurricane conditions to portions of North Carolina and Virginia and record flood levels to the upper Chesapeake Bay. In addition, Tropical Cyclones Bill, Erika, Grace and Henry affected the United Sates. This season's tropical cyclones took a total of 24 lives and a total damage estimated at 3.6 billion dollars in the United States. Most of the damage was caused by Hurricane Isabel.

4.2.2 The Committee was informed by the representative of Canada that in 2003, five tropical cyclones entered the Canadian Hurricane Center (CHC) Response Zone. Two of these moved inland, two entered Canadian waters, and one remained outside Canadian waters. 2003 marked the fourth consecutive year for a landfalling tropical cyclone in Canada, three of which

were hurricanes. Of the three, Hurricane Juan was the worst hurricane to hit the population centre of Atlantic Canada in over 100 years, claiming more inland-lives in Canada than any tropical cyclone since Daisy which claimed six lives in 1962.

4.2.3 The Committee was informed by the representative of Bermuda that the country was affected by five tropical cyclones in 2003. The most significant of these by far was Hurricane Fabian, which caused substantial damage to the island on 5 September. Fabian was one of the strongest hurricanes to hit Bermuda in over 75 years.

4.2.4 The Committee was informed by the representative of the Dominican Republic that the off-season Tropical Storm Odette in 2003 left in its wake overflowing rivers, inland flooding and landslides. The Chairman of the Committee commended the Dominican Republic for the markedly improved coordination between the country's weather service and its civil defense agencies manifested during the occurrence of Odette.

4.2.5 The Committee was informed by the representative of Mexico that the 2003 cyclone season is considered very active as regards the number of cyclones that had made landfall in Mexico, with a total of eight systems from the Pacific and Atlantic Oceans. This number was only exceeded in the 1971 season when there were nine direct impacts, which was a record. The average for the period 1970-2003 was 4.2 cyclones per annum directly affecting the country. The eight landfalling systems in 2003 were Hurricanes Ignacio, Marty and Erica, Tropical Storms Carlos, Olaf, Claudette and Larry and Tropical Depression Nora. He expressed his appreciation to RSMC Miami for the guidance information and coordination from the center that proved very helpful to Mexico.

4.2.6 The observer from Brazil made a very enlightening presentation on the cyclone that struck Caterina, Brazil in late March this year. The Committee expressed its appreciation that Brazil sent an observer to this year's session in the person of Ms Odete Marlene Chiesa, Meteorologist of the Brazilian Meteorological Service (INMET), and reiterated the Committee's invitation that the country participate in future Hurricane Forecasting Workshops at the RSMC Miami and also as observer to future Hurricane Committee meetings. The Committee was informed that the Dvorak estimate from RSMC Miami for the cyclone was that of a Category 1 hurricane. It had been noted that no reliable observation of the maximum winds associated with the cyclone were made as there were no observing stations in its path. The RSMC Miami offered to provide satellite estimates of location and intensity as well as guidance from numerical models on future tropical cyclones in this area. The Chairman encouraged Committee members to attend a special AMS session on the cyclone which struck Brazil scheduled for 2 May.

4.2.7 The reports on the 2003 hurricane season provided by other Member countries are given in Appendix IV.

4.2.8 The Committee was informed that the performance of the super ensemble forecast is not always good while the newer approach of averaging model track forecasts (consensus approach) seems to be giving better results. The Florida State University super ensemble approach, is also available to RSMC Miami.

4.2.9 The Committee recognized the need to promote public awareness that a tropical cyclone is not a point on the map and that destructive winds associated with these systems can extend well away from the cyclone center. This is in response to a suggestion that the meteorological community look for a better definition of the term "direct hit" as exemplified by the extensive damage caused by Hurricane Fabian to Bermuda even though it was not on the direct path of the cyclone's center.

4.2.10 The representative of the Caribbean Institute of Meteorology and Hydrology (CIMH) suggested that Bermuda, which is in current need of a storm surge model for their use, look into the suitability of the storm surge model TAOS (The Arbiter Of Storms). The TAOS model was developed under the Caribbean Disaster Mitigation Project (CDMP) to provide storm surge heights at coastlines, surface wind speeds and wave heights and is installed at the CIMH which now holds the license for the Caribbean region.

4.2.11 The representative of Mexico stated that the summary of the 2003 tropical cyclones affecting Mexico was prepared with the help of other government and academic institutions in the country.

4.2.12 The Committee was informed that Prof William Gray's current forecast for the upcoming hurricane season is that it will be an active one with fourteen tropical storms, with eight developing into hurricanes and three into major hurricanes. It was further informed that Prof Gray will commence issuing this year a probability forecast for each Gulf of Mexico and Atlantic coastal county in the USA.

4.2.13 The Committee noted that one can not effectively equate the number of tropical storms and hurricanes during the season with damage and loss of lives. What is most important is where the hurricanes will strike land and how strong they are at landfall.

5. COORDINATION IN OPERATIONAL ASPECTS OF THE HURRICANE WARNING SYSTEM AND RELATED MATTERS (Agenda item 5)

5.1 The Committee designated Mr Tyrone Sutherland of the British Caribbean Territories to serve as rapporteur for the discussions under this agenda item. The Committee discussed several issues relating to the effectiveness of the regional hurricane warning system. These comprised both scientific and technical matters raised by a number of Committee members and by the RSMC in Miami.

5.2 In this regard, Colombia informed the Committee on its use of the NCAR MM5 numerical model, which had provided acceptable results in forecasting the movement of tropical waves in the Colombian Sea area. Colombia also mentioned that it was able to provide additional upper-air soundings at the San Andrés and Riohacha stations at 0000Z during the threat of tropical storms or hurricanes in the vicinity of its territory. In addition, it reported on other activities that its Service was undertaking towards improving its warning system, including its training programmes.

5.3 Costa Rica informed the Committee on its use of the Eta and GFS (Global Forecast System) models. It indicated that it would seek the cooperation of NOAA for verification of the results of these models. The Chairman informed the Committee that the RSMC Miami verifies the tropical cyclones from these models, although they were not the main models used operationally.

5.4 Mexico referred to the special problems it encountered with the detection of tropical disturbances that develop near the Mexican coasts, which had the potential to develop into tropical storms and hurricanes. It discussed the possibility of running models that would assist in this particular problem, as well as the options of mentioning these systems in its bulletins to local authorities before they were made public. The Chairman expressed caution about decisions that were based on NWP models that may not handle cyclone genesis very well. The Meeting was reminded of the various guidance material that the RSMC Miami issues to assist in this

regard. The Chairman indicated that that there would be a presentation at the upcoming AMS Hurricane Conference, to follow the Hurricane Committee session, on these types of developing systems.

5.5 As a follow-up to the 25th session in 2003, Météo-France (MF) informed the Committee that since July 2003, it had provided RSMC Miami with secure access to the radar images from Guadeloupe and Martinique every 5 minutes from an ftp server in MF in Toulouse-France. Other NMSs in the region continued to access these images via its Web Site: www.meteo.gp. The Members of the Committee expressed their great appreciation to MF for the access to these radars, but noted the difficulty in accessing the Web Site during periods of severe weather, because of the number of hits on the Site. The Meeting discussed several options for improving the situation, including the use of mirror sites designed to separate the public and general users from the NMS users. MF indicated that it would continue to explore various options in this regard.

5.6 Météo-France informed the Committee of its operational use since 2002 in the French West Indies of Ensemble Prediction System (EPS) products for tropical cyclones, as issued by ECMWF and Météo-France. It informed the Committee that access to the ECMWF, although in a test mode, could be obtained through the ECMWF Web Site, and that the MF products provided good guidance in the Atlantic Basin in 2003. The Meeting discussed the varying results of EPS guidance in recent years. It also noted that the IWTC-V (Australia, 2002) recommended that EPS products be made widely available. The Chairman encouraged Committee members to attend sessions on ensemble forecasting at the AMS Hurricane Conference.

5.7 Météo-France (MF) also informed the Committee that in October 2003, it implemented the “non stretched” version of the French model ARPEGE (Action de Recherche Petite Echelle Grande Echelle) with a tropical cyclone “bogus”. While the bogus was only based on a “pseudo” mean sea level pressure (MSL) observation, it had already shown capabilities of improving track and intensity forecasts. MF indicated that the model was developed at the South-West Indian Ocean RSMC in La Réunion (RA I) and that results for the Atlantic were available via its Web Site. In response to questions, MF informed the Committee that while the model depicted tropical waves, there was no bogus in this model for these waves.

5.8 The Meeting was informed of the performance of the MF quasi-operational cyclonic wave model on selected hurricanes during the 2003 season. MF reported encouraging results, as well as several areas for further improvement. At the same time, MF reported on the operational status of, and means to access its moored off-shore buoys located just to the east of the Eastern Caribbean Island chain. These buoys are considered important to the regional warning system.

5.9 Several Committee members reported on activities to improve their warning systems, or on problems encountered that impacted on the system. El Salvador informed the Committee that because of problems in forecasting certain weather features, such as tropical waves, its staff was receiving university training in the use of mesoscale models. On the important issue of the regional upper-air network, Panama reported on problems with its upper-air equipment and the irregular soundings due to staff shortages. It also reported that the WMO was assisting with solving coding and format problems that prevented its soundings from being transmitted on the GTS. Venezuela informed the Committee that three new upper-air stations along the coast and on Aves Island (Bird Island) would be available by the end of 2004.

5.10 In discussing radar matters, the Committee was informed that Doppler radar data and information from Panama is now available on the Internet. Venezuela indicated that of its eight new Doppler radars, two were on the coast and that images should be available for the 2005 hurricane season. The Bahamas and Honduras indicated the possibility of having new Doppler radars in the near future. The Dominican Republic noted that WMO was assisting in efforts to restore the radar in Santo Domingo. Since no weather radar data coverage of Haiti was available operationally, NOAA/NWS was requested to investigate the possibility of access to radar information from the US Naval facility at Guantanamo in southeastern Cuba, which should provide such coverage. Cuba indicated that several of its radars are available in its Web Site, although the Isla de la Juventud (Isle of Youth) was not yet part of the Web site. It indicated that one of its radars in Eastern Cuba could also be helpful to Haiti and Jamaica.

5.11 The Committee discussed proposals of the Chairman to ensure that both the Azores and Cape Verde Islands were able to fully benefit from RSMC Miami products and services. Considering that both set of Islands were in the Atlantic tropical cyclone basin but outside the area covered by RSMC Miami, he requested the WMO Secretariat to provide operational telephone numbers of the Azores and Cape Verde Meteorological Offices for inclusion in the RA IV Hurricane Operational Plan and to provide both Offices with copies of the Operational Plan. The Committee agreed with the Chairman's proposal that WMO invite those offices to send representatives to future hurricane workshops at the RSMC Miami and to RA IV Hurricane Committee Meetings. However, the Committee suggested that, should financial support for participation be required by those Offices, the WMO Secretariat should find such funds from sources other than those assigned to the RA IV.

5.12 The Committee noted with appreciation a presentation by Mr Roy Evers on the on-going Regional Web Site Project. This project, funded by the USA and being executed under the coordination of the RA IV President, is composed of a regional Web Site portal (http://www.caribweather.net) and Web Sites of the NMHSs in RA IV, for the dissemination of meteorological and hydrological data and products.

6. REVIEW OF THE RA IV HURRICANE OPERATIONAL PLAN (Agenda item 6)

6.1 Under this agenda item, the Committee designated Mr Carlos Fuller (representative of English-speaking members) and Mr Jose Rubiera (representative of Spanish-speaking members) to serve as rapporteurs.

6.2 The Committee reviewed the RA IV Hurricane Operational Plan, taking into account changes and additions that came out from the other agenda items.

6.3 As is the normal practice, the Committee retired names of cyclones of significant strength or impact during the previous season. On the Atlantic list, "Fabian, Isabel and Juan" were retired and replaced by "Fred, Ida and Joaquin", respectively. The Committee also overwhelmingly decided to maintain the name "Laura" to replace "Lili" on the list of names to be used in 2008 for the Atlantic basin. It was determined that it was not officially retired but was dropped from the list during the reorganization in 1979.

6.4 The Committee recommended to the President of RA IV the approval of the amendments to the text of the Plan. The President of RA IV approved these amendments. The Committee urged WMO that these amendments and changes made to the attachments to the Plan should be published in a new 2004 edition in English and Spanish, as soon as possible.

7. REVIEW OF THE COMMITTEE'S TECHNICAL PLAN AND ITS IMPLEMENTATION PROGRAMME FOR 2004 AND BEYOND (Agenda item 7)

(a) The Committee designated Mr Carlos Fuller (representative of English-speaking members) and Mr Jose Rubiera (representative of Spanish-speaking members) to serve as rapporteurs.

(b) A detailed review of all components of the Technical Plan and its Implementation Programme was carried out, taking into account the development and progress made by Members since the twenty-fifth session of the Committee. The President of RA IV approved the updated RA IV Hurricane Committee's Technical Plan and its Implementation Programme, which is given in Appendix V.

7.1 Meteorological component (agenda item 7.1)

7.1.1 The Committee was informed that the current Regional Basic Synoptic Network (RBSN) in Region IV, is comprised of 512 surface stations, 142 upper-air stations and 25 automatic marine stations. The annual global monitoring of the operation of the WWW provides information on the performance level of the observing and telecommunications systems. It should be noted that during the intersessional period, the overall status of implementation of the RBSN in Region IV decreased to 89 per cent (90% in 2002) for surface observations and increased up to 93 per cent (91% in 2002) for upper-air observations.

7.1.2 The Committee noted that according to the results of monitoring carried out in October 2003, 449 stations, i.e. almost 88 per cent (85% in 2002) out of the total number of RBSN surface stations, were providing more than 50% of expected SYNOP reports. The number of stations providing less than 50% of expected reports had been decreased from 48 (2002) to 30 stations. An alarming tendency was that the number of "silent" stations increased to 33 (26 in 2001 and 29 in 2002) stations, constituting almost 6.5% of the total number of RBSN surface stations.

7.1.3 The Committee took note that the availability of upper-air data from the RBSN stations in 2003 indicated that 126 or 89 per cent of the total number of RBSN upper-air stations were providing at least 50% of expected reports which showed an improvement as compared with 2001 (119 stations or 83%) and 2002 (122 stations or 85%). The number of stations providing less than 50% of expected TEMP reports reduced noticeably to four stations or almost 3% (11 stations or 7% in 2002) of the total number of RBSN stations. It should be noted however, that the number of "silent" stations increased from nine (2002) to 12 stations.

7.1.4 The Committee noted with appreciation that the old equipment at the ten rawinsonde stations which are supported by the USA in the southern part of RA IV has been replaced by new state-of-the art equipment (rawinsonde systems and hydrogen generators). These stations are a crucial part of the RA IV upper air network and in this regard wishes its thanks to the USA for this important support. There are concerns about the timeliness of technical support offered during breakdowns and maintenance difficulties with the rawinsonde systems and hydrogen generators. The Committee stressed the importance of the regional upper-air network and requested RA IV Members operating upper-air stations to do their utmost to continue to find ways and means to keep the operations of their upper-air stations to appropriate standards.

Telecommunication Systems

7.1.5 The International Satellite Communication System (ISCS), operated by the USA, provides satellite-based telecommunications for the RA IV Regional Meteorological Telecommunications Network (two-way), as well as for ICAO World Area Forecast System (WAFS) and OPMET (i.e., METAR and TAFs) information dissemination. The United States National Weather Service (US NWS) has implemented the upgraded ISCS, that provides an increased capacity and uses TCP/IP procedures in place of the X.25 protocol, which required the replacement of the terminal workstations installed with the initial ISCS. Some difficulties with the finalization of the upgraded ISCS with the satellite-based telecommunications provider, MCI Communication Corporation, lead to the postponement of dual operation (X.25 and TCP/IP) which took place from end of February. The Committee noted with appreciation that the definite switchover to the new ISCS configuration (TCP/IP) that was scheduled to 30 April 2004, had been postponed until end of May; This relaxation was required for fixing some pending problems in the distribution of data (delays for some data sets) and would facilitate the finalization of the workstations upgrade at all sites. The Committee thanked the US NWS for the organization, of a side Informational Briefing on ISCS Transition during the session, with the participation of MCI representatives, as well as workstations vendors concerned. This Briefing greatly facilitated contacts with NMHSs with a view to solving some remaining issues related to billing arrangements with MCI and a few technical matters.

7.1.6 At all sites equipped with ISCS VSAT in Region IV, including some centres in Region III (Colombia, Venezuela, Guyana, French Guyana), the installation of new PC-based workstations was required, in phase with the upgrade of the ISCS in order to ensure a smooth transition and continued operation. Most Caribbean countries have received assistance through the SIDS-Caribbean project for the replacement of their workstations, and the related contract for provision and installation of equipment is coordinated by WMO. The workstations provision and installation for other RA IV NMSs requiring external assistance (in Central America) are supported by the US-NWS under VCP. The overall technical and operational coordination of the ISCS upgrade is undertaken by the US NWS, in close coordination with WMO. The Committee also noted that six smaller meteorological offices in the Caribbean had been equipped with EMWIN receivers in the framework of the SIDS-Caribbean project. Significant changes in the technical specifications of EMWIN, i.e. reduced power level, new carrier frequency of 1692.7 MHz, new binary phase shift keying (BPSK) modulation scheme and forward error correction, were required and the transition was planned for 2005. The current EMWIN radio-receivers would need to be replaced/upgraded. The new EMWIN receiver specifications were currently being finalized. The Committee agreed to keep this matter under review to ensure that adequate action be taken in due time to maintain continued operation in the six meteorological offices concerned.

7.1.7 RTH/WMC Washington has enhanced Web server services in support to the NMHSs of the region, providing access to data and products files as well as procedures for ingesting observational meteorological bulletins via Internet, as a back up to the RMTN.

7.1.8 The Committee noted with appreciation the presentation made by Mr Steve Polonnais, Team Leader of the SIDS-Caribbean Project. He informed the Committee that 29 automatic weather stations are being installed in the Caribbean under the said project. New workstations were being installed in the participating States and the telecommunications component had been upgraded to the new TCP/IP standard for the ISCS.

Marine Meteorology And Oceanography

7.1.9 The Committee was informed that at the kind invitation of the Government of Canada, a workshop on wind wave and storm surge analysis and forecasting, for participants from Caribbean countries, took place at the Maritimes Weather Centre, Meteorological Service of Canada (MSC) in Dartmouth, Canada, from 16 to 20 June 2003. The workshop provided 12 participants from nine countries with both technical and practical knowledge in wave and storm surge analysis and forecasting techniques. Recognizing that the WMO Wave Programme has been transformed into the JCOMM Wind Wave and Storm Surge Programme, lectures and lab sessions on storm surges were also introduced into the workshop. A CD-ROM which includes presentations given at the workshop was published in the JCOMM Technical Report series and distributed to the participants and all WMO Members represented on JCOMM.

Satellites

7.1.10 The Committee was informed that for the RA IV Region during 2003, the space-based constellation, in addition to the R&D satellites, was comprised of the following geostationary and polar-orbiting satellites: GOES-10, GOES-12, NOAA-15, NOAA-16 and NOAA-17 operated by the USA; METEOR 2-21, METEOR 3-5 and METEOR 3M N1 operated by the Russian Federation (although METEOR 3M N1 suffered a severe reduction in capability in late 2003); Meteosat-5, Meteosat-6, Meteosat-7 operated by EUMETSAT; and FY-1C, FY-1D operated by the People's Republic of China. There were several satellites launches in 2003. NASA launched ICESat and SORCE in January, NOAA launched DMSP F-16 in October, and CAST launched CBERS-2 in October.

7.2 Hydrological component (agenda item 7.2)

7.2.1 The Committee was informed that the eighth session of the RA IV Working Group on Hydrology (WGH) was held in Santo Domingo, Dominican Republic, from 14 to 18 July 2003. The activities of the group were reviewed in this meeting, including the Hydrological Component of the Hurricane Committee's Technical Plan. The WGH is working in five high-priority topics: (a) Training and Continuing Education, (b) Hydrological Warning System, (c) Integrated Water Resources Management, (d) CARIB-HYCOS and (e) Transboundary Water Resources Management. The WGH noted progress in the Region with respect to the use of mathematical models for hydrological forecasting and establishment of Hydrological Warning System, mainly in the Central America countries affected by Hurricane Mitch; progress was also noted in the application of WMO standards and recommended practices in hydrology. The WGH summarized the following high-priority regional needs in hydrology for the next working period: (a) Standardization of hydrological format, (b) Training in automated system technology, (c) Training in some aspects of integrated water resources management and (d) distance learning and use of Internet for training.

7.2.2 Regarding the Hydrological Component of the Hurricane Committee's Technical Plan, the RA IV WGH noted advances in the implementation of flood warning system, forecasting hydrological network and countries vulnerability studies. The WGH considers that it is necessary:

(a) to update the Hydrological component of the Hurricane Committee's Technical Plan with the active participation of the national hydrological services;

(b) to increase the coordination between the national meteorological and hydrological services, in all their activities;

(c) to establish between the national hydrological services, a communication and hydrological data transfer system during severe meteorological phenomena; and

(d) to improve hydrological information and data in the hurricane seasonal report.

7.2.3 The WGH will make during 2004, in cooperation with the national hydrological and meteorological services, a detailed evaluation of the Hydrological Component of the Hurricane Committee's Technical Plan. Finally it was noted that the WGH's representatives confirmed the importance of the cooperation with the Hurricane Committee.

7.2.4 After considering the information presented by the representatives of the WGH, the Committee recognized the importance of close coordination between these two bodies and:

1. Invited Member countries to include in their annual reports hydrological information following the "Guide on the hydrological information contained in the annual national reports on hurricanes, tropical storms, and perturbations with associated flooding";

2. Confirmed the importance of the cooperative work between the WGH and the Committee;

3. Confirmed the importance of a member of the RA IV WGH to attend the Committee session; and

4. Expressed its satisfaction at the way the WGH had received the recommendations of the Hurricane Committee sessions for future activities to reinforce the working relation of the two bodies and gave its support to these future activities.

7.2.5 The Committee was briefed on a proposal for an International Flash Flood Workshop to be coordinated by the US National Weather Service and possibly by WMO. The Committee supports this important activity and recommends the workshop to be held in the Region.

7.2.6 The Committee discussed the importance of CARIB-HYCOS to the Region and expressed its disappointment at the slow pace of progress within WMO towards its implementation. The Committee urged the WGH to strongly support the CARIB-HYCOS project implementation to the WMO Secretariat.

7.3 Disaster prevention and preparedness component (agenda item 7.3)

International Strategy for Disaster Reduction (ISDR)

7.3.1 The Committee was informed that WMO participated in the activities of all the working groups established under the ISDR framework, including the ad hoc group on drought. WMO also participated actively in the Second International Conference on Early Warning that aimed to achieve better integration of early warning into public policy. It also collaborated in the review of the Yokohama strategy.

7.3.2 Ms Elina Palm of the ISDR Secretariat presented a report on the activities of ISDR. She also described preparations leading to the World Conference on Disaster Reduction to be held in Kobe Hyogo Japan in 2005 explaining the objectives, expected outcomes, format and preparatory process. She encouraged Members to participate actively at the national level.

WMO's Programme on Natural Disaster Prevention and Mitigation (NDPMP)

7.3.3 The Committee was informed that during the Fourteenth World Meteorological Congress (Geneva, May 2003) the Programme on Natural Disaster Prevention and Mitigation (NDPMP) was established as one of three new major crosscutting programmes of the Organization. The main objectives of the programme are to develop a mechanism to respond to the requirements of Members and to ensure that WMO participates fully in the ISDR.

7.3.4 The Committee was further informed that the WMO Secretariat is currently preparing the NDPMP implementation plan. A Meeting of Experts on Natural Disasters, was held in Geneva from 15 to 17 March 2004, with participants from all the Regions. These experts were invited to analyze the draft proposal of the plan and to provide advice and guidance to the development of the programme from a regional point of view. The final draft of the implementation plan will be submitted to the next Executive Council (EC-LVI) to be held in June 2004.

7.3.5 As result of this meeting of experts, the revised draft implementation plan includes among other activities the establishment of: a project supporting the WMO activities in the area of natural disaster risk reduction, "Disaster risk management associated hazards of hydro-meteorological origin" applying internationally recognised disaster risk management principles and standards; the Web page of the programme as a reference page on information on natural disasters and on natural disasters risk reduction activities; regional expert groups; networks of focal points; a natural disaster information system and an inventory of relevant best practices.

7.3.6 The implementation of such a plan will provide coordinated and coherent actions in the activities of WMO in the area of disaster risk reduction and will also contribute to provide, in an integrated fashion, the WMO response to the needs of Members and of the international community, to assist Members to contribute in an integrated manner to their national disaster risk reduction programmes, to ensure that the results of WMO programmes are fully used in its participation in ISDR and to enhance the image of WMO as a leading international organization in this area.

7.3.7 The integrating role of the NDPMP will be ensured by a coordinated implementation of a number of disaster preparedness and mitigation activities of WMO's technical and scientific programmes. In this context, the Tropical Cyclone Programme will be one of the major contributors to the new programme. Therefore, this Committee is invited to provide comments and suggestions for the implementation of the new programme in order to better contribute to the mitigation of tropical cyclones disasters.

World Conference on Disaster Reduction (Kobe, January 2005)

7.3.8 The Committee was informed that the WMO Secretariat is also planning for WMO's participation at the World Conference on Disaster Reduction to be held in Kobe, 18 to 22 January 2005. WMO will participate actively in the preparatory activities, namely in the preparatory meetings to discuss the probable outcomes of the Conference as well as in the preparation of the Conference itself wherein the parallel activities for knowledge exchange and in public forum will have a significant role.

7.3.9 Taking into account the importance of the Conference, the Members were strongly urged to work actively on being represented at the Conference and to provide comments and suggestions on the preparation aspects of the Conference. As one of the expected outcomes of

the Conference is the adoption of a set of goals and policy measures for guiding and stimulating the implementation of disaster risk reduction from 2005-2015, the Members were also invited to take actions at national and regional level to ensure that their national delegations will contribute to the adoption of the measures needed in the area of tropical cyclone disaster risk reduction.

7.3.10 The representative of the BCT briefed the Committee about a European Union-funded Project, implemented by the UNDP, entitled "*Radar Early Warning Project in the Caribbean*". The Project seeks to provide data, with appropriate training, from the radars in Jamaica and the Dominican Republic to National Disaster Organizations in those countries to improve the early warning system. The Caribbean Meteorological Organization (CMO) is the technical advisor to the Project. The Committee was informed that while the radar in the Dominican Republic was out of service at the time, efforts were being made towards its restoration, after which it would be fully involved in the Project. The Project was being used as a pilot in the region with the intention of undertaking similar projects after the installation of the new radars in CMO countries.

7.4 Training (agenda item 7.4)

7.4.1 The Committee was pleased to note the involvement of its Members in the major education and training activities that have taken place since its twenty-fifth session.

7.4.2 The Committee expressed appreciation for the number of training events that were organized by WMO and Member countries during 2003, especially those events that were of direct relevance to tropical cyclones. The Tropical Desks in Washington and Montreal were considered of great value in stimulating and assisting in further development of tropical cyclones activities. The Operational International Desk in Montreal created by Canada has not operated for several years due to resource constraints. However, Canada will reconsider this decision if there is significant interest in it.

7.4.3 The Committee expressed its appreciation to WMO and those Members, which offered their national training facilities to other Members under bilateral and multilateral arrangements. These co-operative efforts have been found by the recipient countries to be very useful and the Committee strongly recommended that such endeavours should continue in the future and be strengthened. The Committee urged its Members to make maximum use of such training facilities.

7.4.4 The Committee noted that WMO continued to assist RMTCs to improve their training programmes by provision of financial support to purchase textbooks and to staff members for attending specialized training courses and scientific events abroad. The Committee urged its Members to make maximum use of the courses offered by these Centres in meeting the training requirements that cannot be met nationally. It also requested its Members to consider ways and means of assisting the RMTCs in organizing regular and specialized courses of interest to the Committee's activities, using such ways and means as the provision of instructors for short-term assignments, provision of relevant training materials and teaching aids through bilateral and multilateral arrangements.

7.4.5 The Committee noted with satisfaction the information on the activities of the Training Library and the use made of its services by the Members. It also appreciated the continuous updating of the Virtual Training Library (VTL) in an effort to provide the latest and most suitable available training material through Internet and recommended that those actions should be encouraged and continued.

7.4.6 The Committee noted that WMO fellowships continue to be provided to the Members of the Committee under the various WMO technical cooperation programmes. The new scientific and technical developments in the applications of meteorology and hydrology continue to create an increasing demand for postgraduate and specialized studies in such areas as tropical cyclone forecasting, numerical weather prediction and computer science. More fellowships focusing on specific technologies will still be required in the future as these technologies are more and more frequently implemented. The Committee urged donor Members to arrange for relevant training to enable personnel to utilize more effectively the new technologies in these specialized fields.

7.4.7 The Committee once again expressed its concern regarding the difficulties being faced by the NMHSs in the Region with respect to the foreseen retirements in the managements of the NMHSs during the not-too-far future. In particular, the lack of funding of long-term fellowships continues to be a major issue related to this problem. In this connection, the Committee requested the Secretary-General of WMO to continue to look for ways and means to resolve this problem.

7.4.8 The Committee requested its Members to take full advantage of the WMO fellowship programme by selecting well-qualified candidates for training, bearing in mind the requirements for academic qualifications, relevant experience, language proficiency, age limit and other specific requirements, as stipulated by the host training institutions concerned.

7.5 Research (agenda item 7.5)

7.5.1 The Committee noted with satisfaction that copies of the final report of the fifth session of the International Workshop on Tropical Cyclones (IWTC-V) held in Cairns, Australia from 3 to 12 December 2002, have already been distributed to Members and that the report contains very important and useful recommendations separately addressed to WMO, the research community and the tropical cyclone operational scientists. The Committee urged its Members and all concerned to endeavour to implement the recommendations relevant to their activities.

7.5.2 The Committee noted that, at the initiative of Canada and co-sponsorship of WMO, the Second International Workshop on Extra-tropical Transition of Tropical Cyclones (IWET-II) was successfully held in Halifax, Canada from 15 to 21 November 2003. The Committee was pleased that copies of the proceedings of the workshop in CD-ROM was distributed during the meeting.

CAS activities

7.5.3 Prof. Russell Elsberry (USA), representative of CAS, informed the Committee that three working groups had been established by the International Committee for the upcoming IWTC-VI (Costa Rica, 2006). These working groups are on Tropical Cyclone Structure, Ensemble Prediction and the Joint Hurricane Testbed.

8. ASSISTANCE REQUIRED FOR THE IMPLEMENTATION OF THE COMMITTEE'S TECHNICAL PLAN AND STRENGTHENING OF THE OPERATIONAL PLAN (Agenda item 8)

8.1 The Committee reviewed the assistance, pertinent to the implementation of the Technical Plan or strengthening of the operational plan, provided to Members since the Committee's twenty-fifth session and considered the plan for future action.

8.2 The Committee expressed its satisfaction that WMO, through the Technical Cooperation Department (North, Central America and the Caribbean (NCAC)), with the support of the WMO Subregional Office in Costa Rica has continued developing TCO activities to ensure cost-effective services to Members. Activities have focused mainly on the promotion of technical projects in the Region, as well as on the follow-up of ongoing ones. The Subregional Office has also provided support to regional activities and assistance in the implementation of WMO Programmes in the Region. The Committee was informed of the following projects:

Trust Fund Projects

SIDS Project for the Caribbean

8.3 The Committee was informed that the regional project – "Preparedness to Climate Variability and Global Change in Small Island Developing States, Caribbean Region" funded by the Government of Finland continued in 2003 with measurable success in the implementation of all components. In the area of telecommunications ISCS workstations for the new VSAT system were selected and installations are expected to be completed in early 2004 in ten countries. In the area of the rehabilitation and upgrading of observing networks, 29 automatic weather stations will be distributed among 12 countries. Conventional meteorological equipment has also been distributed to eleven recipient countries. In relation to training, fourteen students completed the Basic Instruction Package – Meteorological Technicians (BIP-MT) course in operational forecasting at the CIMH in October 2003. Similar training began in January 2003 with three trainees from Dominican Republic at the University of Costa Rica, and three more from Haiti have been trained at the Météo-France facilities in Toulouse, France. Graduate-level training for faculty replacements at the CIMH began in September 2003 with the identification of two candidates. In the area of Awareness Building, a Web Site has been developed for the project. Other Web sites are in the process of being developed with the assistance of the National Meteorological Service of the Netherlands Antilles and Aruba.

Study on the Prediction and Amelioration of Socio-economic Impacts of El Niño/ Southern Oscillation (ENSO) in Latin America and the Caribbean

8.4 The Committee was also informed that the WMO/Inter-American Development Bank (IDB) Study on the Prediction and Amelioration of Socioeconomic Impacts of El Niño/Southern Oscillation (ENSO) in Latin America and the Caribbean was concluded and the final report has been distributed to 26 participating countries and four regional organizations. The report was also submitted to the IDB and the agencies that supported and helped in the implementation of the Study. Projects on ***Climate Information Systems for Decision Making in Socioeconomic Sectors Affected by ENSO and other Climate Extremes*** were completed for Central America, Colombia and Mexico. Final project documents were delivered recently by WMO to relevant institutions of concerned countries/region and to the IDB.

Mexico Water Resources Management Project

8.5 The Committee was informed that the assistance of WMO to the National Water Commission (CNA) of Mexico for the implementation of the large scale Water Resources Management Project (PROMMA), continued satisfactorily. In 2003, a total of 34 international and 28 national consultants carried out some 90 missions to cover the areas of meteorology, operational hydrology, telecommunications, groundwater, water quality, water resources planning and administration and River Basins Councils. Training of personnel through international fellowships, local training courses on-the-job training and study tours were also completed. A total of 70 participants received training. As the Water Resources Management Project (PROMMA) project will end in 2004, the Mexican Government has requested the World

Bank assistance for the preparation of a PROMMA II project which is planned to start by mid 2005. The work plan for the year 2004 foresees the implementation of activities by WMO with a total estimated cost of US$ 1.5 million.

National Meteorological Office (ONAMET) of the Dominican Republic

8.6 The Committee was informed that the WMO continued assisting the National Meteorological Office (ONAMET) of the Dominican Republic in the rehabilitation and recovery of the meteorological infrastructure damaged as a result of the impacts caused by the Hurricane Georges in 1998. This assistance funded by the World Bank, includes the establishment of a National Early Warning System to prevent the population of the Dominican Republic against hurricanes and severe weather events. During 2003 WMO assisted ONAMET in the installation of 44 automatic weather stations via satellite, radio or telephone. A ground receiving station for the satellite transmission of data was also installed in the facilities of ONAMET in Santo Domingo. As part of the National Early Warning System a display system of weather information to the media was also established. Additionally, a wide area network (WAN) was installed for data and information exchange with other institutions and users, particularly to aeronautical meteorology, civil protection and agriculture.

Regional Activities

8.7 The Committee noted that the WMO continued the co-operation with the World Bank and IDB in areas of mutual interest that include climate change, national disaster prevention and mitigation, El Niño phenomenon and integrated water resources management. In addition, contact was established with the World Bank Institute for possible cooperation in the areas of capacity building and training.

8.8 The Committee also noted that the project proposal requested by the Permanent Representative of Panama in 2002 aimed at improving and reorganizing the hydrometeorological activities in that country was completed and discussed with relevant national authorities including the PR, the Ministry of Finance and the IDB Representative in Panama.

8.9 The Committee was informed that with the purpose of discussing the status of the Ibero-american Climate Project (CLIBER) as well as other topics related to cooperation among NMHS of Ibero-american countries, a meeting of Directors of NMHSs of Ibero-american countries was held at the Training Centre of the Spanish Cooperation in La Antigua, Guatemala from 19 to 21 November 2003. The meeting was organized by the National Meteorological Institute of Spain and co-sponsored by WMO. The meeting reached various conclusions and recommendations, including reviewing and updating the initiative of the CLIBER with the participation of all Ibero-american countries for the execution of projects of common interest

8.10 The Committee expressed its satisfaction that the radar networking system project supported by the European Union is being implemented under the coordination of the Caribbean Meteorological Organization. The project will benefit the Caribbean region providing early warnings on hurricanes and severe weather.

8.11 The Committee also expressed its satisfaction that WMO, Cooperative Institute for Research in the Atmosphere (CIRA)/NOAA-NESDIS developed a regional project on Satellite Meteorological Applications through the RMTCs of Barbados and Costa Rica using Regional and Mesoscale Meteorology Team Advanced Meteorological Demonstration and Interpretation System (RAMSDIS) and Internet to access and display satellite imagery and products. In the

first stage of the Project, seven countries, from Central America, have RAMSDIS systems that are receiving digital imagery and products, and are using this capability for weather analysis and forecasting on a 30 minute basis. The NMS of Costa Rica and CIRA/NOAA/NESDIS are given the maintenance and technical support to the System. An alternative back-up system was created for manually and near real time access of satellite data in case of failure of the main system. The CIMH representative informed the Committee that the Institute had been using a similar RAMSDIS system for the last three years and was in the process of discussing the acquisition of a system to use the products of the Unidata program and the Cooperative Program for Operational Meteorology, Education and Training (COMET) in its training programmes.

8.12 The Committee was informed that Canada, the United States, the University of Costa Rica and Unidata are going to install a NOAA PORT at the RMTC of Costa Rica in February 2004. The University of Costa Rica will provide the telecommunication equipment and facilities; Canada and the United States will facilitate the hardware; and Unidata will assemble the hardware and software. The system will provide a valuable tool to training activities of the RMTC located at the University of Costa Rica.

9. OTHER MATTERS (Agenda item 9)

9.1 The observer from Bermuda informed the meeting that the United Kingdom (U.K.) intended to apply for membership of WMO Regional Association IV by virtue of Bermuda being an Overseas Territory. This would facilitate Bermuda's direct representation and coordination within WMO RA IV, on behalf of the U.K.

9.2 The representative of the BCT, in his role as the Second Vice-president of WMO, briefed the Committee on the new high-level global initiative on Earth Observations. He mentioned that this was initiated by the USA, in partnership with the European Union, Japan and South Africa, shortly after the 14th World Meteorological Congress in May 2003. The aim of the initiative was to coordinate all types of earth observations, which included fields other than those undertaken under the auspices of WMO and its partner organizations. He mentioned that while the only truly operational global observing system was that of the WMO, specifically the World Weather Watch, several other systems would be involved. An Ad-Hoc Group on Earth Observations (GEO) had been established and several other GEO activities had taken place, including a second summit. Because of the very rapid pace of GEO initiatives and activities, the Committee urged all concerned to keep abreast of this issue and to position their Services and organizations to fully contribute to the process when appropriate. Information on the GEO process could be obtained through the Web Site: http://earthobservations.org/

10. DATE AND PLACE OF THE TWENTY-SEVENTH SESSION (Agenda item 10)

10.1 The delegate of Costa Rica informed the Committee that his country would host the twenty-seventh session of the RA IV Hurricane Committee in San José.

10.2 The Committee, in welcoming the information and accepting with pleasure this offer, expressed its warm appreciation to the Government of Costa Rica. The President of RA IV agreed that the session be held tentatively from 30 March to 2 April 2005, in conjunction with the thirteenth session of Regional Association IV tentatively scheduled from 4 to 13 April 2005.

11. CLOSURE OF THE SESSION (Agenda item 11)

The report of the twenty-sixth session of the Committee was adopted at its final meeting on 3 May 2004.

LIST OF APPENDICES

APPENDIX I

LIST OF PARTICIPANTS

2nd Vice-President of WMO	Mr Tyrone Sutherland
President of WMO RA IV	Mr Arthur Dania
MEMBERS:	
ANTIGUA AND BARBUDA	Mr Patrick Jeremiah
BAHAMAS	Mr Jeffrey Simmons
BARBADOS	Mr Chester Layne
BELIZE	Mr Carlos Fuller (Vice-Chairman)
BRITISH CARIBBEAN TERRITORIES	Mr Tyrone Sutherland Mr Fred Sambula
CANADA	Mr William (Bill) Stuart Appleby Mr Harinder P.S. Ahluwalia
COLOMBIA	Mr Maximiliano Henriquez Daza Henriquez
COSTA RICA	Mr Eladio Zarate
CUBA	Mr José Ma. Rubiera Torres (Vice-Chairman)
DOMINICA	Mr Joseph Nathanael Isaac
DOMINICAN REPUBLIC	Mr Jose Duquela Mr Jose Placido Cabrera
EL SALVADOR	Mr Luis Garcia Guirola
FRANCE	Mr Jean Tardieu Mr Jean-Noel Degrace Mr Max Reyal
GUATEMALA	Mr Mario Bautista
HAITI	Mr Ronald Semelfort
HONDURAS	Mr Héctor Flores Calix

JAMAICA	Ms Sylvia McGill
MEXICO	Mr Michel Rosengaus Mr Alberto Hernandez
NETHERLANDS ANTILLES AND ARUBA	Mr Arthur Dania
NICARAGUA	Mr Claudio Gutierrez Huete
PANAMA	Ms Maritza N. Chandeck-Monteza
ST. LUCIA	Mr Herbert Regis
TRINIDAD AND TOBAGO	Mr Willis Mills
USA	(Ret) Brig. Gen. David L. Johnson Mr Bill Proenza Mr Max Mayfield (Session Chairman) Mr Edward Rappaport Mr Lixion Avila Mr Curt Barrett Mr Robert Masters
VENEZUELA	Mr Ramon J. Viñas Garcia Mr Ricardo Torres Mr Alfredo Piñero Diaz
OBSERVERS:	
Bermuda	Mr Roger Williams
Brazil	Ms Odete Marlene Chiesa
Caribbean Institute for Meteorology and Hydrology (CIMH)	Mr Colin Depradine
Caribbean Meteorological Organization (CMO)	Mr Tyrone Sutherland
Commission on Atmospheric Sciences (CAS)	Mr Russell Elsberry
Datelnet/IT Consultant	Mr Roy Evers
Global Science and Technology	Mr Eugene Shaffer Mr Roger Lavallee
Harris Corporation USA	Mr Donald Winter

RA IV Working Group on Hydrology	Mr Eduardo Planos Gutierrez
SIDS-Caribbean Project	Mr Steve Polonnais
WMO Secretariat	Mr Jean-Michel Rainier Ms Nanette Lomarda
WMO Sub-regional Office	Mr Hugo Hidalgo
Interpreters	Ms Esther Crespo Ms Ana Belkind de Salinas
Local Secretariat	Ms Mary Ann Kutny Ms Caroline McMahon

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APPENDIX II

AGENDA

1. ORGANIZATION OF THE SESSION

   1.1 Opening of the session
   1.2 Adoption of the agenda
   1.3 Working arrangements for the session

2. REPORT OF THE CHAIRMAN OF THE COMMITTEE

3. COORDINATION WITHIN THE WMO TROPICAL CYCLONE PROGRAMME

4. REVIEW OF THE PAST HURRICANE SEASON

   4.1 Summary of the past season
   4.2 Reports of hurricanes, tropical storms, tropical disturbances and related flooding during 2003

5. COORDINATION IN OPERATIONAL ASPECTS OF THE HURRICANE WARNING SYSTEM AND RELATED MATTERS

6. REVIEW OF THE RA IV HURRICANE OPERATIONAL PLAN

7. REVIEW OF THE COMMITTEE'S TECHNICAL PLAN AND ITS IMPLEMENTATION PROGRAMME FOR 2004 AND BEYOND

   7.1 Meteorological component
   7.2 Hydrological component
   7.3 Disaster prevention and preparedness component
   7.4 Training
   7.5 Research

8. ASSISTANCE REQUIRED FOR THE IMPLEMENTATION OF THE COMMITTEE'S TECHNICAL PLAN AND STRENGTHENING OF THE OPERATIONAL PLAN

9. OTHER MATTERS

10. DATE AND PLACE OF THE TWENTY-SEVENTH SESSION

11. CLOSURE OF THE SESSION

APPENDIX III

REPORT ON THE 2003 HURRICANE SEASON - RSMC MIAMI-HURRICANE CENTER

(Submitted by the RSMC Miami – Hurricane Center, USA)

Atlantic

There were 16 named tropical cyclones in the Atlantic basin in 2003, of which seven became hurricanes. For comparison, long term averages are 10 named tropical cyclones, of which six become hurricanes. There have been six seasons with 16 or more named tropical cyclones in the 118 seasons since 1886, so 2003 ranks in the upper five percentile of seasonal number of named tropical cyclones. Another measure of seasonal activity is the "accumulated cyclone energy" (ACE) index, or the sum of the squares of the maximum wind speed, every six hours, for all tropical and subtropical storms and hurricanes in a season. The ACE index ranks the 2003 season in the upper ten percentile of seasons. In addition, there were five tropical depressions that did not reach storm strength.

Seven hurricanes are close to the long-term average value of six, but both Fabian and Isabel were exceptionally long-lived and intense. Also, Fabian, Isabel, and Kate were major hurricanes (category three or higher on the Saffir-Simpson Hurricane Scale).

There were two U.S. hurricane landfalls: Claudette struck Texas near Matagorda Island as a category-one hurricane and Isabel's category-two landfall on the Outer Banks of North Carolina brought hurricane conditions to portions of North Carolina and Virginia and record flood levels to the upper Chesapeake Bay. Elsewhere, Fabian was the most destructive hurricane to hit Bermuda in over 75 years and Juan was the worst hurricane to hit Halifax, Nova Scotia in its modern history.

This season's tropical cyclones took a total of 48 lives in the Atlantic basin, including 24 in the United States. Total damage in the United States is estimated at 3.6 billion dollars, mostly from Hurricane Isabel.

One April tropical storm and two December tropical storms extended the season well past the usual June-through-November activity. Ana was the first April tropical storm on record and the year 1887 was the only other year with two December storms.

In the individual summaries given below, dates are based on Universal Coordinated Time and distances are given in statute miles.

Tropical Storm Ana has the distinction of being the first Atlantic tropical cyclone on record in the month of April. It formed as a subtropical cyclone about 250 miles west-southwest of Bermuda on 20 April, and soon became tropical. Ana moved generally toward the east across the central North Atlantic Ocean with maximum winds reaching 60 mph, before becoming extratropical on 24 April. Two deaths are attributed to Ana when a boat capsized at Jupiter Inlet, Florida on 20 April, due to a combination of incoming swells from Ana and the outgoing tide.

Tropical Storm Bill formed over the southern Gulf of Mexico on 29 June, from the interaction of a tropical wave with an upper-level low. It moved northward and made landfall in southeastern Louisiana with winds to 60 mph late on the next day. Bill produced at least five tornadoes, coastal flooding, and heavy rain. One tornado struck Reserve, Louisiana, damaging 20 mobile homes and injuring four persons. Bill was absorbed by a frontal system over Virginia on 3 July, after producing locally heavy rain and floods over much of the southeastern United States. Bill was responsible for four deaths and 50 million dollars in damage.

Hurricane Claudette developed from a tropical wave over the central Caribbean Sea on 8 July. Claudette's winds briefly reached 80 mph on 10 July, before the storm made landfall on the east coast of the Yucatan Peninsula with 60-mph winds on 11 July. Claudette then moved slowly northwestward to west-northwestward across the Gulf of Mexico, before making landfall at Matagorda Island just east of Port O'Connor, Texas on 15 July with 90-mph winds. Claudette turned westward after landfall and moved across southern Texas and northern Mexico, and finally dissipated over the high terrain of northwestern Mexico on 17 July. Claudette was slow to weaken over land, as radar and satellite images indicated that its structure remained distinct for more than 24 hours after landfall. Claudette was directly responsible for one death and 180 million dollars in damage in Texas. Minor damage was reported from St. Lucia in the Windward Islands from the pre-Claudette tropical wave.

Hurricane Danny developed from a tropical wave about 625 miles east of Bermuda on 16 July. Danny moved northward and then eastward across the North Atlantic Ocean on a lengthy clockwise loop. Danny became a hurricane with 75-mph winds on 18 and 19 July. On 21 July, Danny weakened to a non-convective remnant low that continued on the clockwise track, with a smaller loop superimposed on the larger-scale track, for six more days. The remnant low finally dissipated on 27 July about 1250 miles east of Bermuda and only 650 miles east of where Danny originated.

Hurricane Erika was first detected as a weak surface low detached from a decaying frontal system about 1150 miles east of Bermuda on 8 August. This low interacted with an upper-level cold low and the combined system moved across the Bahamas and south Florida, before developing into a tropical cyclone in the eastern Gulf of Mexico on 14 August. Erika briefly strengthened to a 75-mph hurricane as it made landfall along the northeastern coast of Mexico, about 45 miles south of Brownsville, Texas on 16 August. Extreme southern Texas experienced tropical-storm force winds. Erika dissipated on the next day over the mountains of northern Mexico. Two persons died in Montemorelos, Mexico when their truck was swept away by flood waters as they tried to cross a partially-submerged bridge. Damage in Mexico consisted of roof and automobile damage, as well as numerous highways blocked by mud slides. Interestingly, Erika was not operationally upgraded to a hurricane, but a post-storm review of Brownsville Doppler radar data indicates that Erika was briefly a hurricane at landfall.

Hurricane Fabian developed on 27 August from a tropical wave over the far eastern tropical Atlantic Ocean. Its track followed a clockwise path around the western periphery of a subtropical high pressure ridge until it became extratropical over the far North Atlantic Ocean to the east of Newfoundland on 8 September. Fabian moved west-northwestward across the tropical Atlantic from 27 August until 3 September, while strengthening to its peak intensity of 145 mph (category four hurricane), which it reached on 1 September. Fluctuating in intensity for

several days, but remaining at least category three intensity, the hurricane turned northward on 4 September, and hit Bermuda on the next day with winds near 115 mph. Fabian caused four deaths at Bermuda as well as extensive damage estimated near 300 million U.S. dollars. The total death toll of eight includes three fishermen who drowned near Newfoundland and a rip current drowning near Cape Hatteras, North Carolina.

Tropical Storm Grace developed from a tropical wave. The wave became a tropical depression and then a 40-mph tropical storm on 30 August over the west-central Gulf of Mexico. Grace moved northwestward to the Texas coast near Galveston on 31 August as a disorganized and weakening tropical storm. It weakened to a depression as it moved inland and merged with a frontal system over Arkansas two days later. Up to eight inches of rain fell over eastern Texas and southwestern Louisiana.

Tropical Storm Henri formed from a tropical wave on 3 September over the east-central Gulf of Mexico. It moved slowly eastward and winds reached their peak value of 60 mph on 5 September. While weakening, Henri accelerated northeastward across north-central Florida as a tropical depression with 30-mph winds. Henri dissipated on 8 September about 150 miles south of Cape Hatteras, North Carolina while becoming extratropical. Henri dumped up to ten inches of rain over portions of west-central Florida.

Hurricane Isabel was a long-lived Cape Verde hurricane that formed over the eastern tropical Atlantic Ocean on 6 September. It moved in a general west-northwestward direction and strengthened to a category five hurricane by 11 September with 165 mph winds, while located several hundred miles northeast of the Leeward Islands. Isabel's maximum winds fluctuated between 150 and 160 mph for five days from 11 to 15 September. Weakening began on 16 September as the hurricane turned north-northwestward.

Isabel made landfall on the Outer Banks of North Carolina on 18 September as a category-two hurricane with maximum one-minute winds of 105 mph and higher gusts. Portions of eastern North Carolina and southeastern Virginia experienced hurricane-force sustained winds. Tropical-storm-force winds spread inland over a large area from eastern North Carolina northward to the eastern Great Lakes and western New England, as well as spreading northward along the Atlantic coast to New York. Storm surge flooding along the Atlantic coast was 6 to 8 feet above normal near the point of landfall and above normal tides extended to Long Island. Over 10 feet of surge was reported on North Carolina's Neuse River. Surge values of 6 to 8 feet were observed in the upper reaches of Chesapeake Bay and in many of the rivers that normally drain into the bay, including the Potomac and James Rivers. Water levels in Washington, D.C., Baltimore, and Annapolis exceeded the previous levels established by the 1933 Chesapeake-Potomac hurricane. Delaware Bay and the Delaware River also had a significant storm surge flood. Rainfall was in the 4 to 7 inch range over portions of North Carolina, Virginia, and Maryland. Higher amounts up to 11 inches occurred in the Shenandoah Valley.

Isabel was directly responsible for 16 deaths, ten in Virginia and one each in Maryland, New Jersey, North Carolina, Pennsylvania, Rhode Island, and Florida. The Florida and Rhode Island deaths were drowning deaths in high surf generated by Isabel. The total damage caused by Isabel is currently estimated at 3.37 billion U.S. dollars.

Hurricane Juan had a complex formation, developing from the interaction of a tropical wave with a large upper-level low about 300 miles southeast of Bermuda on 25 September. Juan initially appeared to have subtropical characteristics, but became fully tropical as it moved north-northwestward to northward. Continuing northward, the center passed about 200 miles east of Bermuda and Juan's winds increased to 105 mph on 27 September. Hurricane Juan made landfall in Nova Scotia between Shad Bay and Prospect early on 29 September as a category two hurricane with 100-mph one-minute winds. The hurricane ripped northward through the province, weakening over land, and arriving in Prince Edward Island as 75-mph hurricane. Two deaths have been attributed directly to Juan and the Canadian Hurricane Centre states that Juan is the most damaging storm in modern history for Halifax.

Hurricane Kate developed from a tropical wave in the central tropical Atlantic Ocean on 25 September. The tropical cyclone gradually strengthened to a hurricane by 1 October and, after temporarily weakening, reached an estimated 125-mph wind speed (category-three hurricane) on 4 October and then began to weaken. Kate's track was somewhat unusual. Kate moved northwestward and then northeastward for several days. Then, it turned sharply, and moved westward for five days before accelerating northeastward over the far North Atlantic Ocean. Kate became a powerful extratropical low east of Newfoundland on 8 October and merged with another low pressure system near Norway on 10 October.

Tropical Storm Larry developed from a tropical wave that interacted with a frontal system. The system became a tropical storm over the Bay of Campeche on 1 October. Winds reached 65 mph on the next day as the tropical storm drifted slowly and erratically southward. Larry moved inland on 5 October with winds of 60 mph along the coast of the state of Tabasco, Mexico and dissipated inland over the state of Vera Cruz on the next day. Heavy rain affected portions of southeastern Mexico and there were five deaths from freshwater floods attributed to Larry.

Tropical Storm Mindy originated from a tropical wave and became a 45-mph tropical storm on 10 October near the northeastern tip of the Dominican Republic. Mindy moved northwestward to northward for two days, gradually weakened to a depression by 12 October, and then turned eastward ahead of an approaching mid-level short-wave trough. The depression dissipated on 14 October while located about 500 miles north of Puerto Rico. Mindy passed near the Turks and Caicos Islands on 11 October, but heavy rain and tropical storm force winds remained to the east of these islands. Mindy produced periods of heavy rain over portions of Puerto Rico and eastern Dominican Republic.

Tropical Storm Nicholas formed from a tropical wave on 13 October, over the central tropical Atlantic Ocean. Nicholas reached its peak intensity of 70 mph on 17 October, while located several hundred miles east of the Lesser Antilles. Nicholas' track as a tropical cyclone lasted ten days and was slow and generally northwestward. The cyclone degenerated into a non-convective low cloud swirl on 24 October, several hundred miles northeast of the northern Leeward Islands. The remnant low merged with a cold front later that day and meandered slowly and erratically over the western North Atlantic Ocean for several more days.

Tropical Storm Odette formed from an area of disturbed weather that originated along a frontal zone and then lingered over the southwestern Caribbean Sea for several days while the front retreated northward. The disturbed weather became a tropical depression, and then a tropical storm, on 4 December about 325 miles south-southeast of Jamaica. Odette is the first

December storm on record to form over the Caribbean Sea. The storm moved slowly northeastward and its winds increased to 65 mph early on 6 December. Later on the same day, after weakening slightly, Odette made landfall on the Barahona Peninsula of the Dominican Republic with maximum winds estimated at 60 mph. Odette weakened while moving over Hispaniola and dropped copious rain over portions of the Dominican Republic and Haiti. Eight fresh water flood or mudslide-related deaths have been reported from the Dominican Republic. Odette then moved over the southwestern North Atlantic Ocean on 7 December and became extratropical as it merged with a frontal trough. Odette's extratropical remnant raced northeastward and maintained a distinct circulation for two more days before dissipating late on 9 December.

Tropical Storm Peter formed from a large extratropical gale center over the eastern North Atlantic Ocean. Moving southward, the low gradually acquired organized convection and became Subtropical Storm Peter on 7 December while located about 925 miles northwest of the Cape Verde Islands. Peter completed its transformation to a tropical storm by 9 December and reached its maximum intensity of 70 mph later that day. At the same time, Peter reversed its southward motion and headed northward, ahead of a strong approaching frontal trough. This was the same frontal trough that had merged with Odette a few days earlier. Peter quickly weakened as it lost deep convection and moved over colder sea surface temperatures. It became extratropical on 11 December and was absorbed by a cold front soon thereafter. Satellite imagery showed a short-lived banding eye feature on 9 December, suggesting that Peter may have briefly reached minimal hurricane force.

2003 Atlantic tropical storms and hurricanes

name	class*	dates**	max. winds (mph)	min pressure (mb)	direct deaths	U.S. damage ($ million)
Ana	T	20-24 Apr	60	994	2	
Bill	T	29 Jun-2 Jul	60	997	4	50
Claudette	H	8-17 Jul	90	979	1	180
Danny	H	16-21 Jul	75	1000		
Erika	H	14-17 Aug	75	986	2	
Fabian	H	27 Aug-8 Sep	145	939	8	
Grace	T	30 Aug-2 Sep	40	1007		
Henri	T	3-8 Sep	60	997		
Isabel	H	6-19 Sep	165	915	16	3,370
Juan	H	24-29 Sep	105	969	2	
Kate	H	25 Sep-7 Oct	125	952		
Larry	T	1-6 Oct	65	993	5	
Mindy	T	10-14 Oct	45	1002		
Nicholas	T	13-23 Oct	70	990		
Odette	T	4-7 Dec	65	993	8	
Peter	T	7-11 Dec	70	990		

T - tropical storm, maximum sustained winds 39-73 mph; H - hurricane, maximum sustained winds 74 mph or higher. ** Dates based on UTC time and include tropical depression stage.

Eastern North Pacific

There were sixteen named tropical cyclones in the Eastern North Pacific basin in 2003, of which seven became hurricanes. These totals compare to long-term averages of sixteen named tropical cyclones and nine hurricanes. There were no major hurricanes (category three or higher on the Saffir-Simpson Hurricane Scale) during the 2003 season. This is the first time this has occurred since 1977 and is well below the long-term average of four major hurricanes. The first hurricane, Ignacio, did not form until 24 August. This is the latest observed first hurricane of record in the basin since reliable satellite observations began in 1966. (Note that all dates and times are UTC.)

Five named tropical cyclones made landfall in Mexico during the season. Hurricanes Ignacio and Marty came ashore in Baja California bringing high winds, storm surge, and heavy rain. Carlos and Olaf made landfalls along the coast of mainland Mexico as tropical storms, while Nora and Marty made landfall in mainland Mexico as tropical depressions.

Andres developed from an area of disturbed weather first noted on 15 May within a broad area of low pressure south of Guatemala. The disturbance then moved westward for the next few days and became organized into a tropical depression on 19 May about 1060 miles south-southeast of Cabo San Lucas, Mexico. The depression strengthened into the first tropical storm of the season early on 20 May, and maximum winds reached 60 mph later that day. Andres moved uneventfully to the west-northwest until it began to weaken over cooler water on 24 May, at which time it turned westward. Andres weakened to a depression on 25 May and then degenerated to a non-convective remnant low later that day about 1725 miles west-southwest of Cabo San Lucas.

Blanca formed about 240 miles south-southeast of Manzanillo, Mexico on 17 June and reached its peak intensity of 60 mph the next day. It spent its lifetime meandering near its point of origin. Southeasterly vertical wind shear caused it to weaken to a depression on 20 June and to a remnant low on 22 June. The low eventually dissipated about 115 miles south of Manzanillo on 24 June.

Carlos developed on 26 June about 140 miles south of Puerto Escondido, Mexico. The cyclone moved slowly northward and made landfall 60 miles west of Puerto Escondido early on 27 June with an intensity of 65 mph. The storm rapidly weakened to a remnant low over the mountainous terrain of Mexico later that day. The low drifted back into the Pacific on the 28 June and dissipated the next day. Press reports indicate that Carlos caused minor damage in the Mexican state of Oaxaca.

Dolores was a short-lived tropical storm that started as a depression about 750 miles south-southwest of Cabo San Lucas early on 6 July. The system became a minimal tropical storm later that day. Dolores soon weakened back to a depression under the influence of strong northeasterly vertical wind shear. Moving northwestward to west-northwestward, the cyclone degenerated into a remnant low early on 8 July. The low dissipated on 9 July about 1050 miles west-southwest of Cabo San Lucas.

Enrique began as a depression on 10 July about 650 miles south-southeast of Cabo San Lucas and reached tropical-storm strength the next day. Enrique moved west-northwestward for the next two days and reached its peak intensity of 65 mph early on

12 July about 540 miles south-southwest of Cabo San Lucas. Later that day, Enrique began to steadily weaken over cooler water and became a tropical depression late on 13 July. The cyclone turned westward and degenerated into a remnant low pressure system on 14 July. It finally dissipated early on 16 July about 1380 miles west-southwest of Cabo San Lucas.

Felicia formed late on 17 July about 360 miles south of Manzanillo. The cyclone became a tropical storm shortly thereafter and reached its peak intensity of 50 mph later that same day. Felicia moved westward for the next 7 days as vertical wind shear caused a gradual decay. It weakened to a tropical depression on 20 July and a remnant low on 23 July. The low crossed 140^0W longitude into the central Pacific hurricane basin later that day and dissipated on 24 July about 690 miles east of the Hawaiian Islands.

Guillermo developed from a tropical wave that crossed Central America and moved into the Pacific on 1 August. A weak surface low developed on 6 August, which became a depression on 7 August about 605 miles southwest of Cabo San Lucas. The depression moved westward and strengthened into a tropical storm early on 8 August. Guillermo reached its peak intensity of 60 mph later that day. Outflow from Tropical Storm Hilda caused the cyclone began weakening on 10 August, and it became a depression the next day. The cyclone degenerated to a remnant low on 12 August just before entering the central Pacific.

Hilda formed from a tropical wave about 645 miles south of Cabo San Lucas on 9 August. It moved toward the west and west-northwest and became a 40-mph tropical storm later that day. That was the peak intensity, and Hilda began to weaken gradually on 11 August. A combination of cooler water and vertical wind shear caused it to dissipate on 13 August about 1380 miles west-southwest of Cabo San Lucas.

Ignacio was the first hurricane of the 2003 season. A depression developed from a tropical wave on 22 August about 220 miles southeast of Cabo San Lucas, with the cyclone moving slowly north-northwestward for most of its existence. Ignacio became a tropical storm on 23 August and a hurricane on 24 August. It strengthened to 105 mph on 24 August while brushing the east coast of extreme southern Baja California. The hurricane made landfall just east of La Paz, Mexico with estimated winds of 80 mph the next day. Thereafter it weakened while moving over southern Baja California and dissipated late on 27 August over central Baja California.

Ignacio brought hurricane conditions to the east coast of southern Baja California and widespread heavy rains to the southern and central portions of the Baja peninsula. The cyclone was responsible for two drowning deaths in Baja California. Roads, trees, and power lines were damaged, while thousands were evacuated from coastal communities.

Jimena formed from a tropical wave on 28 August about 1725 miles east-southeast of the Hawaiian Islands. The system became a tropical storm later that day and reached hurricane strength the following day. After turning westward and entering the central Pacific, Jimena strengthened to its peak intensity of 105 mph. By 31 August, increasing vertical wind shear caused Jimena to weaken. The cyclone then moved west-southwestward and, after weakening to a tropical storm, passed about 115 miles south of the southern tip of the island of Hawaii on 1 September. Jimena became a tropical depression the next day. The cyclone moved westward to west-southwestward for a few days and dissipated on 5 September just after crossing the International Date Line about 1725 miles west-southwest of the Hawaiian Islands.

Rainfall of 6 to 10 inches and high surf were reported on the Big Island of Hawaii in association with Jimena, and wind gusts near 60 mph occurred over portions of the southern Hawaiian Islands. No casualties or significant damage were reported.

Kevin was a short-lived tropical cyclone that developed as a broad depression early on 3 September about 280 miles south-southwest of Cabo San Lucas. The cyclone moved northwestward parallel to the Baja California peninsula with winds reaching 40 mph late on 4 September. Close proximity to cold water caused Kevin to quickly weaken and it became a depression early on 5 September. It then degenerated into a remnant low early the next day about 575 miles west of Cabo San Lucas. The remnant circulation moved slowly westward for several days before it finally dissipated on 10 September about 420 miles west of Cabo San Lucas.

Linda formed from a tropical wave that crossed into the Pacific on 6 September. The wave spawned a tropical depression late on 13 September about 390 miles southwest of Manzanillo. The cyclone moved northwestward for the next two days. It became a tropical storm later on 14 September and a 75-mph hurricane the next day. Linda turned westward and weakened to a tropical storm on 16 September, then it turned southwestward and weakened to a depression on 17 September. The cyclone weakened to a remnant low later that day about 510 miles west-southwest of Cabo San Lucas.

Marty was the second hurricane to make landfall in Baja California during 2003. It began as a tropical depression on 18 September about 520 miles south-southeast of Cabo San Lucas, which quickly strengthened into a tropical storm as it moved slowly to the west-northwest. Marty turned northwestward and became a hurricane on 21 September. Marty then moved northward toward the southern Baja peninsula, making landfall just east of Cabo San Lucas on 22 September with maximum sustained winds estimated at 100 mph. Marty then moved north-northwestward along the east coast of the Baja California peninsula, weakening to a tropical storm near Santa Rosalia on 23 September and to a tropical depression later that same day. Marty then meandered in and around the northern Gulf of California with heavy rains but weak winds. It made one landfall as a tropical depression on 24 September near Puerto Peñasco on the Mexican mainland and another one as a remnant low the next day south of San Felipe on the Baja peninsula. The circulation dissipated shortly after the latter landfall.

Marty brought hurricane conditions to the southern Baja California peninsula, with tropical storm conditions occurring along the east coast of central Baja. An automated station in Cabo San Lucas reported 10-min average sustained winds of 87 mph with a gust to 117 mph. The hurricane was responsible for 12 deaths, including two individuals listed as missing but presumed dead. Five of the deaths were from the sinking of a fishing boat in the Gulf of California, while five others were caused by fresh-water flooding. Media reports indicate damage to about 4,000 homes in southern Baja California. The cyclone also brought locally heavy rains to much of the remainder of Baja California, portions of northwestern Mexico, and portions of the southwestern United States.

Nora formed on 1 October about 605 miles south of Cabo San Lucas and moved very slowly toward the west and west-northwest with gradual intensification for the next few days. It became a tropical storm on 2 October and a hurricane early on 4 October. It reached its peak intensity of 105 mph later on that day. On 6 October, Nora weakened to a tropical storm while it

turned sharply to the east and then northeast. The cyclone reached the coast of Mexico as a depression on 9 October, just north of Mazatlan, and soon dissipated over high terrain. Nora caused locally heavy rains in the Mexican state of Sinaloa, but there are no reports of damages or casualties.

Olaf began as a tropical depression on 3 October about 360 miles south-southeast of Acapulco, Mexico. It strengthened into a tropical storm later that day while moving slowly northwestward. This motion continued for two days while Olaf gradually strengthened to a 75-mph hurricane on 5 October. Olaf was a hurricane for only a few hours. The storm turned northward on 6 October and made landfall early on the next day near Manzanillo with winds estimated at 60 mph. Olaf then dissipated over the high terrain of the Mexican state of Nayarit on 8 October. The cyclone caused heavy rains in the Mexican states of Jalisco and Guanajuato, with more than 12,000 homes damaged in Jalisco.

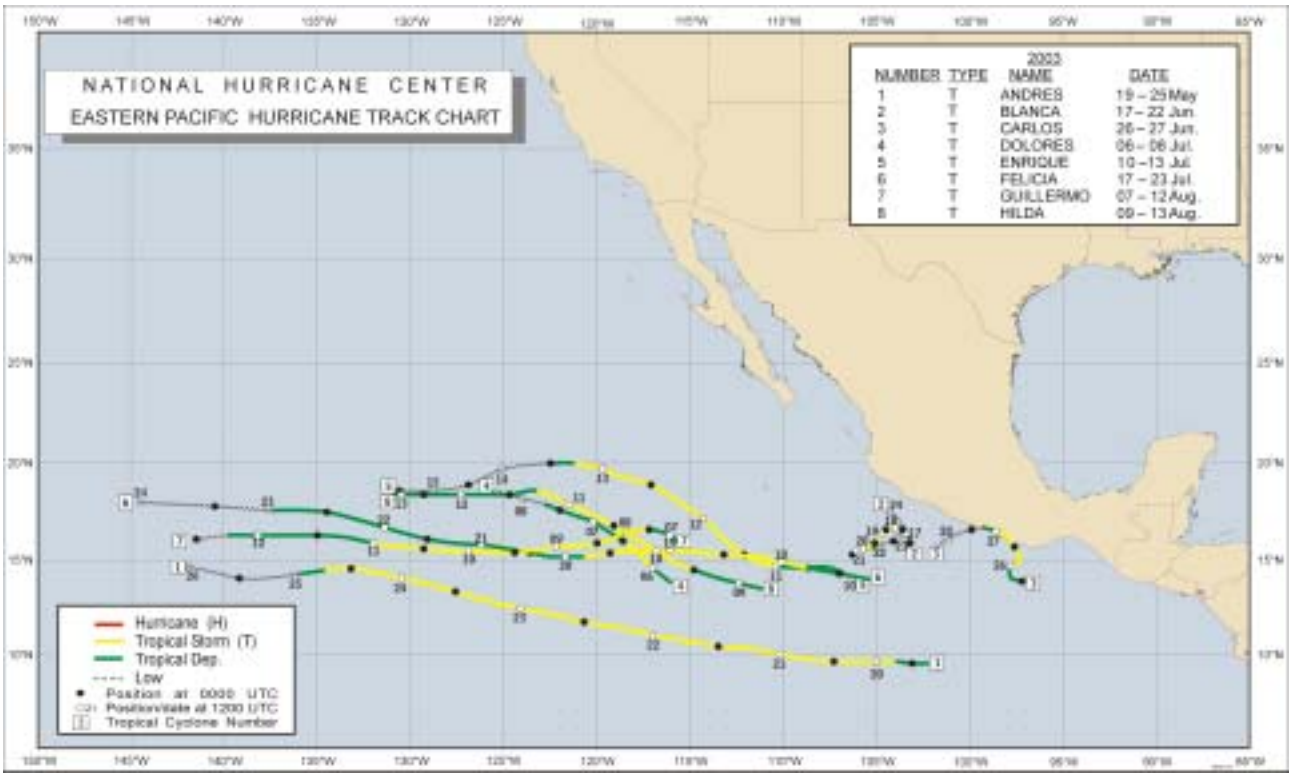
Patricia developed about 460 miles south of Acapulco on 20 October and quickly intensified into a tropical storm later that day. It moved west-northwestward to northwestward and strengthened into a hurricane on 21 October. Maximum winds reached 80 mph early on 22 October. Westerly vertical wind shear caused Patricia to weaken to a tropical storm later that day and, aside from slight re-strengthening on 24 October, slowly weaken over the next several days. Patricia weakened to a depression on 25 October and a remnant low on 26 October. The system dissipated later that day about 605 miles south-southwest of Cabo San Lucas.

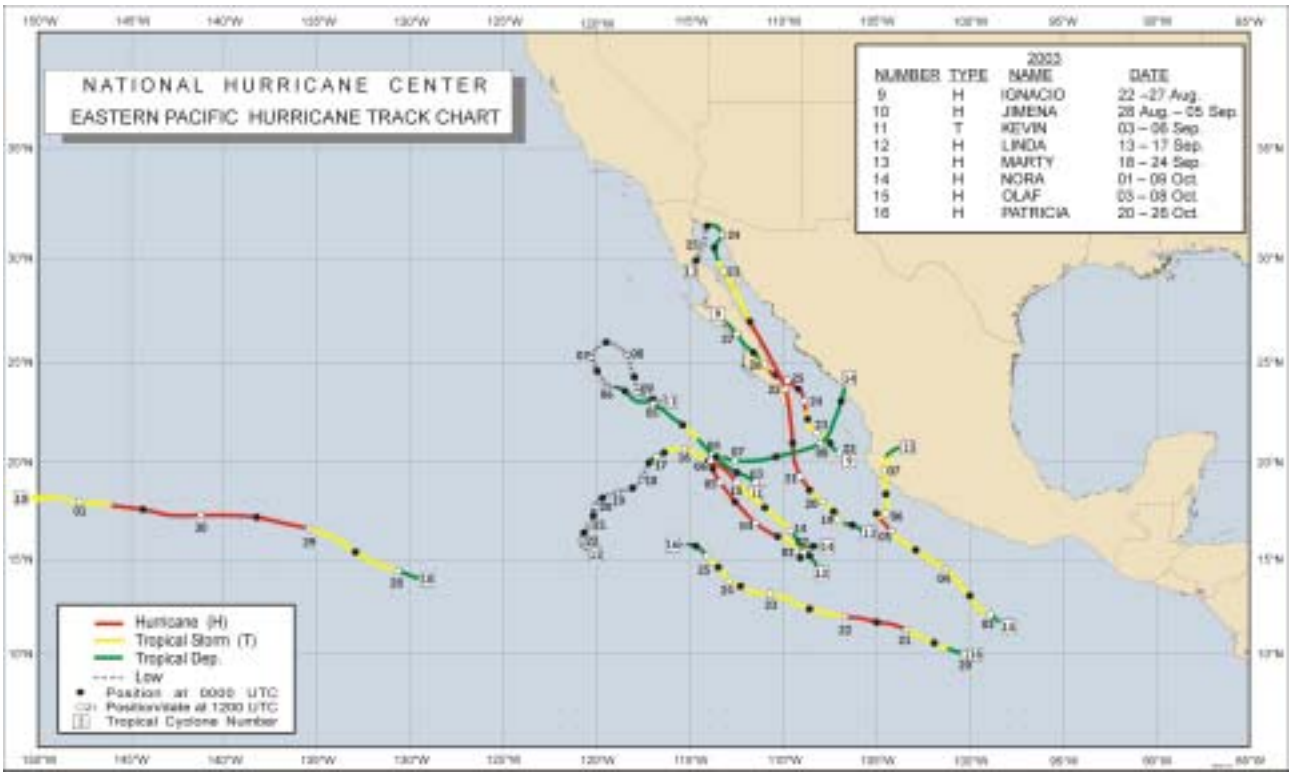
2003 eastern north Pacific tropical storms and hurricanes					
Name	Class*	Dates**	Max. Winds (mph)	Min. Pressure (mb)	Deaths
Andres	T	19-25 May	60	997	
Blanca	T	17-22 June	60	997	
Carlos	T	26-27 June	65	996	
Dolores	T	6-8 July	40	1005	
Enrique	T	10-13 July	65	993	
Felicia	T	17-23 July	50	1000	
Guillermo	T	7-12 August	60	997	
Hilda	T	9-13 August	40	1004	
Ignacio	H	22-27 August	105	970	2
Jimena	H	28 Aug - 5 Sep	105	970	
Kevin	T	3-6 September	40	1000	
Linda	H	13-17 September	75	987	
Marty	H	18-24 September	100	970	12
Nora	H	1-9 October	105	969	
Olaf	H	3-8 October	75	987	
Patricia	H	20-26 October	80	981	

* T - tropical storm, maximum sustained winds 39-73 mph; H - hurricane, maximum sustained winds 74 mph or higher.
** Dates based on UTC time and include tropical depression stage.

RSMC MIAMI – HURRICANE CENTER TRACK CHARTS 2003

(Atlantic track chart – hard copy)


NATIONAL HURRICANE CENTER
EASTERN PACIFIC HURRICANE TRACK CHART
2023
NUMBER TYPE NAME DATE
1 T ANDRES 19 – 25 May
2 T BLANCA 17 – 22 Jun.
3 T CARLOS 26 – 27 Jun.
4 T DOLORES 06 – 08 Jul.
5 T ENRIQUE 10 – 13 Jul.
6 T FELICIA 17 – 23 Jul.
7 T GUILLERMO 07 – 12 Aug.
8 T HILDA 09 – 13 Aug.
Hurricane (H)
Tropical Storm (T)
Tropical Dep.
Low
Position at 0000 UTC
Position/date at 1200 UTC
Tropical Cyclone Number


NATIONAL HURRICANE CENTER
EASTERN PACIFIC HURRICANE TRACK CHART
2023
NUMBER TYPE NAME DATE
9 H IGNACIO 22 –27 Aug.
10 H JIMENA 28 Aug. – 05 Sep.
11 T KEVIN 03 – 06 Sep.
12 H LINDA 13 – 17 Sep.
13 H MARTY 18 – 24 Sep.
14 H NORA 01 – 09 Oct.
15 H OLAF 03 – 08 Oct.
16 H PATRICIA 20 – 26 Oct.
Hurricane (H)
Tropical Storm (T)
Tropical Dep.
Low
Position at 0000 UTC
Position/date at 1200 UTC
Tropical Cyclone Number

APPENDIX IV

REPORTS OF HURRICANES, TROPICAL STORMS, TROPICAL DISTURBANCES AND RELATED FLOODING DURING 2003

(Submitted by Members)

2003 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 (2003) there were fifteen (15) storms, six (6) of which developed into hurricanes and of these hurricanes, three (3) developed into intense hurricanes.

It should be noted that two (2) of these fifteen (15) storms (Ana and Odette) were 'out of season' storms.

Antigua and Barbuda were not affected directly by any tropical depressions, tropical storms, or hurricanes, however, Intense Category Hurricane Fabián produced some storm surge damage to the northern and northwestern coasts of Antigua. A few cases of damage (slight) to boats were also reported.

In late November, a near stationary upper level trough, which affected the area for approximately ten (10) days, produced in excess of seven (7) inches of rainfall which helped tremendously to alleviate 'drought' conditions affecting Antigua and Barbuda.

2003 HURRICANE SEASON SUMMARY

(Submitted by The Bahamas)

The 2003 cyclone season was a quiet one for the Bahamas and the Turks and Caicos Islands with the exception of a close brush from Tropical Storm Mindy on October 11.

Tropical Storm Mindy formed from a tropical wave that moved into the Atlantic from Africa on October 1. The wave further developed as its axis entered the Mona Passage on October 9. On the 10th, strong disorganized convection associated with the wave passed across the eastern Dominican Republic. During the evening hours of the 10th, the system developed into Tropical Storm Mindy with 40 knot winds.

The center of Mindy passed just east of the Turks and Caicos Islands on October 11. However, the islands were not adversely affected as heavy rain and tropical storm force winds remained to the east. Grand Turk reported 27 knot winds and 1007.1 hPa on October 11 as Mindy passed just east of this location.

A tropical storm warning was issued for the southern Bahamas and the Turks and Caicos Islands. However, due to the movement of the storm, tropical storm conditions were not experienced over the warned areas.

HIGHLIGHTS OF THE 2003 HURRICANE SEASON IN BARBADOS

(Submitted by Barbados)

The Atlantic hurricane season of 2003 represents another period of above-normal tropical cyclone activity. Fourteen (14) named storms formed by the end of November, seven of which reached hurricane intensity and of these three were classified as major hurricanes. The formation of two tropical storms, Odette and Peter, in the month of December brought the total to sixteen, and generated a great deal of interest as this represents the first such occurrence since 1887. These two late-season systems and the formation of Ana in April served to reconfigure the period of tropical cyclone activity from April to December.

The month of July was an active and challenging period for Barbados with two tropical weather systems threatening the island within a two-week period. The tropical wave, which evolved into the first hurricane of the season, Claudette, represented a major and difficult challenge during the beginning of the second week of the month.

Two weeks later short-lived tropical depression number six follow a similar path and pattern, which resulted in an elevated state of alert for a portion of the Windward Islands. The system although degenerating into an open tropical wave before reaching the northern Windward Islands, produced wind gusts to near storm force and heavy rains in Dominica.

In the absence of reconnaissance data and information during the pre-event phase a great deal of uncertainty ensued, and the performance of the forecast and warning systems proved somewhat ineffective.

During the month of August, the weather remained generally unsettled, and some significant rainfall events were recorded. More importantly, however, was the sighting of a developing tornado over the central part of the island on 30th of August. Fortunately, the destructive power of the vortex did not impact the island, as dissipation occurred before the circulation made contact with the ground.

Barbados experienced a number of significant rainfall events during the months of October and November, and above average rainfall totals were recorded across the island. Some of these downpours resulted in localized flooding and specifically, persistent heavy rains during the space of a few hours produced flash flooding in Bridgetown and its suburbs on the afternoon of October 14, 2003. Associated lightning bolts struck four people working in the open, and all of them had to seek medical attention. Torrential downpours shifted location from offshore to the environs of the city in the early afternoon, and persisted for over two hours resulting in rapid accumulation of water, urban and small stream flooding. Run-off far exceeded the capabilities of the existing drainage system, and the area was quickly inundated.

Figures for 2003 have shown another year of below average rainfall, despite the number and intensity of significant rainfall events that were recorded in the months of October and November. In reality, by the end of November, the amount recorded represented approximately eighty percent of the annual historical average. The shortfall persisted as a well below-average amount was recorded in December.

Once again, the pattern was established from quite early in the year when it was consistently drier than normal. The total rainfall recorded for 2003 at the Grantley Adams International Airport, exceeds that for the previous year by approximately 14.7 millimeters, and together 2003 and 2004 represent the driest consecutive two-year period since 1973-74. In addition, the aggregated rainfall for the consecutive five years from 1999 to 2003 was 568.94 centimeters, the lowest total for a similar period since 1976 to 1980 with 537.06 centimeters.

Reports from other locations have indicated that there is likely to be a shortfall in the available water resources during the coming year, as a consequence of the persistent rainfall deficit over the past few years.

THE 2003 HURRICANE SEASON IN BERMUDA

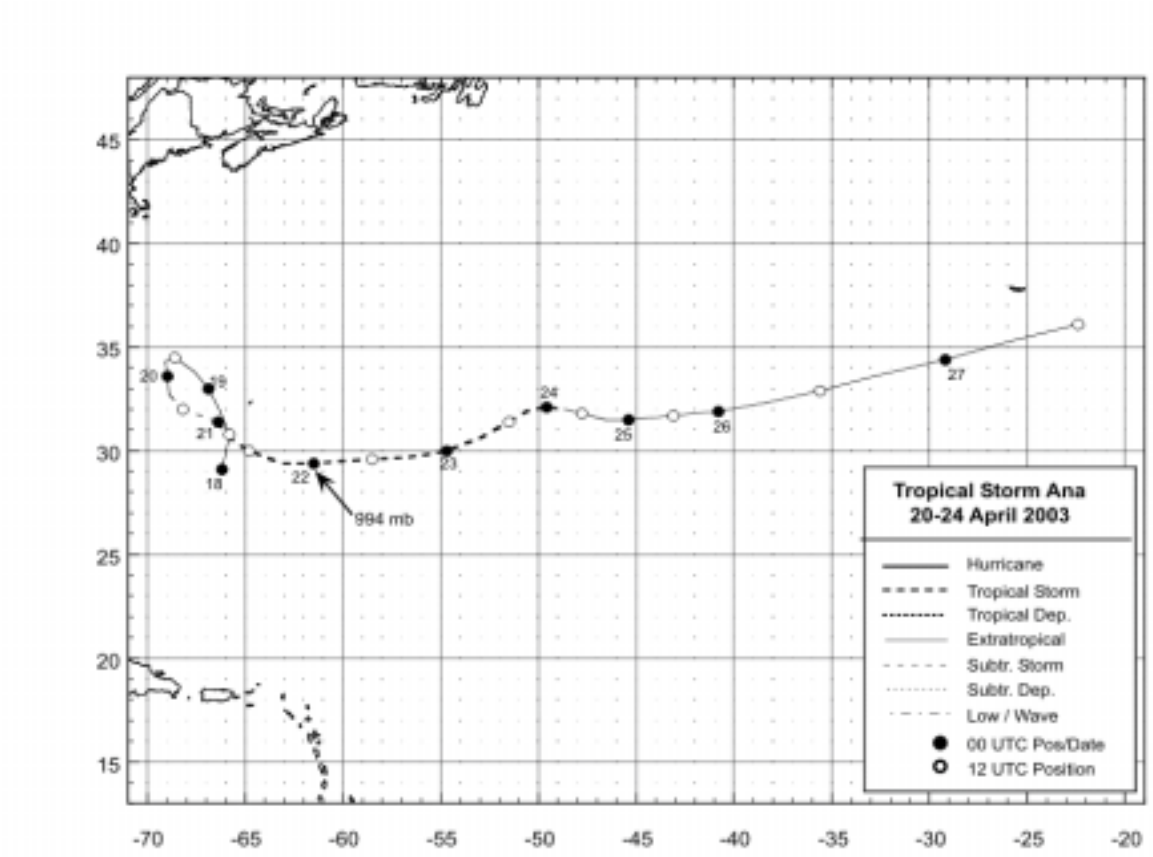
(Submitted by Bermuda)

(Mark Guishard & Roger Williams, Bermuda Weather Service)

Summary:

Bermuda was affected by 5 tropical cyclones in 2003. The most significant of these by far was Hurricane Fabian, which caused substantial damage to the Island on September 5th, 2003. Fabian was one of the strongest hurricanes on record to hit Bermuda. The resulting loss of life, and damage to property, infrastructure and the local environment ensured that Hurricane Fabian would long be remembered in Bermuda. Another notable event was the development of Tropical Storm Ana from a sub-tropical cyclone in April, a full month prior to the official start of the season. Also of significance was the passage of Tropical Storm Henri, bringing unwelcome shower activity, hindering the clean up efforts following Hurricane Fabian's impact.

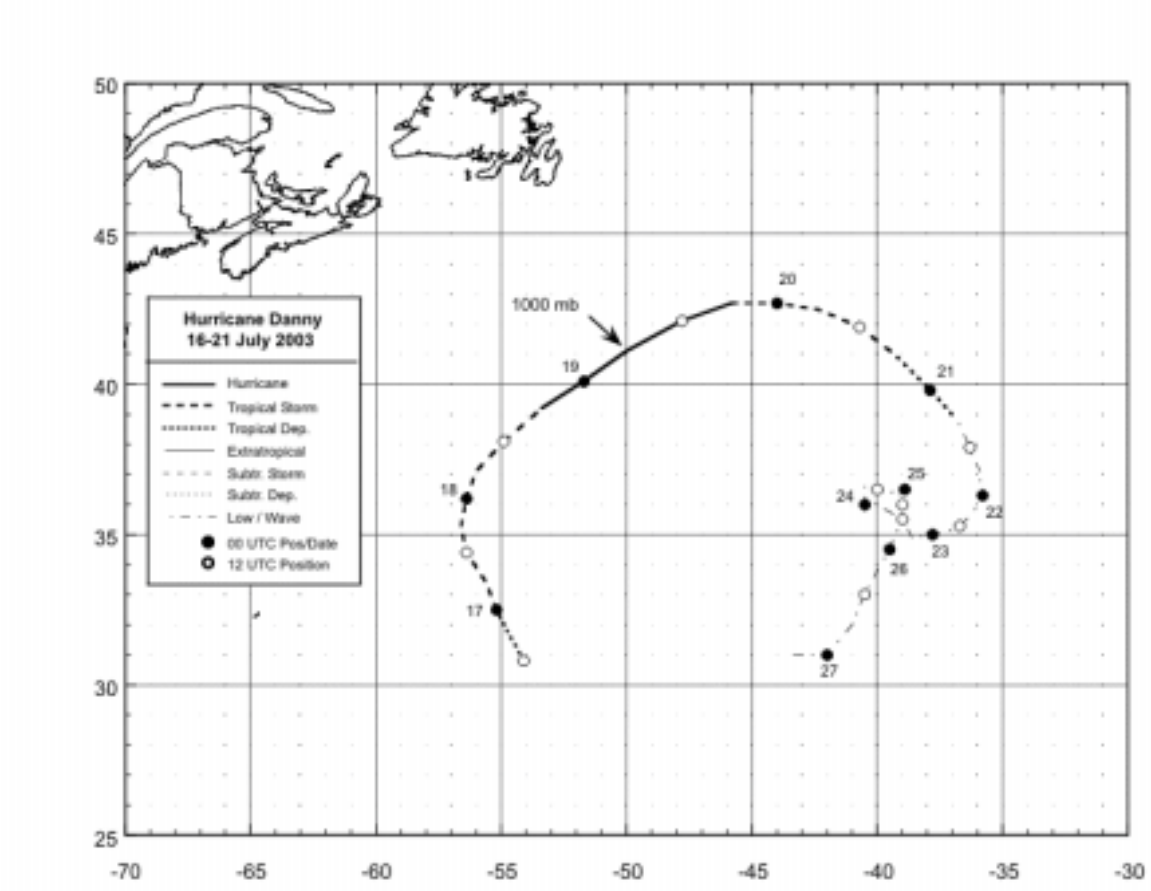
Tropical Storm Ana



National Hurricane Center Best Track of Tropical Storm Ana

Tropical Storm Ana became our first named storm of the year, forming about a month and a half before tropical season. Ana was the first Atlantic tropical storm on record to form in April. The Bermudian tradition of Good Friday kite flying was at a minimum on April 18th, with the rain and strong winds, as an area of low pressure became better organized and moved slowly towards Bermuda. Despite this, the main rain area cleared to the east of the Island on the 19th, and we had a day of mostly sunny skies, an occasional shower and light winds. The low moved back into our area on the 20th causing further outbreaks of rain throughout the day. By now, the low had developed sufficient tropical characteristics to become the first named tropical system of the year; Subtropical Storm Ana. A brief overnight Tropical Storm Warning was issued for Bermuda, as the storm moved eastwards and skirted to our south, though winds over the Island did not quite reach tropical storm force (34 knots or more). Subtropical Storm Ana was upgraded to Tropical Storm Ana on the 21st. With Ana not to far to our southeast, wet conditions continued on and off through out the day with strong winds. As Ana moved further away on the 22nd and high pressure began to build in, a few very light showers popped up, with mostly sunny skies and moderate winds. Tropical Storm Ana moved away to the east on the 23rd.

Tropical Storm Danny

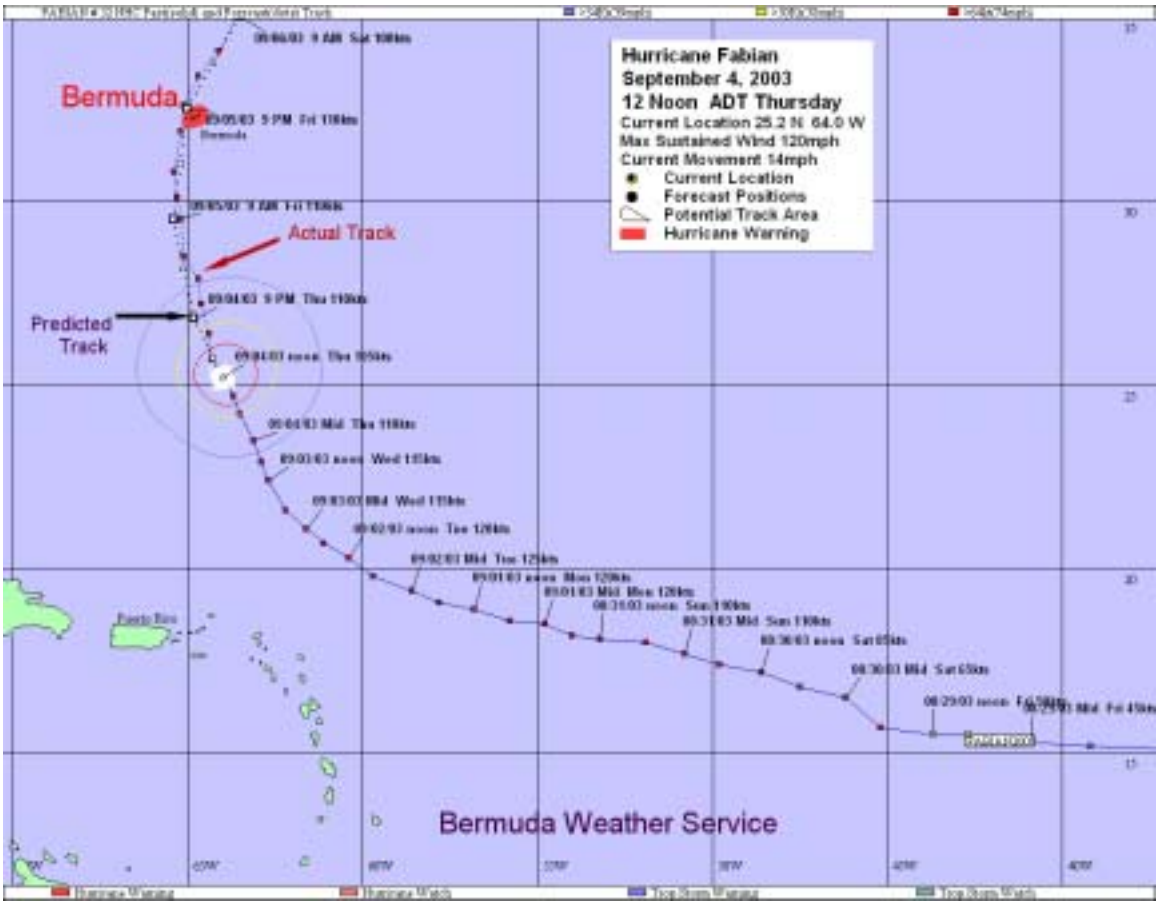


National Hurricane Center Best Track of Tropical Storm Danny

A surface low to the east-southeast of Bermuda developed into a tropical depression on July 16th, eventually intensifying into Tropical Storm Danny on the 17th. Although Danny had been moving towards Bermuda, it began to take a turn to the north, with a ridge of high pressure and pleasant weather remaining over Bermuda into the 18th. Tropical Storm Danny turned towards the northeast, and was forecast to continue to moving away from Bermuda.

Hurricane Fabian

Fabian started life as Tropical Depression 10, which formed in the afternoon of August 27th, 2003, around 2,100 nautical miles (nm) east southeast of Bermuda. By the 29th, the system was upgraded to Hurricane Fabian. located approximately 1450 nm south east of the Island, and forecast to be around 600 nm to our south by the beginning of September. Meanwhile, the Bermuda-Azores high pressure system remained in place through the end of the month, with light winds and sunny skies.

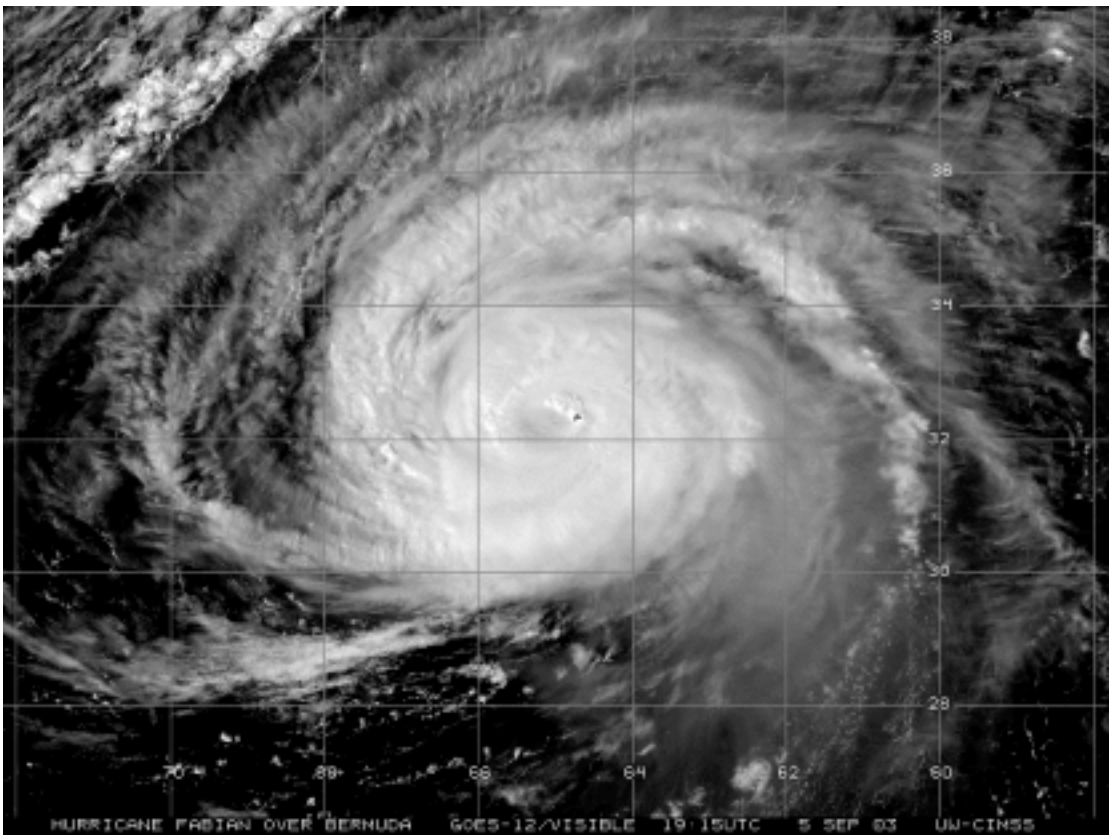


Track Details and forecast track at Noon on Thursday 4th Sept.

By 6pm. on August 30th Fabian had attained Category 3 hurricane status and became the first major storm of the 2003 Atlantic hurricane season. Fabian was further upgraded to a category 4 storm on the evening of August 31st, with estimated maximum winds of 115 knots (kt) with gusts to 140 kt and a central pressure of 948 millibars (mb). By the beginning of September, all eyes in Bermuda began watching out for Fabian, as computer models indicated a turn to the north in the forecast track, during the outlook period, although the storm was still expected to steer well to our west. Meanwhile, high pressure continued to bring sunny skies to the Island, with light winds from the east.

During the 2nd and 3rd of September, each successive predict bulletin brought Fabian's predicted path closer to Bermuda and an Emergency Measures Organization (EMO) meeting was called and began planning for the worst and alerting all relevant agencies. The Bermuda Weather Service (BWS) issued a Hurricane Watch, early on the morning of the 4th, and this was upgraded to a Hurricane Warning at midday. Fabian was forecast to make a direct hit on Bermuda on the afternoon of the 5th, and although downgraded to a Cat. 3 hurricane, with predicted maximum winds of 105kt., substantial damage was anticipated. Following a further meeting of the EMO in the early afternoon of Thursday the 4th, with widespread press and TV coverage, the general public begun to batten down in earnest.

Tropical storm force winds arrived on the Island on the morning of Friday September 5th, increasing to hurricane force by early afternoon. Strong winds, rain, blowing sea spray, and heavy surf reduced visibility and pounded the island. The highest (10 minute) sustained winds recorded were between 102 to 105 kt, at elevated mast locations around the Island. The official National Hurricane Center (NHC) post storm analysis 'best estimate' of the maximum 1 minute sea level (10 metre) wind was 100 kt. The highest gust of 143 kt was reported from Harbour Radio, (just before the mast collapsed). The strongest winds lasted for approximately 3-4 hours, as the eye of Fabian passed just west of Bermuda, with most of the Island in the eyewall region for this period. Conditions calmed on the 6th as Fabian made its way north and skies became mostly sunny again.



Visible Satellite Image of Category 3 Hurricane Fabian over Bermuda.

There was very strong storm surge and huge battering waves associated with Fabian, causing extensive damage to the coastline, especially along the south shore. The winds blew down hundreds of trees Island-wide. Electrical power was lost in the majority of homes and businesses outside the City of Hamilton, and approximately 25,000 out of 32,031 customers experienced outages, due to downed power lines. Remarkably, power was restored to most consumers within three weeks. However various parts of the electrical supply distribution system were substantially weakened and a rehabilitation plan was implemented in October 2003.

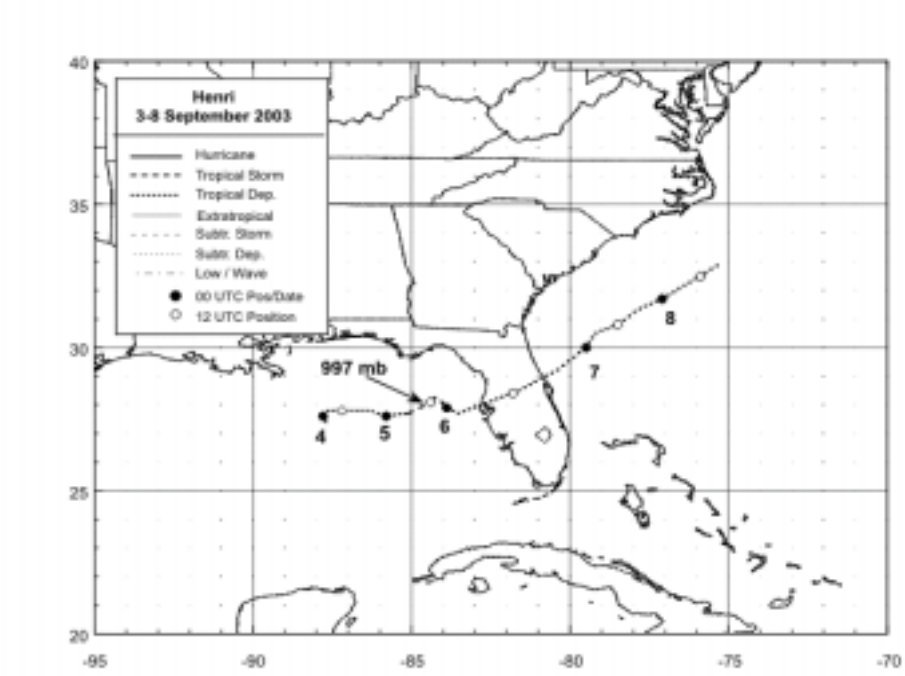
In strictly meteorological terms, Fabian was a well behaved storm. The relatively consistent track, accuracy of the numerical model predictions and good liaison with the NHC enabled the BWS to issue timely warnings and useful guidance on Fabian. This gave most public and private concerns sufficient time to implement and complete their hurricane preparedness plans, prior to the onset of damaging winds and storm surge. Tragically, four people were swept to their deaths off the Causeway[1], at around 2.30 pm on the 5th, most likely due to the storm surge, and only one body was subsequently recovered.

Large battering waves in Hamilton Harbour and Fabian's pressure trace from Bermuda Weather Service.

Tropical activity in September continued, with influence from Tropical Storm Henri and Hurricane Isabel. Hurricane Juan sent the ended the month with excitement as it rapidly formed and developed just south of Bermuda.

[1] The Causeway connects St George's and St David's Islands with the main Island of Bermuda

Tropical Storm Henri

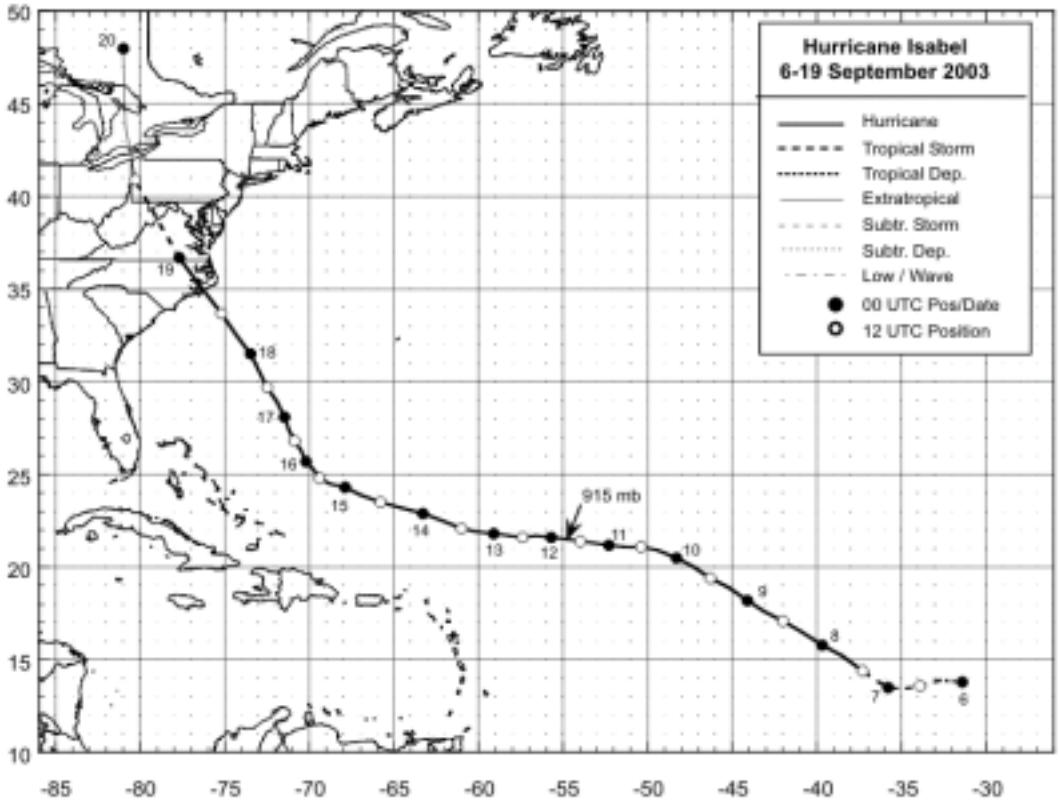


National Hurricane Center Best Track of Tropical Storm Henri

A moist unstable air mass associated with Tropical Storm Henri moved into the area on September 8th, bringing exactly what Bermudians did not need as they began to repair damage after Fabian: torrential rain and thunderstorms. Unstable conditions due to Henri continued on the 9th. Isolated showers and partly sunny skies continued on the 10th as the remnants of Henri moved north.

Hurricane Isabel

Hurricane Isabel, about 700 miles south of Bermuda was upgraded to a Category 4 hurricane on September 11th. Unstable air brought scattered showers to the island through the day of the 12th, as Isabel was upgraded to a category 5 hurricane. Bermuda began to feel the affects of Isabel on the 13th, with mostly cloudy skies and winds moderate to strong from the east, and a few scattered showers. Isabel began to move to the northwest on the 14th, towards the U.S. coastline. Bermuda experienced strong surf, and strong winds from the east, with mostly cloudy skies and a few brief showers.



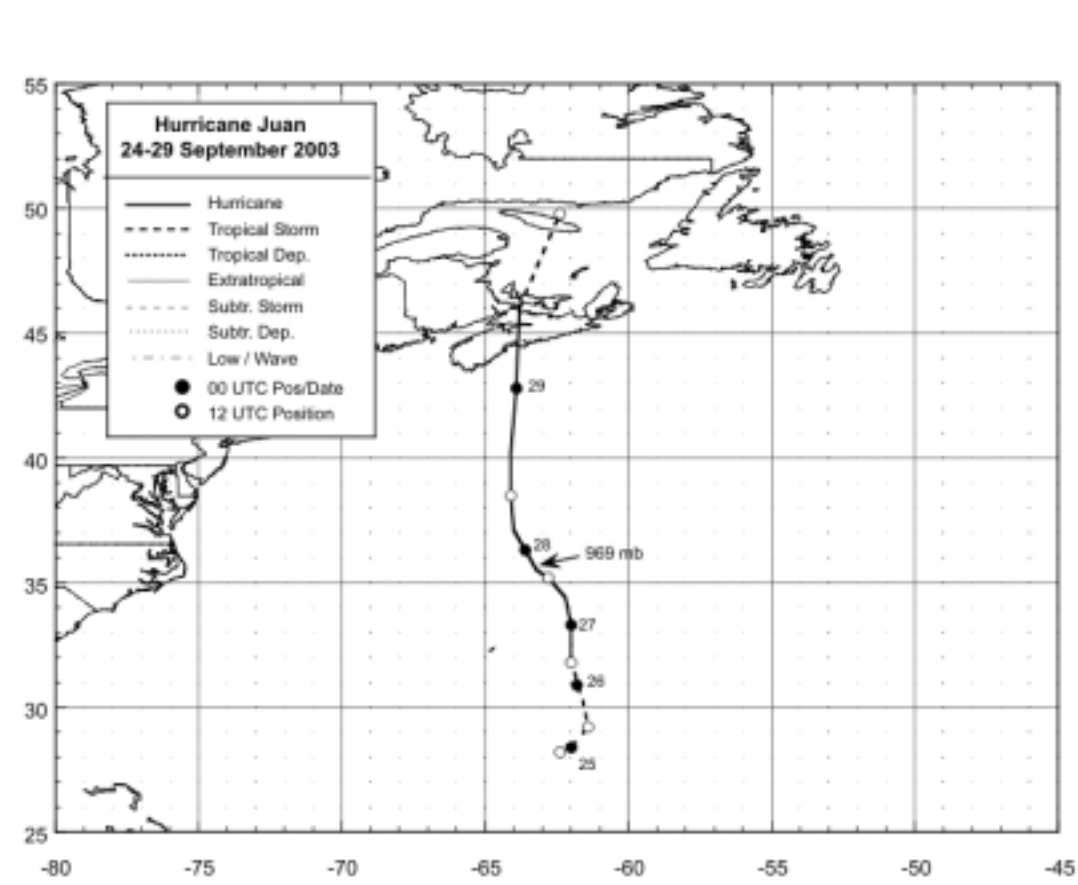
National Hurricane Center Best Track of Hurricane Isabel

Moist air, strong winds and strong surf from Hurricane Isabel continued to affect Bermuda on the 15th with mostly cloudy skies, and a Small Craft Warning was issued. Strong winds from the east and mostly cloudy skies persisted into the 17th. Hurricane Isabel made landfall on the Carolina coastline of the United States causing considerable damage and loss of life on the 18th.

An area of low pressure to Bermuda's south developed into a tropical depression on September 25th, and by later in the day Tropical Storm Juan was named. Conditions in Bermuda remained pleasant with mostly sunny skies and winds increasing through the day from light to strong. However, due to the storm's close proximity and rapid development, Bermuda Weather Service issued a tropical storm warning for the 26th, after conferring with the NHC. Tropical Storm Juan was upgraded to a category 1 hurricane on the 26th, and made its way northward, bringing strong winds to Bermuda. However, the winds over Bermuda did not reach tropical storm strength, and by mid afternoon the Tropical Storm Warning was cancelled, even though

Tropical Storm Juan

Hurricane Juan was at its closest point of approach of 125 nm. Juan continued its track to the north on the 27th, still providing Bermuda with strong winds but as high pressure built in mostly sunny skies prevailed. Juan went on to hit Nova Scotia as a category 2 hurricane, and "will be recorded as one of the most damaging tropical cyclones in modern history for Halifax", according to the US National Hurricane Center.



National Hurricane Center Best Track of Hurricane Juan

Appendices

The Saffir-Simpson Scale:

Type	Category	Pressure	Winds		Surge
		mb	kt.	mph	ft
Depression	TD	-----	< 34	< 39	-----
Tropical Storm	TS	-----	34- 63	39- 73	-----
Hurricane	1	> 980	64- 82	74- 95	4- 5
Hurricane	2	965-980	83- 95	96-110	6- 8
Hurricane	3	945-965	96-112	111-130	9-12
Hurricane	4	920-945	113-134	131-155	13-18
Hurricane	5	< 920	> 134	> 155	> 18

NOTE: Pressures are shown in millibars (or hectoPascals) and winds shown are in knots, with equivalent speeds in miles per hour. Typical storm surge values are in feet.

POST-STORM COUNTRY REPORT
Country: Bermuda
Tropical Cyclone: Hurricane Fabian
Date of data: September 5, 2003 Date of issue: September 17, 2003 (with revision 30 December 2003)

Station	Maximum Sustained Wind			Maximum Wind Gust			Calm	Total Rainfall	Minimum SL Pressure	
	Direction Deg.true	Velocity (knots) 10 min	UTC Time	Direction Deg. true	Velocity (knots)	UTC Time	UTC Time	(mm)	Pressure (hPa)	UTC Time
Bermuda Airport TXKF	190	105[2]	2055	190	130	2055	-	46.2	964	2030
Airport anemometer site[3]	127	72	1927	146	102	1920	-			
Cable and Wireless[4]	150	102	1910	130	131	1933	-			
Bermuda Harbour Radio[5]	n/a	102	1855	n/a	143	1933	-		961	2050
Weatherbird (research vessel)[6]	n/a	67	1933		95	1638			961	2048
Pitt's Bay (Hamilton)[7]									960	2000
Cambridge Beaches[8] Hotel									953	~2100
Southampton[9]									954.5	2000
Warwick Camp (Belco tower)[10]	122	104.5	1900	131	124.7	1910			956.7	1950

[2] TXKF (32deg 21min 55secN 64deg 40min 15 sec W) max wind estimated at weather service building 130 ft asl. Rain data unreliable but total rainfall amounts were unlikely to exceed 75 mm. Most observations reported only light rain and low visibility due to sea spray.
[3] Airfield anemometer (32deg 21min 30secN 64deg 40min 14secW - inst. height 40 ft asl) - power failed at mast base due to storm surge at 1935 UTC
[4] C&W mast (32deg 18.6min N 64deg 45.0minW – inst. height 280 ft asl) – values in red follow reanalysis of original chart data.
[5] Harbour Radio (32deg 22.825min N 64deg 40.950 min W – inst. height 255 ft asl) – mast fell down shortly after peak gust at 1935 UTC. Pressure from Barograph trace.
[6] Weatherbird moored at 32deg 22min N 64deg 42min W – wind instrument not well exposed
[7] Voluntary observer (barograph) 32deg 17.5min N 64deg 47min W
[8] Cambridge Beaches (32deg 18.5N 64deg 52.1W) – west end of Bermuda. Pressure from Barograph (time not calibrated)
[9] Southampton – Voluntary Observer (32deg 16min N 64deg 52minW) – Davis instruments– wind sensor n/a
[10] Warwick Camp (Belco Tower) – (32deg 15.3min N 64deg 48.9min W) – Wind instrument at 356 ft asl

Remarks

The Island was in the eye wall zone for several hours and there were several reports of minor tornadoes. The eyewall clipped the extreme west end of Bermuda and observers reported a brief interlude of blue sky and winds dropping to 50-60 kn. at various times between 1945-2115 UTC with winds quickly increasing again and veering southwest as the system moved away NNE.

There was extensive damage to vegetation and considerable roof damage to houses in exposed locations. (Although the roof structures generally retained their integrity, the roof slates were stripped off). Some buildings had more severe damage. This was due to inherent structural weakness in some cases – although reports from eye witnesses indicated several instances of tornado damage. Rainfall totals were comparatively low for such a major storm, although the amount measured at the airport may have been subject to error due to the high winds. Apart from coastal inundation, there was little flooding due to rainfall. It should be noted that Bermuda seldom suffers from rain induced flooding even in heavy rain events, since there are no mountains or rivers.

There were huge 25-35ft (7-10 M) battering waves on the south shore with reported storm surge estimated at 3 to 3.5 metres. Other areas, including the airport appeared to have experienced surge varying between 1.5 and 3 metres. The Causeway between St George's and St David's Islands (inc. the Airport) and the main Island was badly breached and. Cost estimates for property damage are of the order $US 75 - $100 million but total insured losses (including loss of tourist revenues due to hotel closures, etc.) may be well in excess of this figure.

Overall, the forecast and warning system went exceptionally well with excellent cooperation between the Bermuda Weather Service, the National Hurricane Center and the Bermuda Government Emergency Measures Organisation. The message was conveyed to the general public, via the media, in a forceful and timely manner and the emergency services were well prepared. It was unfortunate, given the warnings, which accurately informed on the timing and the severity of the storm, that lives were lost when 4 persons and their two vehicles were swept off the Causeway around 1830 UTC. Only one body was recovered.

REPORTS OF HURRICANES, TROPICAL STORMS, TROPICAL DISTURBANCES AND RELATED FLOODING DURING 2003

(Submitted by Canada)

CANADIAN HURRICANE CENTRE
45 Alderney Drive
Dartmouth, Nova Scotia B2Y 2N6
CANADA
Website: http://www.ns.ec.gc.ca/weather/hurricane

2003 TROPICAL CYCLONE SEASON SUMMARY

Five tropical cyclones entered the Canadian Hurricane Centre (CHC) Response Zone in 2003: two moved inland, two entered Canadian waters, and one remained outside Canadian waters.

2003 marked the fourth consecutive year for a landfalling tropical cyclone in Canada: three of which were hurricanes. Eleven fatalities resulted from Hurricanes Fabian and Juan: Juan made landfall while Fabian remained offshore. Hurricane Juan was the worst hurricane to hit the population centre of Atlantic Canada in over 100 years, claiming more inland-lives in Canada than any tropical cyclone since Daisy killed six in 1962. The CHC issued 113 bulletins during 2003.

BULLETIN SUMMARY							
	2003	2002	2001	2000	1999	1998	1997
Hurricane Information Statements (WTCN3X/7X CWHX)	113	68	110	109	71	42	26
Number of Storms Represented by these Bulletins	8	8	6	8	6	2	4

Danny (July 17–20)

Tropical Storm Danny was in the CHC Response Zone 181500–200500 UTC July and was subsequently upgraded to a category-1 hurricane during that time. Tropical storm force winds were not reported from Canadian waters. The CHC issued 13 bulletins.

Fabian (August 28–September 8)

Hurricane Fabian was in the CHC Response Zone 070000–081200 UTC September. Fabian was a category-1 hurricane of 130 km/h when it moved through the Southeastern Grand Banks marine area. No in situ data was obtained from Canadian waters during Fabian, however, the CHC waves-storm resonance model indicated that significant wave heights in excess of 20 m may have occurred just outside Canadian waters. Three lives were lost when the vessel, *The Pacific Attitude,* sank in the vicinity of the highest waves. The vessel was just outside Canadian waters when it signaled distress. The CHC issued 24 bulletins.

Isabel (September 6–19)

Isabel was being downgraded from a hurricane to a tropical storm as it entered the CHC Response Zone at 190400 UTC September. Isabel subsequently entered the province of Ontario via Lake Erie at 191600 UTC. Winds of 55 gusting 73 km/h were reported in numerous locations in southern Ontario, along with rainfalls of 30–50 mm near and west of the storm track. Wave heights in western Lake Ontario reached near 4 m. Damage reports included numerous power outages, fallen trees, and some localized flooding. Isabel was the most intense media event for the CHC to date; this was due to a 14 September news story warning that conditions were "ripe" for Isabel to be a repeat of Hazel (1954). The CHC issued 22 bulletins.

Juan (September 25–29)

Hurricane Juan entered the CHC Response Zone at 280100 UTC September as a category-2 hurricane and remained at that strength as it moved through the West Scotian Slope, Lahave Bank, and Southwestern Shore marine areas. It remained at category-2 strength when it made landfall in the province of Nova Scotia (NS), just west of Halifax, at 290310 UTC. Juan was still at hurricane strength when it entered the province of Prince Edward Island (PEI) at 290625 UTC. Juan passed directly over the Confederation Bridge joining the provinces of PEI and New Brunswick.

The strongest 1-minute sustained winds reported were 158 km/h at McNabs Island in Halifax Harbour. The highest peak gust reported was 232 km/h (at the 20 m level) from the vessel *Earl Grey* while at anchorage in the Bedford Basin at the head of the Halifax Harbour. Doppler radar from Gore, NS, recorded highest winds of 213 km/h at 1 km above the ground. At landfall, hurricane force gusts extended 160 km east and 20 km west of the storm centre. As it exited Nova Scotia the hurricane force gusts extended only eastward out to 110 km. Rainfall with Juan was surprisingly low with the highest official accumulation of 38 mm at Halifax International Airport. A subsequent tropical-like weather feature following 8–10 hours after Juan gave an additional 30–40 mm. The two events combined to give localized flooding. The storm surge near and just east of Halifax was estimated at near 2 m, establishing a new record water level at Halifax. Buoy 44258 at the mouth of Halifax Harbour recorded a significant wave height (H_{SIG}) of 9.0 m and a maximum wave height (H_{MAX}) of 19.9 m. The Lahave Bank buoy 44142 measured H_{SIG} of 12.2 m and H_{MAX} of 26.0 m.

Juan is believed to be the most widely destructive tropical cyclone to hit Atlantic Canada in over a century with an estimated loss of 100 million trees in Nova Scotia and 1 million trees in Halifax alone. The storm claimed eight lives: four directly (two inland and two marine) and another four in the aftermath. Power outages in Nova Scotia and PEI left over 300,000 people without power for up to two weeks. Nearly all commercial activity ceased in the Halifax area for 2–5 days and schools were closed for a week. The landmark public park, "Point Pleasant Park," had 90% of the mature growth destroyed or irreparably damaged. Dozens of marinas around Nova Scotia and PEI were destroyed and dozens of small vessels capsized or sank. Public reports of "a wall of water" moving into the coast and up Halifax Harbour coincided with the arrival time of the highest surge and waves. Estimates of $100-150 million damage are conservative. The CHC issued 23 bulletins.

Kate (September 27–October 7)

Hurricane Kate was in the CHC Response Zone 070100–080500 UTC October. Kate entered the Response Zone as a category-1 hurricane and was at tropical storm strength as it moved through the Southeastern and Northern Grand Banks of Newfoundland. Rainfall from Kate was

difficult to determine because tropical cyclone moisture was feeding into a stalled frontal system over the province of Newfoundland. The 24-hour radar derived storm total rainfalls calibrated against surface reports suggest upwards of 100 mm in some regions of southwestern Newfoundland from the combined effects of these two features. The CHC issued 22 bulletins.

Additional Information

Preemptive bulletins were also issued for TS Bill (2), TS Mindy (6), and TS Odette (1), although these systems did not affect Canada. Coordination with the U.S. National Hurricane Center and affected Canadian Regional Weather Centres (Ontario, Québec, New Brunswick, Nova Scotia, and Newfoundland) preceded the issuance of bulletins.

(Available in Spanish only)

FUNCIONAMIENTO DE LOS SISTEMAS DE AVISOS DE HURACANES, TORMENTAS TROPICALES, PERTURBACIONES TROPICALES O INUNDACIONES ASOCIADAS QUE OCURRIERON EN EL 2003

(Presentado por Colombia)

Durante la temporada de huracanes del año 2003 en el Atlántico, mar Caribe y Golfo de Méjico, solamente el paso de la tormenta tropical ODETTE por el mar Caribe colombiano influyó sobre las condiciones meteomarinas en el sector maríitmo y en el centro del litoral Atlántico.

La configuración de la circulación atmosférica y la nubosidad asociada a la depresión tropical N°20 contribuyó al incremento de las precipitaciones en algunas ciudades del litoral Atlántico desde el día 3 de diciembre; un día después, a partir de esta depresión se formó la tormenta tropical ODETTE en el mar Caribe colombiano, aproximadamente a 380 kilómetros al norte de Cartagena.

Las imágenes satelitales mostraron nubosidad asociada a la tormenta tropical durante los 2 días posteriores muy cerca de la costa Atlántica colombiana, situación que generó lluvias fuertes y vendavales en algunas ciudades particulares tales como:

Ciudades	**3 de diciembre**	**4 de diciembre**	**5 de diciembre**
Cartagena	48.6 milímetros	63.3 milímetros	46.3 milímetros
Barranquilla	24.2	27.8	33.0
Puerto Colombia	45.0	30.0	127.0

Precipitación diaria en milímetros

Si tenemos en cuenta que el promedio multianual de precipitación para el mes de diciembre en Cartagena es de 35.7 milímetros, Barranquilla 33.8 milímetros y en Puerto Colombia 7.8 milímetros, se nota claramente la situación atípica que se presentó por la influencia del paso de este ciclón tropical.

Estas lluvias abundantes produjeron inundaciones por encharcamientos en los centros urbanos.

En cuanto a las condiciones marinas, se presentaron vientos fuertes, marejadas, mar de leva y lluvias.

Sobre estos casos particulares, desde el día 3 de diciembre cuando el sistema aún era una depresión tropical, se elaboraron boletines sobre la probabilidad de ocurrencia de lluvias fuertes, el día 4 se dieron avisos sobre el mar de leva en amplios sectores de la costa colombiana, y además se dieron las recomendaciones a las capitanías de puerto para que las embarcaciones de bajo calado estuvieran amarradas en puerto por el oleaje alto y las marejadas. Toda esta información se envió al sistema de prevención y atención de desastres.

Oficina Nacional de Meteorología
Centro de Información Huracanes

REPORTS OF HURRICANES, TROPICAL STORMS, TROPICAL DISTURBANCES AND RELATED FLOODING DURING 2003

(Submitted by the Dominican Republic)

Without doubt, the aftermath of the passage over the Dominican Republic of tropical storm Odette was of greatest importance for the country this season, together with the space-time distribution of precipitation generated by tropical waves nationwide. Once again, the accumulated experience in coordination between the institutions dealing with emergencies and the NMS was evident from the relatively low number of deaths despite the frequent, largely tropical wave-related flooding, landslides and overflowing rivers, as can be seen in the table below.

As regards other cyclonic phenomena, on two occasions our north and north-east coasts experienced conditions of strong swell and dangerous breakers because of the passage, some hundreds of kilometres NE of the northern Dominican Republic coast, of hurricanes Fabián and Isabel. The warning set in motion the prevention procedures of the Emergency Operations Centre, which established a very effective plan of action for the evacuation of families living on the vulnerable coast, prohibition of bathing on the beaches of the north and north-east coasts, and arrangements for small vessels to remain in port until the swell became normal again.

Although the 2003 cyclone season was very active in the North Atlantic, as had been predicted months before, of the tropical cyclones formed, only Odette had a direct impact on the Dominican Republic.

Table 1 below shows the impacts which the tropical waves had on this country, and Table 2 the indirect ones which some tropical cyclones had here. [N.B. In the tables, the unit of measurement, 1 *tarea* = 0.648 ha.]

Table 1 - Tropical waves during the 2003 hurricane season: impacts on the Dominican Republic

Place	Precipitation > 30 mm	*Impact*
	June 09	
Herrera	59.2	Rainstorms, heavy at times, accompanied by electric storms and strong gusts over a large part of the country causing sudden flooding in the Distrito Nacional and Santo Domingo Province, traffic jams hindering the movement of both vehicles and pedestrians, and overflowing of streams and rivers in the eastern region and central Cibao.
Santo Domingo	62.3	
Los Llanos	70.7	
	June 15	
San Fco. De Macorís	33.0	Moderate to strong rainstorms accompanied by occasional electric storms and strong gusts throughout most of the country, causing sudden flooding in towns in the north, north-east and east of the country.
Villa Vasquez	44.8	
Gaspar Hernández	45.2	
Bayaguana	49.0	
San Pedro de Macorís	60.8	
	July 04	
Santo Domingo	31.3	Scattered heavy rainstorms accompanied by isolated electric storms and occasional strong gusts over the Sierra de Yamasa, Atlantic coastal plain, Sierra de Ocoa, coastal plain of Miches y Sabana de La mar and Caribbean coastal plain.
Herrera	35.3	
Bayaguana	48.0	
	July 13	
Padre Las Casas	30.0	Two people died because of the rains, which also caused flooding, landslides and overflowing of rivers, hence also agricultural losses in various villages around Cibao and Puerto Plata. Floods on the river Yuna put the aqueduct out of operation leaving the whole town without drinking water and destroyed 100 m of the access road to the town. The rainstorms caused rivers to burst their banks in San José de Las Matas, Santiago Rodríguez, Nagua, Puerto plata, Cotui and other parts of the region. The damage to the area's agriculture caused by the waterlogging of thousands of ***tareas*** of rice, plantain, cassava and other crops entailed big financial losses.
San Francisco de Macorís	30.3	
Los Llanos	31.3	
Samaná	35.9	
San Rafael de Yuma	39.0	
La Unión (puerto plata)	43.6	
Sabana de La Mar	50.8	
Constanza	52.0	
Las Américas	52.3	
Arroyo Barril	52.4	
Gaspar Hernández	56.3	
Juma(Bonao)	67.0	
La Vega	74.0	
	July 14	
El Seybo	43.7	Heavy rainstorms in the province of El Seybo.

July 22		
Las Américas Salcedo Bayaguana Santiago Gaspar Hernández Juma (Bonao) Sabana de La Mar San Rafael del Yuma Santo Domingo Samaná La Vega Herrera	35.1 37.0 38.4 41.2 43.0 45.0 46.7 48.1 48.9 70.0 82.0 94.6	At midday, the cloud field of the strong tropical wave started to move over the country from the east accompanied by moderate to heavy rainstorms, electric storms and gusty winds; uprooted trees also affected power lines. The rain flooded the main roads in the capital city obstructing all passage and causing prolonged traffic jams. One child died after being crushed by a wall which collapsed as a result of the rain.
July 27		
Santo Domingo Bayaguana Los Llanos	35.0 45.9 58.0	Light to moderate scattered rainstorms accompanied by electric storms occurred over much of the country, with heavy ones in the Cordillera Oriental and Sierra de Yamasá, which caused repeated flooding in the towns of Hato Mayor, Higuey, El Seybo and Bayaguana.
August 02		
Los Llanos	56.2	Heavy rainstorms accompanied by electric storms in parts of the Yamasá mountains as well as in the Caribbean and Atlantic coastal plains, Yaque Valley and Barahona Peninsula.
August 09		
Sabana de La Mar Samaná	34.5 45.8	Gusts accompanied by rainstorms and electric storms started in the NE of the country, blowing down the electricity pylon near the station. The observer estimated the wind at about 85 to 100 km/h .
August 18		
Bayaguana Los Llanos	40.4 42.2	Repeated flooding in the towns of Los Llanos and Baya guana, as well as the metropolitan area around the capital. Light to moderate rainstorms and electric storms were also recorded in the Atlantic coastal plain, Cibao Valley, Sierra de Yamasá, eastern Cordillera and some villages in the border zone.

August 23		
Gaspar Hernández	31.2	Following the degeneration of tropical depression No. 9, in Tamayo more than 100 homes were flooded and 160 people evacuated, while the seeds of various crops were destroyed. The following rivers burst their banks: Palomino, La Vija, Juan Méndez, Brazo Grande and Arroyo Seco. The town of Pedernales was affected by heavy rainstorms and electric storms, as well as gusts uprooting trees which fell onto power lines causing a power cut in the town, the river forming the border rose considerably, and the transport service was affected.
Samaná	31.3	
Moca	40.0	
San Pedro de Macorís	48.0	
Cabrera	50.8	
Barahona	57.3	
Santiago	73.9	
August 25		
La Unión (Puerto Plata)	33.2	The cloud cells of a tropical wave over Puerto Rico started to reach our country in the early afternoon bringing heavy rainstorms, electric storms and gusts, all of this activity continuing through the night and next morning, causing repeated flooding and floods on rivers and streams in about 42 communities in the north-east. In Nagua, flooding affected about 5 districts inundating several tens of homes. The rain also caused one electricity pole to fall down. Twelve sectors of Salcedo were affected, including the district of El Matadero, where one family had to be evacuated because their house was destroyed, and Rabo Duro, where one house partially collapsed.
Santo Domingo	33.3	
Santiago	39.0	
Moca	40.7	
Juma (Bonao)	43.8	
San Francisco de Macorís	46.3	
Imbert	47.0	
La Vega	48.0	
Herrera	48.6	
Río San Juan	57.9	
Salcedo	58.3	
Villa Riva	84.0	
Sánchez	99.1	

August 26		
San Francisco de Macorís	30.3	Settlements in the SE, S and SW of the country were affected: in Bonao 8 houses were destroyed and the overflowing of the rivers Maimón and Massipedro destroyed part of the Los Quemado road. The river Yuna burst its banks, flooding various districts and cutting off some parts of Bonao and Villa Altagracia; in the district Las Flores about 10 houses were destroyed by the flood of the river Maimón, also cutting off the community Massipedro, while families were being evacuated one person drowned in the river Yuna. In San Cristóbal the Los Cacaos-Cambita Garabitos road collapsed and the rivers Nigua and Yubazo overflowed leaving more than 20 families homeless. In the SW, in Paraíso, farm roads were destroyed as well as access routes to various communities in the region. In the town of Pedernales there were power cuts after some trees fell on power lines as a result of the rain and wind; the river forming the border rose considerably. In Barahona and Tamayo some 160 people were evacuated. The La Guazara rivers reached the highest level in the period of recordings (over 40 years).
Duvergé	31.2	
Constanza	32.1	
Samaná	44.3	
Punta Cana	46.6	
Juma (Bonao)	51.5	
San Rafael Yuma	57.5	
Loyola (San Cristóbal)	61.1	
September 18		
El Cercado	39.6	Rainstorms with electric storms and occasional gusts occurred over most of the country, causing flooding and floods on river and streams, uprooting of trees and electricity poles up to the NE regions and border area.
Santiago Rodríguez	47.2	
Villa Riva	60.3	

October 02		
Santiago (Licey al medio)	107.2	Precipitation and electric storms occurred mainly around the border area and central Cibao valley. More than 100 mm of rain fell at the International Airport Licey al Medio (Santiago).
October 09		
Duvergé	40.8	Light to moderate, and occasionally heavy rainstorms with electric storms occurred nationwide, with the highest cumulative values over 24 hours being in the NE region and border area.
Villa Riva	48.5	
Río San Juan	66.0	
Nagua	87.4	
November 08		
Río San Juan	50.4	Electric storms occurred towards the Caribbean coastal plain, in the Cibao valley and the Atlantic coastal plain.
Cabrera	61.2	

Table 2 - Tropical cyclones in the 2003 hurricane season: impacts on the Dominican Republic

Date	Place	Precipitation > 30 mm	Impact
Tropical Storm CLAUDETTE			
July 08	Las Américas	30.5	This phenomenon produced heavy rainstorms with electric storms and gusts reaching 70 km/h, which brought down trees, signposts and corrugated iron roofs (reported in the west of the capital) as well as flooding in the metropolitan area with the resultant blockages for traffic and pedestrians. Rainstorms and electric storms occurred over much of the country, but with most intensity over the mountains. Plantations of banana and other fruit trees in the SW region suffered severe damage.
	Constanza	32.1	
	La Vega	38.0	
	San Rafael de Yuma	40.0	
	Juma (Bonao)	58.5	
	Santo Domingo	79.9	
July 09	Villa Vásquez	37.4	Tropical Storm Claudette continued to affect the country. Causing light to moderate rain over much of the country, and heavy rain mainly in the NW part.
Tropical Depression No. 9			
August 21	Sabana de La Mar	34.5	Moderate precipitation with electric storms occurred over much of the country, with heavy ones in parts of the Eastern Cordillera and the plains of Miches y Sabana de La Mar, owing to the depression's indirect effects.
August 22	Sabana de La Mar	42.5	Heavy rainstorms with electric storms caused repeated flooding in parts of the S, E and NE of the country, mainly east and west of the Santo Domingo metropolitan area, which obstructed traffic and caused the collapse of both a house (wounding an elderly woman and her grandson) and a sports centre.
	San Pedro de Macorís	48.0	
	San Rafael de Yuma	52.5	
	Herrera	80.0	
	San Cristóbal	90.0	
	Santo Domingo	98.0	

Hurricane Fabián

September 03	Small vessels on the Atlantic coast and in the Samaná Bay were advised to stay in port because of abnormal waves and NE winds of 20-25 knots with occasional gusts. Breakers and waves of over 8 feet occurred on the Atlantic coast.
September 04	Several families living near the coast in the town of Nagua (NE region) were evacuated because of heavy seas which flooded their homes.

Hurricane Isabel

September 15	The indirect effects of Hurricane Isabel continued to dominate the country, causing light to moderate rainstorms with electric storms in large areas. The hurricane caused heavy swell on the coast of Puerto Plata province, flooding about 40 houses in the Playa Oeste sector and preventing thousands of tourists staying in the North Coast complexes from bathing on their beaches and practising water sports. On the 16th, storm waves of up to 8 feet hit the beaches at Cabaretes, Sosua, playa Dorada, Costa Ambar, Maimón y Luperón, penetrating in some cases up to 50 m inland and reaching many houses. There was also flooding in Yerba de Guinea in the province of Valverde de Mao, 14 houses being flooded because of the heavy rainstorms and electric storms in the afternoon of 15 September and the following night.

Jimaní	32.4
Santiago Rodríguez	38.8
Mao	54.5
Cabrera	117.3

September 16	Herrera Duvergé Gaspar Hernández	48.0 48.5 50.8	The indirect effects of the hurricane were still being felt, mainly through the S-SW winds which brought humidity from the Caribbean Sea.

Tropical Storm Mindy

October 10	Punta Cana Río San Juan Samaná	39.2 41.4 55.7	Tropical Storm Mindy formed in the extreme NE of the country. Heavy rainstorms with electric storms occurred when it passed from Punta Cana to Samaná.

October 11	Santiago Rodríguez	60.0	Heavy rainstorms caused flooding in the urban area where some vulnerable districts were flooded by the overflowing of the river Gurabo which damaged 320 houses along the river by filling them with sludge 2 feet deep.

TROPICAL STORM ODETTE

Odette as it affected the Dominican Republic

Tropical Depression No. 20 became more organized and intense in the afternoon of 4 December and evolved into Tropical Storm No. 15, named Odette. At 6.00 p.m. this new tropical storm was centred at 14.3ºN 75.5ºW, about 680 km SW of Punta de Maisí, Jamaica and was moving in a direction close to NNE at about 17 km/h.

The maximum sustained winds were in the order of 65 km/h and the minimum central pressure was 1003 hPa.

This was an unseasonal tropical event since the 2003 cyclone season had officially ended on 30 November 2003. Such unseasonal tropical cyclones are infrequent, although they have occurred in the past.

Odette hit the population in the SE of the Dominican Republic with heavy precipitation as from the afternoon of Saturday 6 December when the centre moved NE over the Caribbean country, with sustained 65 km h^{-1} winds and occasional gusts reaching the intensity of a category 1 hurricane. Odette entered Dominican territory as from midday near Bahía de las Águilas, in the vicinity of Cabo Falso or Punta Aguja, the most western part of the country's SW coast.

Similarly, the eastern part of the country received heavy precipitation as from the afternoon of the Saturday, particularly over Isla Saona.

More than 10,000 people were evacuated from homes near rivers in various provinces and at least 2,000 refuges were set up capable of housing up to 800,000.

The army was mobilized during the emergency to forcibly move those unwilling to leave their homes.

The cyclone's landfall in Dominican territory after midday intensified the heavy rainstorms which had already been occurring since the night of Friday, thus worsening the impact of rainfall in the region in the second week of November, damaging the homes and other property of more than 60,000 people through flooding and landslides.

The situation was very worrying because the land in the N and NE was already saturated with the rain that had fallen three weeks previously, which increased the flood hazard.

Most of the evacuations on Friday 6 were from places in the most flood-prone areas in the provinces of Barahona, San Juan de la Maguana and Pedernales (in the SW of the country). The others were from the NW and N of the country, where it was expected that the effects of Odette would be felt later.

Odette left Dominican territory quickly, in the morning of Sunday 7.

Odette is the first tropical storm to start in December in the Caribbean since the beginning of records on these atmospheric phenomena in 1871 and it arrived four days after the official 2003 Atlantic hurricane season ended, although hurricanes originating in the Atlantic have been recorded.

Losses caused by Odette

The National Emergency Committee reported 10 deaths nationwide caused by tropical storm Odette, besides material damage amounting to millions of pesos, 859 families affected, 34 of which lost their homes, 16,020 were evacuated, 1,087 housed and 99 rescued.

Odette affected agriculture in various parts of the country through the rain and flooding, particularly in Barahona and Neiba (according to preliminary information, 35% of sown banana trees).

There were also landslides on various roads, which were quickly repaired by the authorities.

Two electricity pylons in the southern region were severely affected. One that was blown over caused a power cut in the whole area from Azua to Barahona. The most damage occurred in various provinces in the south, such as Barahona, Bahoruco, San Juan de la Maguana and Azua, where there agriculture suffered heavy losses and many homes were affected.

In the town of San Cristóbal, part of one of the bridges over the river Nigua collapsed, preventing the 100,000 inhabitants of the area from crossing the river there.

The river Ocoa swept away the western end of the bridge on the Ocoa-Sabana larga road, leaving the communities in Rancho Arriba, El Naranjal, La Horma, Mahoma and Nizao stranded.

More than 100,000 *tareas* sown under the Isura project, in Azua, with plantains, bananas, cooking bananas and tomatoes were affected.

The rivers Jura, Irabon and Yaque del Sur, flooded fields in Cañá de la Piedra, Los Jovillos, La carretera, Magüeyal and Villalpando, which put this province in a difficult situation.

It was reported in Barahona that the province was without electricity as from Saturday night. Banana crops also suffered considerable damage in Tamayo, Fundación, el Peñón, Uvilla and El Jobo, while in Oviedo the wind uprooted more than 10,000 *tareas* of sorghum. About 500 families were evacuated from San Juan de la Maguana's Mesopotamia area.

In Baní, in the central southern area, banana crops were damaged in Paya, Boca Canasta, Matanzas, Los Tumbaos, Quijá Quieta and the projects in Las Calderas. There was flooding in Santa Rosa, Santa Elena as well as in Arroyo Guázuma.

Odette's passage over the country caused much rainfall in Santiago and other provinces in the Cibao region, but without material damage. In María Trinidad, in the NE of the country, it caused rainfall lasting several hours. The rescue services formed by the Government, Civil Defence, Red Cross, rescue organizations and fire brigade under the emergency commission were placed on alert.

There were 3,600 people evacuated, 1,087 given accommodation and 72 rescued out of a total of 4,759. In Barahona 3,200 people were taken to the homes of family and frieds and 722 families were housed in various hotels. The whole area below this province was flooded. In Polo there was a landslide which destroyed five homes but without causing any casualties.

Material damage

In San Isidro and the municipal district of Guerra, near Santo Domingo, a tornado formed which caused two trees to fall on one house, completely destroying it, and blew the roofs off several other houses in Guerra.

Heavy rain and strong gusts of wind were particularly intense around midnight on the Saturday in Santo Domingo.

Rainfall generated by Tropical Storm Odette

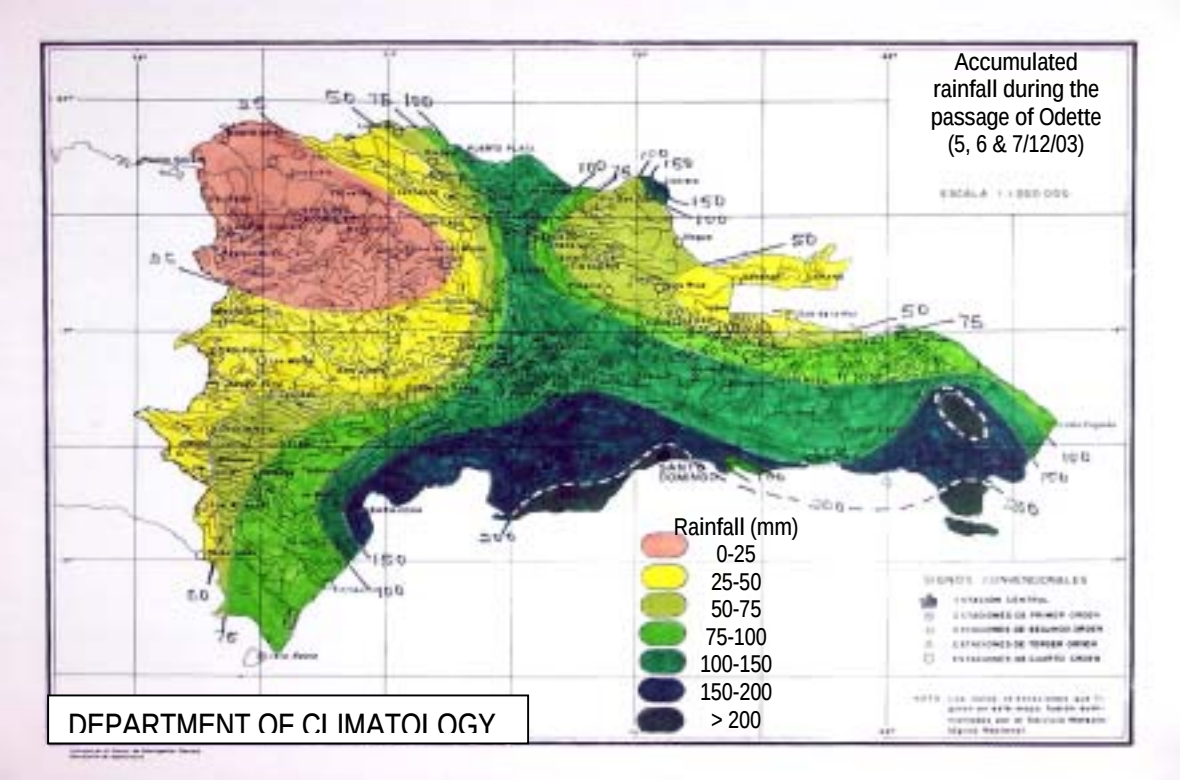
Automatic station data

Station / Day	05	06	07	Total
Miches	33.5	18.3	26.9	**78.7**
Higuey	4.8	132.1	80.0	**216.9**
Hato Mayor	3.9	60.8	53.3	**118.0**
Nagua	3.8	16.8	37.1	**57.7**
El pozo	1.0	36.5	40.9	**78.4**
Pimentel	0.0	1.8	27.8	**29.6**
Las Galeras	2.0	15.3	18.0	**35.3**
Isla Saona	18.8	164.1	47.5	**230.4**
Yamasá	3.6	64.0	48.0	**115.6**
Restauración	0.0	5.9	1.0	**6.9**
Dajabón	0.0	2.3	9.9	**12.2**
Monción	0.0	2.3	9.9	**12.2**
Moca	0.8	66.8	63.8	**131.4**
Valle Nuevo	3.3	90.2	47.5	**141.0**

Comparison of cumulative rainfall on 05, 06 and 07 December 2003 with cumulative normals (1961-1990) during the same period		
Station	Cumulative normal	Total
Miches	26.4	78.7
Higuey	11.7	216.9
Hato Mayor	3.7	118.0
El Seybo	13.9	83.3
San Rafael del Yuma	8.4	73.0
Isla Saona	-	230.4
Punta Cana	6.2	98.3
Sabana de la Mar	34.3	40.3
Los Llanos	2.4	119.9
San Pedro de Macorís	5.4	129.0
Bayaguana	2.9	121.6
Yamasá	15.5	115.6
Las Américas	6.7	93.4
Santo Domingo	8.5	213.0
San Cristóbal	9.4	167.2
Baní	2.2	209.8
Barahona	2.3	183.6
Pedernales	1.2	42.1
Jimaní	3.1	49.0
La Descubierta	2.9	50.0
Las Matas de Farfán	1.2	30.0
San Juan de la Maguana	0.8	40.0
Padre Las Casas	1.7	50.0
Valle Nuevo	_	141.0
Constanza	5.4	43.3
La Vega	7.9	130.5
Moca	12.6	131.4
Villa Rivas	18.7	66.7
Nagua	35.1	57.7
El Pozo	_	78.4
Río San Juan	30.1	71.2
Cabrera	22.1	131.2
Las Galeras	_	35.3
Puerto Plata	28.1	129.6
Santiago	9.5	33.3
Imbert	33.7	51.2
Monción	8.2	12.2
Santiago Rodriguez	3.7	21.4
Restauración	5.3	6.9
Dajabón	7.6	7.0
Montre Cristi	11.1	11.0

Maximum winds recorded on 06 December 2003

Station	Maximum sustained wind speed		Maximum gust speed		Minimum pressure at sea	
	Direction	10-min. speed (km/h)	***Direction***	Speed (km/h)	Pressure (hPa)	HU on 07.XII.03
CENTRAL (SANTO DOMINGO)	SE	30	SE	74	1007	09:00
HERRERA	S	26	-	-	-	-
BARAHONA	SSE	44	-	-	999	00:00
LAS AMÉRICAS	S	46	S	70	1006.	06:00
LA UNIÓN (PUERTO PLATA)	O	28	-	-	1004	09:00
SANTIAGO	E	28	-	-	1005	06:00
PUNTA CANA	-	-	-	-	1007	21:00 (Día 06)
BAYAGUANA	-	-	-	-	-	-
LOS LLANOS	-	-	-	-	-	-
SAN RAFAEL DE YUMA	-	-	-	-	-	-
LA ROMANA	Variable	20	SSO	37	-	-
SAN CRISTÓBAL	-	-	-	-	-	-
BANÍ	-	-	-	-	-	-
HIGUEY	-	-	-	-		-
ISLA SAONA	-	-	-	-	-	-
VALLE NUEVO	-	-	-	-	-	-
YAMASÁ	-	-	-	-	-	-
LA VEGA	-	-	-	-	-	-



Specialized Information Centre
Onamet-Santo Domingo

(Available in Spanish only)

IMPACTO DE LOS FENÓMENOS METEOROLÓGICOS DEVASTADORES DEL 2003 EN EL SALVADOR

(Presentado por El Salvador)

(12 pages in hard copy)

DIRECTION INTEREGIONALE ANTILLES GUYANE

SUMMARY OF THE 2003 HURRICANE SEASON IN THE FRENCH WEST INDIES

(Martinique, Guadeloupe St Barthelemy and St Martin)

(Submitted by France)

No watch and no warning for this very quiet 2003 season on the French Islands. Only light floodings occurred for example during the pass of the future TD #9 in August.

Our islands experienced also moderate swells during the pass in the north to the islands of Fabian (swell up to 4m) and Isabel (swell up to 2.5m).

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THE 2003 HURRICANE SEASON

(Submitted by Jamaica)

The 2003 Hurricane Season was a very active one with 16 cyclones developing, one in April, two in June, three in October, four in July and August, five in September, none in November, and two in December. There was a record three out of season cyclones, Ana in April and Odette and Peter in December. Ana was the first Tropical Storm to form in the Atlantic in April and Odette the first Tropical Storm to have developed in the Western Caribbean in December.

With respect to Jamaica, the 2003 Hurricane Season was an active one. Of the twenty-one cyclones that developed, four (4) had special significance to Jamaica, Tropical Storms Claudette and Odette and Tropical Depression number 6 and 9. Jamaica was, however, spared the worst of nature's fury on all four occasions.

On July 8, a strong Tropical Wave over the Central Caribbean was upgraded to Tropical Storm status – Claudette. With the cyclone near latitude 14.8°N and longitude 70.0°W, a Tropical Storm Watch was issued for Jamaica at 3:00 pm that day in Bulletin #1 from the Meteorological Service. This was upgraded to a Tropical Storm Warning later that day. The warning remained in effect until 7:00 pm on July 9 after a total of 9 bulletins were issued.

As Claudette tracked westwards, maximum sustained winds increased to near 110 km/h. Claudette was forecasted to stay south of Jamaica keeping the island on the northern fringe of the tropical storm force winds. Fishermen on the Banks and Cays South of the island were advised to evacuate.

The morning of July 9, saw Claudette picking up speed as it continued to draw closer to the island. By 1:00 pm Claudette was near latitude 15.8°N and longitude 78.6°W or about 265 km south of Negril Point. Heavy rainfall affected the island but there was no significant flooding or damage during the passage of Claudette.

Tropical Depression #9 developed over the Eastern Caribbean Sea near latitude 14.7°N and longitude 66.1°W on August 21. One day later this was downgraded to a tropical wave. The wave moved rapidly across Jamaica on August 24. Heavy rainfall affected Eastern and Central Parishes as well as offshore areas.

Tropical Storm Odette developed out of Tropical Depression #20 on December 4. This depression developed from a persistent area of low pressure over the South Western Caribbean. The Meteorological Service had been monitoring the system and issuing advisories as early as December 2. Bulletin #1 was issued at 10:00 am on December 4. The island was placed on a Tropical Storm Watch and later that day this was upgraded to a Tropical Storm Warning as Tropical Storm Odette was forecasted to move between Jamaica and Haiti. These projections were gradually modified shifting the projected path further east each time. The tropical storm warning was lifted at 4:00 pm on December 5 after a total of 10 Bulletins were issued. Rainfall associated with Odette affected Central and Eastern parishes of the island, with some flooding in the North East.

Again this year heavy rainfall in May resulted in severe flooding in parts of the island. May marks the first of a bimodal rainfall pattern characteristic of the island, the primary being in October.

May 22-25 saw heavy rains across the island as a result of a surface trough. This resulted in significant flooding in some parishes. Central and eastern parishes were particularly impacted with St. Thomas being the most severely affected. Two lives were lost, many communities were flooded and marooned. There were several landslides and significant loss in infrastructure. Sections of the recently constructed Bailey Bridge at Yallahs and St Thomas was destroyed by flood waters from the Yallahs river.

During the four-day period May 22-25, over 500 mm of rainfall were recorded in parts of St. Thomas, Portland and Manchester. 200-300% of the Mean rainfall for the month of May were recorded in parts of Portland, St. Thomas, Manchester and St. Catherine during the 4-day period.

Some rainfall values, May 22-25, 2003:

Parish	Station	Rainfall (mm)
St. Thomas	Cedar Valley	570
Portland	Fruitful Vale	517
Portland	Sherwood Forrest	513
Manchester	Mandeville	521
St. Catherine	Bernard Lodge	345
St. Catherine	March Pen	327
St. Catherine	Bodles	321

During the month of October, areas of low pressure in the vicinity of Jamaica brought heavy rainfall to the island, particularly in western Jamaica, resulting in flooding in the New River Community of St. Elizabeth.

The Water Resources Authority of Jamaica reported that flood waters rose to a depth of 1.5 metres above road level with an aerial coverage of 3 km^2. This flooding lasted for twenty-nine (29) days from October 16 to November 13, 2003, inundating five houses, partially flooded 10 other houses and 30 persons were evacuated.

The Community Flood Warning Systems, where installed, were utilized by various Flood Response Teams in helping to give prior warning to residents, this resulting in a reduction of the flood impact.

COMISION NACIONAL DEL AGUA

SUBDIRECCIÓN GENERAL TÉCNICA
UNIDAD DEL SERVICIO METEOROLÓGICO NACIONAL

REPORT ON THE 2003 CYCLONE SEASON AND ASSOCIATED FLOODING

(Submitted by Mexico)

Tropical cyclones that affected Mexico during the 2003 season

The 2003 cyclone season is considered very active as regards the number of cyclones which had a direct impact on land in Mexico, with a total of 8 systems with direct impact including those from the Pacific and Atlantic Oceans. This number was only exceeded in the 1971 season when there were 9 direct impacts, which was a record, the average for the period 1970-2003 being 4.2 cyclones per annum directly affecting the country.

Cyclones in the east Pacific Ocean

A total of 16 systems originated in the Pacific during the season, of which five made landfall in Mexico: Hurricanes “Ignacio” and “Marty”, Tropical Storms “Carlos” and “Olaf” and Tropical Depression “Nora”.

Tropical Storm Carlos formed on 25 June very close to the Oaxaca coast with a short passage over land on 27 June, its centre being 15 km NE of Pinotepa Nacional, Oaxaca, with maximum sustained winds of 85 km/h, gusts of 100 km/h and minimum pressure of 996 hPa. It affected the states of Oaxaca and Guerrero. The maximum rainfall accumulated in 24 hours was 254 mm at the station Río Verde, Oaxaca. No deaths were reported, but 44 communities in Oaxaca state had floods and problems with power supply and telephones.

Hurricane Ignacio formed on 22 August and its centre made landfall on 25 August, 25 km NE of the bay of La Paz, in Baja California Sur (BCS), with maximum sustained winds of 140 km/h and gusts of 165 km/h. The maximum rainfall accumulated in 24 hours was 184.1 mm in Ciudad Constitución, BCS, on 26 August. In its trajectory, the system caused very heavy rainfall, strong winds and a high wave in the states of Colima, Jalisco and Nayarit, and later also in BCS and Sinaloa. Its passage caused much material damage, mainly in BCS, where flooding was reported, landslides, roads cut off by water torrents, noticeboards, and posts, trees, power cables and telephone lines blown down. Two deaths were reported in BCS.

Hurricane Marty started SW of the Jalisco coast on 18 September and made landfall on 22 September in San José del Cabo, BCS, with maximum sustained winds of 160 km/h which were category II on the Saffir-Simpson scale. The automatic station of Los Cabos reported maximum sustained winds of 140 km/h and gusts reaching 188 km/h. The maximum rainfall accumulated in 24 hours was 197.5 mm in Todos Santos, BCS. The greatest impacts were reported in the states of BCS, Sinaloa and Sonora, where the resultant flooding entailed 12 deaths and much material damage in 4,000 homes as well as roads, farmland and power supply.

Tropical Depression Nora formed on 1 October SW of Manzanillo, Colima, and after a slow, erratic trajectory eastwards then northwards, it made landfall during the last hours of 8 October near the town of Cruz de Elota, Sinaloa, with maximum sustained winds of 45 km/h. The maximum rainfall reported was 95.3 mm in Mazatlán, Sinaloa. No damage or loss of life was reported.

Tropical Storm Olaf formed on 3 October south of the coast of Guerrero and, during the first hours of 7 October, it made landfall between the states of Colima and Jalisco, with maximum winds of 95 km/h. The maximum rainfall accumulated in 24 hours was 196.8 mm in la Derivadora Jala, Colima. The greatest impact was in Colima and Jalisco, where there was flooding with material damage in homes, roads and farmland and interrupted power supply and telephone service.

Cyclones in the east Atlantic Ocean

A total of 21 systems originated in the Atlantic during the season, of which three made landfall in Mexico: Hurricane Erika and Tropical Storms Claudette and Larry.

Tropical Storm Claudette formed on 8 July in the central Caribbean and during the first hours of 11 July made landfall on the coast of Quintana Roo, 25 km SSW of Cancún with maximum winds of 90 km/h and gusts of 110 km/h. The maximum rainfall was 58 mm in Peto, Yucatán, but no major impacts were reported.

Hurricane Erika formed on 14 August in the NE of the Gulf of Mexico, then, after maintaining a general westward direction, made landfall on 16 August on the coast of Tamaulipas with maximum winds of 110 km/h. The maximum rainfall accumulated in 24 hours was 170.5 mm in Magueyes, Tamaulipas. Two people died in Montemorelos, Nuevo León, when trying to cross a bridge which was partially under water. Damage was reported on blocked roads in Tamaulipas and Nuevo León.

Tropical Storm Larry developed from a tropical wave which interacted with a frontal system and became a tropical storm on 1 October. After a slow, erratic southward trajectory, the centre of the storm hit the coast of Tabasco on 5 October with maximum sustained winds of 95 km/h and gusts of 110 km/h. There was intense rainfall in Tabasco, Chiapas, Oaxaca, Campeche and Veracruz, with maximum rainfall accumulated in 24 hours of 245.5 mm in El Tortuguero, Chiapas. Five people died and there was flooding and major material damage to homes, roads, and crops as well as interrupted power supply and telephone services.

Operation of the early warning system at the NMS of Mexico

The NMS maintained a permanent watch of the tropical cyclones throughout the 2003 season. A total of 375 warnings and 400 alert bulletins was issued for the Pacific as well as 259 warnings and 366 meteorological alert bulletins for the Atlantic.

Recapitulation of tropical cyclones during the 2003 season in Mexico

Tropical cyclone	Trajectory (km)	Duration (hours)	Total No. of warn-ings	Landfall in Mexico		Max. rainfall in 24 h (mm)	Human and material losses (*)
				Place	Max. wind km/h		Deaths
Carlos *Jun 26-27*	570	42	15	Pinotepa Nacional, Oax.	85	254.0 Río Verde, Oax.	0
Ignacio *Aug 22-27*	1,135	129	45	Bahía de La Paz, BCS	140	184.1 Constitución,BCS	2
Marty *Sep 18-24*	2,340	130	47	San José del Cabo, BCS	160	197.5 Todos Santos, BCS	12 4,000 homes affected
Nora *Oct 1-9*	2,160	180	46	Cruz de Elota, Sin	45	95.3 Mazatlán, Sin.	0
Olaf *Oct 3-8*	1,975	108	36	Cihuatlán, Jal.	95	196.8 Jala, Col.	0
Claudette *Jul 8-17*	3,795	174	62	Cancún, QR.	90	58.0 Peto, Yucatán	0
Erika *Aug 14-16*	1,720	54	17	Valle Hermoso, Tam	110	170.5 Magueyes, Tam.	2
Larry *Oct 1-6*	640	129	34	El Alacrán, Tab.	95	245.5 Tortuguero, Chis	5

* Human and material losses figures supplied by the General Civil Defence Coordination Office, Government Secretariat

REPORT OF CYCLONIC VORTICES AFFECTING NICARAGUA DURING THE 2003 SEASON

(Submitted by Nicaragua)

The cyclonic vortices occurring in 2003 in basin No. 3 (Gulf of Mexico, Atlantic Ocean and Caribbean Sea) did not affect Nicaragua directly or indirectly, nor did they significantly affect the cumulative rainfall. Only tropical storms Grace and Larry indirectly caused precipitation in the NW of the Pacific region. The centres of maritime and continental highs blocked the passage of the cyclonic vortices up to Central America and minimized the impact of the tropical waves on precipitation over Nicaragua.

The cyclonic vortex which came closest to Nicaragua was tropical storm Claudette, which was 470 km NE of Puerto Cabezas on 9 July, resulting in the establishment of a green alert on that day which was suspended on the following day as there was no threat to this country.

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(Available in Spanish only)

RESUMEN DE LA PASADA TEMPORADA DE HURACANES

(Presentado por Panamá)

Situado entre el Caribe y el Pacífico y entre Colombia y Costa Rica, el Istmo de Panamá está localizado entre 7° y 9° de Latitud Norte y entre 77° y 83° de Longitud Oeste (Figura No. 1).

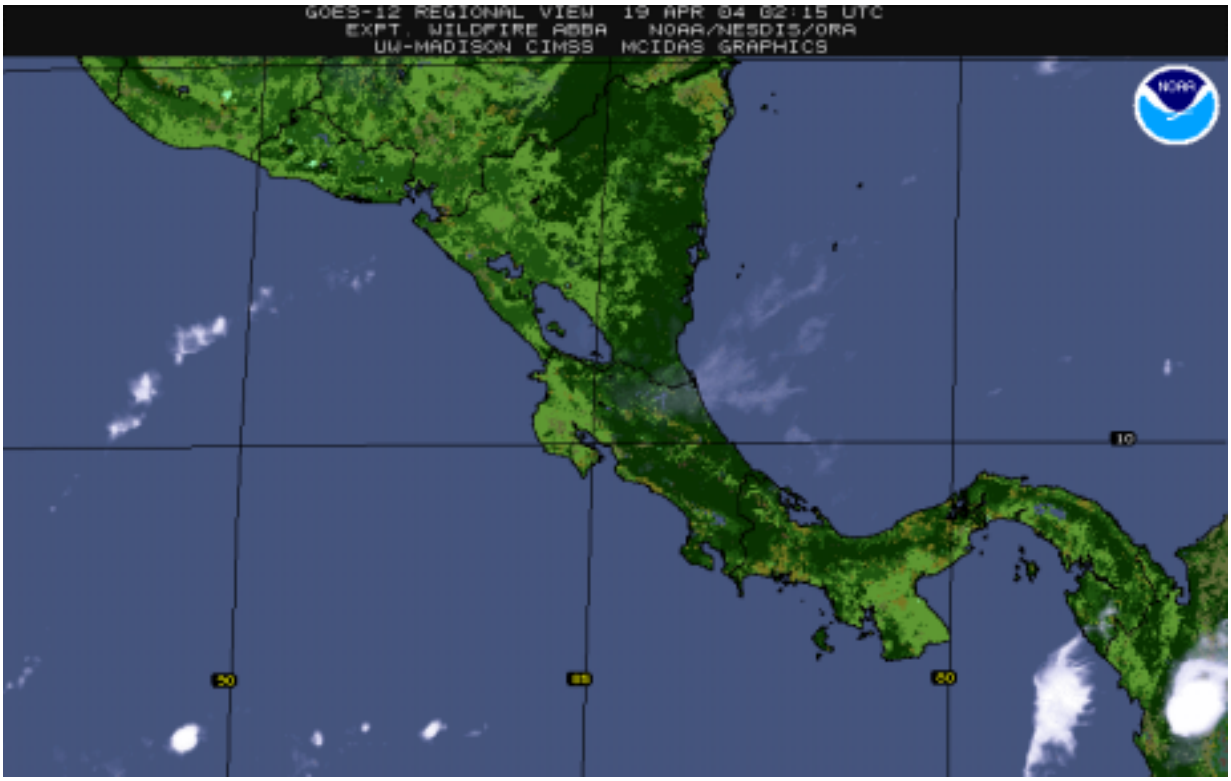

Figura No. 1 Localización del Istmo de Panamá (Fuente: NOAA)

Por su posición privilegiada, ***raramente***, se ve afectado, ***en forma directa,*** por el paso de los huracanes, tormentas y perturbaciones tropicales. Generalmente, en estas raras ocasiones, las aristas de las bandas de alimentación han ocasionado lluvia. La mayor influencia del paso de huracanes y tormentas tropicales es la reactivación de la Zona de Convergencia Intertropical (ITCZ)

Los principales sistemas generadores de lluvia sobre el Istmo (coincide con la época de huracanes) son: La Zona de Convergencia Intertropical, las ondas tropicales u ondas del Este, las vaguadas y los sistemas de baja presión, principalmente, a nivel local.

Ni siquiera la tormenta tropical Odette tuvo mayor relevancia en la ocurrencia de desastres a nivel nacional, a pesar de su formación sobre el Mar Caribe próximo al Istmo (Ver mes 12 - Tabla No. 1). Mayor influencia ejerció la perturbación meteorológica (mal tiempo) previa a Odette, que permaneció por varios días sobre la Costa Este de Nicaragua, Costa Rica y Costa Norte de Panamá.

La Tabla No. 1 presenta un análisis de los daños causados por las inundaciones, deslizamientos y vendavales ocurridos durante el año 2003.

República de Panamá

SISTEMA NACIONAL DE PROTECCION CIVIL (SINAPROC)

Estadística de afectaciones en personas e infraestructura

según tipo de evento

Año 2003

Evento	No. de Eventos	No. de Personas			No. de Viviendas	
		Muertas	Afectadas	Heridas	Destruidas	Afectadas
DESLIZAMIENTO	13	6	112	0	0	23
INUNDACION	30	0	9647	0	0	1464
VENDAVAL	6	0	179	0	0	37
TOTAL	**49**	**6**	**9938**	**0**	**0**	**1524**

Tabla No. 2 Resumen de afectaciones según tipo de evento durante el año 2003

SISTEMA DE AVISO DE HURACANES Y SISTEMAS DE ALERTA TEMPRANA COORDINACIÓN - ASPECTOS OPERATIVOS

Panamá no cuenta con un Instituto o Centro Meteorológico Nacional. Actualmente, si bien existe la iniciativa, la previsión de la creación de un Centro Meteorológico Nacional no es a corto plazo. La Autoridad Nacional del Ambiente (ANAM), la Dirección de Aeronáutica Civil (DAC), la Empresa de Transmisión Eléctrica (ETESA), la Universidad de Panamá, la Autoridad del Canal de Panamá (ACP), el Sistema Nacional de Protección Civil (SINAPROC) incluyen en su organización alguna unidad relacionada con la Meteorología e/o Hidrología.

Por consiguiente, difícil resulta la coordinación efectiva de los aspectos operativos tanto de un Sistema de Aviso de Huracanes y asuntos relacionados, como de un Sistema de Alerta Temprana (SAT) a nivel local.

Difícil es también plasmar las fortalezas y debilidades de un SAT, cuando sólo el pasado 19 de Noviembre el SINAPROC entregó al Organo Ejecutivo el Plan Nacional de Emergencia. Dicho plan da los lineamientos generales par todo tipo de desastre, no sólo los asociados a huracanes, tormentas y disturbios tropicales.

Corresponde a ETESA el análisis de la componente meteorológica e/o hidrológica de un evento que de origen a un desastre. A su vez, el SINAPROC se encarga del correspondiente análisis de vulnerabilidad, donde se identifica a las comunidades con mayor probabilidad de inundación o afectación por otro tipo de evento.

Hasta el presente, el SINAPROC ha realizado los análisis de vulnerabilidad para la Sub-Cuenca del Río Mamoní, en Chepo, la Cuenca del Río Chico, en la Provincia. de Chiriquí y la Cuenca del Río Changuinola, en la Provincia de Bocas del Toro.

Luego de cada uno de estos análisis, el SINAPROC capacitó a la comunidad para que la gente desarrollara su propio plan de emergencia (asistiendo a talleres de trabajo coordinados y organizados por el SINAPROC) con el fin de que ante una alerta de inundación, la comunidad respondiera de la mejor forma y organizadamente.

A continuación, los pasos del SINAPROC en una situación de emergencia:

1. Integración de las Instituciones que conforman el SINAPROC.

2. Establecimiento de los Centros de Acopio en la Región Metropolitana y en la región afectada. La mayoría es administrada por el SINAPROC.

3. Activación del Centro de Operaciones de Emergencia Nal. (COE) para la administración y flujo de información entre los organismos participantes.

4. Redacción de un informe detallado de las personas afectadas y de la afectación por área.

5. Recolección y administración de las donaciones hechas por el Gno. Nal., la Empresa Privada y particulares.

6. Entrega de las donaciones, por sector, familia o residencia.

7. Redacción de un Informe Ejecutivo.

APPENDIX IV, p. 56

APPENDIX IV, p. 57

APPENDIX IV, p. 58

(hard copy of tables)

COUNTRY REPORT

(Submitted by the USA)

Two hurricanes made landfall in the United States in 2003. Claudette struck Texas near Matagorda Island as a category-one hurricane and Isabel's category-two made landfall on the Outer Banks of North Carolina. Isabel brought hurricane conditions to portions of North Carolina and Virginia and record flood levels to the upper Chesapeake Bay. In addition, Tropical Cyclones Bill, Erika, Grace and Henry affected the United Sates. This season's tropical cyclones took a total of 24 lives and a total damage estimated at 3.6 billion dollars in the United States. Most of the damage was caused by Hurricane Isabel.

Tropical Storm Bill formed over the southern Gulf of Mexico on 29 June, from the interaction of a tropical wave with an upper-level low. It moved northward and made landfall in southeastern Louisiana with winds to 60 mph late on the next day. Bill produced at least five tornadoes, coastal flooding, and heavy rain. One tornado struck Reserve, Louisiana, damaging 20 mobile homes and injuring four persons. Bill was absorbed by a frontal system over Virginia on 3 July, after producing locally heavy rain and floods over much of the southeastern United States. Bill was responsible for four deaths and 50 million dollars in damage.

Hurricane Claudette moved slowly northwestward to west-northwestward across the Gulf of Mexico, and made landfall at Matagorda Island just east of Port O'Connor, Texas on 15 July with 90-mph winds. Claudette turned westward after landfall and moved across southern Texas and northern Mexico, and finally dissipated over the high terrain of northwestern Mexico on 17 July. Storm-surge flooding of up to 5.5 feet above normal tide levels occurred near where the eye of Claudette made landfall. Two tornadoes were reported during Claudette, one near Palacios and the other in Port Lavaca, Texas. Claudette was slow to weaken over land, as radar and satellite images indicated that its structure remained distinct for more than 24 hours after landfall. Claudette was directly responsible for one death and 180 million dollars in damage in Texas.

Hurricane Erika was first detected as a weak surface low detached from a decaying frontal system about 1150 miles east of Bermuda on 8 August. This low interacted with an upper-level cold low and the combined system moved across the Bahamas and south Florida, before developing into a tropical cyclone in the eastern Gulf of Mexico on 14 August. Erika briefly strengthened to a 75-mph hurricane as it made landfall along the northeastern coast of Mexico, about 45 miles south of Brownsville, Texas on 16 August. Extreme southern Texas experienced tropical-storm force winds. Erika dissipated on the next day over the mountains of northern Mexico. Interestingly, Erika was not operationally upgraded to a hurricane, but a post-storm review of Brownsville Doppler radar data indicates that Erika was briefly a hurricane at landfall.

Tropical Storm Grace developed from a tropical wave. The wave became a tropical depression and then a 40-mph tropical storm on 30 August over the west-central Gulf of Mexico. Grace moved northwestward to the Texas coast near Galveston on 31 August as a disorganized and weakening tropical storm. It weakened to a depression as it moved inland and merged with a frontal system over Arkansas two days later. Up to eight inches of rain fell over eastern Texas and southwestern Louisiana.

Tropical Storm Henri formed from a tropical wave on 3 September over the east-central Gulf of Mexico. It moved slowly eastward and winds reached their peak value of 60 mph on 5 September. While weakening, Henri accelerated northeastward across north-central Florida as a tropical depression with 30-mph winds. Henri dissipated on 8 September about 150 miles south of Cape Hatteras, North Carolina while becoming extratropical. Henri dumped up to ten inches of rain over portions of west-central Florida.

Hurricane Isabel was a long-lived Cape Verde hurricane that formed over the eastern tropical Atlantic Ocean on 6 September. It moved in a general west-northwestward direction and strengthened to a category five hurricane by 11 September with 165 mph winds, while located several hundred miles northeast of the Leeward Islands. Isabel's maximum winds fluctuated between 150 and 160 mph for five days from 11 to 15 September. Weakening began on 16 September as the hurricane turned north-northwestward.

Isabel made landfall on the Outer Banks of North Carolina on 18 September as a category 2 hurricane with maximum one-minute winds of 105 mph and higher gusts. Isabel is one the most significant tropical cyclones to affect northeastern North Carolina and east-central Virginia since Hazel in 1954 and the Chesapeake-Potomac Hurricane of 1933. Portions of eastern North Carolina and southeastern Virginia experienced hurricane-force sustained winds. Tropical-storm-force winds spread inland over a large area from eastern North Carolina northward to the eastern Great Lakes and western New England, as well as spreading northward along the Atlantic coast to New York. Storm surge flooding along the Atlantic coast was 6 to 8 feet above normal near the point of landfall and above normal tides extended to Long Island. Over 10 feet of surge was reported on North Carolina's Neuse River. Surge values of 6 to 8 feet were observed in the upper reaches of Chesapeake Bay and in many of the rivers that normally drain into the bay, including the Potomac and James Rivers. Water levels in Washington, D.C., Baltimore, and Annapolis exceeded the previous levels established by the 1933 Chesapeake-Potomac hurricane. Delaware Bay and the Delaware River also had a significant storm surge flood. Rainfall was in the 4 to 7 inch range over portions of North Carolina, Virginia, and Maryland. Higher amounts up to 11 inches occurred in the Shenandoah Valley.

Isabel was directly responsible for 17 deaths, ten in Virginia, 2 in New Jersey and one each in North Carolina, Maryland, Pennsylvania, Rhode Island, and Florida. The deaths in Florida and Rhode Island were from high surf generated by the hurricane. The total damage caused by Isabel is currently estimated at 3.37 billion U.S. dollars.

2003 Atlantic tropical cyclones affecting the United States

name	class *	dates**	max. winds (mph)	min pressure (mb)	U.S direct deaths	U.S. damage ($ million)
Bill	T	29 Jun-2 Jul	60	997	4	50
Claudette	H	8-17 Jul	90	979	1	180
Erika	H	14-17 Aug	75	986	2	
Grace	T	30 Aug-2 Sep	40	1007		
Henri	T	3-8 Sep	60	997		
Isabel	H	6-19 Sep	165	915	17	3,370

T - tropical storm, maximum sustained winds 39-73 mph; H - hurricane, maximum sustained winds 74 mph or higher.
** Dates based on UTC time and include tropical depression stage.

(Available in Spanish only)

RESUMEN DE LA TEMPORADA DE HURACANES EN EL MAR CARIBE Y ÁREAS ADYACENTES (2003)

(Submitted by Venezuela)

(hard copy of Power Point presentation)

APPENDIX V

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

I. **METEOROLOGICAL COMPONENT**

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2004	2005	2006	2007	2008			
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 2004-2005 items with an asterisk to be given priority attention

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2004	2005	2006	2007	2008			
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.
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	

* During 2004-2005 items with an asterisk to be given priority attention

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2004	2005	2006	2007	2008			
1.2.2	Upper-air stations								
1.2.2.1	Establishment of the following upper-air stations: ✎ Guatemala ✎ 80400 Isla de Aves - radiosonde* ✎ Maintenance and replacement of hydrogen generators						Guatemala Venezuela Bahamas	) National and) external) assistance USA.	Uper air stations and hydrogen generators had been replaced in several States with the assistance of the USA.
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 2004-2005 items with an asterisk to be given priority attention

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2004	2005	2006	2007	2008			
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 2004-2005 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	29 AWS are being installed in the Caribbean by the SIDS-Caribbean Project.

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2004	2005	2006	2007	2008			
1.2.4.3	Establishment of automatic weather stations at the following locations: Bahamas (3) Dominican Republic (31) Cuba (5) St. Lucia (4) Trinidad and Tobago (7) Mexico (94) Colombia (185) Nicaragua (18) Bermuda (6) Honduras (15)						Bahamas Dom. Rep. Cuba St. Lucia Trinidad and Tobago Mexico Colombia Nicaragua Bermuda Honduras	National & USA 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

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2004	2005	2006	2007	2008			
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 • Honduras • Guatemala (2)						Colombia Costa Rica, Nicaragua, El Salvador. Guatemala	) National and external assistance	

During 2004-2005 items with an asterisk to be given priority attention

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2004	2005	2006	2007	2008			
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	

* During 2004-2005 items with an asterisk to be given priority attention

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2004	2005	2006	2007	2008			
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 2004-2005 items with an asterisk to be given priority attention

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2004	2005	2006	2007	2008			
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	

* During 2004-2005 items with an asterisk to be given priority attention

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2004	2005	2006	2007	2008			
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.

* During 2004-2005 items with an asterisk to be given priority attention

II. HYDROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2004	2005	2006	2007	2008			
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	

II. HYDROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2004	2005	2006	2007	2008			
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 LEMPA • OSTUA, COYOLATE, POLOCHIC and MOTAGUA river basins • International river, RIO GRANDE (RIO BRAVO) river basin • VIEJO,COCO and TUMA river basins • RIO PARRITA and RIO ESCONDIDO						Colombia)) Dominican) Republic El Salvador and Honduras Guatemala Mexico) Nicaragua Costa Rica	National	

II. HYDROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2004	2005	2006	2007	2008			
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: (b) Establishment of flash flood warning systems in flood-prone areas; (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 Members concerned	National National	A flash flood warning system will be installed in 2003 and 2004 in Central America with support of the USA.
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	

II. HYDROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2004	2005	2006	2007	2008			
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
		2004	2005	2006	2007	2008			
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
		2004	2005	2006	2007	2008			
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 HOMS Reference Manual						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
		2004	2005	2006	2007	2008			
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	

III. DISASTER REDUCTION AND PREPAREDNESS

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2004	2005	2006	2007	2008			
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
		2004	2005	2006	2007	2008			
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
		2004	2005	2006	2007	2008			
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*						Members	National	
	(b) Those for which assistance from external sources is needed*						Members	National	
	Take appropriate steps to organize such training programmes*						Members	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 2004-2005 items with an asterisk to be given priority attention

IV. TRAINING COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2004	2005	2006	2007	2008			
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
		2004	2005	2006	2007	2008			
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	

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2004	2005	2006	2007	2008			
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
		2004	2005	2006	2007	2008			
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 2004-2005 items with an asterisk to be given priority attention.