WORLD METEOROLOGICAL ORGANIZATION

RA IV HURRICANE COMMITTEE

THIRTIETH SESSION

Orlando, Florida, USA

(23 to 28 April 2008)

FINAL REPORT

GENERAL SUMMARY OF THE WORK OF THE SESSION

1. ORGANIZATION OF THE SESSION (Agenda item 1)

At the kind invitation of the Government of the United States, the thirtieth session of the RA IV Hurricane Committee was held in Orlando, Florida, USA from 23 to 28 April 2008. The opening ceremony commenced at 0900 hours on Tuesday, 23 April 2008.

In June 2007, the former Chairman of the Committee returned to his prior position within the National Oceanic and Atmospheric Administration (NOAA)/National Weather Service (NWS). In keeping with tradition, the Committee unanimously elected Mr Bill Read (USA), Director of the National Hurricane Center (NHC) as Chairman of the Committee.

1.1 Opening of the session (agenda item 1.1)

1.1.1 The Permanent Representative of the United States with the WMO welcomed the participants of the RAIV Hurricane Committee (HC). He was pleased to see so many WMO RA IV Member countries represented. He remarked that as the Committee convened just over a month from the official start of the 2008 North Atlantic Hurricane Season, he wanted to reflect on some important milestones from the past. He recalled the devastating cyclone that struck the Bay of Bengal in November 1970. He stated it was after this tragedy that the WMO established the Tropical Cyclone Project, in response to a call for international action to mitigate the harmful effects of tropical cyclones. He reflected back that it was in 1978 that the Regional Association IV Hurricane Committee was established. He remarked that four decades later, the need for the countries affected by hurricanes to continue to work together and to increase action to reduce the loss of human life and damage was greater than ever. He emphasized that the National Oceanic and Atmospheric Administration (NOAA) took its responsibilities to the region seriously and was committed to improving products and services both for domestic constituents as well as for international partners. He went on to say that NOAA was dedicated to applying new technologies employed in the United States to benefit the region. He highlighted specific activities and discussed the importance of international cooperation which served to build the capacity of the National Meteorological and Hydrological Service (NMHSs) in the region and in turn create partnerships critical to operations in the region. He closed by stating that NOAA has been an integral part of the Committee throughout its history and, as both the Permanent Representative of the United States with WMO and a member of the WMO Executive Council, he pledged to continue to support the programs of the Committee and encouraged other members to do so. He expressed his thanks to all of participants for attending. Finally he wished all a pleasant stay in Orlando.

1.1.2 On behalf of Mr Michel Jarraud, Secretary-General of WMO, Mr Dieter Schiessl, Director, Weather Service and Disaster Risk Reduction Department of WMO, welcomed the participants and expressed the appreciation of WMO to the Government of the United States for the kind invitation to host the thirtieth session of the Committee. He stated that while climate change increases the risks of environmental disasters specifically in the tropical-cyclone endangered regions, WMO's disaster risk reduction efforts have resulted in a noticeable improvement in the warning systems in many parts of the world. However, there was still much to be done in this area and WMO gave a high priority to developing and promoting an integrated approach towards strengthening the disaster risk management capabilities in its Strategic Plan adopted by Fifteenth Congress last year. In this regard, Mr Schiessl appealed to the Committee to respond to that request and to commence a review of the Committee's expected outcomes, deliverables and performance targets. He also stressed that the synergies between the DRR and the TCP programmes was indispensable, which should be manifested through closely coordinated activities and initiatives of the programmes related to Tropical Cyclone and the Disaster Risk

Reduction in concert with the WMO Regional Programme. Finally, Mr Schiessl underlined the significance of the Central America Multi-hazard Early Warning Systems Project and encouraged the Committee to give guidance to this project in order to ensure that it received the necessary support and achieved its expected outcomes so that other countries could also benefit from it

1.1.3 The Chairman of the Hurricane Committee, Mr Bill Read, welcomed all participants and stated that he looked forward to a fruitful session with the active participation of all those attending this year's session. He thanked the Committee for its consideration of his nomination and stated he was pleased to be chairing the Committee.

1.1.4 The session was attended by 52 participants, including 41 from RA IV Member states of the Committee, observers from Spain and four Regional and International Organizations. The list of participants is given in **Appendix I.**

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

The Committee adopted the agenda as given in **Appendix II** with amendments of adding "Central American Pilot Project on Early Warning Systems" as Agenda Item 9.

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 during the 2007 hurricane season, RSMC Miami began issuing experimental graphical tropical weather outlooks twice a day. This product would continue in experimental mode during this coming season and would be issued four times a day for both North Atlantic and Eastern North Pacific basins. RSMC Miami would also introduce the likelihood of tropical cyclone formation expressed as one of three possible levels: low, medium, and high in colour a coded format. He reported that RSMC Miami would issue public advisories for all tropical cyclones in the Eastern Pacific basin beginning with the 2008 hurricane season, and that more information about the changes would be posted in the coming weeks on the RSMC Miami web site: http://www.nhc.noaa.gov/aboutgtwo.shtml

2.2 Since 2006, RSMC Miami has been operationally issuing graphical (web) and text products that provide location-specific wind speed probabilities out to five days for 34, 50 and 64 kt. The text product lists probabilities at selected U.S. locations and at international sites already provided to RSMC Miami by the WMO RA-IV Members. The tropical cyclone wind speed probability text products are found under headers FONT1 (1-5) for the North Atlantic basin and FOPZ1 (1-5) for the Eastern North Pacific basin. In 2008, the text product would also include a separate table listing tropical cyclone intensity (maximum sustained wind associated with the circulation) probabilities out to five days for the following categories: tropical depression, tropical storm, and hurricane (including the separate categories on the Saffir-Simpson Hurricane Scale).

2.3 During the 2007 season, Glen Lester Albert (meteorologist) and Julian Dubois (Emergency Manager) from St. Lucia, Benito Elvira Montejo (meteorologist) from Spain, and Maria del Carmen del Rosario (meteorologist) from Mexico were among the participants in the RSMC Miami attachment program. The meteorologists helped improve hurricane warning coordination in the region during the tropical cyclone events while they gained valuable training in hurricane forecasting. Mr Dubois had a unique opportunity to work with Federal, State and Local Emergency Management Agencies. He shadowed the FEMA HLT Coordinator at the

National Hurricane Center who explained the role the HLT serves in the emergency management community as well as the general roles and responsibilities of FEMA. Mr Dubois travelled to Tallahassee and spent two days at the Florida State Emergency Operations Center (EOC) and visited the Miami-Dade EOC where he met with the staff and had an opportunity to discuss best practices. The Chairman hoped this program, designed to bring together representatives of both a country's meteorological service and emergency management agency, would foster improved coordination. RSMC Miami and WMO strongly encourage WMO RA-IV Permanent Representatives to continue to support this program. The announcement requesting candidates for 2008 had been sent by the Region IV President in February.

2.4 Three meteorologists from the Mexican Air Force were stationed at the RSMC Miami during 2007. Captains Enrique Bermudez Velazquez, Guillermo Betancourt Gonzalez, and Sergio Azamar Jimenez helped coordinate timely clearances for hurricane surveillance and reconnaissance flights over Mexico during tropical cyclone events that had the potential to make landfall. Their efforts helped improve the overall efficiency of the Hurricane Warning Program. The Chairman urged the continuation of this program in 2008.

2.5 The 2008 RA-IV Workshop on Hurricane Forecasting and Warning took take place from 7 to 19 April. The workshop was conducted in English and Spanish this year. The Chairman strongly believed that offering the bilingual workshop every other year was important to the region's hurricane program.

2.6 The Latin America Caribbean Hurricane Awareness Tour (LACHAT) took place from 24 to 30 March 2008. The U.S. Air Force C-130 (J-model) Hurricane Hunter plane visited Manzanillo and Acapulco, Mexico; Guatemala City, Guatemala, Barbados and Ponce, Puerto Rico. As in past years, the LACHAT increased public awareness of the hurricane threat and served to recognize and strengthen national and international teamwork for storm warning and emergency response. The LACHAT enhanced the visibility of the participating country's weather forecasting and emergency management offices. Slightly over 12,000 people toured the plane last year. A Hurricane Awareness Tour (HAT) took place along the U.S. east coast from 30 April to 4 May 2007. Another HAT took place this year along the Gulf of Mexico coast from 13-18 April 2008.

2.7 Reconnaissance aircraft plays an important role in monitoring the track and intensity of tropical cyclones. This past season, the U.S. Air Force, NOAA Reconnaissance Hurricane and NOAA jet high altitude flights provided valuable meteorological data not available from other sources. In addition, the US Air Force supports the LACHAT mission and the NOAA aircraft support the HAT mission. Cooperation by all parties involved is fully appreciated.

2.8 Radar imagery received operationally at RSMC Miami via the Internet from RA-IV Members proved very useful to the RSMC Miami in tracking tropical cyclones. The Chairman encouraged Member countries to continue to make their radar imagery available operationally via the Internet.

2.9 Surface and upper air observations are very important to the operational forecasts of the RSMC Miami. The Chairman appreciated the Members' efforts to maintain their observation and communication systems, especially the data received from Member countries during Dean, Felix, Noel an Olga. The Chairman thanks the Members affected by tropical cyclones for the timely submission of their post-storm country reports. These reports are vital to the preparation of the RSMC Miami Tropical Cyclone Report.

2.10 Efforts by the HAM radio operators during the hurricane events were invaluable.

2.11 In 2008, the National Hurricane Center began coordinating with the U.S. Department of State Crisis Operations Center to help the Center communicate its off-season activities and in-season forecasts with the Embassies in the RA-IV countries.

2.12 The Swan Island station has had problems is sending data. NWS Telecommunications Operational Center and the Office of International Activities have been working on the issue.

2.13 As part of the United States Weather Research Program (USWRP), the Joint Hurricane Testbed (JHT) continued to evaluate research projects with the goal of transitioning successful projects into operations. These projects aim to improve the analysis and forecast of hurricanes. To date 16 projects had been transitioned to operations and 20 additional projects were being considered for implementation.

2.14 In January 2008, Dr Lixion Avila ended his term as the Chairman of the AMS Tropical Committee. He was selected to continue as an ex officio member.

2.15 Preliminary arrangements had begun for the Seventh International Workshop on Tropical Cyclones (IWTC-VII). RSMC La Reunion was proposed to host IWTC VII in 2010; however, due to budgetary constraints, a final decision had not been made yet.

2.16 Given that RSMC Miami has tropical cyclone forecast and coordination responsibilities for the entire North Atlantic Ocean, the Chairman appreciated the WMO's continuous efforts to ensure that Spain and Cape Verde fully benefited by inviting a representative from each country to participate as observers to the RA-IV Hurricane Committee Meetings.

2.17 Exchange between RSMC Miami and "Agencia Estatal de Meteorología de Espana" continued during 2007 and 2008. Fermín Elizaga Rodríguez, Jefe Área de Predicción Operativa Instituto Nacional de Meteorología visited RSMC Miami and NWS Miami local Forecast Office in September 2007. A workshop on tropical, subtropical cyclones and extratropical transition was scheduled to take place in Madrid during 8 and 9 May, 2008.

2.18 The Chairman was pleased that eight experts of the WMO RA-IV attended the American Meteorological Society (AMS) Annual Meeting in New Orleans, Louisiana from 19-24 January 2008. The eight RA-IV experts joined colleagues from National Hydro-Meteorological Services (NMHSs) from around the world to participate in the AMS International Sessions on the Road to a Perfect Forecast and a Perfect Response: Connecting Hydro Meteorological Services with the Emergency and Disaster Management Communities. The International Sessions were hosted by the NOAA/NWS Office of International Activities (IAO).

2.19 Additionally, NOAA/NWS has been engaged in other capacity-building efforts within the region. NWS IAO supports capacity-building, education and outreach activities in RA-IV through the WMO's Voluntary Cooperation Program (VCP). Many of the projects were in support of the monitoring and warning of hurricanes operations of RSMC Miami, but the activities also supported the routine forecasting and operations of NMHSs in the region.

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

3.1 The Committee was informed by the WMO Secretariat that the 15th WMO Congress (Geneva, May 2007) discussed theTropical Cyclone Programme (TCP) from a broad perspective. Major guidance given from the Congress is represented by the following key points:

1) To continue to give priority to capacity building, particularly in Small Island Developing States (SIDS) and Least Developed Countries (LDCs);

2) To promote cooperation with relevant WMO programmes such as DRR, PWS, MMOP, HWR and AREP;
3) To facilitate participation of hydrologists and DRR experts in the regular sessions of the five tropical cyclone regional bodies;
4) To pursue recommendations from the Sixth International Workshop on Tropical Cyclones (IWTC-VI).

TCP's activities during the inter-sessional period in 2007 and 2008 were implemented based on this guidance and contributed to various outcomes of WMO Strategic Plan, in particular Expected Result (ER) I (better forecasts and warnings) and ER VI (Multi-hazard early warning and DRR).

3.2 The Committee was also informed that during the period the 40th session ESCAP/WMO Typhoon Committee was held in Macao, China from 21 to 26 November 2007. Currently, arrangements are underway for the 35th session WMO/ESCAP Panel on Tropical Cyclones (5-9 May 2008, Bahrain), 12th session of RA V Tropical Cyclone Committee (18-24 July 2008, Niue) and 18th session of RA I Tropical Cyclone Committee (6-10 October 2008, Malawi). Under the guidance as above, TCP is collaborating closely with DRR programme to promote involvement of DRR community in these sessions.

3.3 The Committee was pleased to note that various training programmes were arranged by TCP to address the issue of sustainable development of NMHSs. In particular, RA IV Workshop on Hurricane Forecasting and Warning (Miami, USA, 16-28 April 2008 & 7 -19 April 2008) and Southern Hemisphere Training Course on Tropical Cyclones and Workshop on PWS (Melbourne, Australia,10-21 October 2007) were organized in cooperation with Public Weather Services Programme and highly valued for the practical training for operational forecasting as well as media skills. A similar event is planned jointly with PWS to be held in the Typhoon Committee region as a roving seminar in 2008. Attachment training was carried out by 4 RSMCs including RSMC Nadi, which hosted the training for the first time despite of its unfavourable operational situation. The Indian Institute of Technology Delhi hosted the attachment training for storm surge experts for the consecutive 7 years.

3.4 The Committee noted that TCP are making efforts also to promote application of research findings to operations in cooperation with AREP. International Training Workshop on Tropical Cyclone Disaster Reduction was held in Guangzhou, China in March 2007 and the RA I Regional Workshop on Tropical Cyclone Research will be held in La Réunion next month.

3.5 The Committee noted with pleasure that TCP has undertaken the update of "Global Guide to Tropical Cyclone Forecasting" to respond the recommendation of IWTC-VI. A new structure is currently under review based on the two major concepts:

1) It should be published primarily as a Web version in view of cost saving and easier access ; .
2) It should have linkages with associated hazards (storm-surge, flash flood, etc.) from a multi-hazard point of view.

It is still on a planning stage and the whole structure will be drafted by the middle of 2008.

3.6 The Committee was informed that the scope of the Regional Workshop on Storm Surge and Wave Forecasting has been reviewed by TCP. This workshop aims to enable trainees to run operational wave and storm surge forecasting. Origin of the workshop is traced to the Storm Surge Workshop in the South China Sea which was held in 2002 in Viet Nam in cooperation with the Typhoon Committee. Since then, the workshop was held four times mainly for the Members in RA II and RA V. During the years, storm-surge operation has been initiated at several NMHSs. TCP, in cooperation with MMOP, plans to expand this activity to all TC regions including RA IV and RA I. The Fifth workshop is planned tentatively to be held in Melbourne, Australia in December 2008.

3.7 The Committee was informed that completion of the Study on the Wind Averaging Guideline has been delayed. A main report, which was submitted by the Systems Engineering Australia Pty Ltd (SEA) in January 2008, is currently under review by the TCP Technical Coordination Meeting and a one-page summary for inclusion in operational manuals is being produced by SEA. In this regard, the Committee expressed a view that establishment of the Wind Averaging Guidelines are particularly required for the Hurricane Committee region where different averaging standards are applied to wind speed observations. The Committee requested the WMO Secretariat to finalize this study as early as possible and to bring the results for discussion at the next session of the Committee before they could be integrated into the Operational Plan.

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 2007 hurricane season in the North Atlantic basin and in the Eastern North Pacific was presented to the Committee by Dr Lixion Avila, Hurricane Specialist, on behalf of RSMC Miami - Hurricane Center.

RSMC Miami 2007 North Atlantic Hurricane Season Summary

4.1.2 Overall activity during the 2007 North Atlantic hurricane season was near average. There were fifteen tropical and subtropical named storms, six of which became hurricanes, with two becoming major hurricanes (category three or higher on the Saffir-Simpson Hurricane Scale). For the 40-year period 1967-2006, the averages for named storms, hurricanes and major hurricanes are eleven, six, and two, respectively. Even though the number of named storms was above average, including a record-tying eight storms that formed in September, many of these storms were short-lived. In terms of the NOAA Accumulated Cyclone Energy (ACE) index, which measures the collective strength and duration of named storms and hurricanes, the season produced about 84% of the 1951-2000 median activity. This percentage is the lowest observed since 2002.

4.1.3 Despite the near-average overall activity, the impacts from the North Atlantic basin tropical cyclones were devastating outside of the United States. Two category five hurricanes made landfall in the basin during the season. Dean struck the Yucatan Peninsula of Mexico at category five strength in August, and soon thereafter came ashore in mainland Mexico as a category two hurricane. Felix then hit north-eastern Nicaragua as a category five hurricane in early September. Hurricane Lorenzo later struck mainland Mexico in nearly the same location as Dean’s final landfall. Late-season Noel and post-season Olga dumped heavy rains that caused flooding, mud slides, and large loss of life in the Caribbean. Overall, the total death toll in the region from tropical cyclones during 2007 was about 360. One hurricane, one tropical storm, and three tropical depressions made landfall in the United States during 2007, causing a total of 10 fatalities and about $50 million in damages.

RSMC Miami 2007 Eastern North Pacific Hurricane Season Summary

4.1.4 Tropical cyclone activity in the Eastern North Pacific basin during the 2007 season included eleven named tropical storms. Only four of the tropical storms became hurricanes and only one became a major in the basin. There were four additional depressions that did not reach tropical storm intensity. Tropical cyclone activity was below normal in terms of the numbers of hurricanes and major hurricanes. The long-term seasonal averages (1971-2006) are: 15 tropical storms, 9 hurricanes, and 4 major hurricanes.

4.1.5 A useful measure of the season's overall activity is the Accumulated Cyclone Energy (ACE) index, which reflects the combined intensity and duration of the entire season's storms. It is calculated by summing the squares of the 6-hourly intensities (maximum sustained surface winds in kt) of all tropical cyclones while at tropical storm or hurricane strength. In terms of the Accumulated Cyclone Energy index (ACE), 2007 was the second quietest season observed (only 1977 was lower), since reliable records began in 1971.

4.1.6 Most of the tropical cyclones developed from tropical waves that moved westward from the North Atlantic basin into the Eastern North Pacific, and most of them ultimately weakened due to cold waters and high wind shear. Henriette was the only Pacific basin hurricane to hit Mexico in 2007, causing at least nine deaths. Barbara made landfall as a tropical storm near the Guatemala/Mexico border.

4.1.7 The summary report on the 2007 hurricane season provided by the RSMC is given in **Appendix III.**

4.2 Reports on hurricanes, tropical storms, tropical disturbances and related flooding during 2007 (agenda item 4.2)

4.2.1 Members provided the Committee with reports on the impact of tropical cyclones and other severe weather events in their respective countries in the 2007 hurricane season. In particular, serious impacts of Hurricane Dean, Felix and Noel and warning operations associated with these cyclones were presented by many members. The summary of the reports is given in **Appendix IV**.

4.2.2 A view was presented by some members that for a more effective review of the hurricane season under this agenda item, it is vital to avoid overlap in following the track of each cyclone in its course of life in all country reports. Noting that actual and forecast tracks of all the tropical cyclones during the season are reviewed in detail by RSMC Miami under the above agenda, the Committee urged its members to focus their annual reports on 1) meteorological conditions in the proximity of the country, 2) performance of their warning systems during the threat of cyclones and 3) social and economic impact of the tropical cyclones on their countries.

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

5.1 Mr Tyrone Sutherland (BCT) agreed to serve as rapporteur on this agenda item. This agenda item allows members to raise matters that have an impact on the effectiveness of the Hurricane Warning System.

5.2 In this regard, the BCT member brought the Hurricane Committee up-to-date on the implementation of the weather radar project implemented by the **Caribbean Meteorological Organization** (CMO). The **13.2 million Euros** CMO radar project, funded by the **European Union**, was installing new radars to replace the old and obsolete radar network installed by the CMO in the late sixties and early seventies. The **four** S-band Doppler radars, manufactured by the Selex-Gematronik Company of Germany, would be phased into operations during the 2008 hurricane season, providing a major contribution to the Early Warning System in RA IV, as called for in the RA IV Hurricane Committee's Operational and Technical Plans.

5.3. The Committee was informed of the expected operational dates of the radars, as follows:

Location	Maximum Range	Expected Operational Date
Barbados	400 KM	July 2008
Belize	400 KM	August 2008
Trinidad	400 KM	May 2008
Guyana (RA III)	400 KM	December 2008

5.4. The meeting noted that the CMO Radar Project included a large training programme for Meteorological staff and maintenance personnel, as well as a central spares facility. As part of the Project, Météo-France provided special radar training in French for staff of the Haitian Meteorological Service during March and April 2008.

5.5 In connection with the data availability, the Committee was informed that base data from the four new radars would be made available to the wider meteorological community, the public and special users such as the aviation industry and Disaster Management Agencies, via the Internet. Specific data, including Doppler data, would be made available to the Meteorological Services in RA IV, **RSMC-Miami** and relevant services in RA III via FTP servers. Addresses for the data will be distributed as the radar systems came online during the 2008 hurricane season.

5.6. An important result of the availability of the new radars was the creation of a regional radar composite comprising these four radars, plus existing radars in *Jamaica, the Dominican Republic, Guadeloupe, Martinique, and French Guiana*. The composite was created and would be operated by the French Meteorological Service - **Météo-France**, in close collaboration with the CMO. This network composite assumed the availability of at least one radar in the Dominican Republic. For the creation of the composite, 400 km data from each radar in the network will be sent to the Météo-France facility in Martinique via the ISCS/VSAT component of the WMO *Regional Meteorological Telecommunication Network* (RMTN). The composite data will be rebroadcast from Martinique via the ISCS. This facility has been facilitated in collaboration with the **US National Weather Service** in Washington.

5.7. The BCT indicated that a proposal has been made to add an additional Doppler radar to the network to close the gap in the vicinity of the **Cayman Islands**, hopefully by 2010-11. If that proposal is agreed to, the extended network composite could be as shown in **Figure 1.**

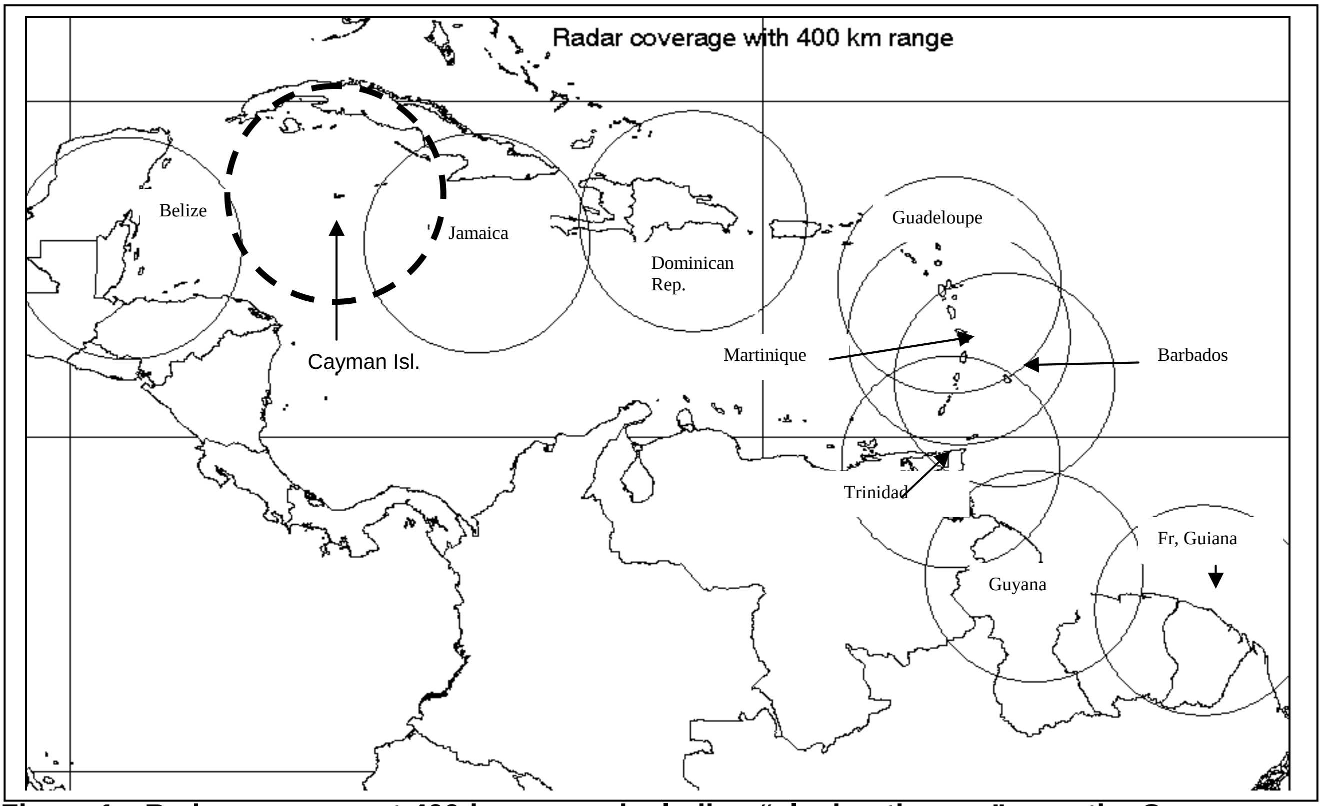

Figure 1 Radar coverage at 400 km range, including "closing the gap" over the Cayman Islands. The radars in Puerto Rico and St. Maarten are not shown in this network.

5.8. The Netherlands Antilles also indicated that its radar in St. Maarten was expected to return to operations in October 2008 after refurbishment. The BCT and the Netherlands Antilles agreed to discuss the inclusion of that radar in the composite. The Dominican Republic member proposed that the privately-owned Doppler radar in Punta Cana, located at the eastern end of the country, be included in the composite in place of the one in Santo Domingo that is shown in the network diagram, and indicated that efforts were underway to have the data fully available operationally. At the same time, the Dominican Republic requested the CMO to continue efforts to diagnose the status of the old radar in Santo Domingo, even though its manufacturer indicated that it was not worth saving.

5.9 The Cuban member of the Committee offered to include the radars from his country to form part of a wider Caribbean radar composite. The BCT suggested that, for communication purposes, it might be preferable to create a series of smaller high-resolution composites for specific geographic groups..

5.10. In answer to questions, the Meeting was informed that there were no known plans for a similar Central American radar network composite, although some new radars were expected in that part of RA IV.

5.11 The Committee was informed that both Cuba and Nicaragua experienced communication failures during the 2007 hurricane season due to lightning strikes. Cuba indicated that while it had been making some efforts to rectify its situation, it preferred to await the implementation of the ISCS upgrade to avoid great expenditure. In the interim, the use of the aeronautical communication system AFTN, the internet and other transmission methods would be explored, particularly for the SYNOP data. Nicaragua indicated that it had requested interim assistance from NOAA National Weather Service but had experienced difficulties with the arrangements. NOAA promised to continue to assist.

5.12 The Committee expressed its concern that there were still some uncertainties among several Members in RA IV regarding the future ICAO requirements for ISO certification for the provision of Aviation Meteorological Services. In this connection, the Committee expressed an urgent need for assistance to NMHSs in RA IV to prepare for this ICAO requirement. Furthermore, the Committee recognized the importance of the active participation of ICAO in the work of the Committee over many years. It therefore expressed its concern that ICAO had not participated in the Committee's session in recent years and requested the WMO Secretariat to urge ICAO to resume its active participation in the future.

5.13 The Committee was briefed on USAF and NOAA "Hurricane Hunter" aircraft reconnaissance operations, more specifically ICAO airspace and diplomatic clearance requirements which limit Flight Operations. Due to the nature of tropical weather systems and the inherent uncertainty in forecasting and tracking them, the time required to respond and fly missions in support of the NHC is extremely limited. Aircraft reconnaissance flights are conducted 24 hours a day, 7 days a week and the effort and time required to obtain short notice clearances or the inability to obtain these clearances is detrimental to mission accomplishment. Therefore, the Aircraft Operators requested assistance from the Committee in simplifying diplomatic clearance and notification requirements for all affected countries throughout the NHC area of responsibility. The following diplomatic clearance language was proposed: "Weather observation flights for tropical storm & hurricane reconnaissance missions flown by WC-130J aircraft (call sign "Teal") and P-3 or G-4 aircraft (call sign "NOAA") have permanent blanket over flight clearance." Since these missions are announced in the NHC Plan-of-the-Day (POD), and the missions are flown on an ICAO Instrument Flight Rules (IFR) flight plan, it was further requested that no additional pre or post flight notification of these missions through diplomatic channels be required. In addition to the above request, a more specific issue with diplomatic clearances was discussed. Due to diplomatic relations between Venezuela and the United States, it was brought to the attention of the Committee that Weather Reconnaissance Flights have been denied entry into Maiquetia ACC controlled airspace. This denial affects the accuracy of the tropical cyclone forecast for the region. The Committee expressed its concern and suggested Member countries coordinate a unified response, through the RAIV Hurricane Committee, and pursue a regional approach to addressing the denial of diplomatic clearances among Committee Member countries.

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

6.1 Under this agenda item, the Committee designated Mr Arthur W. Rolle (Bahamas; Vice-chairman and representative of English-speaking members) and Dr José Rubiera Torres (Cuba; Vice-chairman and representative of Spanish-speaking members) to serve as rapporteurs. Mr John Parker (Canada) accepted to serve as a coordinator for ATTACHMENT 8 A (List of Telephone Numbers of National Meteorological Services and Key Officials) to the RA IV Hurricane Operational Plan.

6.2 The Committee reviewed in depth the Operational Plan, taking into account changes and additions, which came out from the other agenda items.

6.3 Amendments were made in many chapters, including Chapter 4 GROUND RADAR OBSERVATIONS. In this relation, the Committee requested the WMO Secretariat to update the maps of coastal radar coverage in this Chapter and all other maps in the Operational Plan.

6.4 The Committee urged the Secretariat to have Chapter 5 on Satellite Surveillance updated annually by the WMO Satellite Office and have it presented to the Committee in a document under this agenda item for all future sessions.

6.5 Recognizing that the Operational Plan was only available in English and Spanish, the Committee urged Météo-France, whenever it made internal updates of the Operational Plan in French, that it makes some copies available to the Meteorological Service of Haiti. In this connection however, the Committee requested the WMO Secretariat to assist Météo-France with the changes of the last few years.

6.6 As is the normal practice, the Committee considered retirement of the names of tropical cyclones of significant strength or impact during the previous season. "Dean", "Felix", and "Noel" on the Atlantic list were retired and replaced by "Dorian", "Fernand" and "Nestor", respectively.

6.7 The Committee recommended to the President of RA IV the approval of the amendments to the text of the Plan. The Committee urged the WMO Secretariat that these amendments and changes made to the Plan should be posted to the TCP Web site both in English and Spanish, before commencement of the 2008 hurricane season.

7. REVIEW OF THE COMMITTE'S TECHNICAL PLAN AND ITS IMPLEMENTATION PROGRAMME FOR 2006 AND BEYOND (Agenda item 7)

(a) The Committee designated Mr Arthur W. Rolle (Vice-chairman of English-speaking members) and Dr José Rubiera Torres (Vice-chairman 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-ninth session of the Committee.

(c) CDERA informed the Committee that a pipeline project "Caribbean Disaster Management Project" is expected to commence before the end of 2008 with a financial support of the Japan International Cooperation Agency (JICA). It will be carried out in collaboration with the Caribbean Institute for Meteorology and Hydrology (CIMH) and the University of the West Indies (UWI). In this respect, CDERA suggested that there will be opportunities for collaboration with the Committee under the relevant tasks of the Technical Plan.

(d) The updated RA IV Hurricane Committee's Technical Plan and its Implementation Programme, which awaits the approval of the President of RA IV is given in **Appendix V**.

7.1 Meteorological Component (agenda item 7.1)

Regional Basic Synoptic Network (RBSN)

7.1.1 The Committee was informed that during the intersessional period the number of surface (535) and upper-air (136) stations in the RBSN remained unchanged. The current RBSN consists of a total of 696 stations (that includes also 25 automatic marine stations). Out of the above 696 stations, 220 are AWSs (193 in 2006), an increase of 14% during the intersessional period which is consistent with the worldwide trend. It should also be noted that the overall status of observations implemented by RBSN stations remained stable at around 90 per cent for surface observations and 95 per cent for upper-air observations.

7.1.2 The Annual Global Monitoring (AGM) of the operation of the WWW provides information on the performance level of the observing and telecommunications systems. According to the results of monitoring carried out in October 2007, gaps in the SYNOP data coverage continue to exist over certain areas in the southern part of the Region. The availability of SYNOP reports on the Main Telecommunication Network (MTN) amounted to 80% (79% in 2006) of expected reports from the RBSN. The number of 'silent' non-reporting surface stations increased to 76 (74 in 2006).

7.1.3 According to the AGM results in October 2007, the availability of TEMP reports on the MTN amounted to 88% (89% in 2006) of expected reports from the RBSN. The number of 'silent' non-reporting TEMP stations remained almost unchanged at 7 stations (8 in 2006).

7.1.4 The Representative of Panama informed the Committee that Panama Meteorological Service started 24-hour operation as from March 2008 and two synoptic stations changed the schedule of observations.

Aircraft Observations

7.1.5 The Committee was informed that, generally the global AMDAR programme continues to expand into new areas, more operational programmes commenced reporting and more countries and regions are looking to explore the possibility of developing their own AMDAR programmes. The volume of data disseminated on the GTS continues to increase and is now peaking at around 240,000 to 250,000 observations per day. The Humidity-water vapour sensors are now closer to becoming operational with the USA and E-AMDAR trials due to release reports into the performance of the WVSS-II sensor in early 2008. The AMDAR community with the assistance of WMO has been working towards the development of the WVSS-II water vapour sensor and an AMDAR software solution as standard part numbers for all aircraft makes and models. It has been identified that the future work programme of the AMDAR Panel must include developing a strategy to implement a standard suite of AMDAR software solutions that could be made available to all NMHS

7.1.6 In the Gulf region, only the US NOAA is running an operational AMDAR program, but plans are advancing on developing a national program for Mexico with support from NOAA and the AMDAR Panel. Brazil is considering extending its national program towards the Gulf coast in the future. The most important progress is expected from the inclusion of water vapour data given the overriding importance of this parameter for Hurricane forecasting in coastal areas.

7.1.7 The NWS has entered into a contract with AirDat LLC (TAMDAR Contract) for the provision of real-time weather data for a 12 month period beginning June 28, 2007. In addition to relative humidity (RH), the data elements provided are pressure altitude, temperature, wind, icing (yes or no) and turbulence information. Quality assurance data are also included. Under the terms of the contract, 49 Mesaba Airlines' Saab 340 aircraft outfitted with the AirDat instrument will provide the real time observations. Data coverage will include most of the Great Lakes, upper Midwest and Ohio Valley southward to the Gulf coast.

7.1.8 As one of its goals, the TAMDAR project intends to fill the spatial gaps which exist in the current United States upper air observation network. By utilizing the Mesaba aircraft, many locations from the upper Midwest to the Gulf coast will now have profiles of moisture, temperature and winds available routinely.

7.1.9 The TAMDAR moisture sensor measures RH which can be converted to a mixing ratio value, if required. The moisture instrument employs two independent sensors to ensure reliability and allow for self-checking of measurement accuracy. TAMDAR RH measurement accuracy is 4% at speeds less than Mach 0.5 and 5% at Mach 0.5 to 0.6.

7.1.10 Typically the TAMDAR sensor samples the atmosphere at 5 or 10hPa intervals during the ascent and descent phases of flight. En route sampling intervals default to 3 minutes below 20,000 feet and 7 minutes above 20,000 feet. If required, TAMDAR reporting can be modified to make time-based event observations during ascent or descent.

Marine and Ocean Meteorological Observations

7.1.11 The Committee was informed that the global surface buoy network (DBCP) is now essentially complete and being sustained (1250 units). Efforts are being made to increase the number of surface drifters reporting sea level pressure (580 units in December 2007). Recent technological developments has lead to the production of cost-effective surface drifters equipped with thermistor strings and designed to be deployed in hurricane conditions many of them have been deployed operationally in the Gulf of Mexico. The Argo profiling float programme reached completion in November 2007 (3000 units) and is now providing essential upper ocean thermal data for Tropical Cyclones research, monitoring and forecast activities.

7.1.12 Substantial development of the Pilot Research Moored Array in the Tropical Atlantic (PIRATA) moored array has been achieved since 2005 thanks to the SouthWest extension (2005), NorthEast extension (2006), and SouthEast extension (2006, one year only), with good data return. The PIRATA array increased in 2007 to a 17 surface mooring and 1 subsurface ADCP mooring configuration with the addition of 2 ATLAS moorings in the northern tropical Atlantic. The primary data telemetered in real time from moorings in both the TAO/TRITON and PIRATA Arrays are daily mean surface measurements (wind speed and direction, air temperature, relative humidity and sea surface temperature) and subsurface temperatures. NextGeneration ATLAS moorings provide optional enhanced measurements, which include precipitation, short and long wave radiation, barometric pressure, salinity, and ocean currents. High temporal resolution (10-min or less record interval) measurements are available in delayed mode. A new initiative to add heat, moisture, and momentum flux measurements at 4 TAO and three PIRATA moorings was completed in 2007.

Meteorological Satellites

7.1.13 The Committee was informed that the space-based observing system includes three constellations comprising respectively operational geostationary satellites, operational Low-Earth Orbit (LEO) satellites and environmental Research and Development (R&D) satellites. Operational weather forecasting relies heavily on space-based observations acquired by the operational geostationary and LEO satellites, namely for cloud imagery and characterization, vertical temperature and humidity sounding, atmospheric motion vectors, and sea surface temperature. R&D satellites provide a useful complement to these observations thanks to advanced visible and infrared imagers for cloud tracking and sea surface temperature, additional microwave and infrared sounders for vertical temperature and humidity profiles, GPS radio-occultation sounders for temperature and humidity sounding mainly in stratosphere and high troposphere, radar altimeters for sea state and scatterometers for ocean surface wind fields.

7.1.14 With respect to tropical cyclones specifically, operational or R&D satellites are particularly useful for the detection, monitoring and structure characterization of tropical cyclones and for predicting their evolution. Observations of particular relevance are the permanent high resolution visible and infrared imagery from geostationary spacecraft, microwave sounding from LEO satellites (e.g. with AMSU instrument) to derive total precipitable water, microwave imagery associated with active microwave sensors for precipitation rate (like TRMM and the future GPM), as well as scatterometry altimetry and/or microwave imagery to derive ocean surface wind fields (e.g. with Quikscat, Jason-1, or METOP/ASCAT) and sea state. Numerical experiments performed in 2005 also suggest that cloud track wind vectors derived from visible and infrared imagery over the Polar Regions (e.g. from Aqua/MODIS instrument) have a significant impact to improve the accuracy of hurricane track forecasts.

7.1.15 It should be recalled that, in response to tropical cyclone monitoring requirements, NASA has agreed to extend the operation of the Tropical Rainfall Measurement Mission (TRMM) until the end of 2009. As concerns the Global Precipitation Measurement (GPM) programme, the launch of its core satellite is planned in December 2013. The continued availability of sea surface wind observations over the next decade, according to currently available plans, is not yet guaranteed.

7.2 Hydrological Component (agenda item 7.2)

7.2.1 The Committee was informed that since the last session of the Hurricane Committee, the coordinators of two of the five sub-groups had sent progress reports to the Chairman of the WGH. The meeting of the RA IV Working Group on Hydrology (WGH) held in San Salvador, El Salvador, from 4 to 7 December 2006 decided that progress reports should be prepared by the coordinators of the Sub-groups on 7 June 2007 and 7 December 2007. The Chairman planned to request the President of RA IV to appoint one new coordinator and to remove two of the existing coordinators.

WMO's Commission for Hydrology (CHy)

7.2.2 The President of the Commission for Hydrology invited on 14 September 2007 the Regional Hydrological Advisers to contribute with information on the regional needs in the field of Hydrology and Water Resources that could be addressed by the Commission in its next intersessional period starting immediately after its Thirteenth Session (Geneva, 4 to 12 November 2008). The Regional Hydrological Advisers were also invited to participate in the Third Session of the CHy Advisory Working Group (AWG) (Geneva, 11 to 15 February 2008).

7.2.3 The RA IV Hydrological Adviser could not attend the session of the AWG but he has sent before the session the information on the regional needs. This information was considered by the Group and has been used for the preparation of the "Proposed CHy Work Plan for the Thirteenth Period".

7.2.4 The information provided by RA IV on its needs is seen as a very important development because of the past lack of involvement of developing countries in the definition of the CHy Work Plan. Only one expert from an RA IV developing country has participated in one of the last two CHy's sessions. Detailed information can be found in the letter of the President of CHy:

> www.wmo.int/pages/prog/hwrp/documents/RegionalneedsinthefieldofHydrologyandWaterResource-Englishversion.doc; and
>
> www.wmo.int/pages/prog/hwrp/documents/NecesidadesRegionalesenelcampodeHidrologiayRecursosHidricos.doc

7.2.5 As part of the WMO's Quality Management Framework, CHy is preparing a series of publications entitled "Technical Guidance Documents". The Committee was informed last year on the "Quality Management Framework – Hydrology". During this reporting period, Supplement 1 of the 2006 Edition of the "Technical Regulations Volume III; Hydrology" was prepared in

English, Arabic and Russian. The Supplement will be distributed once the French, Spanish and Chinese versions are ready.

7.2.6 The Committee was also informed during its last session about the status of the Manual on Flood Forecasting and Warning. With a substantial contribution of the RA IV Hydrological Adviser, the draft is expected to reach its final stage before April 2008.

7.2.7 The Integrated Flood Management (IFM) concept plays an essential role to manage floods in the context of Integrated Water Resources Management and to enable future sustainable use of flood plain resources. However, there is a growing demand for continued scientific and technical inputs of the hydrological, meteorological and climatological communities into flood management policies and practices. There is need for an impartial, scientific-technical institution on the inter-governmental level to provide demand-driven advice and guidance to countries in the process of implementing integrated flood management policies.

7.2.8 With the financial and technical support from the Governments of Japan, the Netherlands and Switzerland, the Associated Programme on Flood Management (APFM) has been functioning under the guidance of its Advisory Committee, where CHy is represented by its President and one Regional Representative. It has been providing the crucial inputs to NHSs responsible for flood management, and has been providing WMO Members with flood management policy guidance. The APFM is presently developing various tools for facilitating implementation of IFM and is working on the establishment of a decentralized HelpDesk on IFM.

7.2.9 The Third AWG session held in February 2008 decided to recommend the inclusion of the topic of Integrated Flood Management as part of the Hydrology and Water Resources Programme.

7.2.10 In relation to the WMO's Flood Forecasting Initiative, Cg-XV, through its Resolution 21, endorsed the Strategic and Action Plan, as can be seen in **Appendix VI** of this document. The Committee is requested to take note and comment on the importance of this resolution for the Committee's activities.

7.2.11 During March and April, the Carib-HYCOS team visited several countries including Barbados, Jamaica, Trinidad & Tobago, Cuba, the Dominican Republic, and the French Islands of Martinique and Guadeloupe where they met with local water resources managers and senior personnel in the National Meteorological Services to discuss specific country needs that may be addressed under the project. The team is currently seeking input on the status of water resources management and hydro-meteorological infrastructure in a number of other Caribbean islands.

7.2.12 The WMO/NOAA Hydrologic Forecasting and Analysis course is now planned to occur June 9-30,2008 in Boulder, Colorado. Over 120 applications were received for this course and 28 students were selected.

7.2.13 The Central America Flash Flood Guidance System (CAFFG) had operational problems which required urgent maintenance. The RAMSDIS Satellite Processing server failed in 2007 and NOAA dispatched the vendor Global Imaging to address the problem. In addition, plans were underway to undertake training in all 7 countries on the operation of the system starting in September 2008????. The CRRH intended to work with SMN of Costa Rica to train 2-Meteorologists from each country.

7.2.14 The RA-IV Working Group on Hydrology was working with the WMO Secretariat, NOAA, WMO Office for North America, South America and the Caribbean, the Hydrologic Research

Center (HRC), ISDR and the World Bank to establish an end to end Warning and Response System for Nicaragua, El Salvador and Costa Rica. The World Bank was expected to fund this project. The purpose of the project was to analyze weaknesses in generating and disseminating warnings to Emergency Response agencies from the national to the community level. The Hurricane hazard would be the focus of this project.

7.3 Disaster Prevention and Preparedness Component (agenda item 7.3)

7.3.1 The Committee reviewed the progress with the WMO Disaster Risk Reduction Programme. It recalled that Congress XV approved WMO strategic priorities in disaster risk reduction to strengthen capacities of the Members' NMHSs in (i) Maintaining, analyzing and providing hazard information for risk assessment, (ii) Strengthening and sustainability of early warning systems with multi-hazard approach, (iii) Delivery of timely and understandable warnings and specialized forecasts driven by user requirements, (iv) Strengthening of their cooperation and partnerships with disaster risk reduction organizations, and (v) Public outreach campaigns. It noted that the Congress requested that these strategic priorities be implemented through national and regional projects leveraging WMO and other partners' resources and expertise to ensure maximum benefit to the Members.

7.3.2 Specifically, the Committee was informed that through the crosscutting framework of its Disaster Risk Reduction (DRR) Programme, with the participation of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM), Tropical Cyclone Programme, the Commission for Atmospheric Science (CAS), the Commission of Hydrology (CHy), the Commission for Basic Systems (CBS) and external partners WMO has been developing a coordinated project for development and demonstration of integrated marine-related forecasting and warning systems for improved coastal risk management. Effective disaster risk management preventive and preparedness strategies through land-use planning, resource and environmental management, early warning systems and emergency preparedness, could highly reduce risks associated with tropical cyclones and other related hazards in coastal areas. However, this required relevant meteorological, oceanographic and hydrological information to support different decision processes.

7.3.3. The Committee considered several areas of potential contribution through its technical plan including: (i) standardization of tropical cyclone databases, metadata, analyses and mapping to support risk assessment projects such as World Bank's CAPRA which was initiated in February of 2008, (ii) an integrated approach to tropical cyclone, storm surge, wind-waves, swells and flood forecasting, through model-based marine-related forecasting systems, (iii) need for enhanced warning communication and dissemination targeted at coastal risk managers and decision-makers, (iv) strengthening the interfaces with the regional and national offices of the humanitarian agencies to provide more targeted information to support humanitarian contingency planning and response operations, and (v) development of value-added products combining meteorological, oceanographic, and hydrological information and forecasts with high resolution satellite imagery, building on innovative examples emerging from the collaboration of WMO with UNOSAT and RSMCS-ECMWF.

7.3.4 The Committee noted the views expressed by CDERA concerning a perceived deficiency within a specific hurricane warning arrangement between two countries of the Eastern Caribbean. In this regard, the Committee was informed that this matter has been extensively discussed and appropriately addressed at the sub-regional level.

7.3.5 The Committee was informed that the Third Session of the Intergovernmental Coordination Group (ICG) for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE EWS III) was held March 12-14, 2008 in

Panama City, Panama. The ICG falls under the auspices of the Intergovernmental Oceanographic Commission of UNESCO. Dr. Mark Guishard of Bermuda represented the Hurricane Committee in order to facilitate dialogue between our two groups, which have some overlap in their mandates for disaster mitigation.

7.3.6 A dominant theme of the ICG deliberations was the need for the establishment of a Regional Tsunami Warning Centre by 2010, based on criteria proposed by the Working Groups at previous ICG meetings. The ICG committed itself to naming the location of the Regional Tsunami Warning Centre at ICG-IV in 2009. In the interim, the USA will continue to provide support for the Caribbean and adjacent regions via the Pacific Tsunami Warning System. A Regional Tsunami Information Centre (RTIC) which would serve as a clearinghouse and repository for tsunami data and information is due for implementation in the near future. Barbados and Venezuela both offered to host the Regional TIC and are currently discussing a proposal on co-location.

7.3.7 It was also proposed by the Working Groups that additional day(s) be added to storm surge modelling workshops, to accommodate tsunami modelling, taking into account the similarities of the two hazards. In addition, Members are requested to complete an inventory of coastal hazard maps incorporating topography and bathymetry. Tsunami Focal Points and Tsunami National Contacts still need to be identified by all the Member States. There is scope in the future for co-location of the ICG and the Hurricane Committee, with one days' overlap, and the Membership is urged to investigate the feasibility of this.

7.3.8 The Committee requested Dr. Mark Guishard to attend the next ICG (IV) to be held in March 2009 in Martinique.

7.4 Training (agenda item 7.4)

7.4.1 The Committee noted that RA IV Members had benefited from WMO's education and training activities, relating to a number of training courses, workshops, seminars, the preparation of training publications, and the provision of advice and assistance to Members. The training seminars, workshops and courses that have been organized or co-sponsored by WMO to meet the needs of the Committee Members since its last session include:

- Workshop on Hurricane Forecasting and Warning and PWS, Miami 16-28 April 2007;
- Second Course on the Use and Interpretation of Products, Santa Cruz de la Sierra, 26-30 November 2007;
- Roving Seminar on Operation and Maintenance of Automatic Hydrometric Stations, La Paz, 18 - 22 June 2007;
- Seminar on Best Practices for Disaster Risk Reduction for the Iberoamerican NMHSs and National Civil Defence Agencies, Maracay, 25 - 27 July 2007;
- Training Course on Climate Risk Management in Agriculture, Brasilia, 10-14 December 2007;
- WHO Conference and Workshop on Climate Variability and Change and their Health Effects in Central America, San Jose, 06 - 09 August 2007.

7.4.2 The Committee noted that fellowships for long-term and short-term training totalling 105.9 person x months were granted to the Member countries of the Committee under the various WMO programmes. It further noted with satisfaction the continued efforts being made to enhance the WMO fellowships programme and urged its Members to continue to utilize more effectively this programme. The Committee was reminded that the new Fellowship Nomination Form which could be accessed from the Education and Training Department website, should be used when requesting WMO fellowship.

7.4.3 The Committee encouraged greater contribution of RA IV Members in various education and training activities supported under WMO Voluntary Co-operation Programme (VCP), Trust Fund, UNDP and TCDC arrangements.

7.4.4 The Committee expressed its gratitude to all those Member countries which made available their training facilities and/or experts to other Members under bilateral or other types of arrangements. It strongly recommended that such endeavours should continue in the future and be strengthened. The Committee urged Members to make maximum use of such training facilities.

7.4.5 The Committee noted the further development of the ETRP Website and the current initiatives to facilitate online access to worldwide training resources, as well as exchange of meteorological case studies and related documentation between advanced and less advanced training institutions.

7.5 Research (agenda item 7.5)

7.5.1 The Committee was informed that the International Training Workshop on Tropical Cyclone Disaster Reduction was successfully held in Guangzhou, China, from 26 to 31 March 2007. The primary objective of this workshop was to facilitate application of recent achievements in research to operational forecasting. Of the 60 participants, 45 were operational forecasters from Members of the five tropical cyclone regional bodies while 15 were tropical cyclone researchers. The lecturers included leading experts in the field of tropical cyclone research and forecasting namely Dr Peter Black, Prof. Lianshou Chen, Prof. Russell Elsberry, and Mr Charles Guard. The training workshop provided the trainees with new knowledge gained from recent advances on tropical cyclone research and how best to apply these to operational prediction activities in order to enhance the accuracy and usefulness of tropical cyclone forecasts and warnings. It also enabled participants to be aware of the issues associated with disaster mitigation, such as factors contributing to human and economic losses, conveying forecasting and warning information to stakeholders, users and the general public, evaluating the effectiveness of warning systems, mitigation strategies and community capacity building for disaster reduction.

7.5.2 The Tropical Cyclone Panel of the World Weather Research Programme's Working Group on Tropical Meteorology Research was organizing an "Expert Meeting to Evaluate Skill of Tropical Cyclone Seasonal Forecasts". The meeting, which was scheduled to be held in Boulder, Colorado, USA from 24 to 25 April 2008, would review the status of a number of statistical and dynamical techniques for seasonal forecasts. As recommended by the Sixth International Workshop on Tropical Cyclones (San Jose, November 2006), the meeting was expected to formally establish a website for seasonal tropical cyclone forecasts, which was proposed to be on the WMO/WWRP/TMR website. In developing this website, the expert group would (i) Define the metrics for the seasonal forecasts and (ii) Set guidelines for verification measures (seven measures for deterministic forecasts and three for probabilistic forecasts) and choose appropriate reference score.

7.5.3 The Committee noted that steps were underway to organize the Regional Research Workshop on Tropical Cyclones in La Réunion, France, from 26 to 30 May 2008. The workshop would focus on the following main topics: (a) current status of research activities on tropical cyclones and tropical convection in the south-west Indian Ocean (b) future research activities in the region and (c) research needs in the south-west Indian Ocean. The objectives of the workshop were: (a) to determine the areas of research which are of particular interest to the

Members of the RA I (Africa) Tropical Cyclone Committee for the South West Indian Ocean and (b) to develop future collaborations between researchers in the region.

8. ASSISTANCE REQUIRED FOR THE IMPLEMENTATION OF THE COMMITTEE'S TECHNICAL PLAN AND STRENGHTNING 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-ninth session and considered the plan for future action.

8.2 The Committee expressed its satisfaction that WMO, through the Department of Development and Regional Activities (DRA), with the support of the WMO Office for North, Central America and the Caribbean (NCAC), 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 WMO/NCAC Office has also provided support to regional activities and assistance in the implementation of WMO Programmes in the Region.

Regional activities

8.3 The Committee was informed that:

- During 2007 the WMO has continued its Project Office in Mexico to support the National Water Commission in achieving integrated, sustainable management of water and the PREMIA project aimed to, as outlined in the agreement between the WMO and the Government of Mexico, the efficient management of water, technical support in the fields of hydrology, meteorology, climate variability and change and their effects on water availability, in particular ground water reserves, prevention of floods will be also another area to be covered.

- As a result of the meeting of the Conference of Directors of Ibero-American NMHSs, AWS training was held in Panama and El Salvador and EUMETCast Reception Stations were sent to Costa Rica, Cuba, Dominican Republic, El Salvador, Guatemala, Honduras, Mexico, Nicaragua and Panama. NCAC has also participated in the joint mission, WMO/AEMET to Guatemala and Dominican Republic to initiate the preparation of a development project for Dominican Republic and Haiti under the framework of the Ibero-American Climate Project.

- In RA IV WMO continued to collaborate with the various economic and technical organizations in the development and implementation of meteorology programmes and projects. These included the Association of Caribbean States (ACS), CARICOM, SICA, CRRH, CMO and CEPREDENAC.

- As a follow up of the activities of WMO and ICG/IOCARIBE, NCAC participated in the Third Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions held in Panama City, Panama in March 2008. Also NCAC attended the 30th Session of RA IV Hurricane Committee in Orlando, USA in April 2008.

- In November 2007 the Meeting of NMS's Directors of Ibero-American Countries was held in Asunción Paraguay with the attendance of the members of the RA IV.

- The radar networking system project supported by the European Union has continued being implemented under the coordination of the CMO. The project will benefit the Caribbean region providing early warnings on hurricanes and severe weather.

- In 2002, in order to support the acquisition of climate information, the Global Climate Observing System (GCOS) assisted the CAC countries in developing a Regional Action Plan. Implementation of the projects in the Plan was far from complete but remained important to the Region. A strategy meeting was therefore held in Belize City, Belize from 28-30 January 2008, to consider how the projects in this Action Plan, as well as newer priorities not contained in the original Plan, could be funded and implemented.

- The First Planning Meeting for Central American Project on Multi-Hazard Early Warning System was held in New Orleans, USA on 18 January 2008, organized by WMO and with the participation of different regional and finance agencies. This was the first step to develop an end-to-end early warning system for Central America.

Training

8.4 The Committee took note that the WMO, the University of Costa Rica and the University of Oslo had opened a Master Degree Programme in Hydrology with strong distance and computer aided learning components. The programme started with 10 students from Costa Rica, El Salvador, Guyana, Panama and 3 students from the University of Oslo.

8.5 The Committee also took note that the RTC of Costa Rica continued its support of multimedia and computer aided learning for continuing education by translating COMET's modules on Ensemble Forecasting, Aviation Weather, Climate Change, Hurricane Strike, Hydrology, Satellite Meteorology and Numerical Weather Prediction into Spanish.

8.6 The Committee was pleased to know that the RA IV Workshops on Hurricane Forecasting and Public Weather Services took place in Miami, U.S.A, in the first quarter of 2008. These very important workshops are organized on an annual basis at the National Hurricane Center in Miami, USA, with strong support of WMO and the U.S.A. All Members of RA IV strongly endorsed the need for continued support for these workshops.

8.7 The Committee was informed that the Focus Group of WMO’s Virtual Laboratory on Satellite Meteorology, using Internet and Visit View software, had become a well attended forum of discussion with the attendance of more than 10 Latin American and Caribbean countries. Discussion routinely took place 3 or 4 times a month and every other day when the region was under the threat of a hurricane. These discussions also kept in close monitoring of the evolution of ENSO. The group was lead by NOAA, US National Weather Service at Comet, Barbados and Costa Rica RTCs and Colorado State University.

Assistance to NMHS

8.8 The Committee was informed that WMO, through DRA Department and the WMO/NCAC Office, have assisted Guatemala in the reformulation of the modernization project for the NMHS. Also WMO, with the assistance of Spain, have been working to rehabilitate the operative capacity of the meteorological and hydrological observing network in Guatemala and El Salvador after Hurricane Stan.

8.9 The Committee was also informed that the DRA Department and the WMO/NCAC Office have continued to assist Members in the implementation of the regional components of WMO scientific and technical programmes. The general level of implementation remained satisfactory; however, there were still areas that required further attention and improvement.

8.10 The Committee was pleased to note that as a result of the meeting of the Conference of Directors of Ibero-American NMHSs, WMO had initiated experts' missions to some Latin American countries for the preparation of development projects for NMHS under the framework of the Ibero-American Climate Project.

VCP Projects

8.11 The Committee was informed that at the end of 2007, four VCP project requests were submitted to the WMO Secretariat by four RA IV Members for the provision of upper-air consumables, update of workstations for the RA IV satellite communications system, rehabilitation of meteorological observing network, and equipment for dissemination of meteorological information. The rehabilitation of meteorological observing networks in El Salvador and Guatemala continued during 2007 under the support received from Spain. In spite of the support obtained during 2002-2007, six valid projects have not received support as of 31 December 2007.

8.12 The Committee was also informed that during 2007, a total of 6 fellowships of different duration were awarded to fellows within the framework of the VCP.

8.13 Additionally, NOAA/NWS has been engaged in other capacity-building efforts within the region. NWS IAO supports capacity-building, education and outreach activities in RA-IV through the WMO's Voluntary Cooperation Program (VCP). Many of the projects were in support of the monitoring and warning of hurricanes operations of RSMC Miami, but the activities also supported the routine forecasting and operations of NMHSs in the region. Annually, IAO supported:

- **CaribWeather.net:**Caribweather.net website is a clearinghouse of Caribbean Island weather forecasts. Visitors to the site can find forecasts for the Caribbean as a whole and for individual countries/islands.

- **NOAA Tropical Training Desk**: NOAA trains six fellows from Central America and the Caribbean each year at the Tropical Desk at the NCEP HPC. Fellows are trained on operational skills, including numerical weather prediction techniques.

- **Data Rescue:** NWS IAO was facilitating data rescue projects in the Americas to improve documentation for long term climate and weather information. The first phase would focus on the rescue of surface observations in Uruguay and the Dominican Republic. NWS and NCDC visited Uruguay in fall 2004. Each country received a PC, digital camera, and cd-roms. Paper archives are photographed, burned on CD, and mailed to NCDC where they are digitized.

- **Desktop Weather Forecast System**: NOAA, through contract with the Center for Ocean-Land-Atmosphere (COLA), successfully deployed four PC-based ETA numerical weather prediction (NWP) workstations in El Salvador, Peru, Senegal, and Viet Nam during 2007. One-week training sessions were held in the first three countries to enable the forecasters at each meteorological service to learn how to run the ETA model. Viet Nam was a NOAA-COLA activity, and COLA provided the ETA system, but the meteorological service had their own computer capabilities. NWS IAO also submitted a new proposal for WRF workstations for the Caribbean and South America. If funded, NWS IAO planned to purchase three workstations for the Desk student's country. The proposal included the hope that countries purchase their own dual processor workstation and NWS IAO helps setup the WRF model.

International Satellite Communication System (ISCS): The ISCS System covers three-quarters of the globe for aviation and meteorological-hydrological data and products. Similar responsibility for the remaining fourth of the globe is managed by the UK with their SADIS System. The system contract for the current ISCS (ISCS-G2) expires on 31 December 2009. As of that date, the United States would no longer broadcast ISCS meteorological and aviation weather products via the ISCS-G2, but would use the ISCS-G3 to broadcast ISCS products. Planning was underway for the transition to the ISCS-G3 from the current ISCS-G2. A contract for the ISCS-G3 would be awarded by early 2009. The ISCS-G3 would provide improved performance compared to that of the current system. A draft of the ISCS-G3 system requirements document (Statement of Work - SOW) was available for review and comment.

The HC requested the RA-IV Communications Working group and any interested member states in the RMTN to review the Draft SOW for any major concerns or requirements which may have been omitted in the document. This review should be completed by 15 May 2008. The U.S. would send the document to the appropriate Members.

An evaluation form was recently sent by ICAO to all ICAO Member States in CARSAM to assess user satisfaction with the ISCS or SADIS systems. The US PR requested that all Members of the RMTN who had not completed this survey to do so, and email the completed form to the Directors by 15 May 2008.

The current version of the ISCS was experiencing a minimal drop out of GRIB products during the first and second model runs on the RMTN data broadcast. Some member states had noted the missing GRIB products. The problem appeared to be isolated to the interface between the PES-8000 and the site workstation. Verizon continued diligently working to diagnose this problem, and to provide a resolution. Member States could obtain any of the missing GRIB products (as well as all other ISCS data products) from the NWS FTP public server (http://www.weather.gov/tg/dataprod.html).

The HC and the RMTN Member States continued to monitor and documented any loss of products. All missing products should be reported to Patrick.Gillis@noaa.gov and Robert.Gillespie@noaa.gov. Information should include WMO header for the missing product with both the date and time.

The HC asked the RA-IV Communications Working Group to work with RMTN Member States and the ISCS Program office to develop an inventory of products they transmitted and received over the ISCS. This document would also be analyzed for any missing requirements. This task should be completed by 30 September 2008.

Information about the Re-compete and the ISCS/WAFS is found at http://www.nws.noaa.gov/iscs/advisorys.htm

Current Plan for ISCS Re-compete and New System Installation

- *27 March 2008 Draft RFP available and open for questions*
- *Official RFP out June 2008*
- *Award Expected by end of December 2008 at earliest – early February 2009 at the latest*

  - *Dual Systems running through end of December 2009*
  - *Old ISCS (ISCS-G2) decommissioned 01 January 2010*

- **E-Learning Initiative:** NWS IAO was exploring several options to fulfil the training gap in RA-IV. Among them, a modified proposal for an MBA with a focus on environmental management for the e-learning initiative. The new proposal included an MBA with an environmental emphasis. The MBA degree would take two years to complete and required students to work in their forecast office 50% of the time. NWS IAO was working with COMET, WMO and others to start the program by August 2008. NWS would encourage students' government to pay for costs to this MBA program, with a select few students receiving 100% funding through the WMO VCP fellowship program. More information on this Masters' On-Line Degree Program was expected to be made available in April. An update was provided during this session.

- **WMO Region IV (RA-IV) Regional Climate Centre (RCC):** WMO directed each of its six Regional Associations to develop a Regional Climate Centre (RCC) based on local needs and priorities. In July 2003, an RA IV Ad Hoc Advisory Group met to discuss and advise on development of an RCC. It was determined that the needs of WMO RA-IV would best be served by a virtual RCC structure. NOAA's NWS agreed to fund an RCC Pilot Project. The Regional Committee on Hydrologic Resources/ Comité Regional de Recursos Hidráulicos (CRRH) in Costa Rica, was awarded $30K to develop the Central American "node" of a virtual RA IV RCC, and there was an inaugural signing ceremony at the RA-IV Meeting in San Jose, Costa Rica, in April, 2005. The pilot project focused on Central America, but would serve as a prototype for the region. The node approach to a RA-IV RCC was being explored because of the varying climate services and products needed throughout the region. Among other applications, the climate services and products would be geared toward decision-support tools.

8.14 With regards to the issues reported by NOAA/International Activities Office, the following comments and recommendations were made:

- With respect to CaribWeather.net, some Members reported that the site was used from time-to-time. Belize stated the server that hosts the website also acted as a server for the Belize Meteorological Service. Representatives from BCT expressed concern over changes to the server housed in the Netherlands Antilles and stated they would continue to work with the webmasters to find a solution.

- The emerging issue of WMO/ICAO requirements for aeronautical forecasts was discussed. One member stated it would be a big issue for RA IV at the upcoming WMO Executive Council meeting in Geneva, Switzerland, in June 2008.

- The President of RA IV, Mr. Carlos Fuller, expressed an interest in the strategy for WRF-Desktop Weather Forecast System implementation which IAO was developing as a possible VCP program. IAO stated RA IV would certainly be a region of priority if the program moved forward.

- Committee members from the BCT requested a status update of the transition from current EMWIN operations (EMWIN I) to the GOES-N series era EMWIN operations (EMWIN-N). Due to changes in the next series of GOES satellites, the GOES-N thru P constellation, that necessitated development of EMWIN-N; sometime before 2011 the current GOES satellites would be decommissioned and would be replaced by the new series. All current EMWIN users will need to migrate to newer technologies due to frequency, power and modulation changes. The NWS IAO would request a status update from the EMWIN program manager and appraise the Committee.

- The request in the previous bullet prompted a discussion on the EMWIN implementation in RA IV through the Third Border Initiative. Some members reported successful operations and others reported on problems with receiving certain products while in full mode. Belize offered to run a test for one week to determine if this is a region-wide problem or isolated to some countries. Belize will report the findings to NOAA for trouble-shooting and apprise the Committee.

- The discussion concluded with RA IV President thanking the WMO, RSMC-Miami and NWS IAO for the continued support for regional capacity building activities such as the RA IV Workshop on Hurricane Forecasting and Warning, HURREVAC and the other VCP activities of IAO that go beyond the Committee.

8.15 NOAA/NWS IAO also has additional projects that support operations in RA IV NMHSs and build the capacity of the region to continue to substantively support NOAA/NWS, RSMC Miami, the WMO and the RA IV Hurricane Committee. In Fiscal Year 2005, NOAA/NWS received $260,000 in hurricane supplemental funds following Hurricane Ivan (2004). In Fiscal Year 2006, NWS procured hydro-meteorological equipment for Grenada, Cayman Islands, Bahamas, Jamaica, and Honduras. As of the beginning of the 2006 hurricane season all equipment was installed.

8.16 In FY07, NWS received $452,000 in funding from the Department of State in support of the Third Border Initiative (TBI), which was able to leverage off the hurricane supplemental funds. The TBI supported a targeted package of programs designed to enhance diplomatic, economic, health, education, and law-enforcement cooperation and collaboration in the Caribbean region. The TBI also supported increased funding for disaster preparedness and mitigation efforts to shield critical commercial and environmental infrastructure from natural disasters. Activities focused on enhancement, renovation, and rehabilitation of the hydro-meteorological monitoring network in the 12 TBI-eligible countries, including upper-air and surface observation systems as well and hydro-meteorological and sea-level monitoring networks (i.e., tide-gage networks). The 12 countries included Antigua & Barbuda, Bahamas, Belize, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, St. Kitts & Nevis, St. Lucia, and Suriname. A tide gage deployment in the Dominican Republic was an initial step in a larger multi-purpose Caribbean sea-level monitoring system, which will require wider national commitments to implement.

8.17 The second component of the TBI project included implementation of and training on the Emergency Managers Weather Information Network (EMWIN). Emergency managers in the U.S., Pacific, Caribbean, and in other nations have used EMWIN to rapidly respond to tornados, hurricanes and tsunamis. EMWIN was a reliable, priority-driven weather-warning and data-broadcast system, which provides free and rapid dissemination of warnings, forecasts, graphics and imagery that has been in operation for nearly ten years. It was a key component in strengthening emergency preparedness and disaster risk reduction. In the Caribbean region, the primary users would be meteorological services who have warning responsibilities and emergency managers who have disaster mitigation responsibilities. The regional emphasis will be on early warning and dissemination of hurricane-related information for use in decision-making. However, EMWIN had the potential to be part of an integrated multi-hazard early-warning system.

8.18 EMWIN Training, in support of the TBI, consisted of comprehensive one-week training workshops. The first of two training opportunities was conducted at the NOAA National

Hurricane Center in Miami, Florida, from March 5-9, 2007. One representative each from the meteorological service and the national emergency management organization of Antigua & Barbuda, Dominica, Grenada, St. Kitts & Nevis, and St. Lucia were invited to participate. The second training opportunity took place in July 15-22, 2007 in Silver Spring at the NOAA Campus and involved the other seven TBI countries: Bahamas, Belize, Dominican Republic, Guyana, Haiti, Jamaica, and Suriname. In addition, although Trinidad & Tobago are not eligible for TBI funds, they were eager to utilize the EMWIN capability and paid for two members from the emergency management agency to attend the second training opportunity.

9. SPECIAL SESSION

Central American Pilot Project on Early Warning Systems

9.1 The Committee was informed of progress of the Central American Pilot Project on Early Warning Systems with Focus on Hydrometeorological Hazards. It noted that a regional planning and advisory group had been established, chaired by the president of RA IV and involving chairs of Working Groups in the region and representatives from NOAA, the World Bank, and IFRC. The partners who cooperated in and contribute to the project were the NMHSs of the three pilot countries (Costa Rica, Nicaragua, El Salvador), their Disaster Risk Management Agencies, Red Cross Societies at the national level and World Bank, IFRC, NOAA, ISDR, and OCHA.

9.2 The Committee noted that the pilot project aimed to develop a coordinated project for strengthening of operational early warning systems from national to community levels, building and leveraging existing capacities, tools and resources and focusing on strengthening of operational interfaces between NMHS and key stakeholders. The Committee noted that these developments were guided by a number of fundamental criteria including: (i) alignment with WMO Strategic goals, (ii) building on priorities, requirements and needs at regional, sub-regional, or country-grouping levels, (iii) integrated planning, budgeting, implementation, leveraging WMO and partners' expertise and resources, (iv) result-based approach with clear outcomes, deliverables, timelines, (iv) scalability, (v) sustainability of capacities overtime, (vi) end-to-end solutions leading to better decision-making capacities, and (vii) extra-Budgetary resource mobilization strategy for implementation.

9.3 The Committee appreciated that significant progress had been made including, (i) development of criteria for selection of pilot countries and initiation of buy-in regionally and nationally, (ii) completion of fact finding missions to three pilot countries including Costa Rica, Nicaragua, and El Salvador, (iii) development of detailed project concept, (iv) proposal development process, and (v) fundraising. It noted that proposals were under preparation for three countries with the aim of raising funds in the fourth quarter of 2008 and launching the project in the first quarter of 2009.

9.4 In considering the concept of the project, the Committee emphasized that WMO Strategic Plan:

- Expected Result 6 "Enhanced capabilities of Members in multi-hazard early warning and disaster prevention and preparedness"; and
- Expected Result 7 "Enhanced capabilities of Members to provide and use weather, climate, water and environmental applications and services";

formed the basis on which the project had been built. The Committee further emphasized that for WMO, and specifically for the NMHSs of its Members, achieving the high-level objective of improving the delivery of weather, climate, water, and related environmental information and services to the public, governments and other users in order to protect lives and property, required that the NMHSs look beyond the production of the best possible forecasts and warnings and understand how this information was understood and used with the national DRR systems and user communities. The Committee was satisfied that the project was designed to address and improve these complex issues.

9.5 The Committee endorsed this initiative and welcomed that lessons learned from this initiative would be rolled out to other countries as appropriate giving special attention to the needs of the Small Island Developing States (SIDS) during the project expansion.

9.6 The Committee requested that a progress report be presented at its meeting in 2009 and agreed to review lessons learned from these pilots and provide guidance on the further course of the project and make a recommendation to the next session of the RA IV on lessons learnt and on the expansion of this project to other countries in the region.

10. SCIENTIFIC LECTURES AND DISCUSSIONS (Agenda item 9)

10.1 The following scientific lectures were presented during the session:

- NOAA and NASA Collaborative efforts using Unmanned Aircraft Systems (UAS) in Tropical Cyclones: Recent Successes and UAS plans for 2008
  - Mr.Joe Cione (USA)

- Post-Tropical Storm Noel; A Case Study in Coordination, Communication & Cooperation
  - Mr John Parker (Canada)

- SFMR- Stepped Frequency Microwave Radiometer
  - Lt. Douglas Gautrau (USA)

- The Hurricane Hunters – Flight Operations
  - Lt. Col. David Borsi (USA)

  (Subsequent discussions occurred. Please see paragraph 5.13 for details.)

- WMO Integrated Global Observing Systems (WIGOS) and WMO Information System (WIS)
  - D.C. Schiessl (WMO)

- WMO Strategic Plan
  - D.C. Schiessl (WMO)

- WMO Secretarial Organization
  - D.C. Schiessl (WMO)

10.2 The lectures were followed by discussions in which all actively participated.

11. OTHER MATTERS

The representative of Cuba expressed concern about the irregularities in granting of visas to the Cuban officials who participate in the Committee sessions. Visas were granted with "time limit" dates that are consistent only with the agenda of the meeting but not consistent with actual itineraries of the trip. Issuance of visas also took time and often caused a problem in travel arrangement by the officials as well as funding agencies. The representative of Cuba requested that this matter be considered by the Committee and the United States and an appropriate action be taken to address this issue.

12. DATE AND PLACE OF THE THIRTY-FIRST SESSION (Agenda item 10)

12.1 The delegate from Bahamas informed the Committee that his country would consider hosting the thirty-first session of the RA IV Hurricane Committee in Nassau, Bahamas in 2008. The session will be held in conjunction with the RA IV 15th session.

12.2 The Committee, in welcoming the information and accepting this offer, expressed its warm appreciation to the Government of Bahamas.

12.3 The Committee also welcomed the preliminary information from Bermuda (UK) that it was considering hosting the Hurricane Committee session in 2010. It looked forward to receiving further information during its 2009 session.

13. CLOSURE OF THE SESSION (Agenda item 11)

The report of the thirtieth session of the Committee was adopted at its final meeting at 1140 hours on 28 April 2008.

LIST OF APPENDICES

APPENDIX I

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APPENDIX II

AGENDA

1. ORGANIZATION OF THE SESSION

    1.1 Election of officers
    1.2 Opening of the session
    1.3 Adoption of the agenda
    1.4 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 2007

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 2008 AND BEYOND

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

9. SPECIAL SESSION

10. SCIENTIFIC LECTURES AND DISCUSSIONS

11. DATE AND PLACE OF THE THIRTY-FIRST SESSION

12. CLOSURE OF THE SESSION

APPENDIX III

REVIEW OF THE PAST HURRICANE SEASON

RSMC Miami 2007 Atlantic and Eastern North Pacific Hurricane Season Summary

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

ATLANTIC

Overall activity during the 2007 Atlantic hurricane season was near average. There were fifteen tropical and subtropical named storms, six of which became hurricanes, with two becoming major hurricanes (category three or greater on the Saffir-Simpson Hurricane Scale). For the 40-year period 1967-2006, the averages for named storms, hurricanes and major hurricanes are eleven, six, and two, respectively. Even though the number of named storms was above average, including a record-tying eight storms that formed in September, many of these storms were short-lived. In terms of the NOAA Accumulated Cyclone Energy (ACE) index, which measures the collective strength and duration of named storms and hurricanes, the season produced about 84% of the 1951-2000 median activity. This percentage is the lowest observed since 2002.

Despite the near-average overall activity, the impacts from Atlantic basin tropical cyclones were devastating outside of the United States. Two category five hurricanes made landfall in the basin during the season. Dean struck the Yucatan Peninsula of Mexico at category five strength in August, and soon thereafter came ashore in mainland Mexico as a category two hurricane. Felix then hit northeastern Nicaragua as a category five hurricane in early September. Hurricane Lorenzo later struck mainland Mexico in nearly the same location as Dean's final landfall. Late-season Noel and post-season Olga dumped heavy rains that caused flooding, mud slides, and large loss of life in the Caribbean. Overall, the combined international death toll from tropical cyclones during 2007 was about 360. One hurricane, one tropical storm, and three tropical depressions made landfall in the United States during 2007, causing a total of 10 fatalities and about $50 million in damages.

In the individual storm descriptions that follow, all dates and times are based on Universal Coordinated Time (UTC).

Subtropical Storm Andrea formed from a large extratropical cyclone that originated just offshore the mid-Atlantic United States coast on 6 May. The cyclone was initially a potent extratropical system, but by late on 7 May, the cyclone lost most of its baroclinic support and development ended. However, interaction of the low and strong high pressure to the north produced hurricane-force winds that generated large waves that impacted much of the coast of the southeastern United States and the Bahamas Islands. On 8 May, the low weakened and began drifting westward over warmer waters in the western Atlantic, where decreasing vertical shear allowed for the generation of deeper and more symmetric convection around the center. The system lost its frontal structure, and it is estimated that it transformed into a subtropical cyclone early on 9 May while centered about 175 miles east of Jacksonville, Florida.

The cyclone's weakening continued during the subtropical phase, so Andrea's peak intensity of 60 mph occurred early on 9 May. Andrea initially drifted slowly westward, but late that day it came under the influence of strong northerly flow aloft, resulting in increasing vertical shear and a slow southward motion. Andrea weakened to a depression on 10 May while centered about 110 miles east-southeast of Jacksonville, Florida. Lacking significant deep convection, Andrea degenerated into a remnant low early the next day. The low accelerated northeastward on 12-

13 May ahead of an advancing cold front and was later absorbed within the frontal boundary by 14 May.

There were no reports of deaths directly attributable to Andrea as a subtropical storm. However, the pre-Andrea extratropical cyclone was directly responsible for six deaths, including all four crew members of the 54-foot sailing vessel *Flying Colours* whose last known location was off the coast of North Carolina on 7 May. Some minor damages occurred from North Carolina through Florida during 6-8 May as a result of very strong winds and waves associated with the pre-Andrea extratropical cyclone.

Tropical Storm Barry formed in association with a tropical wave just northwest of the western tip of Cuba early on 1 June. The depression became a tropical storm later that day, and it reached its peak intensity of 60 mph very early on 2 June about 195 miles west-southwest of the Dry Tortugas. Thereafter, a mid- to upper-level trough over the central Gulf of Mexico produced strong upper-level southwesterly winds over the cyclone, resulting in weakening. The center of the broad circulation reached the Tampa Bay area on 2 June. By then, the system had weakened to a tropical depression and had begun to acquire extratropical characteristics.

The depression moved generally northeastward across northern Florida and became extratropical early on 3 June over eastern Georgia. The extratropical cyclone intensified and moved along the east coast of the United States. It became absorbed by a larger extratropical cyclone on 5 June near the St. Lawrence River. Strong winds occurred off the coast of northeastern Florida, when Barry was just north of Cuba. These winds were associated with a strong high pressure system and a cold front and not directly with the tropical cyclone. There were no reports of casualties in association with Barry and damages were very minor.

Tropical Storm Chantal formed from a frontal system moved off the coasts of North Carolina and South Carolina on 21 July. The front decayed into a low-level trough, and eventually produced an area of disturbed weather that became quasi-stationary a few hundred miles east of the Bahamas by 26 July. Convection was not very persistent over the area for the next few days while the system moved slowly northward. Very early on 31 July, however, a low-level circulation center had developed and become well-enough involved with the deep convection to designate the system as a tropical depression, while centered about 240 miles north-northwest of Bermuda and about 525 miles east of Cape Hatteras, North Carolina. Over the next several hours, deep convection increased near the center, and the cyclone strengthened into a tropical storm. QuikSCAT observations indicate that Chantal reached its peak intensity of 50 mph later on 31 July.

A mid-tropospheric trough just off the U.S. east coast drove the tropical cyclone generally northeastward at an increasing forward speed. By early on 1 August, the circulation became embedded within a frontal zone, signifying that Chantal was losing tropical characteristics. The system transformed into an extratropical cyclone later that day, and passed over the eastern end of the Avalon Peninsula of Newfoundland, producing very heavy rainfall there. The post-Chantal cyclone intensified to near hurricane force on two separate occasions over the north Atlantic. The cyclone began its final weakening late on 3 August, and passed a couple hundred miles southeast of Iceland the next day. On 5 August, the system turned northeastward and finally lost its identity as it merged with another extratropical cyclone. There were no reports of damage or casualties associated with Chantal, but the extratropical cyclone that was formerly Chantal did cause some flood-related damages in southeastern Newfoundland.

Hurricane Dean formed from a tropical wave over the far eastern Atlantic Ocean on 13 August. The cyclone became a tropical storm the next day about 1500 miles east of the Lesser Antilles and strengthened to a hurricane on 16 August as it moved just north of due west. The center of

Dean passed between St. Lucia and Martinique early on 17 August, with the northern eyewall passing over Martinique with category one sustained winds of about 90 mph. After clearing the Leeward Islands, Dean became a major hurricane later that day, and its winds reached 165 mph (category five) early the next day about 700 miles east-southeast of Jamaica. Continuing on a track just north of west, the center of Dean passed about 25 miles south of the south coast of Jamaica on 19 August. At that time Dean was a category four hurricane with maximum winds of 145 mph, although these strongest winds likely remained just offshore.

Dean's heading remained remarkably constant as it continued over the deep warm waters of the northwestern Caribbean. Dean again became a category five hurricane very early on 21 August about 200 miles east of Chetumal, Mexico, and reached its peak intensity of 175 mph just prior to landfall later that day near Costa Maya on the Yucatan Peninsula. Dean weakened to a category one hurricane during its traverse of the Yucatan and emerged into the Bay of Campeche late on 21 August. Dean strengthened to a category two hurricane with winds of about 100 mph just before making its final landfall on 22 August about 40 miles south of Tuxpan, Mexico. The cyclone dissipated early on 23 August over the high terrain of central Mexico. Preliminary reports from various media sources indicate that Dean is responsible for roughly 32 deaths across the Caribbean, with the largest tolls in Mexico and Haiti.

Tropical Storm Erin formed over the Gulf of Mexico in association with a tropical wave very early on 15 August while centered roughly 430 miles east-southeast of Brownsville, Texas. Moving northwestward to the south of a deep-layer ridge over the southern United States, the depression became a tropical storm with maximum winds of 40 mph later that day. Bands of heavy rain began moving ashore along nearly the entire coast of Texas at about that time. Erin did not strengthen any further over the Gulf, and it barely maintained tropical storm status early on 16 August. Erin made landfall on San Jose Island, Texas (about 35 miles east-northeast of Corpus Christi) later that day, but by that time it had weakened to a depression with maximum winds of 35 mph. The depression continued northwestward and inland. The circulation remained intact, but the system was no longer a tropical cyclone by 17 August when it was located about 60 miles south of San Angelo, Texas. The low turned northward over extreme western Texas on 18 August around the western periphery of the ridge over the southeastern United States. Upon reaching the northwestern extent of the ridge, the low turned northeastward into southwestern Oklahoma very early on 19 August. The low had produced some heavy rainfall during the preceding 36 hours, but the convection was not sufficiently persistent and organized to continue to designate the system as a tropical depression.

When the surface low moved east-northeastward over Oklahoma early on 19 August, thunderstorm activity abruptly increased as the low interacted with an eastward-moving upper-level shortwave trough. During an approximately six-hour period, sustained winds of gale force were observed at several locations in western and central Oklahoma (as strong as about 60 mph), with isolated gusts of hurricane force (as strong as 82 mph). The system's organization also briefly became dramatically enhanced, with an eye-like feature readily discernible in WSR-88D radar imagery for about five hours. This episode was short-lived, however, and the eye-like feature quickly dissipated thereafter. The thunderstorm activity and strong winds had already begun to weaken by that time, as the upper-level shortwave trough proceeded eastward and away from the surface low. The surface circulation dissipated late on 19 August over northeastern Oklahoma, but remnant moisture continued northeastward into Missouri.

While the system's structure, particularly its convective organization as seen on radar, resembled and had some characteristics of a tropical or subtropical storm for a few hours on 19 August, the prevailing view from the National Hurricane Center's Hurricane Specialists is that the system was not a tropical or subtropical cyclone over Oklahoma. While it is a subjective determination, in this case the deep convection is judged to have lasted an insufficient period of time to classify the system as a tropical or subtropical cyclone. The limited duration of the convection also appears to be indicative of the physical mechanisms that caused the low to briefly strengthen. It is speculated that the upper-level shortwave trough forced the deep convection to increase via upper-level difluence, while briefly superimposed above the surface low that provided a focus for low-level confluence. The upper-level forcing was apparently a dominant mechanism, which is in contrast to tropical cyclones that are maintained primarily by extraction of heat energy from the ocean. Since the system was clearly non-frontal over Oklahoma, designating it as an extratropical cyclone is also not the most appropriate solution. Given all of these considerations, the system is simply designated as a “low” by NHC on 19 August.

Erin and its remnants brought heavy rains to many portions of Texas and Oklahoma, and portions of southern Missouri, directly causing 16 fatalities, nine of which occurred while Erin was still a tropical cyclone. Significant damages occurred on 19 August in some communities northwest of Oklahoma City, where several homes were flooded, and strong winds damaged some mobile homes and downed several trees and power lines.

Hurricane Felix formed from a tropical wave on 31 August about 225 miles east-southeast of Barbados. The depression initially moved generally westward and became a tropical storm early on 1 September about 70 miles south of Barbados. The center of Felix passed over Grenada a few hours later, and then moved across the southern Caribbean Sea within deep-layer easterly flow. The storm quickly strengthened and became a hurricane early on 2 September while centered about 180 miles east of Bonaire in the Netherlands Antilles. The center of Felix later passed 40-50 miles north of the Netherlands Antilles. Very rapid strengthening occurred during the day, with the maximum sustained winds increasing to 165 mph (category five) early on 3 September. The central pressure fell to 929 mb later that morning after a 64-mb fall in 32 hours. An eyewall replacement cycle began later that day, with Felix weakening to a category three hurricane. This was followed by re-intensification at the end of the cycle, and it is estimated that Felix regained category five status just before landfall near Punta Gorda, Nicaragua on 4 September.

Felix weakened rapidly over northern Nicaragua, becoming a tropical storm less than 12 hours after landfall. The cyclone decelerated and turned west-northwestward, and it weakened to a remnant low over northern Honduras early on 5 September. The low briefly emerged over the Gulf of Honduras later that day. However, no re-development occurred before it moved into Belize and Guatemala. While the remnant low dissipated over eastern Mexico late on 6 September, the residual cloudiness and showers moved westward into the Pacific and could be tracked until 9 September.

Media reports indicate that Felix caused 130 deaths in Nicaragua and Honduras, along with 70 others missing. While detailed figures on how many were killed in each country are not available, the reports suggest that the majority of the deaths were in Nicaragua. Felix’s landfall in Nicaragua caused severe damage to structures from winds and storm surge along the coast from Puerto Cabezas northward. Media reports indicate thousands of homes and other structures were destroyed. Additional damages from rain-induced flooding occurred inland in both Nicaragua and Honduras. Monetary damage figures are not available.

Tropical Storm Gabrielle’s genesis on 7 September can be traced back to a non-tropical low pressure area that formed along a frontal boundary near the coast of Georgia on 3 September. This system eventually led to the formation of a subtropical storm early on 8 September about 415 miles southeast of Cape Hatteras, North Carolina. Gabrielle’s outer convective bands weakened that day, and new convection developed near the center, which led to the transition of Gabrielle to a tropical storm late on 8 September. Gabrielle gradually strengthened while moving northwestward toward North Carolina, and shortly before reaching the coast it attained a peak intensity of 60 mph on 9 September. A few hours later, the center of Gabrielle made landfall along the Cape Lookout National Seashore, but strong northerly upper-level winds initially kept the convection and strongest surface winds offshore. Shortly thereafter, Gabrielle weakened due to the northerly wind shear and its interaction with land. Gabrielle turned northeastward and exited the coast near Kill Devil Hills early on 10 September, and it weakened to a depression a few hours later. The depression moved east-northeastward, passing well southeast of the northeastern United States. The circulation of Gabrielle dissipated ahead of a frontal boundary on 11 September about 350 miles south-southwest of Nova Scotia. There were no reports of casualties associated with Gabrielle, and damages were very minor.

Hurricane Humberto's genesis can be traced to the remnants of a frontal trough (the same front that spawned Gabrielle) that moved over the southeastern Gulf of Mexico on 5 September. Eventually the slow-moving trough was located over the northwestern Gulf of Mexico on 11 September, and convection increased markedly near the trough axis that day a couple hundred miles south of Galveston, Texas. Although thunderstorms diminished that night, a weak surface low had formed along the trough. A tropical depression formed early on 12 September, about 120 miles south of Galveston, Texas, when convection re-fired near the low. The depression became a tropical storm within the next three hours and moved slowly to the north. Intense thunderstorm activity in well-defined spiral bands continued near Humberto, and the small tropical cyclone rapidly strengthened just offshore of the upper Texas coast. Later that day, the system turned to the north-northeast due to steering around a large mid-level high over the southeastern United States. Radar data indicate that the storm became a hurricane about 20 miles south of High Island, Texas very early on 13 September, and the cyclone reached an estimated peak intensity of 90 mph as it made landfall a few hours later just east of High Island in McFaddin National Wildlife Refuge. The hurricane moved over extreme southeastern Texas and southwestern Louisiana, weakening into a tropical storm about 75 miles west-northwest of Lafayette, Louisiana. It became a depression near Alexandria, Louisiana late on 13 September, and dissipated the next day over central Mississippi.

There was one death in Bridge City, Texas directly associated with Humberto, and 12 injuries were reported in southeastern Texas. Insured losses from Humberto are estimated by the Insurance Services Office to be less than $50 million, and a rough estimate of total property damages is about $50 million. The relatively small damage total is probably due to the small size of the system and the relatively unpopulated area that it impacted. In addition, Hurricane Rita caused much more severe conditions to impact extreme southeastern Texas in 2005, which might have limited the amount of damage that could have been done by a small category one hurricane. Most of the damages from Humberto were due to fresh water floods and strong winds, with the latter knocking down trees and power lines and causing roof damage.

Tropical Storm Ingrid developed from a large tropical wave early on 12 September about 1130 miles east of the Lesser Antilles. The depression moved generally west-northwestward within weak steering flow south of a mid-tropospheric ridge. Despite moderate westerly vertical wind shear, the cyclone became a tropical storm early on 13 September, while centered about 840 miles east of the Lesser Antilles, and reached its maximum intensity of 45 mph later that day. Persistent westerly shear reversed the strengthening trend, and Ingrid weakened to a tropical depression on 15 September. Ingrid remained a depression for a day or so before degenerating into a remnant low early on 17 September, while centered about 160 miles east-northeast of Antigua. The remnants of Ingrid moved slowly northwestward and west-northwestward within the lower-tropospheric steering flow, and the low dissipated on 18 September. No casualties or damages were reported in association with Ingrid.

Tropical Storm Jerry formed from a non-tropical low in the central North Atlantic on 21 September. The low meandered for a few days, while gradually developing deep convection. The thunderstorm activity became better organized and eventually wrapped around the low. Since the system was still well-involved with an upper–level low and the strongest winds were well removed from the center, it is estimated that the depression that formed early on 23 September was subtropical in nature. The cyclone lacked a well-defined inner core but still became a subtropical storm later that day. Jerry evolved into a tropical storm early on 24 September, with a peak intensity of 40 mph, when deep convection developed near the center and the radius of maximum winds decreased. Thereafter, Jerry moved slowly toward the northeast over cooler waters and weakened. A strong cold front forced Jerry to accelerate northeastward, and early on 25 September the circulation dissipated ahead of the front. No casualties or damages were reported in association with Jerry.

Hurricane Karen formed from a tropical wave early on 25 September about 830 miles west-southwest of the Cape Verde Islands. The depression strengthened into a tropical storm a few hours later. For about a day after its formation, there was only a slight increase in the cyclone's organization and intensity. Early on 26 September, however, Karen's cloud signature became much better organized, and it strengthened significantly. The cyclone reached hurricane strength, and its peak intensity of about 75 mph, later that day. Soon thereafter, however, a sharp upper-level trough to the west of Karen produced a substantial increase in southwesterly vertical shear over the hurricane. Karen quickly lost organization, and it weakened below hurricane status early on 27 September. Later that day, the low-level circulation center became exposed to the west and southwest of the deep convection. Karen diminished to marginal tropical storm intensity on 28 September. The relentless southwesterly shear caused further weakening, and by early on 29 September, Karen weakened to a tropical depression and turned westward in the low-level easterlies. The circulation dissipated later that day, although a remnant area of showers and squalls lingered near the Leeward Islands for a few more days. No casualties or damages were reported in association with Karen.

Hurricane Lorenzo formed from a tropical wave on 25 September, when the system was centered over the Gulf of Mexico about 175 miles east-northeast of Tuxpan, Mexico. Steering currents were weak initially, and the depression made a small cyclonic loop over the next day or so. There was little development during this period, due to upper-level southwesterlies associated with a trough near the Texas coast. As the trough moved westward, however, the southwesterly upper flow gave way to an anticyclone above the depression, and the system became a tropical storm on 27 September about 150 miles east of Tuxpan. At about this time, a mid-level ridge built eastward across the northern Gulf of Mexico and pushed Lorenzo westward. Lorenzo strengthened rapidly as it approached the coast, becoming a hurricane less than 12 h after becoming a tropical storm. Lorenzo reached its peak intensity of 80 mph very early on 28 September, then weakened slightly, to 75 mph, before making landfall that morning near Tecolutla, Mexico, about 40 miles south-southeast of Tuxpan. The small circulation weakened very rapidly over land, with the system decaying to a tropical depression and then dissipating within 18 h after landfall.

The government of Mexico reports six deaths attributable to Lorenzo, with one in the state of Veracruz and five in Puebla. At least four of the deaths were caused by flash floods or mud slides. Damage in the two states included downed trees and power lines, as well as washed out roads and flooded homes.

Tropical Storm Melissa formed from a tropical wave on 28 September about 115 miles west-southwest of the Cape Verde Islands. Lacking a subtropical ridge to its north due to a deep-layer low pressure system over the northeastern Atlantic, the depression was initially trapped within very weak steering currents. While inching westward, it strengthened slightly and became a tropical storm early on 29 September. Melissa remained at its peak intensity of 40 mph for the remainder of that day. The storm then weakened to a depression early on 30 September within an environment of increasing westerly wind shear. Now a more shallow system, the cyclone began moving a little faster toward the west-northwest, to the south of a rebuilding low-level ridge over the central and eastern Atlantic. Thunderstorm activity sputtered later on 30 September, and the depression degenerated to a remnant low later that day about 550 miles west of the Cape Verde Islands. Remaining south of the low-level ridge, the low continued generally west-northwestward for the next several days, producing intermittent convection until it dissipated within a frontal zone late on 5 October about 700 miles northeast of the northern Leeward Islands. No casualties or damages were reported in association with Melissa.

Hurricane Noel originated from the complex interaction between a tropical wave, a surface trough, and an upper-level trough, with the depression forming about 215 miles south-southeast of Port-au-Prince, Haiti early on 28 October. After genesis, the depression turned northwestward around the eastern side of a mid-to upper-level low, and it became a tropical storm later that day. Thereafter, Noel continued to strengthen, reaching an intensity of 60 mph late on 28 October. As Noel continued toward the southern coast of Haiti the next day, interaction with the mountainous terrain of the island resulted in the disruption of the low-level circulation. Noel's maximum winds decreased to 50 mph before the center made landfall along the southern coast of Haiti early on 29 October. During its passage along the west coast of Haiti, the low-level circulation became very difficult to track, and it appears to have re-formed north of Haiti later that day as the system turned westward to the south of a mid-level ridge over the western Atlantic. Noel then hugged the northern coast of eastern Cuba and regained an intensity of 60 mph early on 30 October, and made landfall near Guardalavaca, Cuba shortly thereafter. Noel's center spent a little more than 30 hours moving very slowly over Cuba. While over the island, the maximum winds decreased, but ship and surface observations show that Noel remained a minimal tropical storm.

The storm re-emerged over the Atlantic from the north-central coast of Cuba on 31 October and slowly regained strength during the next day or so. Early on 1 November, Noel turned north-northeastward ahead of a mid-latitude trough that was moving across the Gulf of Mexico. At this time, a very strong burst of deep convection developed just northeast of the center. The center of Noel moved across Andros Island in the northwest Bahamas near midday on 1 November with maximum winds of 60 mph, and later that day passed very near Nassau with winds of 65 mph. Despite southwesterly shear, Noel continued to intensify over the northwestern Bahamas and, shortly after passing between Eleuthera and Abaco Islands, it attained hurricane strength. Noel reached a peak intensity of 80 mph and accelerated northeastward ahead of the mid-latitude trough. Shortly thereafter, the satellite appearance of Noel began to deteriorate as the inner-core convection weakened. By early on 3 November, Noel lacked the deep convection required to consider it a tropical cyclone, and the system became extratropical while centered about 275 miles southeast of Cape Hatteras, North Carolina.

The extratropical low grew into a very large and powerful cyclone as it moved north-northeastward off the east coast of the United States. The cyclone reached a peak intensity of 85 mph on 3 November. Late that day, the low weakened slightly as its center passed about 85 miles east-southeast of Nantucket Island, Massachusetts. Early on 4 November, the center of the low made landfall near Chebogue Point, Nova Scotia with maximum winds of 75 mph. The cyclone weakened after landfall in eastern Canada and exited the coast of Labrador about 18 h later. The low continued northeastward and merged with another extratropical cyclone over Greenland early on 6 November.

Torrential rains from Noel produced widespread damage and loss of life in the Dominican Republic, Haiti, Jamaica, eastern Cuba, and the Bahamas. As of this writing, Noel is estimated to have caused a total of 163 deaths (87 in the Dominican Republic, 73 in Haiti, one in the Bahamas, one in Jamaica, and one in Cuba). Nearly all of the fatalities were the result of floods and mudslides. In the Dominican Republic and Haiti, there were several reports of villages being swept away by flood waters. The cyclone is estimated to have damaged nearly 15,000 homes with a little more than 6,000 homes destroyed in the Dominican Republic. In Haiti, government reports note that nearly 18,000 homes were damaged and almost 4,000 homes were destroyed. In Cuba, 22,000 houses were damaged or destroyed and over 8,000 miles of roads were damaged. Other infrastructures including railroad lines, drainage systems, bridges and power lines were also damaged. Agricultural losses accounted for $305 million of the $500 million (United States dollars) in financial losses in Cuba as reported by the Granma International Newspaper. The Cuban Meteorological Service stated that rains from Noel produced the worst flooding in Cuba since Hurricane Flora in 1963. As a tropical cyclone, Noel was not directly responsible for any damage in the United States, but the extratropical cyclone produced strong winds that downed trees and power lines in the northeastern United States and eastern Canada. Although not directly associated with the tropical cyclone circulation of Noel, the gale-force winds created by the combination of Noel and a strong high over the eastern United States generated large waves that produced significant beach erosion along the Atlantic Coast of Florida prior to Noel's center passage offshore.

Tropical Storm Olga's genesis resulted from the interaction between an upper-level low and a low-level trough over the central Atlantic Ocean. By 10 December, a broad area of surface low pressure formed about 400 miles east of Puerto Rico. Although thunderstorm activity remained disorganized at that time, the low produced gale-force winds to the north of its center. Early on 11 December, the system developed a well-defined surface circulation and sufficiently organized convection relatively close to the center to be designated as a subtropical storm about 60 miles east of San Juan, Puerto Rico. The surface and upper-level lows had moved in tandem, and the surface low was initially classified as a subtropical storm because of its large radius of maximum winds, and because the surface low was still associated with the cold low aloft.

Under the influence of a low- to mid-level ridge to its north, Olga moved westward along the northern coast of Puerto Rico and then made landfall along the north-central coast of the island early on 11 December. As the day progressed, shower and thunderstorm activity increased near the center, and the radius of maximum winds decreased. Late on 11 December, Olga became a tropical storm at its peak intensity of 60 mph as it was making landfall just south of Punta Cana in the Dominican Republic. Despite the mountainous terrain, Olga maintained its peak intensity for about 12 h while moving across eastern Hispaniola, with the strongest winds remaining offshore in the area of deepest convection. Olga finally weakened over central Hispaniola, and by the time the cyclone emerged over the Windward Passage on 12 December, the intensity had decreased to 40 mph. Olga became a tropical depression later that day and degenerated into a remnant low the next day just north of Jamaica.

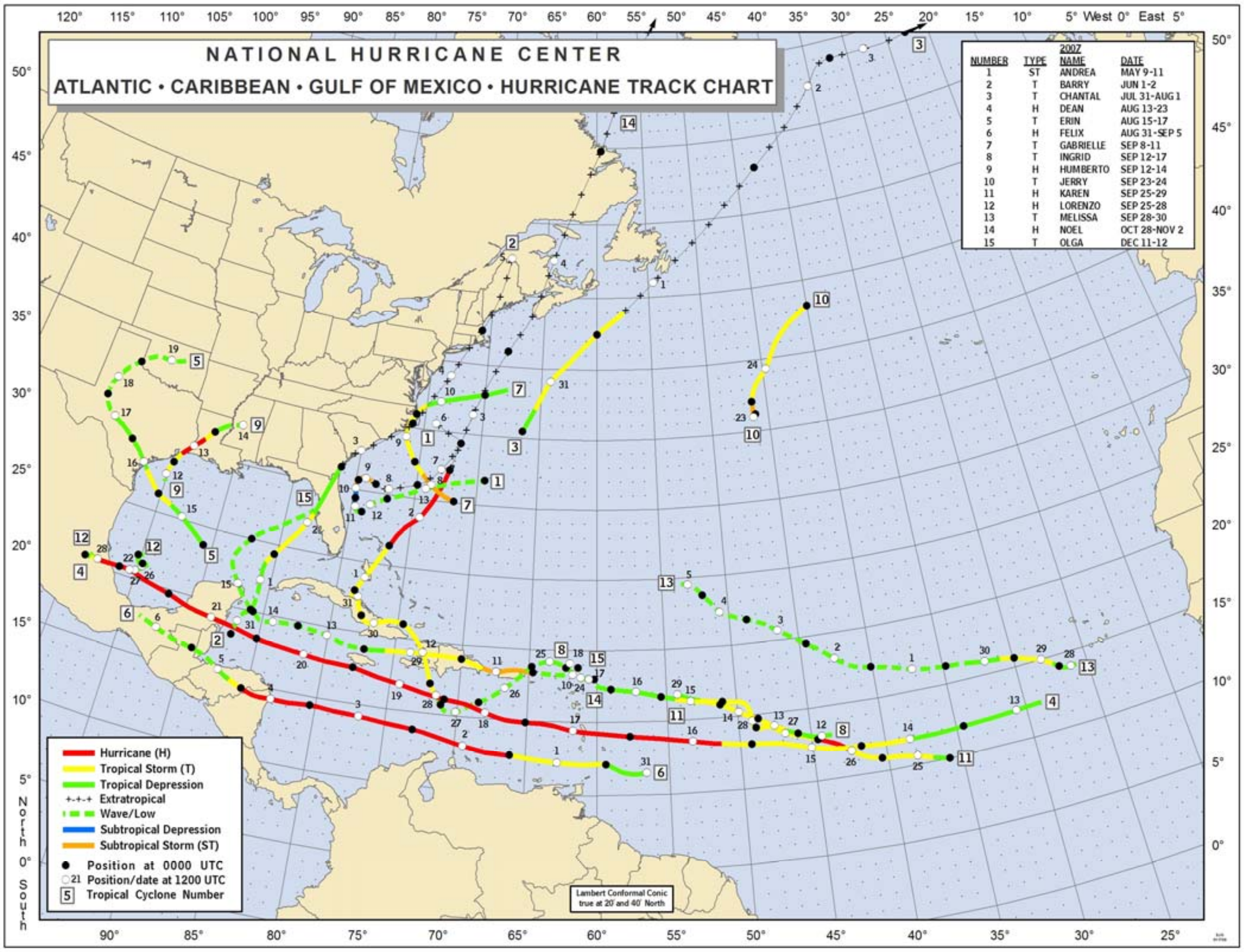
The remnant low continued westward across the northwestern Caribbean Sea during the next couple of days. By 15 December, the non-convective low moved northwestward and northward around the western periphery of a low- to mid-level ridge. Later that day and on early 16 December, the remnants of Olga accelerated northeastward over the eastern Gulf of Mexico ahead of an approaching cold front, producing disorganized thunderstorms. Satellite imagery and radar data suggest that, later on 16 December, a small circulation crossed the west-central coast of Florida, just north of Tampa, and was quickly absorbed into the cold front thereafter.

Due primarily to torrential rainfall, mud slides, and flooding of the Yaque River in the Dominican Republic, at least 25 deaths are directly associated with Olga in that country. In addition, two deaths in Haiti and one in Puerto Rico were reported. Olga's impact was unusually severe due to the grounds previously saturated from the passage of Noel at the end of October. At the time of this writing, news reports indicated that almost 12,000 homes were damaged, including 370 that were completely destroyed, which caused more than 60,000 people to be displaced.

2007 Atlantic Basin Named Storms and Hurricanes

Name	Class[a]	Dates[b]	Maximum Winds (mph)	Minimum Pressure (mb)	Direct Deaths	U. S. Damage ($million)
Andrea	SS	May 9-11	60	1001	0	minor[c]
Barry	TS	Jun 1-2	60	997	0	minor[c]
Chantal	TS	Jul 31 – 1 Aug	50	994	0	0
Dean	H	Aug 13-23	175	905	32	0
Erin	TS	Aug 15-17	40	1003	9	minor[c]
Felix	H	Aug 31- Sep 5	175	929	130	0
Gabrielle	TS	Sep 8-11	60	1004	0	minor[c]
Humberto	H	Sep 12-14	90	985	1	50
Ingrid	TS	Sep 12-17	45	1002	0	0
Jerry	TS	Sep 23-24	40	1003	0	0
Karen	H	Sep 25-29	75	988	0	0
Lorenzo	H	Sep 25-28	80	990	6	0
Melissa	TS	Sep 28-30	40	1005	0	0
Noel	H	Oct 28 – Nov 2	80	980	163	0
Olga	TS	Dec 11-12	60	1003	25	0

[a] TS - tropical storm, maximum sustained winds 39-73 mph; H - hurricane, maximum sustained winds 74 mph or higher, SS – subtropical storm, maximum sustained winds 39-73 mph.
[b] Dates begin at 0000 UTC and include tropical/subtropical depression stage, but exclude extratropical stage.
[c] Minor damage was reported but the extent of the damage was not quantified.



NATIONAL HURRICANE CENTER
ATLANTIC • CARIBBEAN • GULF OF MEXICO • HURRICANE TRACK CHART
2007
NUMBER TYPE NAME DATE
1 ST ANDREA MAY 9-11
2 T BARRY JUN 1-2
3 T CHANTAL JUL 31-AUG 1
4 H DEAN AUG 13-23
5 T ERIN AUG 15-17
6 H FELIX AUG 31-SEP 5
7 T GABRIELLE SEP 8-11
8 T INGRID SEP 12-17
9 H HUMBERTO SEP 12-14
10 T JERRY SEP 23-24
11 H KAREN SEP 25-29
12 H LORENZO SEP 25-28
13 T MELISSA SEP 28-30
14 H NOEL OCT 28-NOV 2
15 T OLGA DEC 11-12
Hurricane (H)
Tropical Storm (T)
Tropical Depression
+-+-+ Extratropical
Wave/Low
Subtropical Depression
Subtropical Storm (ST)
Position at 0000 UTC
21 Position/date at 1200 UTC
5 Tropical Cyclone Number
Lambert Conformal Conic
true at 20° and 40° North
5° West 0° East 5°
North
South

EASTERN NORTH PACIFIC

Tropical cyclone activity in the eastern North Pacific basin during the 2007 season included eleven named tropical storms. Only four of the tropical storms became hurricanes and only one became a major hurricane (category three or stronger on the Saffir-Simpson hurricane scale) in the basin. There were four additional depressions that did not reach tropical storm intensity. Tropical cyclone activity was below normal in terms of the numbers of hurricanes and major hurricanes. The long-term seasonal averages are: 15 tropical storms, 9 hurricanes, and 4 major hurricanes.

A useful measure of the season's overall activity is the Accumulated Cyclone Energy (ACE) index, which reflects the combined intensity and duration of the entire season's storms. It is calculated by summing the squares of the 6-hourly intensities (maximum sustained surface winds in kt) of all tropical cyclones while at tropical storm or hurricane strength. In terms of the accumulated Cyclone Energy index (ACE), 2007 was the second quietest season observed (only 1977 was lower), since reliable records began in 1971.

Most of the tropical cyclones developed from tropical waves that moved westward from the Atlantic basin into the eastern Pacific, and most of them ultimately weakened due to cold waters and high wind shear. Henriette was the only Pacific basin hurricane to hit Mexico in 2007, causing at least nine deaths. Barbara made landfall as a tropical storm near the Guatemala/Mexico border.

Tropical Storm Alvin, the first storm of the season, developed from a tropical wave that reached Central America on May 20 and continued westward into the eastern North Pacific basin. Shower activity associated with the wave gradually increased, and it is estimated that a tropical depression formed on May 27 about 345 miles south of the southern tip of Baja California, and then became a 40 mph tropical storm early on May 29. Thereafter, Alvin continued westward and degenerated into a remnant low on June 1 about 800 miles south-southwest of the southern tip of Baja California.

Tropical Storm Barbara originated from a slow-moving tropical wave that moved westward off the coast of Central America on May 25, producing disorganized showers and thunderstorms during the next couple of days. On May 27, a small area of low pressure formed a couple of hundred miles southwest of the Gulf of Tehuantepec as the wave interacted with the Intertropical Convergence Zone (ITCZ). The thunderstorm activity gradually became better organized near the low and a tropical depression developed on May 29 about 1115 miles south-southeast of Puerto Escondido, Mexico. The depression moved slowly southeastward and became a tropical storm the next day. The storm turned east-northeastward late on June 1 and reached its peak intensity of 50 mph. Barbara then moved northeastward and made landfall as a tropical storm on June 2 about 25 miles northwest of the border between Mexico and Guatemala. The cyclone quickly dissipated over land later that day. Barbara brought tropical storm conditions to portions of the coast of Guatemala and damages of more than 50 million US dollars to agricultural crops in southeastern Mexico.

Hurricane Cosme originated from a tropical wave that entered the eastern North Pacific basin around July 8, and began to show additional signs of organization on July 10. A tropical depression formed from the system on July 14 about 1985 miles east-southeast of Hilo, Hawaii. The depression initially moved slowly toward the northwest in response to a weakness in the subtropical ridge to the north. The depression became a tropical storm on July 15, and reached hurricane strength the next day about 1600 miles east of Hilo. Early on July 17, the cyclone turned toward the west in response to a strengthening ridge to the north. By this time, Cosme was in an environment of moderate easterly shear and over ocean waters of 25 degrees

Celsius, and the hurricane weakened to a tropical storm on July 17. The cyclone continued to slowly weaken as it moved westward, and became a tropical depression late in the day on July 18, just prior to crossing into the Central Pacific basin. The depression continued westward for the next four days and degenerated to a remnant low about 60 miles south-southwest of Johnston Island.

Tropical Storm Dalila developed from a tropical wave that spawned a broad low pressure area south of the Gulf of Tehuantepec on July 19. The low moved slowly westward while the associated thunderstorm activity acquired some organization. On July 22, the disturbance was classified as a tropical depression while located about 460 miles south of Manzanillo, Mexico. Despite northeasterly shear that initially inhibited significant strengthening, the depression became a tropical storm on July 24, and reached a peak intensity of 60 mph on the next day, while centered about 60 miles southeast of Socorro Island. Thereafter, Dalila moved over cooler waters and weakened to a tropical depression. It degenerated into a remnant low on July 27 about 460 miles west of the southern tip of Baja California. The remnant low moved west-northwestward during the next few days and dissipated on July 30.

Tropical Storm Erick was a short-lived tropical storm that formed from a broad surface low associated with a tropical wave on July 31 about 1065 miles southwest of the southern tip of Baja California. The cyclone became a 40 mph tropical storm early on August 1, but unfavorable wind shear prevented the system from strengthening further. It then weakened to a depression and degenerated into a low pressure trough on August 2. The remnants continued moving westward and a weak low reformed within the wave on August 3 before entering the central North Pacific basin early on August 4. The low dissipated several hundred miles southwest of the Hawaiian Islands on August 8.

Hurricane Flossie developed from an area of disturbed weather that had been tracked westward across the eastern North Pacific basin for several days. The system became a tropical depression on August 8, while centered about 1840 miles southeast of Hilo, and became a tropical storm early August 9. Flossie moved generally westward while strengthening, and became a hurricane on August 10 about 1380 miles east-southeast of Hilo. By then, an eye was evident on satellite imagery. Flossie strengthened further and became a category 4 hurricane on the Saffir-Simpson Hurricane Scale early on August 12. Flossie reached a peak intensity of 140 mph on August 12, while centered about 975 miles east-southwest of Hilo, and maintained major hurricane strength for the next two days as it moved toward the west-northwest. Thereafter, increasing vertical wind shear and lower sea-surface temperatures caused the system to weaken below hurricane strength on August 15, when the cyclone was passing about 100 miles south of the Big Island. Flossie turned to the west and west-southwest and weakened into a tropical depression early on August 16. It dissipated later that day. Flossie's impacts on the Hawaiian Islands were minimal.

Tropical Storm Gil originated from a tropical wave that entered the eastern Pacific on August 27. The wave continued westward and the shower activity became concentrated just south of Cabo Corrientes, Mexico. It is estimated that a tropical depression formed early on August 29 about 275 miles south-southeast of the southern tip of Baja California. The depression became a tropical storm later that day and reached a peak intensity of 45 mph on August 30. A strong high pressure system anchored over the southwestern United States steered Gil on a general westward track for the next several days. Thereafter, Gil gradually weakened due to both shear and cooler waters, and it became a westward-moving remnant low by September 2.

Hurricane Henriette was the only hurricane eastern Pacific hurricane to make landfall in Mexico during the 2007. It originated from a tropical wave with an embedded low pressure area that moved westward off the coast of Central America on August 28. The associated shower and thunderstorm activity gradually improved in organization and, early on August 30, the system became a tropical depression about 360 miles southeast of Acapulco. The depression gained organization as it moved west-northwestward around a subtropical ridge centered over the western Gulf of Mexico. It became a tropical storm on August 31 about 85 miles south of Acapulco. During the next 36 hours, Henriette slowly strengthened and continued west-northwestward, parallel to the coastline, with its center passing roughly 50-60 miles offshore. Despite not making landfall during this period, the storm brought heavy rainfall to portions of the coast, particularly near Acapulco.

Henriette's winds remained just shy of hurricane strength for the next three days as the cyclone headed generally northwestward, passing about 1200 miles west of Cabo Corrientes. On September 4, Henriette became a hurricane and turned north-northwestward toward the Baja California peninsula ahead of a mid-latitude trough approaching the west coast of the United States. The hurricane reached its peak intensity of 85 mph later that day while centered about 785 miles south-southeast of the southern tip of Baja California. Henriette made landfall near San Jose del Cabo late on September 4 with maximum winds near 80 mph and emerged over the Gulf of California early on 5 September. The brief interaction with land caused slight weakening, but Henriette remained a category 1 hurricane for most of that day. Henriette began to weaken and made its final landfall along the Gulf of California coast of mainland Mexico, near Guaymas, very early on September 6 with an estimated intensity of 70 mph. Henriette deteriorated quickly over land and dissipated over the mountains of northwestern Mexico later that day. Media reports indicate at least nine fatalities in Mexico are directly attributable to Henriette. Six of these deaths occurred near Acapulco due to mud slides induced by heavy rains while the center of Henriette passed just offshore.

Hurricane Ivo formed from a tropical wave that crossed Central America on September 15. It moved westward while its associated shower activity gained in organization. It became a depression on September 18 about 460 miles south-southwest of Manzanillo. It then became a tropical storm early the next day as it moved west-northwestward, and reached hurricane strength early on September 20. Ivo turned northwestward and then northward around the periphery of a high pressure system and reached its peak intensity of 80 mph late on September 20, about 400 miles south-southwest of the southern tip of Baja California. Ivo turned north-northeastward on September 21 and began to weaken under the influence of westerly shear, becoming a tropical depression early on September 23 about 150 miles west-southwest of the southern tip of Baja California. Ivo turned eastward and degenerated to a remnant low later that day about 90 miles southwest of the southern tip of Baja California.

Tropical Storm Juliette developed from an area of showers and thunderstorms associated with a tropical wave and a surface low pressure centered about 360 miles southwest of Acapulco. The disturbance moved westward and became a tropical depression early on September 29 about 420 miles southwest of Manzanillo. The depression intensified to a tropical storm later that day and reached its peak intensity of 60 mph on the next day. Strong vertical shear, lower sea-surface temperatures, and a more stable air mass resulted in weakening and Juliette degenerated into a remnant low on October 2.

Tropical Storm Kiko originated from the same tropical wave that had spawned Tropical Storm Melissa over the eastern tropical Atlantic Ocean. The wave continued westward over the Atlantic and entered the eastern Pacific on October 8. An area of low pressure, accompanied by showers and thunderstorms, developed along the wave axis and the system eventually acquired enough organization to be classified as a tropical depression early on October 15, while centered about 400 miles southwest of Manzanillo. The depression drifted southward and briefly was a tropical storm on October 16, before weakening back to a depression. The cyclone moved eastward and east-northeastward with a gradual increase in forward speed. It regained tropical storm strength early on October 17 about 385 miles south-southwest of Manzanillo. Kiko moved east-northeastward toward the southwestern coast of Mexico as a minimal storm and by early on October 19, it turned toward the northwest as a ridge of high pressure developed over Mexico. During the next couple of days, Kiko moved slowly toward the northwest and gradually strengthened, and reached its maximum intensity of 70 mph on October 20 while centered about 170 miles west-southwest of Manzanillo. Kiko gradually weakened due to both increasing southerly shear and a more stable environment and became a tropical depression early on October 23, while centered about 250 miles west-southwest of Cabo Corrientes. The depression moved westward and degenerated into a remnant low early on October 24. The remnant low continued to move generally westward for the next couple of days and dissipated early on October 27.

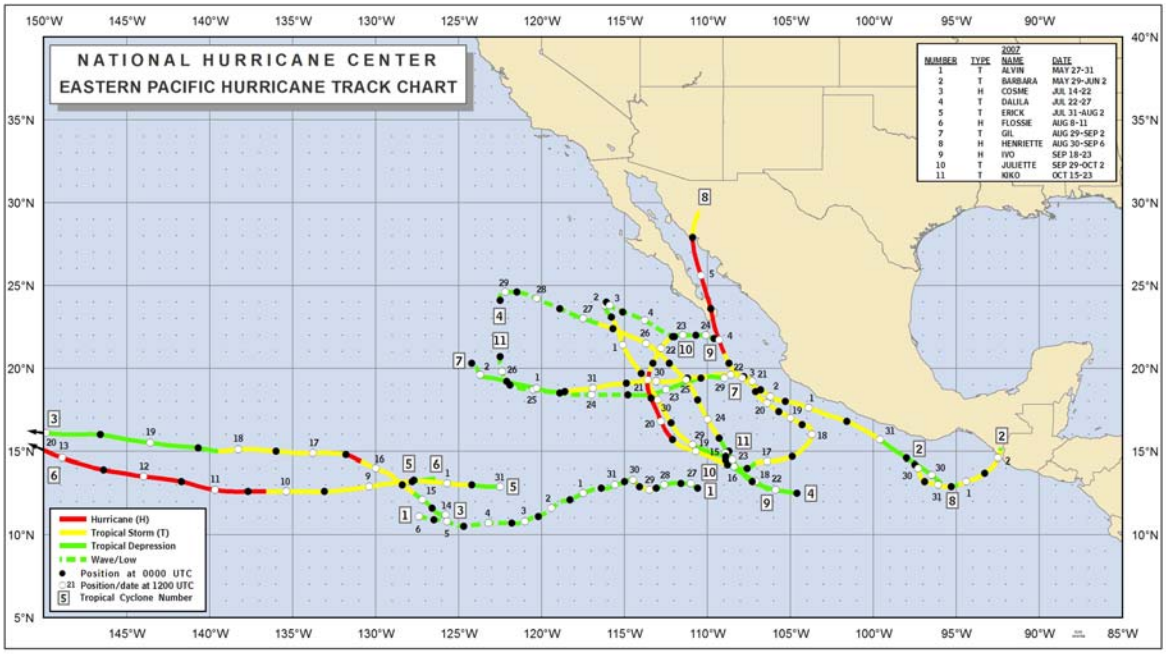
The cyclone summaries are based on Tropical Cyclone Reports prepared the hurricane specialists at the National Hurricane Center. These reports are available at *www.noaa.gov/2007epac.shtml*

2007 Eastern North Pacific Named Storms and Hurricanes

Name	Class[a]	Dates[b]	Maximum Winds (mph)	Minimum Pressure (mb)	Direct Deaths
Alvin	TS	May 27-31	40	1003	0
Barbara	TS	May 29- June 2	50	1000	0
Cosme	H	Jul 14-22	75	987	0
Dalila	TS	July 22-27	60	995	0
Erik	TS	July 31-August 2	40	1004	0
Flossie	H	Aug 8-16	140	949	0
Gil	TS	Aug 29 - Sep 2	45	1001	0
Henriette	H	Aug 30 - Sep 6	85	972	9
Ivo	H	Sep 18-23	80	980	0
Juliette	TS	Sep 29- Oct 2	60	997	0
Kiko	H	Oct 15- 23	70	991	0

[a] TS - tropical storm, maximum sustained winds 39-73 mph; H - hurricane, maximum sustained winds 74 mph or higher, SS – subtropical storm, maximum sustained winds 39-73 mph.
[b] Dates begin at 0000 UTC and include tropical/subtropical depression stage, but exclude extratropical stage.

APPENDIX III



APPENDIX IV

REVIEW OF THE PAST HURRICANE SEASON

Reports of hurricanes, tropical storms, tropical disturbances and related flooding during 2007

(Submitted by Members of the RA IV Hurricane Committee)

Reports are posted on the WMO/TCP Website along with the main report.

APPENDIX V

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

(To be published separately)

Annex to Resolution 21 (Cg-XV)

FLOOD FORECASTING INITIATIVE

Enhancement of Cooperation between National Meteorological and National Hydrological Services for Improved Flood Forecasting

Strategy and Action Plan

Executive Summary

General

1. Flood forecasting provides a valuable tool in reducing flood impacts, thereby contributing to national sustainable development. Advances in data collection, continual model development, calibration and verification, etc., contribute to improving the accuracy of forecasts. Recent enhancements in meteorological forecasting have made it possible to extend the lead time for flood forecasting. A timely and reliable forecast helps greatly in disaster risk management responses. However, this requires a set of multidisciplinary (meteorology, hydrology and emergency management) collaborative efforts.

2. At present many National Meteorological Services (NMSs) and National Hydrological Services (NHSs) do not have adequate means or the necessary know-how to provide extended forecasting services in flood critical situations and to communicate effectively with disaster management authorities. A strategic/coordinated approach is therefore needed for NMSs and NHSs to work closely together, making use of the state-of-the-art forecasting technologies, to improve hydrological forecasting products and provide better services.

Scope

3. Recognizing the need to improve the capacity of NMSs in detecting flood-critical situations and to improve the capacity of NHSs in using meteorological forecasting information, the WMO Flood Forecasting Initiative was launched in April 2003. The major activities within the scope of this initiative included an overall analysis of the strengths and weaknesses of current flood forecasting systems in the Member countries through a series of regional workshops (eight) organized for different Regions, which were attended by hydrologists and meteorologists engaged in forecasting from 85 countries along with a number of regional and river basin organizations, technical institutions and experts.

4. As collaborative efforts between NMSs and NHSs will not only improve flood forecasting services in the countries but also other domains such as water resources assessment and use of climate prediction products in water management, the workshops provided a unique opportunity for meteorologists and hydrologists to exchange experiences and views on these issues, which came up strongly during some of the workshops. Similarly, lack of financial resources for the NHSs and NMSs also emerged as one of the major concerns in certain workshops, particularly involving countries from Region I (Africa).

Strategy and Action Plan

5. In order to fulfil the objectives of the Initiative, a Synthesis Conference of the WMO Flood Forecasting Initiative was organized by WMO in November 2006 with the aim to analyse the key challenge areas that would need to be addressed as identified during the regional workshops. The conference resulted in the establishment of an agreed Strategy and Action Plan to improve national and regional capacities for flood forecasting. The Strategy and Action Plan concentrates on the areas of collaboration between the NMSs and NHSs in the field of flood forecasting and other issues raised in the workshops as mentioned in paragraph 4 above.

6. The Strategy and Action Plan, once considered and endorsed by Fifteenth Congress, would serve as a guide to the technical commissions and WMO Secretariat in all activities related to improving flood forecasting capabilities worldwide. In developing the Action Plan the diversity of conditions of levels of development, capabilities and status of National Meteorological and Hydrological Services, the various possible user requirements and the possibilities of using advanced technologies were kept under consideration.

7. The Strategy and Action Plan identifies the following areas of activities that need to be addressed to improve the overall chain of hydrological forecasting:

(a) Strengthening of observing and information systems;
(b) Promoting data exchange at the national and international river basin levels;
(c) Improvement of meteorological forecasting practices and products;
(d) Improvement of hydrological forecasting practices and products;
(e) Strengthening of institutional coordination, cooperation and integration between NMSs and NHSs;
(f) Strengthening of cooperation and coordination of countries in issues related to flood forecasting and warning;
(g) Promoting training and capacity-building in National Meteorological and Hydrological Services;
(h) Formulating technical documentation and guidelines related to flood forecasting and warning;
(i) Supporting disaster management;
(j) Addressing climate variability and change in the light of extreme events;
(k) Demonstrating the value of meteorological and hydrological data, information and products, including forecasts.

Activities under (c) to (h) would form the core of the Flood Forecasting Initiative, while the rest would be mainly addressed under, and in cooperation with, other programmes.

8. The Strategy and Action Plan promotes the preparation of national implementation plans. These would logically vary and have to be adapted in accordance with current national and regional flood forecasting capabilities, specific requirements and priorities of the corresponding National Meteorological and Hydrological Services. Access to information, reliability of forecasts and public trust are critical issues to be addressed when developing a modern flood forecasting system.

9. The Strategy and Action Plan suggests the implementation of demonstration projects at various levels (country-specific, subregional and regional projects). These would identify the technical and administrative difficulties in and showcase the value of an increased cooperation between NMSs and NHSs in flood forecasting. It is expected that the demonstration projects, at the national level, would assist National Meteorological and Hydrological Services in coping with

their changing role in disaster risk reduction by means of a comprehensive suite of activities for the upgrading, modernization and strengthening of their flood forecasting and warning systems.

10. At the regional level, the Strategy and Action Plan advocates the establishment of a framework under which partnerships and development assistance could be provided and coordinated amongst the Members and the various contributing agencies while taking advantage of existing regional and international arrangements. Countries in a given region or river basin would be invited to collaborate on projects and activities to be undertaken to strengthen collaboration between NMSs and NHSs for improved flood forecasting and warning.

11. The Strategy and Action Plan also addresses requirements of well-established flood forecasting and warning systems for their further improvement through the development and use of new technology.