WORLD METEOROLOGICAL ORGANIZATION

RA IV HURRICANE COMMITTEE

THIRTY-SECOND SESSION

Hamilton, Bermuda

(8 to 12 March 2010)

FINAL REPORT

GENERAL SUMMARY OF THE WORK OF THE SESSION

The RAIV Hurricane Committee identified the following highest priority activities for the next Year:

1. Assist the Haiti Meteorological Service to provide adequate warnings for the protection of life and property
2. Develop the capacity of NMHSs to strengthen Public Education and Outreach programs of their PWS, thereby enhancing awareness of the risks associated with TCs and other hazards at national levels
3. Complete and deliver the CMO/Meteo France radar composite to the wider meteorological community on an operational basis
4. Pursue closer working relationships with the tsunami warning community through the organisation of a conjoint session of the HC33 and ICG/CARIBE EWS-VI
5. Pursue closer working relationships with the RAIV Task Team on DRR through the nomination of Dr José Rubiera as the representative of the Hurricane Committee
6. Capacity Building in storm surge forecasting and Global Information Systems

1. ORGANIZATION OF THE SESSION

At the kind invitation of the Government of Bermuda, the thirty-second session of the RA IV Hurricane Committee was held in Hamilton, Bermuda from 8 to 12 March 2010. The opening ceremony commenced at 0830 hours on Monday, 8 March 2010.

1.1 Opening of the session

1.1.1 Dr Mark Guishard, Director of the Bermuda Meteorological Service, welcomed the participants to the session. He mentioned that it was only through the generous donations from Corporate Sponsors in addition to Government of Bermuda support, that Bermuda was able to host the 32nd session of the Regional Association IV Hurricane Committee.

1.1.2 The Chairman of the Hurricane Committee, Mr Bill Read, welcomed all participants and stated that he looked forward to a productive session with the active participation of all those attending this year's session.

1.1.3 On behalf of Mr. Michel Jarraud, Secretary-General of the World Meteorological Organization (WMO), Mr Koji Kuroiwa, Chief of Tropical Cyclone Programme, welcomed the participants and expressed the sincere appreciation of WMO to the Government of the United Kingdom for hosting the thirty-second session of the Committee in Hamilton, Bermuda. He extended his particular gratitude to Dr Mark Guishard, Director of the Bermuda Weather Service for his earnest effort in the arrangements for this session. Showing his deep sympathy to Haiti which was hit by a deadly earthquake in January 2010, Mr Kuroiwa mentioned that this session would give a great opportunity for WMO to coordinate Members' immediate support to Haiti. He also emphasized that the Region should be constantly on the alert and persistent in the efforts to strengthen its capacities and capabilities in warning and service delivery. In ensuring WMO's continued support for the Committee's programmes and activities, he wished the participants a very successful session and an enjoyable stay in Bermuda.

1.1.4 Senator the Honourable Lieutenant Colonel David Burch, Minister of Labour, Home Affairs and Housing delivered the opening speech. He applauded the collective sharing of data, resources and knowledge towards the common goal of protection of life and property within the WMO framework. The Minister made special welcome to the Director of the Haiti Meteorological Service and encouraged the Meeting to give consideration to the fact that Haiti's population is more vulnerable than usual to the risks from hurricanes, given the recent devastating earthquake in that country. He also encouraged the improvement of linkages and robust communications between emergency managers, businesses, the public, and the meteorological community.

1.1.5 The session was attended by 47 participants, including 38 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

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

1.3 Working arrangements for the session

The Committee decided on its working hours and the arrangements for the session. It also decided to create an executive summary of the final report of the session to highlight the priority areas of the discussions.

2. REPORT OF THE CHAIRMAN OF THE COMMITTEE

2.1 The Chairman reported to the Committee that during the 2009 hurricane season, RSMC Miami included in the Tropical Weather Outlook (text form), the likelihood of tropical cyclone formation expressed as one of three possible levels. In 2010, RSMC Miami would add the likelihood of tropical cyclone formation in percents. Information about these and other changes at the RSMC Miami can be found on its Website at: http://www.nhc.noaa.gov/pns_index.shtml

2.2 During the 2009 season, Lieutenant Commander Carla Damasio-Cordero from the Institute of Meteorology of Brazil, Mr. Orvin Page from the Meteorological Services of Antigua and Barbuda and Mr. Filmore Mullin from the National Office of Disaster Services, and Mr. Venatius Descartes from St. Lucia were among the participants in the WMO/RSMC Miami attachment program. The meteorologists helped with hurricane warning coordination in the region during the tropical cyclone events while they gained valuable training in hurricane forecasting. RSMC Miami and WMO strongly encouraged RA IV Permanent Representatives to continue to support this program. The announcement requesting candidates for 2010 will be circulated by the President of Region IV in late March.

2.3 Three meteorologists from the Mexican Air Force were stationed at the RSMC Miami during 2009. Captains Enrique Velazquez, Alejandro Lopez, and Marco Munoz 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 2010.

2.4 The 2010 WMO RA IV Workshop on Hurricane Forecasting and Warning and Public Weather Services would be held at RSMC Miami from 15 to 26 March 2010. This year's workshop would be conducted in English and Spanish via interpreters. The Chairman strongly supports the offering of the bilingual workshop every other year due to the importance to the region's hurricane program.

2.5 The Latin America Caribbean Hurricane Awareness Tour (LACHAT) would take place from 18 to 29 March 2010. The U.S. Air Force C-130 (J-model) Hurricane Hunter plane would visit Bermuda, Mazatlan and Merida, Mexico, San Salvador, El Salvador, Antigua, and Puerto Rico. As in past years, the LACHAT was expected to increase public awareness of the hurricane threat and would serve to recognize and strengthen national and international teamwork for storm warning and emergency response. The LACHAT has enhanced the visibility of the participating country's weather forecasting and emergency management offices. About 10 to 15 thousand people toured the plane in 2009. A Hurricane Awareness Tour (HAT) would take place along the Gulf of Mexico coast from 26 to 30 April 2010.

2.6 WMO/TCP organized the RSMC/TCWC Technical Coordination Meeting in Brisbane Australia from 2 to 5 November, 2009 with the participation of Directors of TC RSMCs and TCWCS. The meeting coordinated the services and activities of TC RSMCs (Miami, Tokyo, Honolulu, New Delhi, La Reunion and Nadi) and TCWCs (Darwin, Perth, Brisbane, Wellington, Port Moresby and Jakarta) for improving regional TC warning services. It also discussed the global standards in forecasting techniques and warning services, including those for data exchange and forecasts verification. Bill Read and Lixion Avila represented RSMC Miami.

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 and NOAA Reconnaissance Hurricane and NOAA aircraft provided valuable meteorological data not available from other sources. Many of the NOAA P-3 aircraft missions were devoted to the collection of data for the Intensity Forecasting EXperiment (IFEX) project, primarily lead by the NOAA Hurricane Research Division. In addition, the US Air Force supports the LACHAT mission and the NOAA aircraft supported the HAT mission. Cooperation by all parties involved was fully appreciated.

2.8 RSMC Miami and the Chairman greatly appreciated the radar imagery received operationally via the Internet from RA IV Members during the hurricane season. The Chairman encouraged NMHSs to continue to make their radar imagery available operationally via the Internet or any other possible way.

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 the Member countries during hurricanes.

2.10 Although the 2009 season was relatively quiet in the Atlantic, the Chairman thanked the Members affected by tropical cyclones for the timely submission of their post-storm country reports. These reports were vital to the preparation of the RSMC Miami Tropical Cyclone Report.

2.11 Coordination between RSMC Miami and the U.S. Department of State Crisis Operations Center during hurricane events was helpful in communicating forecasts with the U.S. Embassies in the RA IV countries. Numerous conference calls were performed between RSMC Miami and State Department during tropical cyclone events.

2.12 As part of the United States Weather Research Program (USWRP), the Joint Hurricane Testbed (JHT) was one of the primary avenues to evaluate research projects with the goal of transitioning successful projects into operations. There were 12 completed projects which were being evaluated to be implemented to operations.

2.13 The NOAA Hurricane Forecast Improvement Program (HFIP) is a multi-agency effort to improve tropical cyclone track and intensity forecast accuracy by 50% over a ten-year period. HFIP conducted its first summer "Demonstration" project during 2009, using supercomputer assets not previously accessed to run multiple global and regional models with experimental high resolution, physics, ensembling techniques, etc. The program, including another demonstration project, has been funded for 2010.

2.14 Arrangements were still in process for the Seventh International Workshop on Tropical Cyclones (IWTC-VII), expected to be held at RSMC La Reunion between 15-20 November 2010. Dr. Lixion Avila continued as the RA IV International Organizing Committee representative.

2.15 The Chairman was pleased that 15 participants from WMO RA IV attended the American Meteorological Society (AMS) Annual Meeting in Atlanta, Georgia from 15 to 22 January 2010. The 15 RA IV participants joined colleagues from National Meteorological and Hydrological Services (NMHSs) from around the world in the AMS International Session. This session was hosted by the NOAA/NWS Office of International Activities (IAO) and the AMS.

3. COORDINATION WITHIN THE WMO TROPICAL CYCLONE PROGRAMME

3.1 The Committee was informed by the WMO Secretariat that the Executive Council, at its 61st session in June 2009, gave following guidance to the Tropical Cyclone Programme (TCP):

- To give high priority to the organization of training workshops for the best use of ensemble-based products;
- To enhance the support measures for operational forecasters through update of the *Global Guide to Tropical Cyclone Forecasting* and development of the *Tropical Cyclone Forecaster's Websit*e.
- To promote the transfer from R&D to operational use through interactions between researchers and operational forecasters such the seventh International Workshop on Tropical Cyclones (IWTC-VII); La Reunion, 15-20 November 2010.
- To give high priority to development of the Storm Surge Watch Schemes with emphasis on capacity-building.

3.2 The Committee was pleased to note that TCP, in collaboration with World Weather Research Programme (WWRP) and Public Weather Services (PWS) Programme, has formulated the "*Typhoon Landfall Forecast Demonstration Project*" on the initiative of the Shanghai Meteorological Bureau of China. This project was one of the major outcomes of the second *International Workshop on Tropical Cyclone Landfall Processes* (IWTCLP-II) held in Shanghai, China, in October 2009. It aims to demonstrate the performance of the most advanced forecasting techniques for landfalling typhoons and was expected to achieve development of techniques for evaluation & assessment of landfall forecasts, as well the forecast of landfalling typhoons including associated heavy rain.

3.3 The TCP/WWRP North Western Pacific Tropical Cyclones Ensemble Forecast Project was another outcome of WTCLP-II. The main objective of this project was to evaluate the effectiveness of the *THORPEX Interactive Grand Global Ensemble* (TIGGE) data to the operational tropical cyclone forecasting. TIGGE typhoon track data would be provided to the Typhoon Committee Members on a real-time basis via a password protected Web site which was expected to be established in May 2010. Training for operational forecasters and evaluation of the utility of such data in operational forecast were also planned to be conducted under the project. The project was targeted at the Typhoon Committee region in its first phase for 2010-2012 and would be extended to other regions in the future.

3.4 The update of the *Global Guide to Tropical Cyclone Forecasting* was progressing with authorship of many distinguished experts and would be completed by the end of October 2010. The new Global Guide deals with almost all areas of forecasting of tropical cyclone and associated hazards, as well as warning and response strategies. It would satisfy the need for comprehensive enhancement of capabilities in tropical cyclone related disaster risk reduction. It would be published primarily as a Web version in view of cost saving and easier access. The Global Guide, in combination with the newly developed Tropical Cyclone Forecaster Web Site, would serve as a fundamental source for tropical cyclone forecasters to obtain forecasting and analytical tools, techniques and data and to improve their warning services. The Committee recommended that the WMO Secretariat consider the translation of the Global Guide into other languages, for example French and Spanish, which are commonly used in the Tropical Cyclone bodies.

3.5 *Storm Surge Watch Schemes* (SSWSs) have been developing steadily in the tropical cyclone regional bodies. Most recently, the RSMC New Delhi Tropical Cyclone Centre has been in collaboration with Indian Institute of Technology (IIT) to implement the IIT storm surge model for operational provision of storm surge advisories to the Members in the Bay of Bengal and the Arabian Sea. The RSMC Tokyo Typhoon Centre has circulated questionnaires to the Typhoon

Committee Members on SSWS, and plans to provide storm surge advisories to the Committee Members in the next typhoon season. In this connection, the Committee was informed that a plan was underway to organize a training workshop for storm surge forecasting in Dominican Republic for RA IV Hurricane Committee members late 2010 as part of the development of the Global SSWS.

3.6 The Committee welcomed the proposal of the WMO Secretariat for holding the storm surge workshop. In response to the inquiry from WMO Secretariat about a suitable date of the proposed storm surge workshop in RA IV, the Committee expressed its view that the second week of December would be most convenient in consideration of the major events relevant to tropical cyclone late this year, such as IWTC-VII and the NOAA Hurricane Conference. The Committee also showed its expectation that due consideration would be given by WMO to the linguistic issue in this region.

3.7 As regards WMO's support to operational forecasters, the Committee urged WMO to complete the update of the Global Guide as early as possible. With a view to making the most of the new Global Guide, the Committee stressed that WMO should pay attention to the active use of the new Guide in various occasions, such as the training courses and workshops for forecasting of tropical cyclones in particular. The Committee also urged NMHSs to ensure that the Global Guide, when available, was used by operational staff. Referring to the recommendation of the Executive Council at its 61st session, the Committee also requested WMO to further strengthen its training activities for promoting the use of EPS products.

4. REVIEW OF THE PAST HURRICANE SEASON

4.1 Summary of the past season

4.1.1 A report of the 2009 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 2009 North Atlantic Hurricane Season Summary

4.1.2 The 2009 Atlantic hurricane season was marked by below-average tropical cyclone activity with the formation of nine tropical storms and three hurricanes, the lowest numbers since the 1997 Atlantic hurricane season. Two of the hurricanes strengthened into major hurricanes, Category 3 or higher on the Saffir-Simpson Hurricane Wind Scale. The numbers of tropical storms and hurricanes were below the long-term averages of 11 and 6, respectively, although the number of major hurricanes equalled the long-term (1966 to present) average of 2. In terms of the Accumulated Cyclone Energy (ACE) index, 2009 had 60% of the long-term median ACE, also the lowest value since 1997. There were two tropical depressions that did not reach tropical storm strength. The below-normal activity appeared to be the result of strong vertical wind shear and large-scale sinking in the tropical atmosphere, associated with the development of El Niño during the summer months.

RSMC Miami 2009 Eastern North Pacific Hurricane Season Summary

4.1.3 Tropical cyclone activity during the 2009 eastern North Pacific hurricane season was near average. Seventeen named storms formed, of which seven became hurricanes and four became major hurricanes, category three or higher on the Saffir-Simpson Hurricane Wind Scale. Although the number of tropical storms and major hurricane was near average, the number of hurricanes was slightly below average. The total of four major hurricanes was the highest total since 2006, the last time mature El Niño conditions were observed over the equatorial tropical Pacific. Two tropical depressions formed but did not reach tropical storm strength. An additional depression formed and became *Tropical Storm Lana* in the central Pacific. Hurricane Rick became the second strongest hurricane ever recorded in the eastern North Pacific (behind Hurricane Linda in 1997) and the strongest hurricane observed during the month of October in the eastern North Pacific since reliable records began in 1971. In terms of the Accumulated Cyclone Energy (ACE) index, 2009 had about 95% of the long-term median value. Many of the tropical cyclones formed farther west than normal, closer to cooler waters and enhanced westerly vertical wind shear at higher latitudes. This contributed to a large number of weak and short-lived systems over the central and western part of the basin.

4.1.4 Few tropical cyclones affected land during the 2009 hurricane season. Hurricane Jimena made landfall as a category two hurricane along the west coast of the southern Baja California peninsula, and Tropical Storm Rick made landfall close to Mazatlán, Mexico, several weeks later. Hurricane Andres brought heavy rainfall and winds to portions of western mainland Mexico near Manzanillo and Acapulco even though the centre remained offshore. Tropical Storms Olaf and Patricia briefly threatened the southern Baja California peninsula but weakened before reaching that area.

4.1.5 In response to the inquiry about an assessment of operational impacts due to loss of the QuikSCAT satellite, the RSMC discussed the use of other satellites with the capability of ocean surface winds (OSVW) measurements, such as ASCAT, as potential replacement for QuikSCAT. It also suggested other technologies to partially fill the gap. Collaboration with India on their recent launch of a satellite with a QuikSCAT-like instrument was being reviewed. A new OSVW instrument was proposed to be included in a joint effort with Japan targeting a launch during the 2010s.

4.1.6 The detailed report on the 2009 hurricane season provided by the RSMC is given in **Appendix III.**

4.2 Reports on hurricanes, tropical storms, tropical disturbances and related flooding during 2009

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 2009 hurricane season. The summary of the reports is given in **Appendix IV**.

4.2.2 A discussion arose as to advisability of the designation of Tropical Storm Grace, which had a non-tropical origin, from the aspect of a clear definition of a tropical cyclone. RSMC Miami stated that the definitions are well established and the best tracks produced by the RSMC clearly show the different stages of the cyclones. Many Committee members were of the opinion that, although the system was difficult to classify, it was necessary to act on the safe side for the sake of protection of life and property.

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

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

5.2 The Hurricane Committee held a long discussion on the status of new weather radars in the region and the progress towards the development of various radar composites. The Caribbean Meteorological Organization (CMO) informed the Committee that while the new S-band Doppler radars in Barbados, Belize, Trinidad & Tobago and Guyana (Region III) were fully functional, there were still some technical issues to be resolved to enable the composite of these and other radars, created by Météo-France, to be available to the wider meteorological community.

5.3 In this regard, the Committee noted that the telecommunication configuration via the *International Satellite Communications System* (ISCS), which enabled individual radar data to flow directly into, and the resulting composite to flow out of the Météo-France centre in Martinique, had been significantly impacted by the transition to the new generation ISCS-G2e. The configuration under the ISCS-G2e required transmission via the Regional Telecommunications Hub (RTH) in Washington so that, at the time of this Meeting, some work was still required at the RTH to complete the link to Martinique. Details of the ISCS-Ge2 can be found in Chapter 8 of the Hurricane Operational Plan. Nonetheless, while individual radar imagery would eventually be available to all via the internet, separate arrangements would be made by the CMO to provide RSMC Miami with ftp access to the radar imagery in Barbados, Belize, Trinidad & Tobago and Guyana.

5.4 The Committee was informed that the research community had been requesting access to raw radar data, including Doppler data. In addition, there were requests from the private meteorological sector for access to raw data for the creation of its own regional radar composite. The Committee decided that the priority must be to satisfy operational needs first, including the full development of an operational regional radar composite, after which the needs of the research community and private sector could be addressed. In this regard, the Meeting recalled the discussion at its 31st session on the need to develop a regional composite as a contribution to the *WMO Integrated Global Observing System* (WIGOS) and noted that initial steps had already been made towards fulfilling this plan. Nonetheless, the Chairman of the Committee agreed to provide details of the research needs for radar data at the next session in 2011.

5.5 The Meeting was reminded about the WMO and ICAO requirements for the migration to *Table-Driven Code Formats* (TDCF) for data transmissions. It has been recognized that the use of TDCF provides a solution to satisfy the demands of rapidly evolving science and technology, particularly communications technology. The WMO ***Binary Universal Format for Representation*** (BUFR) had been identified as the primary code form for the future. The Meeting noted that radar data was, in many cases, already being transmitted in BUFR, but stressed that SYNOP, SHIP, PILOT, TEMP and CLIMAT, along with aviation products METAR, SPECI and TAF, were among the priority messages to be migrated from the traditional alphanumeric format to BUFR. The Meeting discussed the varying state of readiness among the NMHSs in RA IV for the migration to TCDF, especially as some specific deadlines had been identified. The representative of the USA pointed out that, from the RTH point of view, the alphanumeric format would remain in use for some time while the migration process was underway. It was suggested to the members of the Committee that NMHSs need to put plans in place to automate the BUFR encoding and decoding of messages, as well as the automation of chart plotting and other similar activities, with as little disruption as possible to operational functions. However, it was stressed that a critical component of the migration to BUFR was the preparation of ***metadata*** (data about data) on stations and instruments. The provision of metadata in a broader context, which is very critical to the new *WMO Information System* (WIS), is discussed in detail under Agenda item 7.1.

5.6 The ICAO representative thanked the NMHSs and FIR Watch Offices in the region for their support to ICAO-activities in RA IV, particularly in the supply of timely tropical-cyclone

SIGMETs. He reiterated the importance of providing short clear SIGMET messages to airlines and Air Traffic Services since they did not receive the longer TC bulletins issued by RSMC-Miami.

5.7 There was some discussion on the effectiveness of the Public Weather Services component of several NMHSs in the region in the delivery of severe weather warnings. It was felt that in most NMHSs, there was the need to educate the public about details of the warning system and the warnings issued at the national level. The Committee agreed that the Internet was one of the most effective mechanisms in the education process. At the same time, it was felt that several NMHSs needed to pay greater priority and attention to developing high quality Websites as their primary tool for public information and education, and to take steps to ensure that their Websites were at the top of the list through any Internet search engine. Therefore there should be an emphasis on capacity building within NMHSs in order to ensure the continued relevance and visibility of these services.

5.8 The discussion also focussed on the need for greater synergies, at the WMO Programme level, between the WMO Disaster Risk Reduction (DRR) Programme, Public Weather Services (PWS) Programme and the Tropical Cyclone Programme (TCP). The Committee was of the view that such synergies had to be developed and exploited at the regional level to improve service delivery to Member States, but stressed that the Programmes themselves were very different one to the other. In this regard, the Committee made it clear that the development of these synergies cannot and must not be interpreted as a combination of the functions of the DRR, PWS and TCP, nor lead to a combination of DRR and PWS activities with the functions of any regional TC body, such as the RA IV Hurricane Committee. The Committee therefore urged the RA IV Member States to properly articulate this view at the relevant constituent bodies of the WMO and in particular at the next session of the Congress in 2011.

5.9 The Chairman of the Hurricane Committee introduced some of the 2010 operational changes internal to the RSMC Miami that could impact on the overall Hurricane Warning System. He indicated that advancements in track forecasts made it possible for forecasters to provide greater lead time for action in threatened areas. He announced that the RSMC will issue watches and warnings for tropical storms and hurricanes along threatened US coastal areas 12 hours earlier than in previous years. Specifically, the following changes in lead time were introduced, effective from the 2010 hurricane season, which begins on May 15 in the Eastern Pacific and on June 1 for the Atlantic Basin:

(i) Tropical storm watches will be issued when tropical storm conditions are possible along the coast within 48 hours;

(ii) Tropical storm warnings will be issued when those conditions are expected within 36 hours;

(iii) Similar increases in lead-time will apply to hurricane watches and warnings. Hurricane watches and warnings will generally be timed to provide 48 and 36 hours notice, respectively, before the onset of tropical storm force winds.

5.10 The Chairman also informed the Committee that the RSMC had adopted, in its internal operations, the **"post-tropical"** terminology that had been adopted by the RA IV Hurricane Committee in 2009. As a result, it updated the definitions for "remnant low" and "extratropical cyclone" in its Hurricane Operational Plan. In addition, the Chairman indicated that the RSMC had introduced the following changes that could be considered by the Hurricane Committee itself for the RA IV Hurricane Operational Plan:

(a) Potential revisions to the Tropical Cyclone Public Advisory (TCP);

(b) Add storm summary information in the Tropical Cyclone Update (TCU) when storm information has changed since the previous issuance NHC public advisory.

5.11 The Chairman briefed the Committee of the negative reaction of the general public, media and emergency management community in the USA on the use of the Greek Alphabet for naming tropical cyclones when the published list was exhausted, as occurred for the first time in 2005, instead of using more easily understood names from a secondary list. The Committee reaffirmed the fact that, as articulated by the Chairman in response to the reaction, the lists of tropical cyclone names are developed by this WMO RA IV Hurricane Committee to ensure a proper use of French, Spanish, Dutch and English names due to the geographical coverage of the storms throughout the Atlantic and Caribbean. The Committee felt that the use of the Greek Alphabet was not expected to be frequent enough to warrant any change in the existing naming procedure for the foreseeable future and therefore decided that the naming system would remain unchanged.

5.12 Decisions or further discussions on the implications of the matters raised by the Chairman in paragraphs 5.9 to 5.11 on the RA IV Hurricane Operational Plan can be found under Agenda item 6.

6. REVIEW OF THE RA IV HURRICANE OPERATIONAL PLAN

6.1 Under this agenda item, the Committee designated Dr Mark Guishard (Bermuda; 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) agreed to serve as a coordinator for ATTACHMENT 8A (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 that came out from this and the other agenda items.

6.3 Amendments were made in many chapters to the Plan, including update of the post-tropical cyclone terminology in Chapter 1, revision to the Tropical Cyclone Public Advisory (TCP) and addition of storm summary information in the Tropical Cyclone Update (TCU) in Chapter 3 as discussed under Agenda Item 5. In particular the Committee decided to adopt into the Operating Plan, the same changes to lead times for watches and warnings that were to be introduced at RSMC Miami, namely:

(i) Tropical storm watches will be issued when tropical storm conditions are possible along the coast within 48 hours;

(ii) Tropical storm warnings will be issued when those conditions are expected within 36 hours;

(iii) Similar increases in lead-time will apply to hurricane watches and warnings. Hurricane watches and warnings will generally be timed to provide 48 and 36 hours notice, respectively, before the onset of tropical storm force winds.

6.4 The Committee urged the WMO Secretariat to amend the maps of tropical cyclone warning responsibility of RA IV in Chapter 2 as some of the Member countries are not adequately represented. It also requested the Secretariat to have Chapter 5 on Satellite Surveillance updated by the WMO Satellite Office prior to the annual sessions and presented to the Committee in a document under this agenda item as was recommended at the 30th session.

6.5 Considering that the Operational Plan was only available in English and Spanish, the Committee requested the Secretariat to provide Météo-France with all the changes to the Plan to facilitate Météo-France's internal French version. The Committee also urged Météo-France to continue to make copies available to Haiti as soon as it was updated.

6.6 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 to ensure that the amendments and changes made to the Plan are posted to the TCP Web site both in English and Spanish, before commencement of the 2010 hurricane season.

7. REVIEW OF THE COMMITTEE'S TECHNICAL PLAN AND ITS IMPLEMENTATION PROGRAMME FOR 2010 AND BEYOND

The Committee designated Dr Mark Guishard (Vice-chairman of English-speaking members) and Dr José Rubiera Torres (Vice-chairman of Spanish-speaking members) to serve as rapporteurs.

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 thirty-first session of the Committee. As highlighted in section 1.3, the Committee agreed to develop a summary sheet or executive summary for the Technical Plan highlighting achievements and projects to be pursued etc. In

The Committee recommended to the President of-RA IV the approval of the updated RA IV Hurricane Committee's Technical Plan and its Implementation Programme, which is given in **Appendix V.**

7.1 Meteorological Component

Regional Basic Synoptic Network (RBSN)

7.1.1 The Committee was informed that, during the intersessional period, the number of surface stations increased to 539 (535 in 2008) and upper-air stations reduced by one to 135 (136 in 2008). It should be noted that the overall status of observations implemented by RBSN stations remained stable at over 90% for surface observations and 95% for upper-air observations, as recorded in WMO Weather Reporting Publication No. 9, Volume A.

7.1.2 According to the results of the Special Main Telecommunication Network Monitoring (SMM) carried out on a quarterly basis during 2009, the average availability of SYNOP reports on the Main Telecommunication Network (MTN) amounted to 81 per cent (80 per cent in 2008) of expected reports from the RBSN. The number of 'silent' non-reporting surface stations decreased from 56 stations in 2008 to 46 stations in 2009.

7.1.3 The average availability of TEMP reports on the MTN as per the SMM exercise carried out in 2009, showed a marginal increase from 87% (in 2008) to 88% (in 2009) of expected reports from the RBSN. The number of 'silent' non-reporting upper-air stations (TEMP) remained unchanged at 6 stations as in the previous year.

Aircraft Observations

7.1.4. The Committee was informed that the volume of AMDAR data disseminated on the GTS has stabilized at around 220,000 to 230,000 observations per day. The humidity-water vapour sensors were closer to becoming operational with the USA and European-based E-AMDAR trials due to release reports into the performance of the WVSS-II sensor in early 2010.

7.1.5 NOAA has signed a new contract with AirDat for the provision of TAMDAR observations. This contract runs through November 18, 2010. Due to economic considerations for both the government and AirDat, the amount of data to be purchased will be significantly reduced from that of the previous contract.

7.1.6 As one of its goals, the TAMDAR project intended 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 would now have profiles of moisture, temperature and winds available routinely.

Marine and Ocean Meteorological Observations

7.1.7 The global surface buoy network (DBCP) was now essentially complete and being sustained (1512 units in October 2009). Efforts were being made to increase the number of surface drifters reporting sea level pressure (612 units in October 2009). Cost-effective technology exists for surface drifters equipped with thermistor strings and designed to be deployed in hurricane conditions; many of them were routinely being deployed operationally in the Gulf of Mexico.

7.1.8 Tropical oceans provide for an important heat engine of global climate and weather patterns. The Pilot Research Moored Array in the Tropical Atlantic (PIRATA) moored array was now essentially completed with 18 operational sites, and data return in the order of 85% (mainly due to vandalism). The primary data telemetered in real time from surface moorings in the arrays are daily or hourly mean surface measurements (wind speed and direction, air temperature, relative humidity and sea surface temperature and salinity) and subsurface temperatures.

WMO Information System (WIS/GTS)

7.1.9 Within the WIS, the newest service would be the Data Access and Retrieval (DAR) service which is completely dependent on availability of metadata. This metadata is called discovery metadata, based on the WMO/ISO standards, focused on providing that information needed by a user to discover what information is available and how to gain access to that data. The metadata needed for WIGOS, although also based on WMO/ISO standard, is focused on information about the content of the data and includes information such as the instruments and algorithms that generated the data, its precision and quality, etc. There is some overlap such as the information needed to geo-locate the data.

7.1.10 Data providers have a responsibility to provide metadata and maintain ownership of their metadata. They can make arrangements to someone else to generate metadata but that does not change the ownership of or responsibility for the metadata. Most of this metadata is available today but not necessarily in the standard formats. The main part of the work is the initial conversion and provision of the metadata.

- More information for WIS can be found at: http://www.wmo.ch/pages/prog/www/WIS/
- More information for WIGOS can be found at: http://www.wmo.ch/pages/prog/www/wigos/

7.2 Hydrological Component

7.2.1 The RAIV Hydrological Advisor, Dr Eduardo Planos Gutierrez, briefed the Committee that the RA IV Working Group on Hydrology (WGH) was phased out of the structure of the RA IV, and that during the present working period the Regional Management Group would decide as appropriate to set up specific time-bound working groups and concrete goals to deal with the most important tasks in the Region. In this regard, disaster management and integrated water resource management, including capacity-building and training in both activities, were defined as priority activities; efforts are underway to set up a working group to cover these activities. One of the decisions adopted was to admit the Regional Hydrological Advisor as a member of the Management Group.

7.2.2 During the past intersessional period, the Regional Hydrological Advisor continued to work on five high-priority topics: (a) Training and Continuing Education; (b) Hydrological Warning Systems; (c) Integrated Water Resources Management; (d) CARIB-HYCOS; (e) Transboundary Water Resources Management; and (f) the definition of training needs in the field of hydrology and water resources that the Commission on Hydrology asked it to provide. The RAIV Hydrological Advisor indicated progress made in the Region with regard to the use of mathematical models for hydrological forecasting and the establishment of the Early Warning System, primarily in the Central American countries. It further reported that the CARIB-HYCOS Project had been launched and that the phase of delimitation of scope and identification of the needs of each participating country had been concluded.

7.2.3 Regarding the hydrological component of the Hurricane Committee’s Technical Plan, in view of the changes to the region’s structure, the Advisor deemed it necessary:

a) To update the hydrological component of the Hurricane Committee’s Technical Plan with the active participation of the National Hydrological Services;
b) To establish a regional mechanism for monitoring the hydrological component of the Hurricane Committee’s Technical Plan, bearing in mind that the WGH has been phased out;
c) To increase coordination between the National Meteorological and Hydrological Services, in all their activities;
d) To strengthen the system for the communication and transfer of hydrological data during severe meteorological phenomena among the National Hydrological Services;
e) To continue to improve the hydrological information and data in the hurricane seasonal report.

After considering the information presented by the Regional Hydrological Advisor, the Committee recognized the importance of establishing a coordination mechanism for the hydrological component of the Hurricane Committee’s Technical Plan and:

1. Invited the Management Group to review how best to maintain regional cooperation ties between meteorological and hydrological services, bearing in mind that the WGH has been phased out;
2. Noted that, taking into account the new structure of RA IV and the priorities set by the Regional Partnership in the field of Hydrology and thus recognizing the need to adapt the Hydrological Component of the Technical Plan of the Hurricane Committee, the Regional Hydrological Adviser submitted a proposal of modification of the component, which will encourage the strengthening of working relationships between NMHSs and developing and strengthening regional capacities for hydrological early warning systems. The proposal will be reviewed at the next session of the Hurricane Committee;
3. Invited Member countries to include in their annual reports hydrological information following the “Guide on the hydrological information contained in the annual national reports on hurricanes, tropical storms, and perturbations with associated flooding” (see **Appendix VI**);

4. Reiterated how important it was that the Hydrological Advisor attends the Committee session and the role of hydrology needs to be increased in the Committee's activities;
5. Thanked the WGH for the work done and the support it had given the Hurricane Committee during its life.

7.3 Disaster Prevention and Preparedness Component

Training workshop on multi-hazard early warning systems (MH-EWS)

7.3.1 The Committee was informed that WMO, in collaboration with NOAA/NWS, ISDR, World Bank, CEPREDENAC and CDEMA, was organizing a "Training Workshop on Multi-Hazard Early Warning Systems with focus on Institutional Partnerships and Coordination", to be held from 22 to 25 March 2010, in San Jose, Costa Rica.

7.3.2 The workshop targeted at directors and senior executives of National Disaster Risk Management Agencies, NMHSs and other ministries and agencies engaged in EWS in Central America and the Caribbean, would enable (1) the sharing of experiences and lessons learnt from documented good practices in early warning systems, including Cuba, France, Italy, China/Shanghai and USA); (2) the review of regional initiatives in support of disaster risk reduction and particularly EWS; (3) identification of national capacities and gaps related to planning, legislative, institutional and operational aspects of EWS of countries in the region, and (4) the identification of priorities for the development of national EWS and opportunities for regional cooperation.

7.3.3 The outcomes would be used in facilitating a more coordinated approach among regional and international development and funding agencies, supporting EWS projects. Information about the workshop could be found at:

http://www.wmo.int/pages/prog/drr/events/MHEWSCostaRica/index_en.html

7.3.4 Recognizing the important contributions the Committee can make towards the outcomes of this workshop, the Committee decided to designate Dr Jose Rubiera of Cuba to represent the Committee at this workshop.

Central America pilot project on early warning systems for hydrometeorological hazards

7.3.5 The Central America Regional Planning and Advisory Group (CARPAG), which was established in early 2008 to facilitate identification and development of project proposal on EWS for hydrometeorological hazards in Central America and the Caribbean, submitted to the Global Facility for Disaster Risk Reduction (GFDRR) a proposal for Costa Rica, El Salvador and Nicaragua. Following the submission, the WMO has been informed that funding for Costa Rica would be made available in 2010. WMO Secretariat was seeking funding from other sources and bilateral donors for the remaining countries. It was expected that the project will proceed with implementation in 2010.

7.3.6 Lic. Lorena Soriano (El Salvador) expressed the gratitude of El Salvador to WMO/DRR and RA IV Task Team on Disaster Risk Reduction for their efforts in the implementation of the pilot project. She also stressed that the development of NMHS capacities on end-to-end EWS would be a key to success in promoting the community emergency preparedness and action.

7.3.7 The Committee discussed the relationship between the work of the Committee and the Disaster Risk Reduction programme. Members recognized the Committee has much to offer to the work of DRR programme and DRR activities of Members and therefore nominated Dr Jose

Rubiera as the representative to the RAIV Task Team on Disaster Risk Reduction. Members further recognized that a multi-hazard approach to hydro-meteorological threats must be pursued. However, the Committee reaffirmed its long history of setting and achieving its priorities including coordination among Members to address the most significant hazard in the region. It was therefore agreed to work with the Disaster Risk Reduction programme, noting the sentiments expressed by the Committee in paragraph 5.8 of this report.

Proposal for improving hydrometeorological data collection and implementation of an early warning system in Haiti

7.3.8 Following the recent earthquake that devastated Haiti on the 12 of January 2010, WMO was coordinating a Flash Appeal to support the development of warning capacities of the Meteorological Services of Haiti for the upcoming rainy and Hurricane season. The objective of the coordinated Flash Appeal is to support the implementation of an early warning system to make available reliable and authoritative multi-hazard meteorological and hydrological early warnings and related information during the 2010 rainy and Hurricane seasons (March – December 2010) to support: (1) Haitian government's contingency planning and response for the safety of the population in Haiti, and (2) operations of humanitarian, development and other agencies working in Haiti (see para 9.5).

Building operational forecasting and warnings capability for coastal inundation

7.3.9 A joint JCOMM/CHy Coastal Inundation Forecast Demonstration Project (CIFDP) for building improved operational forecasts and warnings capability for coastal inundation had been initiated. The major outcome of this project would be the development of an effective software package involving both ocean and hydrological models to enable an assessment and forecast of total coastal inundation from combined extreme events.

7.3.10 During the first CIFDP meeting, regional assessments/requirements for coastal inundation prone-areas in different Regional Associations were presented. In particular, the regional aspects in West Africa (RA I); South China Sea with focus on Shanghai area (RA II); Bay of Bengal (RA II); Caribbean (RA III/IV); Indonesia (RA V), and South Pacific Ocean (RA V) were presented.

Collaboration with the ICG/CARIBE-EWS

7.3.11 Recognising the commonalities in the establishment of an early warning system for tsunami and the existing warning systems in place associated with Hurricane Committee activities the Committee decided to seek to strengthen its linkages with groups such as the ICG/CARIBE-EWS as discussed further in paragraphs 9.8 – 9.12.

7.4 Training

7.4.1 The Committee noted with satisfaction that the RA IV Workshop on Hurricane Forecasting and Warning and Public Weather Services was successfully organized in RSMC Miami Hurricane Center from 23 March to 3 April 2009. In 2010, the Workshop will be held from 15 to 26 March. The Committee emphasized that the Workshop has made a significant contribution to the capacity building in tropical cyclone forecasting in this region and expressed its appreciation to WMO and RSMC Miami for annually organizing this workshop.

7.4.2 The Committee noted that fellowships for long-term and short-term training totalling 58.5 person x months were granted to the Member countries of RA IV 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 more effectively utilize this programme. However, the Committee was of the view that the WMO fellowship programme was not adequately utilized by the Members for the training in operational forecasting of tropical cyclones. It therefore encouraged the Members to fully exploit the programme for this purpose.

7.4.3 The Committee expressed its gratitude to all those Members who made available their training facilities and/or experts to other Members under bilateral or other type of arrangements. It strongly recommended that such endeavours should be continued and be strengthened. The Committee urged its Members to make maximum use of such training facilities.

7.4.4 NOAA trains six fellows from Central America and the Caribbean each year at the Tropical Desk at the NCEP HPC (see para 8.10). Fellows are trained in operational skills, including numerical weather prediction techniques. Many members stressed the importance of this training to building capacity in their forecasting service including for tropical cyclones. The Committee thanked WMO and NOAA/NWS/IAO for implementation of the Tropical Desk programme for years. NOAA/NWS/IAO confirmed the continued support for the programme and recognized the importance of ensuring that all the Committee Members have the opportunity to send experts to the Desk.

7.4.5 The Conference of Directors of Iberoamerican Meteorological and Hydrological Services is implementing several training activities and workshops in the region, such as installation, management and maintenance of automatic stations, use of software and visualization of meteorological data, satellite meteorology and coastal flooding in the Caribbean area.

7.5 Research

7.5.1 Prof. Russell Elsberry, the representative of WMO/CAS, presented an overview and the tentative program of the seventh International Workshop on Tropical Cyclones (IWTC-VII) that would be held in La Reunion, France from 15 to 20 November 2010. The International Organizing Committee is chaired by Chris Velden (USA) and Jeff Kepert (Australia), and Lixion Avila (USA) is coordinating attendance of forecasters from Region IV. It was emphasized that the forecasters need to be active participants in the workshop to ensure that the needs of the forecaster community are addressed. A concern was raised about the sole use of English as the working language for the IWTC-VII in La Reunion.

7.5.2 Prof. Elsberry provided an overview of the USA Hurricane Forecast Improvement Project (HFIP) that was addressing the primary forecaster requirement for improved intensity forecast guidance. This HFIP program included enhanced observations, data assimilation, and numerical modeling initiatives. A special arrangement for computing resources was to allow on-demand very high resolution numerical forecasts including ensemble forecasts when the research aircraft are providing Doppler radar radial winds and other observations. Diagnostic tools for evaluating the numerical model predictions and visualization tools are being developed as part of the HFIP program.

7.5.3 He also presented an overview of three coordinated field programs in the Atlantic during the 2010 hurricane season that are expected to provide improved real-time analyses and numerical model forecast guidance. In addition to three NOAA aircraft participating as part of the HFIP IFEX program, the NASA Genesis and Rapid Intensification Processes (GRIP) and National Science Foundation PRE-Depression Investigation of Cloud systems in the Tropics (PREDICT) would also be carrying out field experiments on genesis and intensification. As many as eight research aircraft would be participating, including the unmanned Global Hawk and the HAIPER Gulfstream-V high-altitude aircraft for the first time. RA IV Members were requested to provide extra rawinsonde observations as appropriate, and it was emphasized that special field experiment analyses and numerical predictions would be available to Members from the respective websites.

7.5.4 Prof. Elsberry informed the Hurricane Committee of the seasonal tropical cyclone activity forecasts for the Atlantic from four groups that are now available on a World Weather Research Program (WWRP) website. Additional agency/research group forecasts are to be added.

7.5.5 Prof. Elsberry reviewed the action items from the second International Workshop on Tropical Cyclone Landfall Processes (IWTCLP-II) co-sponsored by the WWRP and TCP that was held in Shanghai China during 19-23 October 2009. Forecasters from various countries (including Cuba) provided ranked operational needs that will guide the future WWRP Tropical Cyclone Panel activities.

7.5.6 The Third International Quantitative Precipitation Estimation (QPE)/Quantitative Precipitation Forecasting (QPF) that would be held in Nanjing China during October 2010 would have one focus on tropical cyclones, and thus be of interest to the Hurricane Committee Members.

7.5.7 Prof. Elsberry presented information on two western North Pacific initiatives that would make use of the THORPEX Interactive Grand Global Ensemble (TIGGE) tropical cyclone tracks, which are to be provided to the ESCAP/WMO Typhoon Committee Members. The objective of the Research Demonstration Project was to develop multi-model ensemble forecasts for operational use, and the specific objective of the Forecast Demonstration Project was to provide tropical cyclone forecasts for the Shanghai World Expo 2010. Such projects utilizing the TIGGE data sets are expected to be extended to the Severe Weather Forecast Demonstration Project (SWFDP) in South Africa and the South Pacific areas, and thus also to the Atlantic.

7.5.8 The WWRP Tropical Cyclone Panel was facilitating a targeted observation program similar to that in the Atlantic and a tropical cyclone-topography interaction study in conjunction with the proposed Southwest Indian Ocean Experiment (SWICE) field experiment during January and February 2011.

7.5.9 An updated book Global Perspectives on Tropical Cyclones from the IWTC-VI will be published in March 2010, and a website version of the Global Guide on Tropical Cyclone Forecasting will be available prior to IWTC-VII for evaluation by Hurricane Committee forecasters.

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

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

8.2 The Committee expressed its satisfaction that WMO, through the Development and Regional Activities Department (DRA) with the support of the WMO Office for North America, Central America and the Caribbean (NCAC), has continued the development of technical cooperation activities to ensure cost-effective services to the Members. The NCAC Office has also provided support to regional activities and assisted in the implementation of WMO Programmes in the Region.

Regional activities

8.3 The Committee was informed that:

- During 2009 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.

- The Meeting of Directors of the Meteorological and Hydrological Services of the Iberoamerican Countries was held in Dominican Republic in November 2009 with the attendance of the Spanish and Portuguese speaking members of the RA III and RA IV. The Iberoamerican meeting adopted and approved the Action Plan for 2010-2011 with an implementation cost of more than EU$ 1.5 million which would be contributed by Spain. The main activities of the Plan are to continue with the activities of the Iberoamerican Climate Project (CLIBER) in Guatemala, Paraguay and Uruguay, to execute the CLIBER in Venezuela, to support more than 20 training activities in different Latin-American countries for member of RA III and IV and some activities aimed to support management activities of the NMHS. The NMS's Directors decided also to support the Central America Climate Forum meetings.

- WMO made high level missions during 2009 to present the CLIBER projects of Colombia, Honduras and Nicaragua to their national authorities.

Training

8.4 The Committee was pleased to note that the RA IV Workshops on Hurricane Forecasting and Public Weather Services took place in Miami, U.S.A, in the first quarter of 2009. These very important workshops are organized on an annual basis at the National Hurricane Centre in Miami, USA, with strong support of WMO and the U.S.A.

8.5 The Committee was informed that Focus Group of WMO's Virtual Laboratory on Satellite Meteorology, using Internet and Visit View software, has continued with great success. Discussion takes place 3 or 4 times a month and an every other day presence during the threat of a hurricane. These discussions also closely monitor the evolution of ENSO. The group is led by NOAA, National Weather Service in collaboration with COMET, Barbados and Costa Rica RTCs and Colorado State University.

8.6 The Committee was also informed that the ICAO, cosponsored by WMO, organized a Workshop on Development of a Quality Assurance System to enhance the Aeronautical Meteorological Service, Montego Bay, Jamaica, and 25-27 Nov 2009. WMO assisted to facilitate the attendance of some participants from the NMHSs.

8.7 The Committee was pleased to note that the WMO, through the fund in deposit from Spain, supported during 2009 more than 10 different courses in automatic weather stations, data processing, climate change, administration of meteorological and hydrological services, flood management, seasonal forecast, hydrology, statistic forecast tools, use of forecast products and satellites from the European Centre for Medium-range Forecast (ECMWF), and other topics during 2009. Additional a series of seminars and workshops were also supported especially in hydrological forecast, seasonal forecast, coastal flooding, telecommunications and interaction with the media.

Assistance to NMHS

8.8 The Committee was informed that the Central American Project on Multi-Hazard Early Warning System to develop an end to end early warning system for Central America, financed by the World Bank and executed by WMO, was ready to start its execution on the first months of 2010. The Project implementation would start its implementation in Costa Rica and will continue in El Salvador and Nicaragua later on.

VCP projects

8.9 The Committee appreciated that during 2009, WMO continued providing assistance to NMHSs through the VCP Programme. A total of 2 VCP projects were supported benefiting 2 countries, namely, Haiti and Saint Lucia. Saint Lucia's project is the provision of meteorological equipment for refurbishing and upgrading of the AWS network. Procurements procedures have already started with the kind assistance of the UK Met Office on the technical specifications definition. Haiti has been supported with two automatic weather stations which are being increased to seven (7) in order to reinforce the NMS of Haiti after the earthquake event of 12th January 2010. WMO with the assistance of Spain through the VCP has completed the delivery of seven (7) hydrometeorological stations for Guatemala and two (2) for El Salvador aimed at strengthening the flood forecasting in these countries after the hurricane Stan.

8.10 Annually and on-going IAO supported:

- **CaribWeather.net:** Caribweather.net website was designed as 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 has been supporting hydrometeorological data rescue and digitization projects in the Americas to improve the availability of historic digitized weather observations as input to climate change and global warming studies, disease vectorization actions as well as direct benefits to agriculture, flood forecasting and drought statistics. Current ongoing projects in RAIV include the national meteorological services of the Dominican Republic and El Salvador. Of note was the effort to image and digitize over 330,000 precipitation strip charts from El Salvador alone providing precipitation measurements at 5 minute intervals to the NCDC resulting in over 95 million parameter values saved and available.

- **WMO Region IV Hurricane Committee Conference (HC-32):** Funding has been made available via the WMO's Tropical Cyclone Program for specific use with RA IV.

- **WMO Participants attending the Hurricane Attachment Program:** Located at NOAA's National Hurricane Center/Tropical Prediction Center, this program brings weather service personnel from vulnerable Member States to train on forecasting, preparedness, and public outreach during hurricane season. Three participants would be trained during the hurricane season.

- **WIGOS RAIV Demonstration Project:** The RA-IV Management Group has identified implementation of WIGOS as a priority. To this end it established an RA-IV Task Team on Regional WIGOS Implementation. A Charge was developed and provided for the

Task Team and VCP funds have been provided by the US targeted to the work of the Task Team. The key elements of the Task Team work are:

- o Review the evolving WIGOS requirements and strategies to complete an RA IV WIGOS Implementation Plan including an Operations plan which will be the basis to manage future regionally coordinated observation requirements and operations;
- o Participate in the larger WMO WIGOS development process to ensure RA IV needs are represented;
- o Develop and guide regional implementation of RADAR data as an initial phase of WIGOS in RA IV;
- o Seek funding for projects through the WMO Resource Mobilization Office, through direct contact with donor countries and through other avenues;
- o Developm Regional WIGOS observing requirement for input to the CBS RRR process; and
- o Develop a regional instrument calibration strategy.

- **WMO AMDAR Activities:** capacity building activities to improve upper air observations and data collection using commercial airplanes with a pilot project in Mexico. Travel funding for experts to provide technical support and coordination with air carrier management and WMO for the installation of observation platforms in aircrafts

- **WMO Training Workshop on Multi-Hazard Early Warning Systems (MHEWS)**: Funding has been made available via the WMO's DRR program for specific use with RA IV.

  The workshop would take place in San Jose, Costa Rica from March 22-25, 2010 and would be followed by a "Coordination Meeting for Development of Early Warning Systems in Central America and the Caribbean" on March 26. The workshop will bring together directors of National Meteorological and Hydrological Services and National Disaster Risk Management Agencies from twenty-six countries in North and Central America and the Caribbean region. A number of regional and international organizations as well as development agencies will participate in both events. Sessions would cover: (1) regional Initiatives in Disaster Risk Reduction and Early Warning Systems in Central America and the Caribbean; (2) review and analysis of national early warning systems capacities, gaps and needs in Central America and the Caribbean.

- **International Satellite Communication System (ISCS):** The ISCS was introduced into the World Meteorological Organization (WMO) Regional Association IV (RA IV) to meet the WMO's need for improving the reliability and availability of regional telecommunication services supporting the Global Telecommunication System (GTS) in the Caribbean and Central America. ISCS, a satellite data distribution system operated by National Oceanic and Atmospheric Administration (NOAA), was upgraded in 2003 to a more robust communications protocol allowing increased data capacity and greater flexibility for the exchange of meteorological products by end users. Through VCP, this capability was made available to RA IV Members. In addition to its services to the WMO, ISCS provides timely distribution of World Area Forecast System (WAFS) aviation-related weather information to support air traffic management and flight operations in RA-IV and other regions of the world as part of the US commitment as a World Area Forecast Center (WAFC) provider state, to the International Civil Aviation Organization (ICAO). ISCS services more than 66 countries, as a coordinated effort of the U.S. National Weather Service (NWS), the U.S. Federal Aviation Administration (FAA), ICAO, and the WMO.

With a focus on reducing implementation and operational costs and minimizing the transition impact on end users in RA IV and the ICAO communities, the targeted ISCS-G2e follow-on technical solution changed from an entirely satellite based transmit and receive system, to a receive only satellite broadcast service with the NWS terrestrial-based NOAAnet Multiprotocol Label Switching (MPLS) circuits installed to provide a means for transmitting products back to the Regional Telecommunications Hub (RTH). Of the 90 total ISCS sites, the transition impact was limited to VSAT technology refresh at the 27 RA IV two-way sites, along with the implementation of the NOAAnet circuits and Customer Edge Routers at these locations. Sites were not required to pay for this transition, but would be responsible to identify and pay for equipment maintenance service of their choosing, if they elect to do so. All RA IV Member states were invited to the NWS ISCS Program Office briefing on the new acquisition strategy and impact on 22 October 2009. The transition was now well underway and, with few exceptions, it was expected to be completed by the end of March 2010. Information regarding the transition was posted on the ISCS homepage along with updates and advisories about the new system. http://www.weather.gov/iscs/.

Currently there are three satellite based systems using the DVB-S protocol which disseminate weather, water and climate related information with a footprint in RA-IV. They are the ISCS discussed above, GEONETCAST for the Americas also operated by NOAA and part of GEOSS and EUMETCAST operated by EUMETSAT and contributing to both the WMO IGDDS and the GEO GEONETCAST systems. At the recent joint RA-III and IV Satellite Data Requirements and through additional coordination it has been recognized there are overlaps of both mission and delivery capability of these systems. The system providers have begun preliminary discussion about what the future satellite dissemination system may look like. This includes the possibility of convergence of the missions of ISCS and GEONETCAST for the Americas and the discontinuance of EUMETCAST over the region. No decisions have been made at this time.

8.11 Training and technical assistance to WMO RA IV to help meet International Civil Aviation Organization (ICAO) for Quality Management of aviation forecasts. This task would be addressed by the RA IV Task Team on Aviation.

9. OTHER MATTERS

Assistance to Haiti

9.1 After the destructive earthquake that caused severe impact on Haiti on 12 January 2010, the WMO, including some Members of RA IV took quick action and provided immediate assistance to Haiti. In addition various offers of assistance have been received, from Members and some private firms and individuals, including for example offers of various equipment, and technical personnel and French speaking forecasters. A first side meeting was therefore planned and took place on 9 March 2010 at the 32nd HC meeting to clearly identify in particular the urgent needs and actions for assistance, and to refine the relevant offers.

9.2 The side meeting was convened by the President of RA IV, and most of the HC representatives participated, and supported by the WMO Secretariat. A comprehensive presentation was made to the meeting, jointly by the Secretariat and Mr Ronald Semelfort, director of the Haitian Meteorological Service.

9.3 The meeting was informed that 7 new automatic weather stations would be acquired by the end of April 2010; the provision of 2 EMWIN systems to Haiti by the USA has been confirmed, including a technician who would both install the equipment and train the local staff (interpretation services will be coordinated by WMO with the support of IADB mission in Haiti); Canada will provide up to 9 laptops and 6 PCs, in-house built rugged weather stations, and possibly also the secondment of a French speaking forecaster(s). The UK provided an update on the possible deployment of AWS and technical support, secondment of a French speaking forecaster, the use of VCP funds held at WMO and the use of NWP model data particularly EPS and seasonal forecasts. Other Member countries, such as the Dominican Republic and Cuba, stated that they could consider offering the use of Human resources to help Haiti.

9.4 The WMO has established a Task Team at the Secretariat to coordinate assistance including the development of a project entitled "Meteorological and Hydrological Early Warning Services to Support Emergency Contingency Planning for Safety of Population and Early Recovery Activities During the 2010 Rainy and Hurricane Season in Haiti", and was developed in partnership with the Haiti National Meteorological Service and has received a strong support from the Government of Haiti.

9.5 The project is now included in the Haiti Revised Flash, which is a coordinated, strategic humanitarian plan jointly developed by 76 of the major organizations working on the ground and is as such the best catalogue of humanitarian needs in Haiti after the January earthquake. The Revised Flash Appeal can be downloaded from the URL:

http://ochadms.unog.ch/quickplace/cap/main.nsf/h_Index/Revision_2010_Haiti_FA/$FILE/Revision_2010_Haiti_FA_SCREEN.pdf?OpenElement

The project was requesting potential donors to address the identified needs through funds and in-kind assistance.

9.6 At the side meeting on Assistance to Haiti, after deliberations on the different aspects of the immediate assistance required and offers that have been made, the President of RA IV requested an ad hoc task team be established responsible to the RA IV Management Group, to include representatives from France United States, and Canada, and Haiti, to define course of action for the next months, as a first and urgent stage. Mr Jean-Noël Degrace (France – Martinique) agreed to chair this task team, and to convene a first side meeting during the Hurricane Committee session, with the assistance of the Secretariat. The second meeting was scheduled to be held during the "Coordination Meeting on Multi-Hazard Early Warning Systems Development in Central America and the Caribbean" on 26 March 2010, in San Jose, Costa Rica.

9.7 The report of the first meeting of the Assistance for Haiti Task Team is found in the **Appendix VII.**

Sponsorship of the 32nd Session of the RAIV Hurricane Committee

9.8 The Committee expressed it's thanks to the Govt. of Bermuda for hosting the 32nd Session of the RAIV Hurricane Committee (HC32) and complimented the local organising committee.

9.9 The Members of the Committee also noted that the hosting of HC32 was made possible by the generous sponsorship of the private sector in Bermuda. The Committee recommended that members and the WMO Secretariat take note of the success of this arrangement and pursue efforts to utilise similar approaches in the future.

Tsunami Early Warning System for the Caribbean

9.10 Dr. Mark Guishard reported on the outcomes of the ICG/CARIBE EWS-IV meeting held in Martinique, France in June 2009. The Committee was informed that national representatives acknowledged the need for a multi-hazard approach to Early Warnings but also noted with concern that there were few NMHSs represented at the meeting.

9.11 The Committee acknowledged that there were differing national approaches to the challenge of communicating tsunami warnings but also noted that the 24/7 operational capabilities of the NMHSs can offer a solution to the challenge of disseminating these warnings. During the ICG meeting the representative from Anguilla informed the Committee of the progress of the Common Alerting Protocol (CAP), an XML based technology for coding and disseminating warnings.

9.12 The proposed Caribbean Tsunami Information Centre (CTIC) is expected to be hosted jointly by Barbados and Venezuela. The Pacific Tsunami Warning Center in Hawaii is currently providing warnings for the region, however discussions are ongoing to determine the possibility of hosting the Caribbean Tsunami Warning Center within the region itself.

9.13 The Committee agreed that close cooperation between NMHSs and the national Tsunami Warning Focal Point and the wider Emergency Management Community was critical to ensuring the safety of life and property. The Committee therefore recommended that the possibility of holding a conjoint meeting of HC-33 and ICG/CARIBE EWS-VI in 2011 be explored.

9.14 The members of the Hurricane Committee expressed their thanks to Dr Guishard for representing their interests on the ICG and requested him to keep them informed of the outcomes of the upcoming meetings.

9.15 The Committee welcomed the attendance of a representative of the ICG, Bart Hagemeyer of NOAA, and seeks the continued participation of the ICG at Hurricane Committee Meetings.

9.16 The Committee sought to clarify its role in the Tsunami EWS by stating that NMHSs in the region may be able to facilitate the dissemination of tsunami watches and warnings, given:

- the availability of dedicated and robust communication systems such as the GTS
- the existing familiarity of meteorologists with the workings of warnings systems
- the existing liaisons between the meteorological and emergency management communities.

However, it should be noted that despite these capabilities, some NMHSs may not be able to act as full Tsunami Warning Centres, without further training or resources.

9.17 In addition, the Committee urges NMHSs to work where appropriate with the Tsunami EWS community to facilitate the rapid communications of warnings to communities at threat from this hazards, recognising that some Members have agencies undertaking Tsunami Warning Services which are not NMHSs.

BUFR Software

9.18 Mr Glendell De Souza (BCT) gave a brief overview of the BUFR software which was available to Members as they transition from the traditional alphanumeric codes to the WMO Binary Universal Format for Representation (BUFR). The Committee was provided with information of where the software to encode and decode synoptic and upper-air observations and CLIMAT messages could be sourced.

9.19 The ease of decoding observations which were coded in BUFR using software from the European Centre for Medium-Range Weather Forecasts (ECMWF) through its graphical user interface was demonstrated. It was highlighted that in order to encode each observation, the metadata of the station needs to be encoded once and saved within the software. It was stressed that the metadata about the station was very important and care should be taken in collecting and encoding this data.

9.20 The software which was demonstrated was intended to be used by any individual NMHS to encode the meteorological elements observed, after changing the units to some elements, such as temperature. The Committee was informed that there was other BUFR software available, such as that developed by National Institute for Space Research (INPE) and ECMWF (bufr_000383), which allowed for the input to be an observation in the SYNOP code and it would then convert the observation into BUFR for transmission.

10. SCIENTIFIC LECTURES AND DISCUSSIONS

10.1 The Bermuda Hurricane Seminar was held under this agenda item with the aim of stimulating the interaction between scientists, operational meteorologists and representatives of the international insurance industry, who have sponsored the hosting of the Hurricane Committee in Bermuda. The following lectures were presented during the Seminar:

- Best job in the world - riding a hurricane
  - *Lt. Col. David Borsi, USAF*
- Challenges in hurricane track and intensity forecasting
  - *Dr. Lixion Avila, NHC/NOAA*
- How reinsurers use hurricane data
  - *Dr. Jan Kleinn, Aspen Re*
- Long-term records and hurricane activity
  - *Mr. Bill Read, NHC*
- Damage normalization and the influence of landfall variation on losses
  - *Mr. Kevin Sharp, University of Colorado*
- Storm surge and hurricanes
  - *Dr. Jerome Aucan, BIOS*
- From Intensity change to landfall risk: An overview of tools developed at FSU
  - *Prof. Robert Hart, FSU*
- Tropical cyclones and climate change
  - *Prof. Russ Elsberry, Naval Postgraduate School*

10.2 The presentation materials of these lectures are available at http://www.bas-serco.bm/hc32/Bermuda_Hurricane_Seminar_2010/

11. DATE AND PLACE OF THE THIRTY-THIRD SESSION

The Committee was informed that a few Member States were given consideration to hosting the 33rd Session of the RAIV Hurricane Committee. A final decision will be made by 1st July in coordination with the president of RAIV, the Chairman of the Committee and the WMO Secretariat.

12. CLOSURE OF THE SESSION

The report of the thirty-second session of the Committee was adopted at its final meeting at 12:00 hours on 12 March 2010.

LIST OF APPENDICES

APPENDIX I	List of Participants
APPENDIX II	Agenda
APPENDIX III	RSMC Miami - 2009 North Atlantic and Eastern North Pacific Hurricane Season Summary
APPENDIX IV	2009 Hurricane Season Reports (Submitted by Members of the RA IV Hurricane Committee)
APPENDIX V	RA IV Hurricane Committee's Technical Plan and its Implementation Programme
APPENDIX VI	Guide on the hydrological information contained in the annual national reports on hurricanes, tropical storms, and perturbations with associated flooding
APPENDIX VII	Report of the first meeting of the Assistance for Haiti Task Team

APPENDIX I

LIST OF PARTICIPANTS

1. MEMBERS

COUNTRY	PARTICIPANT
ANTIGUA AND BARBUDA	**Mr. Keithley MEADE** Tel. No: + 1.268.462.4606 Fax No: + 1.268.462.4606 E-mail: keithleym@yahoo.com metoffice@antigua.gov.ag
BAHAMAS	**Mr. Arthur ROLLE** Tel. No: + 1.242.356.3726 Fax No: + 1.242.356.3739 E-mail: rollearthur@gmail.com
BARBADOS	**Mr. Hampden LOVELL** Tel. No: + 1.246.418.0818 Fax No: + 1.246.428.1676 E-mail: hlovell@barbados.gov.bb dirmet@sunbeach.net
BELIZE	**Mr. Dennis GONGUEZ** Tel. No: + 501.225.2012 Fax No: + 501.225.2101 E-mail: dgonguez@hydromet.gov.bz dennis_gonguez@yahoo.com

APPENDIX I

BERMUDA (UNITED KINGDOM)	**Dr. Mark GUISHARD** Tel. No: + 1.441.293.5067 x 400 Fax No: + 1.441.293.6658 E-mail: mguishard@bas-serco.bm mark@weather.bm **Ms. Kimberley ZUILL** Tel. No: + 1.441.293.5067 x 400 Fax No: + 1.441.293.6658 E-mail: kzuill@bas-serco.bm **Mr. Simon Gilbert** Tel. No: +44(0) 1392 886807 E-mail: simon.gilbert@metoffice.gov.uk
BRITISH CARIBBEAN TERRITORIES	**Mr. Tyrone SUTHERLAND** Tel. No: + 1.868.622.4711 Fax No: + 1.868.622.0277 E-mail: TSutherland@cmo.org.tt suthcmo@tstt.net.tt **Mr. Fred SAMBULA** Tel. No: + 1.345.945.5773 Fax No: + 1.345.945.5773 E-mail: fred.sambula@caymanairports.com **Mr. Glendell DE SOUZA** Tel. No: + 1.868.622.4711 Fax No: + 1.868.622.0277 E-mail: GDe_Souza@cmo.org.tt
CANADA	**Mr. John PARKER** Tel. No: + 1.902.426.3836 Fax No: + 1.902.426.0259 E-mail: john.k.parker@ec.gc.ca **Mr. Bruce ANGLE** Tel. No: + 1.613.820.2454 E-mail: bruce.angle@ec.gc.ca

APPENDIX I

COLOMBIA	**Mrs. Maria Teresa Martinez** Tel. No: + 571.342.1586 Fax No: + 571.342.1619 E-mail: mariatma@ideam.gov.co
COSTA RICA	**Mr. Juan Carlos FALLA SOJO** Tel. No: + 506.2222.5616, x 108 Fax No: + 506.2223.1837 E-mail: jcfallas@imn.ac.cr
CUBA	**Dr. José Ma. RUBIERA TORRES** Tel No.: + 537.867.0708 Fax No.: + 537.867.0708 E-mail: jose.rubiera@insmet.cu rubieraj@yahoo.com
DOMINICA	**Mrs. Sheryl ETIENNE-LEBLANC** Tel No.: + 1.767.449.1990 Fax No.: + 1.767.449.2020 E-mail: metoffice@cwdom.dm
DOMINICAN REPUBLIC	**Euripides Bolivar LEDESMA V.** Tel. No: + 809.788.1122, EXT. 224 Fax No: + 809.597.9842 E-mail: bolesmb@yahoo.com
EL SALVADOR	**Ms. Lorena R. SORIANO** Tel No.: + 503.22482353 Fax No.: + 503.22679522 E-mail: lsoriano@marn.gob.sv
FRANCE (Martinique)	**Mr. Jean-Noël DEGRACE** Tel. No: + 596.696.25.1230 Fax No: + 596.596.57.2383 E-mail: jean-noel.degrace@meteo.fr

APPENDIX I

GUATEMALA	**Mr Cesar GEORGE** Tel. No: + 502.22606599 Fax No: + 502.22606303 E-mail: gerolc2002@yahoo.com
HAITI	**Mr. Ronald SEMELFORT** Tel. No: + 509.37332885 E-mail: ronasem@yahoo.fr
HONDURAS	**Mr. German J. GÓMEZ C.** Tel. No: + 504.2331114 Fax No: + 504.23333342 E-mail: joaquin_honduras@yahoo.com
JAMAICA	**Mrs. Sylvia McGILL** Tel. No: + 1.876.960.8990 Fax No: + 1.876.960.8989 E-mail: metja@infochan.com wxservice.dir@cwjamaica.com
MEXICO	**Mr. Miguel Á. GALLEGOS BENITEZ** Tel. No: + 1.525.526.364619 E-mail: miguel.gallegos@conagua.gob.mx
NETHERLANDS ANTILLES AND ARUBA	**Dr. Albert A.E. MARTIS** Tel. No: + 599.9.839.3366 Fax No: + 599.9.868.3999 E-mail: albmartis@meteo.an
NICARAGUA	**Mr. Alejandro RODRIGUEZ** Tel. No: + 505.2249.2757 Fax No: + 505.2249.1890 E-mail: ara@ds.ineter.gob.ni

APPENDIX I

PANAMA	**Mr. Cesar Oriel OSORIO VERGARA** Tel. No: + 507.501.3987 Fax No: + 507.501.3992 E-mail: cosorio@etesa.com.pa
SAINT LUCIA	**Mr. Venantius DESCARTES** Tel. No: + 1.758.287.5653 Fax No: + 1.758.453.2769 E-mail: vdescartes@yahoo.com slumet@hotmail.com
SPAIN	**Mr. Fermin ELIZAGA** Tel. No: + 34.915.819.854 E-mail: fermin.elizaga@inm.es
TRINIDAD AND TOBAGO	**Mr. Emmanuel MOOLCHAN** Tel No.: + 868.669.5465 Fax No.: + 868.669.4009 E-mail: dirmet@tstt.net.tt e-moolchan@hotmail.com
UNITED KINGDOM	**Dr Mark GUISHARD** Tel. No: + 1.441.293.5067 x 400 Fax No: + 1.441.293.6658 E-mail: mguishard@bas-serco.bm

APPENDIX I

UNITED STATES OF AMERICA	**Mr. Bill READ** Tel. No: + 1.305.229.4409 Fax No: + 1.305.553.1901 E-mail: bill.read@noaa.gov **Dr. Lixion A. AVILA** Tel. No: + 1.305.229.4410 Fax No: + 1.305.553.1901 E-mail: lixion.a.avila@noaa.gov **Ms. Caroline E. CORVINGTON** Tel. No: + 1.301.713.1790 x 126 Fax No: + 1.301.587.4524 E-mail: caroline.corvington@noaa.gov **Mrs. Courtney DRAGGON** Tel. No: + 1.301.713.1786 E-mail: courtney.draggon@noaa.gov **Mr. Fredrick BRANSKI** Tel. No: + 301.713.3538 Fax No: + 301.713.9450 E-mail: fred_brankski@noaa.gov **Mr. Bart HAGEMEYER** Tel. No: + 321.254.6083 Fax No: + 321.255.0791 E-mail: bart.hagemeyer@noaa.gov **Lt. Col. David BORSI** Tel. No: + 228.596.7071 E-mail: david.borsi@us.af.mil

2. OBSERVERS

RA IV Hydrological Advisor	**Mr Eduardo PLANOS GUTIÉRREZ** Tel. No: + 537.828.6672 Fax No: + 557.826.8010 E-mail: eduardo.planos@insmet.cu
CARIBBEAN METEOROLOGICAL ORGANIZATION	**Mr. Tyrone SUTHERLAND** Tel. No: + 1.868.622.4711 Fax No: + 1.868.622.0277 E-mail: TSutherland@cmo.org.tt
WMO/CAS	**Mr. Russell ELSBERRY** Tel. No: + 831.656.2373 Fax No: + 831.656.3061 E-mail: elsberry@nps.edu
ICAO	**Mr. Enrique Camrillo** Tel. No: + 52.55.5250.3211 E-mail: ecamarillo@mexico.icao.int

3. WMO SECRETARIAT

Mr. Koji KUROIWA	Chief Tropical Cyclones Division (TCP) Weather and Disaster Risk Reduction Services Department (WDS) Tel. No: + 41.22.730.8453 Fax No: + 41.22.730.8128 E-mail: kkuroiwa@wmo.int
Mr. Peter CHEN	Chief Data Processing and Forecasting Division Weather and Disaster Risk Reduction Services Department (WDS) Tel. No: + 41.22.730.8231 E-mail: pchen@wmo.int

Mr. Hugo HIDALGO	WMO Office for North America, Central America and the Caribbean, Programme Officer Tel. No: + 506.2258.2370 Fax No: + 506.2256.8240 E-mail: hhidalgo@wmo.int
Ms. Marta ARTERO	WMO, Spanish Translator Tel. No: + 41.22.730.8465 E-mail: martero@wmo.int

4. OTHER ATTENDEES

CAYMAN ISLAND HMO	**Mr. Frederick MCCLEARY** Tel. No: + 345.526.6362 E-mail: mccleary.frederick@gov.ky
GLOBAL SCIENCE & TECHNOLOGY INC.	**Mr. Gene SHAFFER** Tel. No: + 240.542.1129 E-mail: shaffer@gts.com

APPENDIX II

AGENDA

1. ORGANIZATION OF THE SESSION

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

2. REPORT OF THE CHAIRMAN OF THE COMMITTEE

3. COORDINATION WITHIN THE WMO TROPICAL CYCLONE PROGRAMME

4. REVIEW OF THE PAST HURRICANE SEASON

    4.1 Summary of the past season

    4.2 Reports of hurricanes, tropical storms, tropical disturbances and related flooding during 2009

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 2010 AND BEYOND

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

9. OTHER MATTERS

10. SCIENTIFIC LECTURES AND DISCUSSIONS

11. DATE AND PLACE OF THE THIRTY-THIRD SESSION

12. CLOSURE OF THE SESSION

APPENDIX III

SUMMARY OF THE PAST SEASON

2009 Atlantic and Eastern North Pacific Hurricane Season Summary

(***Submitted by the RSMC Miami***)

Atlantic

The 2009 Atlantic hurricane season was marked by below-average tropical cyclone activity with the formation of nine tropical storms and three hurricanes, the lowest numbers since the 1997 Atlantic hurricane season. Two of the hurricanes strengthened into major hurricanes, Category 3 or higher on the Saffir-Simpson Hurricane Wind Scale. The numbers of tropical storms and hurricanes were below the long-term averages of 11 and 6, respectively, although the number of major hurricanes equaled the long-term (1966 to present) average of 2. In terms of the Accumulated Cyclone Energy (ACE) index1, 2009 had 60% of the long-term median ACE, also the lowest value since 1997. There were two tropical depressions that did not reach tropical storm strength. The below-normal activity appears to have been the result of strong vertical wind shear and large-scale sinking in the tropical atmosphere, associated with the development of El Niño during the summer months.

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

Tropical Depression One

Tropical Depression One formed before the official start of the Atlantic hurricane season, originating from a decaying frontal boundary over the western Atlantic Ocean. An area of low pressure developed along the boundary on May 26 about 290 miles south-southeast of Wilmington, North Carolina, and moved northward and northeastward over the next couple of days. The low produced scattered shower activity across parts of eastern North Carolina before becoming a tropical depression on May 28 about 175 miles east-northeast of Cape Hatteras. The depression moved northeastward over the warm waters of the Gulf Stream, but westerly vertical wind shear soon developed over the system, and it degenerated into a remnant low centered about 345 miles south-southeast of Halifax, Nova Scotia, early on May 30. The remnant low then merged with a warm front that extended southeastward from a larger area of low pressure over eastern Canada.

Tropical Storm Ana

Ana developed from a well-organized tropical wave that moved off the west coast of Africa on August 8. A surface low formed along the tropical wave axis on August 10, and the system became a tropical depression on August 11 about 230 miles west of the Cape Verde Islands.

The depression strengthened and was a tropical storm for a brief period on August 12, but easterly shear, cool sea surface temperatures, and dry air in the mid- to upper-levels of the atmosphere caused it to weaken to a depression and then a remnant low on August 13. The

1 The Accumulated Cyclone Energy (ACE) index is a measure of the collective strength and duration of all tropical storms and hurricanes during the year, calculated by adding up the squares of the maximum wind speeds (in knots) at six-hour intervals for each storm.

remnant low moved westward at a faster forward speed for a day or so, and thunderstorm activity increased near its center on August 14. The system once again became a tropical depression early on August 15 about 1075 miles east of the Lesser Antilles and reached tropical storm intensity later that day. However, westerly shear and dry air aloft caused Ana to weaken back to a tropical depression a day later while centered about 405 miles east of the Lesser Antilles. Satellite and aircraft reconnaissance observations indicated that Ana lost its well-defined center on August 16 as it moved rapidly westward, and it became a tropical wave before reaching the Lesser Antilles.

Hurricane Bill

Bill formed from a vigorous tropical wave and associated broad area of low pressure that moved off the west coast of Africa on August 12. The low moved westward, well to the south of the Cape Verde Islands, and developed into a tropical depression on August 15 centered about 380 miles west-southwest of those islands. Light vertical wind shear allowed the depression to steadily intensify, and it became a tropical storm later on August 15 and then a hurricane on August 17 about midway between the Cape Verde Islands and the Lesser Antilles. Bill continued to strengthen and reached its estimated peak intensity of 135 mph at 0600 UTC on August 19 when it was centered about 345 miles east-northeast of the northern Leeward Islands. Bill remained a Category 4 hurricane for about a day as it began to turn northwestward over the western Atlantic between a trough near the east coast of the United States and a subtropical high over the central Atlantic. Vertical shear began to increase, and Bill slowly weakened to a Category 2 hurricane by the time its center passed 175 miles west of Bermuda on the morning of August 22. The hurricane recurved over the western Atlantic and turned toward the northeast with increasing forward speed, brushing the southern coast of Nova Scotia and making landfall as a tropical storm on the Burin Peninsula of Newfoundland on August 23. Bill then crossed the southeastern portion of Newfoundland and became extratropical over the north Atlantic on August 24. The extratropical low then moved eastward for a couple of days and was absorbed by a larger extratropical low near the British Isles early on August 26.

Although the center of Bill passed west of Bermuda, the hurricane produced tropical-storm-force winds on that island. An elevated observing site at the Bermuda Maritime Operation Centre reported a 1-minute sustained wind of 75 mph and a peak gust of 78 mph. In Canada, Sable Island, Nova Scotia, reported a sustained wind of 60 mph with a gust to 77 mph, and Cape Race, Newfoundland, reported a sustained wind of 58 mph with a gust to 82 mph. Elsewhere, NOAA buoy 41044, located over the west-central Atlantic about 360 miles northeast of the northern Leeward Islands, measured a 1-minute sustained wind of 77 mph with a gust to 92 mph. The highest reported rainfall associated with Bill was 2.83 inches from Queensport, Nova Scotia, and 2.80 inches from Gander, Newfoundland.

Bill produced large swells as it moved across the western Atlantic Ocean. High surf and rip currents were reported along most of the U.S. East Coast, causing damage to coastal infrastructure and producing some coastal flooding. A 7-year-old girl died in Acadia National Park, Maine, when she was swept into the ocean by large waves, and a 54-year-old swimmer drowned in rough seas near New Smyrna Beach, Florida. Some coastal flooding and damage also occurred in parts of the Dominican Republic. Numerous power outages were reported in Nova Scotia, and road washouts and localized freshwater flooding occurred in Nova Scotia and Newfoundland.

Tropical Storm Claudette

Claudette originated from a well-defined tropical wave that crossed the west coast of Africa on August 7 and moved across the Atlantic over the next several days. Just after the wave passed the Lesser Antilles on August 13, an area of disturbed weather formed near the northern end of the wave axis and then moved west-northwestward across the Bahamas, the Straits of Florida, and the Florida Keys on August 14 and 15. A broad area of low pressure developed once the system moved into the extreme southeastern Gulf of Mexico early on August 16 and quickly became a tropical depression about 60 miles west-southwest of Sarasota, Florida, when showers and thunderstorms became sufficiently organized.

The depression strengthened that day due to favorable upper-level winds, becoming a tropical storm and then reaching its peak intensity of 60 mph as it moved northwestward to north-northwestward over the eastern Gulf of Mexico. However, this strengthening trend was short-lived, and increasing vertical shear caused Claudette to weaken as it approached the Florida Panhandle. Claudette made landfall near Fort Walton Beach, Florida, early on August 17 with maximum sustained winds of 45 mph. Later that morning, the cyclone weakened to a tropical depression as it moved into southern Alabama. It then dissipated late on August 17 near the Alabama-Mississippi border.

The highest sustained wind observed in Claudette was 51 mph from an elevated anemometer on the Tyndall Air Force Base C-MAN tower located about 30 miles offshore the Florida Panhandle. The highest wind gust was an unofficial report of 66 mph from Eastport, Florida. In addition, the largest rainfall total was 4.66 inches from Milligan, Florida, and the maximum reported storm surge was 3 feet at Indian Pass, Florida.

Claudette's impacts along the northern Gulf Coast were minimal, mainly being limited to minor tree damage and beach erosion as well as sporadic power outages. However, a 28-year-old man drowned in heavy surf near the Broadwater Condominiums in Panama City Beach, Florida, and a 45-year-old man was missing and presumed drowned near Shell Island, just to the southwest of Panama City, Florida.

Tropical Storm Danny

Danny was spawned by a tropical wave that moved westward from the coast of Africa on August 18. Shower activity associated with the wave showed some organization on August 22, but westerly vertical wind shear prevented development. On August 25, a U.S. Air Force Reserve Hurricane Hunter aircraft investigating the system found a large area of tropical-storm-force winds but could not find a closed surface circulation. By early on August 26, satellite data indicated that a closed circulation had formed, and the system became Tropical Storm Danny while centered about 495 miles east of Nassau, Bahamas. Due to its interaction with an upper-level trough, Danny had a very non-classical structure, somewhat resembling a subtropical cyclone, with the strongest winds and most of the showers and thunderstorms displaced far from the center.

Danny moved erratically toward the northwest and gradually strengthened, reaching a peak intensity of 60 mph on August 27. However, southwesterly vertical wind shear increased, and Danny began to gradually weaken as it continued moving northwestward. Late the next day, a strong upper-level trough moving across the southeastern United States caused Danny to turn northeastward and also contributed to the formation of a low pressure area near the coast of North Carolina. Danny subsequently degenerated to a trough on August 29 about 275 miles southeast of Wilmington, North Carolina, and its remnants were absorbed by a developing frontal zone extending south of the coastal low.

The highest reported winds in Danny were a sustained wind of 45 mph and a gust to 55 mph, received from NOAA buoy 41047, located northeast of the Bahamas. One death occurred in Corolla, North Carolina, when a 12-year-old boy drowned in surf generated by the storm.

Tropical Storm Erika

Erika originated from a tropical wave that moved off the west coast of Africa on August 25. The wave moved quickly westward and generated a broad area of low pressure late on August 27 centered about 390 miles southwest of the southernmost Cape Verde Islands. For several days the low produced showers and thunderstorms, developing winds to tropical storm force but lacking a well-defined low-level center. On September 1, a U.S. Air Force Reserve reconnaissance aircraft found a broad closed circulation that was sufficiently well-defined to classify the system as a tropical cyclone. At that time, Tropical Storm Erika was centered about 290 miles east of Guadeloupe and had maximum winds near 50 mph. The low-level center was exposed to the west of a large cluster of showers and thunderstorms at formation, but aircraft reconnaissance indicated that new centers reformed twice in the subsequent hours. Erika continued to move generally westward, and westerly vertical wind shear kept the low-level center exposed to the west of the thunderstorm activity. This led to weakening, and Erika is estimated to have been a 40-mph tropical storm when its center crossed near or over Guadeloupe on September 2. Although Erika strengthened slightly over the eastern Caribbean Sea early on September 3, it ultimately weakened to a tropical depression later that day while located about 80 miles south-southeast of St. Croix in the U.S. Virgin Islands. Erika quickly degenerated into a remnant low and dissipated early on September 4 as its center passed about 80 miles south of the southwestern tip of Puerto Rico.

There were no reports of sustained tropical-storm-force winds associated with Erika in the Lesser Antilles. Antigua reported a peak 1-minute sustained wind of 35 mph with a gust to 45 mph and a storm-total rainfall of 1.94 inches. Some flooding and landslides occurred in parts of the northern Leeward Islands, and Erika's remnants caused minor flooding in Puerto Rico and the Dominican Republic.

Hurricane Fred

Fred developed from a tropical wave that moved off the west coast of Africa on September 6. A broad area of low pressure formed along the wave later that day, and the thunderstorm activity became organized enough for the system to become a tropical depression on September 7 about 220 miles south-southeast of the island of Brava in the Cape Verde Islands. The depression moved westward and quickly strengthened into a tropical storm on September 8 and then a hurricane early on September 9. Fred then turned toward the west-northwest and rapidly intensified, reaching an estimated peak intensity of 120 mph later that day. Only six hours later, Fred began to weaken due to increasing southwesterly vertical wind shear and an eyewall replacement. Fred turned toward the north-northwest and then northeast ahead of a trough on September 10, and persistent wind shear and lower sea surface temperatures caused the hurricane to weaken to a tropical storm the next day. The system then turned toward the east with the forward motion slowing to less than 5 mph, and the strengthening vertical shear resulted in Fred's low-level center becoming detached from the thunderstorm activity on September 12. The remainder of the thunderstorms dissipated later that day, and Fred degenerated into a remnant low about 570 miles west of Santo Antao in the Cape Verde Islands. The remnant low turned westward on September 13 and moved generally westward to west-northwestward across the Atlantic for nearly a week, ultimately dissipating on September 19 about 520 miles southwest of Bermuda. Fred became the strongest hurricane so far south and east in the north Atlantic basin since 1972, when reliable satellite techniques were developed to estimate storm intensity.

APPENDIX III

Tropical Depression Eight

Tropical Depression Eight formed from a tropical wave that moved off the west coast of Africa on September 23. A broad area of low pressure developed along the wave later that day about midway between Africa and the southernmost Cape Verde Islands. Shower and thunderstorm activity was sporadic, although it slowly became better organized over the next couple of days. The system became a tropical depression on September 25 while centered about 500 miles west of the Cape Verde Islands, but it did not intensify further due to moderate southwesterly shear and marginal sea surface temperatures. The shear continued to increase, and the depression dissipated into a trough of low pressure on September 26.

Tropical Storm Grace

Unlike the other tropical storms and hurricane of 2009, Grace had non-tropical origins. A large extratropical low formed along a cold front on September 27 over the north Atlantic Ocean about 470 miles east of Cape Race, Newfoundland. The low occluded on September 28 and then moved generally southeastward over the next few days. Already producing gale-force winds, the low turned northeastward on October 1 and began to make a counterclockwise loop across the central and western Azores as its structure evolved. It became a tropical storm over the western Azores about 130 miles west of Lajes on October 4 when the associated frontal features dissipated and the thunderstorm activity became sufficiently organized and persistent - meeting the necessary conditions to be considered a tropical cyclone. Records indicate that no other cyclone has become a tropical storm as far northeast over the Atlantic Ocean as did Grace, but like Hurricane Fred, it would have been difficult to identify and assess the intensity of tropical cyclones in this part of the Atlantic basin before the use of reliable satellite intensity techniques began in 1972. Grace developed an eye-like feature while passing through the Azores, and after turning to the northeast, its maximum sustained winds increased to 65 mph early on October 5. Moving quickly north-northeastward over cooler water, Grace merged with a frontal boundary on October 6 and became an extratropical low again about 230 miles west-southwest of Cork, Ireland. The small extratropical low moved east-northeastward over the Celtic Sea and dissipated early on October 7 as it approached Wales in the United Kingdom.

No known damage occurred in the Azores in association with Grace. The highest reported wind in the archipelago was a sustained wind of 31 mph with a gust to 44 mph at Ponta Delgada on São Miguel Island.

Tropical Storm Henri

On October 1, a tropical wave moved off the west coast of Africa and produced intermittent and disorganized shower and thunderstorm activity during the next few days. As the thunderstorms began to increase over a large area around the wave on October 4, a broad low formed and gradually became better defined as it moved westward. Even though the shower and thunderstorm activity was displaced to the east of the low center due to westerly vertical shear, the system did acquire enough organization to become a tropical depression early on October 6 while centered about 775 miles east of the Lesser Antilles.

Moving west-northwestward, the depression became a tropical storm six hours after formation, but the center remained on the western edge of the thunderstorm activity. Despite vertical shear, Henri strengthened and reached a peak intensity of 50 mph early on October 7. The shear over Henri then increased, and steady weakening commenced with the system becoming a tropical depression early on October 8. Henri then degenerated to a remnant low about 155 miles north-northeast of Anguilla and moved generally westward for a couple of days, ultimately dissipating when its circulation was disrupted by the high terrain of Hispaniola.

Hurricane Ida

Ida was a late-season hurricane that had the greatest impacts on land of all the 2009 Atlantic tropical cyclones. It originated from a poorly-defined tropical wave that reached the western Caribbean Sea on November 1 and a large cyclonic gyre located over the southwestern Caribbean Sea, Central America, and the adjacent eastern North Pacific Ocean. A low formed over the southwestern Caribbean Sea on November 2 and moved very little over the next couple of days. Surface pressures continued to fall as showers and thunderstorms became organized near the center of the low, and a tropical depression formed early on November 4 just to the southeast of San Andres Island. The depression quickly strengthened to a tropical storm while heading northwestward toward the coast of Nicaragua and intensified to a hurricane early on November 5. Soon thereafter, Ida passed over the Corn Islands and made landfall in the vicinity of Rio Grande on the east coast of Nicaragua with maximum sustained winds of 80 mph.

For the next 30 hours, Ida moved northward over the high terrain of Nicaragua and Honduras and consequently weakened into a tropical depression. However, it re-strengthened into a tropical storm early on November 7 once it moved back over water just north of the eastern tip of Honduras. Ida regained hurricane status early on November 8 over the northwestern Caribbean Sea and then accelerated northward through the Yucatan Channel into the southeastern Gulf of Mexico, becoming the first November hurricane in the Gulf since Hurricane Kate of 1985. It reached a peak intensity of 105 mph early on November 9 but then weakened to a tropical storm later that day over the central Gulf of Mexico due to increased vertical shear.

The weakening trend was reversed when thunderstorm activity re-developed near the center of Ida around midday on November 9. Reconnaissance and oil rig data indicated that Ida once again reached hurricane strength as it was approaching the mouth of the Mississippi River later that afternoon, with maximum sustained winds of 85 mph. Cooler waters in the northern Gulf of Mexico and a new round of strong shear then caused Ida to weaken for the final time. The cyclone turned toward the northeast and east and lost its tropical characteristics just before its center moved ashore along the Alabama coast on the morning of November 10. Nevertheless, a large portion of the northern Gulf of Mexico coastline experienced tropical-storm-force winds before the center of Ida reached the coast and before the storm evolved into an extratropical cyclone. The cyclone dissipated over the Florida Panhandle on the morning of November 11, but Ida's remnants contributed to the formation of a separate, strong extratropical storm that affected the U.S. East Coast during the following few days.

Due to the sparse observing network in Central America, no wind reports of tropical-storm or hurricane force have been received from Nicaragua and Honduras. However, NOAA buoy 42056 in the northwestern Caribbean Sea did report a maximum sustained wind of 74 mph with a gust to 86 mph. Maximum rainfall reports from the region include 9.1 inches from Puerto Cabezas, Nicaragua, 7.1 inches from Puerto Lempira, Honduras, and 12.5 inches from Manuel Lazo, Cuba. The Meteorological Service of Nicaragua reported that about 6,000 residents along the Caribbean coast of Nicaragua and on the Corn Islands were affected by Ida. More than 80% of the houses and schools were demolished, but there were no reported deaths in that region. At the time, press reports had indicated that 124 people died in El Salvador from flooding and mud slides, but these deaths were due to a separate area of low pressure over the far eastern North Pacific Ocean.

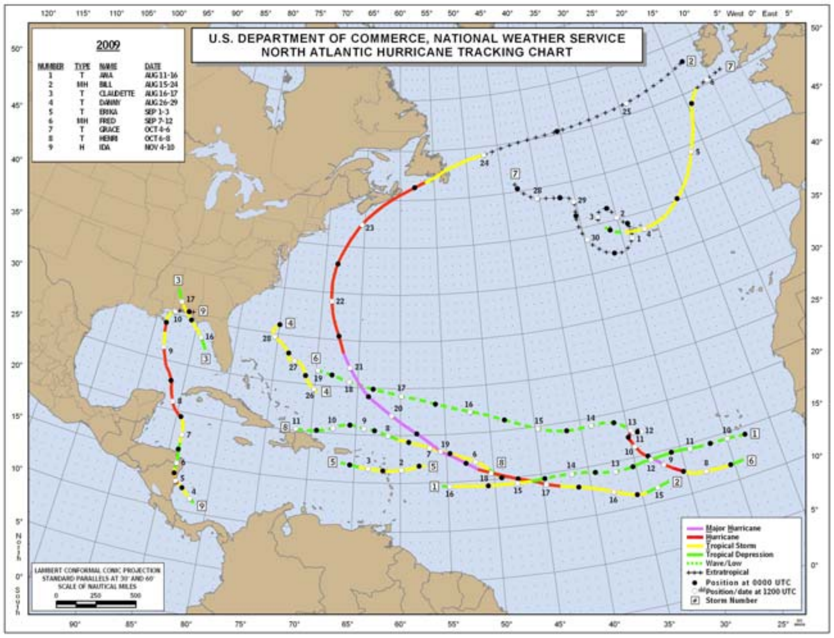
In the United States, the highest reported sustained wind was 60 mph with a peak gust of 74 mph from an elevated sensor at Pilot's Station East on the Southwest Pass of the Mississippi River. Another elevated anemometer at a nearby station on the Southwest Pass reported a maximum sustained wind of 58 mph with a gust to 68 mph. Rainfall totals were generally light, and the highest reported rainfall was 3.42 inches at Pascagoula, Mississippi. Ida produced a storm surge along the northern Gulf Coast from the Florida Panhandle to Louisiana, and the highest reported surges were 6.53 feet from a gauge in Bay Gardene, Louisiana, and 5.62 feet from Shell Beach, Louisiana. One death was reported in Louisiana when a 70-year-old man went missing after motoring his boat into the Mississippi River to assist two men who were ultimately rescued by the U.S. Coast Guard.

Storm Name	**Class***	**Dates****	**Maximum Winds (mph)**	**Minimum Central Pressure (mb)**	**Deaths**	**U.S. Damages ($million)**
One	TD	May 28 – 29	35	1006		
Ana	TS	August 11 – 16	40	1003		
Bill	MH	August 15 – 24	135	943	2	
Claudette	TS	August 16 – 17	60	1005	2	minor
Danny	TS	August 26 – 29	60	1006	1	
Erika	TS	September 1 – 3	50	1004		
Fred	MH	September 7 – 12	120	958		
Eight	TD	September 25 – 26	35	1008		
Grace	TS	October 4 – 6	65	986		
Henri	TS	October 6 – 8	50	1005		
Ida	H	November 4 – 10	105	975	1	minor

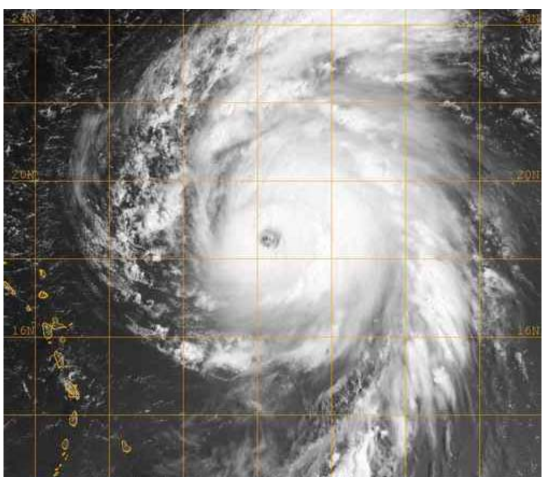
*TD – tropical depression, maximum sustained winds 38 mph or less; TS – tropical storm, maximum sustained winds 39 – 73 mph; H – hurricane, maximum sustained winds 74 – 110 mph; MH – major hurricane, maximum sustained winds 111 mph or higher.

**Dates based on UTC time and include tropical depression stage.

APPENDIX III



Tracks of Atlantic tropical storms and hurricanes of 2009.
The letter indicators correspond to the names of the storms.



Visible satellite images of Hurricane Bill (left) at 1045 UTC 19 August and intensifying Hurricane Ida (right) at 1635 UTC 8 November, 2009 while the hurricane was heading toward the Yucatan Channel

APPENDIX III

Eastern North Pacific

Tropical cyclone activity during the 2009 eastern North Pacific hurricane season was near average. Seventeen named storms formed, of which seven became hurricanes and four became major hurricanes, category three or higher on the Saffir-Simpson Hurricane Wind Scale. Although the number of tropical storms and major hurricane was near average, the number of hurricanes was slightly below average. The total of four major hurricanes was the highest total since 2006, the last time mature El Niño conditions were observed over the equatorial tropical Pacific. Two tropical depressions formed and did not strength to tropical storm strength. An additional depression formed and became Tropical Storm Lana in the central Pacific. Hurricane Rick became the second strongest hurricane ever recorded in the eastern North Pacific (behind Hurricane Linda in 1997) and the strongest hurricane observed during the month of October in the eastern North Pacific since reliable records began in 1971. In terms of the Accumulated Cyclone Energy (ACE) index, 2009 had about 95% of the long-term median value. Many of the tropical cyclones formed farther west than normal, closer to cooler waters and enhanced westerly vertical wind shear at higher latitudes. This contributed to a large number of weak and short-lived systems over the central and western part of the basin.

Few tropical cyclones affected land during the 2009 hurricane season. Hurricane Jimena made landfall as a category two hurricane along the west coast of the southern Baja California peninsula, and Tropical Storm Rick made landfall close to Mazatlán, Mexico, several weeks later. Hurricane Andres brought heavy rainfall and winds to portions of western mainland Mexico near Manzanillo and Acapulco even though the center remained offshore. Tropical Storms Olaf and Patricia briefly threatened the southern Baja California peninsula but weakened before reaching that area.

Tropical Depression One-E

The genesis of Tropical Depression One-E can be traced to a tropical wave that entered the eastern North Pacific on June 10. The wave moved westward during the next five days while generating vigorous but disorganized convection and late on June 15, a broad low formed within the wave several hundred miles south-southwest of Acapulco, Mexico. Convection increased near the center early on June 18, and a tropical depression formed around 1200 UTC that day, when it was centered about 405 miles south-southwest of Mazatlán, Mexico.

The depression turned northward on June 18 and north-northeastward the next day as it moved between the western periphery of a mid-level ridge of high pressure over Mexico and an unusually deep upper-level trough approaching California. Although the depression was briefly on the verge of becoming a tropical storm, the associated convection began to weaken, and the low-level circulation became elongated by June 19 as it approached southwestern Mexico. The depression degenerated into an open trough of low pressure later that day near Las Tres Marías, Mexico.

Hurricane Andres

Andres originated from a tropical wave that entered the eastern North Pacific Ocean on June 16. Shower and thunderstorm activity associated with the wave gradually increased over the next few days as it moved slowly westward, and an area of low pressure formed along the wave on June 20 about 175 miles south-southeast of Acapulco, Mexico. The low became better defined on June 21, and became a tropical depression early that day. The depression moved westward and strengthened into a tropical storm six hours after genesis, while centered about 180 miles south-southwest of Acapulco. Andres then turned northwestward around the southwestern periphery of a mid-level area of high pressure and continued on that heading for nearly the remainder of its existence. Andres steadily intensified during the next 36 hours, and the cyclone reached hurricane strength with an estimated peak intensity of 80 mph around 0600 UTC June 23 while located about 80 miles southwest of Lázaro Cárdenas, Mexico.

As Andres moved nearly parallel to the southwestern coast of Mexico, northeasterly shear increased, and weakening began. The center of Andres passed about 50-60 miles off the southwestern coast of Mexico before weakening to a tropical storm around late that day. The highest wind observation on land was 35 mph with a gust to 45 mph at Manzanillo late on June 24. Thereafter, Andres began moving over cooler waters and into a more stable air mass; this, combined with the northeasterly shear, led to rapid weakening of the cyclone. Andres weakened to a tropical depression by 1200 UTC June 24 while centered about 100 miles west of Cabo Corrientes. The depression then turned northward and became an open trough of low pressure late that day.

Andres was responsible for one death in Mexico. Press reports indicate that damage along the southwestern coast of Mexico was minimal. However, heavy rainfall from Andres and its precursor disturbance flooded homes in a portion of Acapulco, which resulted in the evacuation of about 200 people.

Tropical Storm Blanca

Blanca formed from a tropical wave that entered the eastern North Pacific basin on June 29. Showers and thunderstorms associated with the wave increased near the Gulf of Tehuantepec on July 1; however, the organization of the system did not change much as it moved westward over the next few days. By July 4, deep convection became more consolidated a couple hundred miles south of Manzanillo, Mexico. Additional slow development occurred over the next couple of days, and the system became a tropical depression while centered about 435 miles south of Cabo San Lucas, Mexico, around 0600 UTC July 6.

The flow south of a broad mid-level area of high pressure steered the cyclone on a west-northwestward course throughout its lifetime. About six hours after forming, the system strengthened into a tropical storm, and Blanca is estimated to have reached its maximum intensity of 50 mph by 0000 UTC July 7. Later that day the storm reached waters with sea surface temperatures below 27ºC and began to gradually weaken. Deep convection associated with the cyclone pulsated over the next couple of days but slow weakening continued. Blanca became a tropical depression by July 8 and degenerated into a remnant low early on July 9, while centered about 795 miles west of Cabo San Lucas.

Hurricane Carlos

Carlos originated from an area of disorganized showers and thunderstorms associated with a tropical wave that entered the eastern North Pacific on July 4. The wave changed little during the next few days as it continued westward. Convection increased on July 8, and a tropical depression formed around 0600 UTC July 10 about 900 miles south of the southern tip of Baja California.

The depression moved westward along 10°N over warm waters in an environment of low wind shear, and became a tropical storm around 1800 UTC July 10. Steady intensification of this small tropical cyclone continued, and Carlos became a hurricane with an intensity of 85 mph at 0000 UTC July 12. Shortly thereafter, Carlos weakened as quickly as it had strengthened and became a 50-mph tropical storm by 0000 UTC July 13. A new round of intensification then began, and the cyclone reached an estimated peak intensity of 105 mph around 0000 UTC 15 July, becoming the strongest hurricane so far south in the eastern North Pacific since reliable records began in 1971.

Carlos encountered strong shear as it approached 130°W on July 15. This caused an abrupt deterioration of the cloud pattern, and the cyclone weakened rapidly from its peak intensity to a tropical depression in about a day. By 0000 UTC July 17, the circulation of Carlos dissipated about 2185 miles west-southwest of the southern tip of Baja California.

Tropical Storm Dolores

Dolores formed from a tropical wave that entered the eastern Pacific basin on July 8. The wave moved slowly westward, and a large but poorly defined low pressure area developed from it several hundred miles south of Acapulco, Mexico, on July 11. The circulation of the low became better defined, and the associated shower activity became better organized on July 14 as the system moved west-northwestward. It is estimated that a tropical depression formed near 0000 UTC July 15 about 695 miles west-southwest of Manzanillo, Mexico.

The cyclone moved generally northwestward on the southwestern side of a mid-level ridge over northern Mexico and the adjacent Pacific waters. Although the depression was located in an environment of southwesterly vertical wind shear, it strengthened to a tropical storm about 12 hours after genesis. Dolores reached an estimated peak intensity of 60 mph near 0000 UTC July 16 about 620 miles southwest of the southern tip of Baja California. The associated convection dissipated shortly afterward, possibly due to the entrainment of dry air associated with an upper-level trough. Dolores degenerated into a gale-force non-tropical low around 1800 UTC July 16, and the sustained winds fell below gale force six hours later.

Tropical Depression Six-E

Tropical Depression Six-E originated from a westward moving tropical wave that entered the eastern North Pacific on July 21. A tropical depression formed around 1200 UTC July 30 while centered about 1185 miles east-southeast of Hilo, Hawaii. The depression moved quickly westward to the south of the subtropical ridge, and crossed 140°W longitude into the central North Pacific basin. It became Tropical Storm Lana around 1800 UTC that day, when it was centered about 1075 miles east-southeast of Hilo.

Tropical Storm Enrique

Enrique developed from a tropical wave that crossed Central America on July 30. Although disorganized, convection gradually increased over the next few days, and a tropical depression formed around 1800 UTC August 3, centered about 665 miles southwest of Manzanillo, Mexico. The depression became a tropical storm around 0000 UTC August 4.

Enrique strengthened quickly after becoming a tropical storm, but its intensification was interrupted later that day. The cyclone moved west-northwestward and then northwestward over the next few days, steered between a subtropical mid-level ridge to its north and the circulation associated with Hurricane Felicia to its west. Enrique began to move over cooler sea surface temperatures on August 5, which combined with northerly shear to cause slow weakening. Enrique weakened to a tropical depression around 0000 UTC August 7 about 910 miles west-southwest of Punta Eugenia, Mexico, and then degenerated into a remnant low by 0000 UTC August 8.

Hurricane Felicia

Felicia's genesis can be traced to a tropical wave that moved into the eastern North Pacific on July 30. After the wave passed 110°W on 1 August, convection increased and exhibited signs of organization, and a tropical depression formed on August 3 around 1800 UTC. The depression became a tropical storm by 0000 UTC August 4, while centered about 1140 miles southwest of the southern tip of Baja California.

In an environment of low shear and 28°- 29°C sea surface temperatures, Felicia began a period of rapid intensification and reached hurricane strength by 1800 UTC August 4. The hurricane initially moved west-northwestward to the south of a deep-layer ridge over the central portion of the basin. By August 5, Felicia turned northwestward as it reached the western edge of the ridge and encountered a trough digging along 130°W.

On its northwestward course, Felicia continued to rapidly intensify and reached its estimated peak intensity of 145 mph at 0600 UTC August 6, while located about 1685 miles east-southeast of Hilo, Hawaii. Gradual weakening began during the next 24 hours, followed by a faster weakening after Felicia began moving over 26°-27°C sea surface temperatures. Around this time, mid-level ridging increased to the north and west of the hurricane, resulting in a west-northwesterly course just prior to Felicia's entrance into the central North Pacific basin with 90 mph winds around 1200 UTC August 8.

Tropical Depression Nine-E

Tropical Depression Nine-E formed from a tropical wave that entered the eastern North Pacific basin on August 1. The wave spawned a broad area of low pressure on August 7 about 800 miles south-southwest of the southern tip of Baja California. The circulation gradually became better defined over the next 24 to 36 hours, although the associated shower and thunderstorm activity remained limited. Around 1200 UTC August 9, thunderstorm activity began to increase in association with the low, and a tropical depression formed around 1800 UTC that day, about 885 miles southwest of the southern tip of Baja California.

In an environment of moderate westerly shear, the depression did not strengthen as it moved generally westward during the next day or so. Although the depression briefly neared tropical storm strength, microwave imagery indicated that the low-level center soon became exposed to the west of the convective activity. The deep convection dissipated later that day, and the depression degenerated into a remnant low around 0000 UTC August 12, while centered about 1380 miles west-southwest of the southern tip of Baja California.

Hurricane Guillermo

Guillermo was spawned by a tropical wave that entered the eastern Pacific on August 5.
An elongated area of low pressure formed along the wave axis, and disorganized banding features formed on August 8. Thunderstorms increased near the circulation center late on August 11, and it is estimated that a tropical depression formed by 1200 UTC August 12, located about 655 miles south-southwest of the southern tip of Baja California. The depression became a tropical storm 12 hours later.

Guillermo intensified to a major hurricane in about 48 hours, as it moved westward to west-northwestward. A banded eye was noted in visible satellite images late on August 13, and Guillermo became a hurricane on 14 August. Thereafter, intensification was briefly interrupted, as the banding eye structure transitioned into a central dense overcast, and rapid intensification began later that afternoon. Guillermo became a major hurricane on August 15, reaching an estimated peak intensity of 125 mph at 0600 UTC while located about 1495 miles from the southern tip of Baja California. Slow weakening began later that day due to decreasing sea-surface temperatures, and Guillermo crossed into the Central Pacific basin around 0000 UTC August 17 with an intensity of 80 mph.

Tropical Storm Hilda

Hilda appears to have originated from a tropical wave that entered the eastern Pacific on August 13. The system moved westward for several days with little or no signs of development.

A low-level circulation formed by 1200 UTC August 21, however, thunderstorm activity associated with this circulation remained disorganized until 1200 UTC August 22 when it is estimated that a tropical depression formed while centered 1300 miles east-southeast of the Big Island of Hawaii. Although the cyclone was situated in an environment of northeasterly vertical shear, it became a tropical storm about six hours after genesis.

Hilda moved westward around 10 mph to the south of the eastern edge of a subtropical ridge over the central North Pacific. Strengthening was limited by persistent northeasterly shear, and Hilda crossed into the Central Pacific basin around 1200 UTC August 23 with an intensity of 45 mph.

Tropical Storm Ignacio

Ignacio formed from the same tropical wave that spawned Tropical Storm Ana in the Atlantic basin. The southern portion of the wave entered the eastern North Pacific south of Mexico on August 20, and disorganized shower activity associated with it gradually increased. A broad area of low pressure formed on August 22 south of Cabo Corrientes, Mexico, as the system moved toward the west-northwest. The cloud pattern had enough organization to classify the system as a tropical depression at 1800 UTC August 24 about 690 miles southwest of the southern tip of Baja California, and the depression became a tropical storm six hours later. Ignacio reached its estimated maximum intensity of 50 mph at 1200 UTC that day and then maintained the same strength for a day or so. Afterwards, Ignacio weakened as it moved northwestward over cooler waters. The cyclone degenerated into a remnant low at 1200 UTC August 27 and dissipated on August 29.

Hurricane Jimena

Jimena was spawned by a tropical wave that moved into the eastern Pacific on August 25. The associated shower activity increased in coverage on August 27, and early the next day a low pressure area formed about 300 miles southeast of Acapulco, Mexico. It is estimated that a tropical depression formed around 1800 UTC August 28 about 220 miles south of Acapulco.

The depression initially moved westward on the south side of a mid-level ridge and then turned northwestward on August 30. Microwave imagery indicated that the depression had a small radius of maximum winds at the time of genesis, and the subsequent development was rapid.

The cyclone became a tropical storm early on August 29 and a hurricane later that day. Strengthening continued until Jimena reached an estimated intensity of 140 mph on August 30. At that time, development was interrupted by an eyewall replacement cycle. The cycle finished early on August 31, and Jimena again strengthened, reaching a peak intensity of 155 mph later that day.

Late on August 31, Jimena turned north-northwestward between the ridge, Tropical Storm Kevin to the west, and a mid- to upper-level low west of Baja California. The combination of increasing vertical wind shear, cooler sea surface temperatures, and a second eyewall replacement cycle caused Jimena to weaken early on September 1. Steady weakening and a north-northwestward motion continued until Jimena made landfall over Isla Santa Margarita, Baja California del Sur, about 1200 UTC September 2, with an estimated intensity of 105 mph – Category 2 on the SSHWS. A second landfall occurred an hour later at Puerto San Carlos, Baja California del Sur.

The center of Jimena then briefly re-emerged over the Pacific before turning northward and making a third landfall just east of San Juanico in Baja California del Sur around 2100 UTC September 2. Jimena continued northward across Baja California while weakening to a tropical storm, and the center emerged into the central Gulf of California around 0600 UTC September 3. The steering currents then collapsed, and Jimena drifted erratically over the Gulf for the next 24 hours as weakening occurred, and Jimena become a depression early on 4 September. The depression began moving southwestward later that day and made its final landfall near Santa Rosalia, Baja California del Sur, around 1900 UTC September 4. The depression then weakened to a remnant low as it crossed Baja California, and this low dissipated over the Pacific on September 5.

Media reports indicate that Jimena's winds and rains caused widespread damage on the central and southern Baja California peninsula. The cities of Ciudad Constitución, Mulege, and Loreto were hard hit, along with many smaller towns near the track of the center. Severe freshwater flooding occurred on the Mexican mainland near Guaymas in Sonora where the maximum reported storm-total rainfall was 26.46 inches. However, this total is double that reported at the nearby station of Empalme, and its accuracy is in doubt. While there were no reports of sustained hurricane-force winds, hurricane conditions likely affected much of the Pacific coast of Baja California south of San Juanico. Storm chasers in Puerto San Carlos reported a pressure of 973.0 mb as the eye of Jimena passed over that town.

Reports suggest that the number of damaged buildings was in the tens of thousands, however, no monetary damage figures are available as of this writing. One death has been attributed to Jimena – a drowning due to freshwater flooding in Mulege, Baja California del Sur.

Tropical Storm Kevin

Kevin originated from a tropical wave that entered the eastern Pacific on August 23. The wave moved westward uneventfully for a few days until an area of low pressure formed along the wave on August 27. Deep convection remained intermittent until early on August 29, and it is estimated that a tropical depression formed from the disturbance around 1200 UTC that day, centered about 1025 miles southwest of the southern tip of Baja California. As the cyclone moved west-northwestward, the depression became a tropical storm at 1800 UTC on August 29 while centered about 1045 miles southwest of the southern tip of Baja California.

Kevin moved slowly west-northwestward around the time of genesis, however, the combination of a digging mid- to upper-level trough to the northwest and an anticyclone to the southeast caused a sharp turn toward the north late on August 29. This general northward motion continued for the remainder of Kevin's life as a tropical cyclone. While sea-surface temperatures were moderately warm, Kevin was located in an environment of weak to moderate vertical wind shear, upper-level sinking motion, and relatively dry air in the lower to middle levels of the atmosphere. Despite this, Kevin reached an estimated peak intensity of 50 mph during the period from 0600 to 1200 UTC but began to weaken slowly thereafter. Kevin weakened to tropical depression around 0600 UTC August 31, as it turned toward the north-northwest and northwest. Kevin became a remnant low around 1800 UTC, when centered about 840 miles west-southwest of the southern tip of Baja California.

Hurricane Linda

Hurricane Linda developed from a tropical wave that moved off the west coast of Africa on August 18. The wave split, with the northern portion developing into Atlantic Tropical Storm Danny east of the Bahamas on August 26, while the southern part entered the eastern Pacific basin on August 28. Shower and thunderstorm activity was limited until September 3, and low pressure developed along the wave around 0000 UTC September 6. Deep convection became organized enough for the low to be considered a tropical depression by 0600 UTC September 7, while centered about 1130 miles west-southwest of the southern tip of Baja California. The depression then strengthened into a tropical storm about six hours later.

Linda moved very slowly westward over the next day or so as steering currents collapsed. A mid-level ridge developed east of the cyclone by September 9, and Linda turned toward the northwest and increased in forward speed. The storm gradually intensified during that time, and became a hurricane by 1800 UTC September 9, while centered about 1315 miles west-southwest of the southern tip of Baja California. Linda reached an estimated peak intensity of 80 mph from 0000 to 1200 UTC September 10. Subsequently, shear and cooler sea surface temperatures led to weakening, and Linda became a tropical storm by 0000 UTC September 11. After losing all deep convection, the cyclone degenerated into a remnant low by 0000 UTC September 12, while centered about 1385 miles west of the southern tip of Baja California.

Tropical Storm Marty

Marty originated from a tropical wave that entered the eastern North Pacific on September 10. Disorganized convection developed with the wave on September 13 and became better organized over the next day or two. A broad area of low pressure formed along the wave by 1200 UTC September 15 and the system is estimated to have become a tropical depression around 0000 UTC September 16, while located about 375 miles south of the southern tip of Baja California.

The depression moved slowly northwestward on the western periphery of a subtropical ridge while in an environment of moderate southeasterly shear. In spite of the shear, the cyclone slowly strengthened and reached tropical storm strength about 12 hours later, when it was located 330 miles south-southwest of the southern tip of Baja California. Weak steering currents caused Marty’s forward speed to slow further, and the cyclone drifted northwestward to north-northwestward on September 17 without strengthening further. Around this time Marty began to weaken as it ingested drier and more stable low-level air and encountered increasing southwesterly shear associated with a mid- to upper-level trough near Baja California. The weakening trend accelerated after Marty reached cooler waters, but Marty maintained tropical storm strength until around 1800 UTC September 18. Devoid of deep convection, Marty became a remnant low the following day.

Tropical Storm Nora

Nora originated from a tropical wave that entered the eastern North Pacific on September 15. On September 18, deep convection associated with the wave increased near the Gulf of Tehuantepec and then gradually improved in organization during the next several days.

A low developed along the wave axis on September 22, and late that day convection began to increase near the center. By 0000 UTC September 23, a tropical depression formed about 645 miles southwest of the southern tip of Baja California.

The depression strengthened to a tropical storm six hours later as it moved west-northwestward to northwestward around the southwestern periphery of a subtropical ridge. In a low wind shear environment and over warm waters, Nora steadily strengthened over the next 18 hours and reached a peak intensity of 60 mph around 0000 UTC September 24, while centered about 690 miles southwest of the southern tip of Baja California. Strong southwesterly shear associated with an upper-level trough and cooler waters caused the system to weaken as it turned westward under the influence of a low-level ridge to the north. Nora became a tropical depression around 0000 UTC September 25 about 815 miles west-southwest of the southern tip of Baja California and then degenerated into a remnant low six hours later.

Tropical Storm Olaf

Olaf's precursor wave and an associated area of low pressure entered the eastern North Pacific on September 24. The broad low was close to becoming a tropical depression on September 30 before the associated deep convection dissipated. However, convection returned that night in the northern portion of the large circulation, causing the center to reform farther north. A tropical depression developed around 1200 UTC October 1, when the system was located about 545 miles west-southwest of the southern tip of Baja California.

The depression turned northward and became a tropical storm while moving around the western periphery of a mid-level ridge and reached an estimated peak intensity of about 45 mph around 1200 UTC October 2. Olaf turned sharply eastward early the next day and weakened due to cooler waters and increasing southerly shear. The cyclone weakened to a tropical depression at 0600 UTC October 3, and 12 hours later degenerated into a remnant low about 155 miles west-southwest of Cabo San Lázaro, Mexico.

Tropical Storm Patricia

Patricia formed from a tropical wave that crossed Central America on October 6. Widespread but sporadic deep convection was observed in association with the wave as it slowly moved across the eastern North Pacific during the next few days. A broad low pressure area formed a couple of hundred miles south of Manzanillo, Mexico, on October 9. By October 11 convection became more persistent and a well-defined center of circulation formed. The system became a tropical depression around 1800 UTC that day about 405 miles south-southeast of the southern tip of Baja California, Mexico.

The system reached tropical storm intensity about six hours after genesis. Patricia then gradually strengthened over the next day while moving over very warm waters and experiencing light easterly wind shear. Patricia moved generally north-northwestward between a deep-layer ridge to the east and a mid- to upper-level trough to the northwest, and reached an estimated peak intensity of 60 mph around 0000 UTC October 13, while centered about 220 miles south of the southern tip of Baja California. Moderate southeasterly vertical shear and a more stable air mass then caused Patricia to suddenly weaken. Deep convection dissipated late on October 13, and the cyclone became a remnant low around 0600 UTC October 14, while centered just 30 miles east-southeast of the southern tip of Baja California.

APPENDIX III

Hurricane Rick

Rick developed from a tropical wave that entered the eastern North Pacific on October 12. Associated thunderstorm activity gradually increased in organization as the wave moved westward south of Central America and the Gulf of Tehuantepec. The low acquired sufficient organization to be considered a tropical depression by 1800 UTC October 15, while centered about 320 miles south-southwest of the Gulf of Tehuantepec. Rick rapidly intensified almost immediately after formation as it moved on a west-northwestward course to the south of a deep-layer ridge of high pressure. The cyclone reached tropical storm intensity within six hours and hurricane strength within 24 hours of genesis. Rapid intensification continued for another 36 hours, and Rick attained major hurricane status by 1200 UTC 17 October. Rick finally reached its estimated maximum intensity of 180 mph around 0600 UTC October 18 and became the second strongest hurricane ever recorded (since accurate records began in 1971) in the Pacific Ocean east of the International Date Line, behind only Hurricane Linda of 1997.

After reaching its peak intensity, Rick began to weaken almost as quickly as it strengthened due to increasing southwesterly wind shear east of a mid- to upper-level trough. Rick fell below major hurricane status by 1800 UTC October 19 as it slowed and turned northwestward and then northward under the influence of the trough. Rick continued to rapidly weaken and became a tropical storm 12 hours later, while centered about 270 miles south-southwest of the southern tip of Baja California. Rick then accelerated northeastward as it passed about 150 miles south of the southern tip of the Baja peninsula late on 20 October. Rick made landfall near Mazatlán, Mexico, around 1400 UTC October 21 with maximum sustained winds of around 60 mph. Once inland, Rick quickly dissipated as it moved over the rugged terrain of west-central Mexico and encountered southwesterly shear of about 45 mph.

Media reports indicate that there were two deaths associated with large waves caused by Hurricane Rick. A 38-year-old man fishing was swept out to sea on October 18 at Los Cabos harbor in San José del Cabo. On 19 October, a 16-year old boy drowned at El Medano beach in Cabo San Lucas.

Official Forecast Verification

For all operationally designated tropical (or subtropical) cyclones in the Atlantic and eastern North Pacific basins, the NHC issues an official forecast of the cyclone's center position and maximum 1 –min surface wind speed. Forecasts are issued every 6 h and contain projections valid at 12, 24, 36, 48, 72, 96 and 120 h after the forecast's nominal initial time (0000, 0600, 1200 or 1800 UTC). At the end of the season, forecasts are evaluated by comparing the projected positions and intensities to the corresponding post storm derived "best track" positions and intensities of each cyclone. A forecast is included in the verification only if the system is classified in the best track as a tropical (or subtropical) cyclone at both forecast's initial time and the projection's valid time. All other stages of development (e.g., tropical wave, remnant low, extratropical) are excluded. For verification purposes, forecasts associated with special advisories do not supersede the original forecast issued for that synoptic time; rather, the original forecast is retained. All verifications here include the depression stage. The 2009 NHC official track and intensity forecast verifications for the Atlantic and eastern North Pacific area attached.

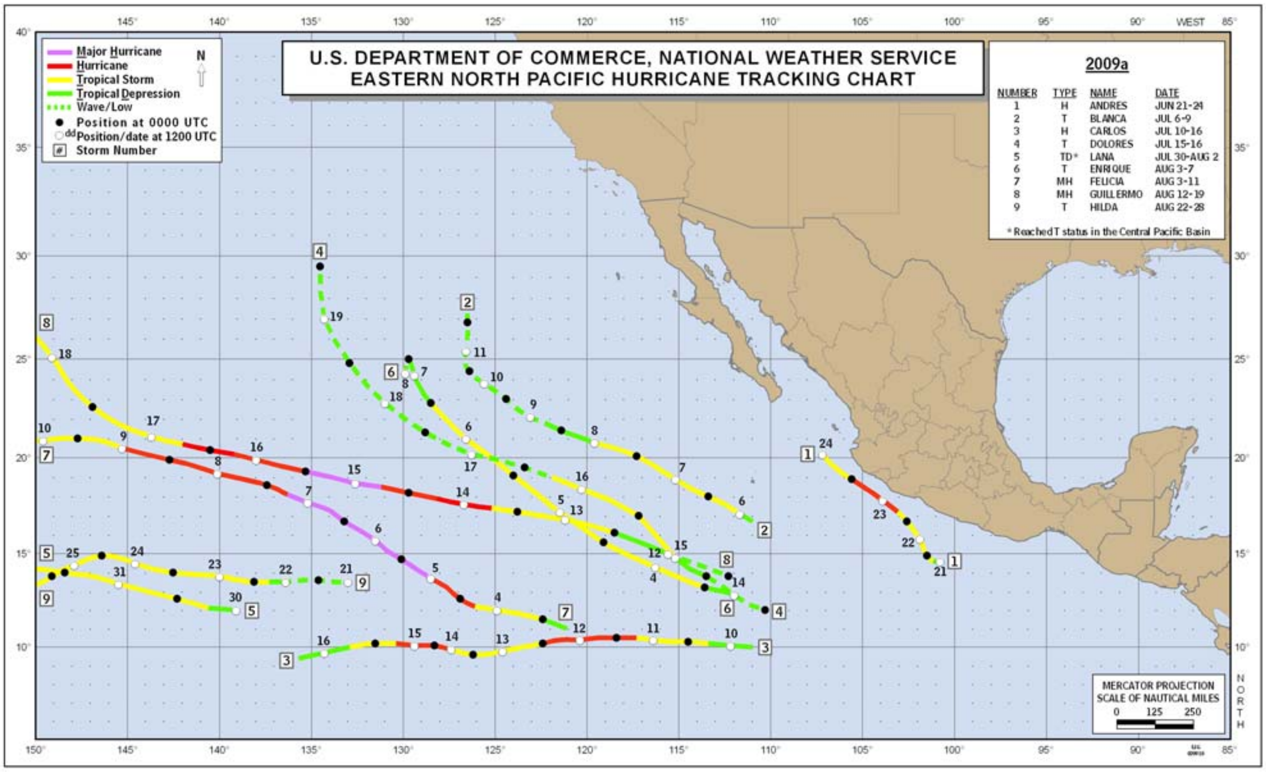
2009 Eastern North Pacific Tropical Storms and Hurricanes

Name	Class[a]	Dates[b]	Winds (mph)	Pressure (mb)	Deaths
Andres	H	June 21-24	80	984	1
Blanca	TS	July 6-9	50	998	
Carlos	H	July 10-16	105	971	
Dolores	TS	July 15-17	50	1000	
Enrique	TS	August 3-7	65	994	
Felicia	MH	August 3-11	135	935	
Guillermo	MH	August 12-20	125	954	
Hilda	TS	August 22-28	65	999	
Ignacio	TS	August 24-27	50	1000	
Jimena	MH	August 29-September 4	155	931	1
Kevin	TS	August 29- September 1	50	1000	
Linda	H	September 7-11	80	985	
Marty	TS	September 16-19	45	1001	
Nora	TS	September 23-25	60	997	
Olaf	TS	October 1-3	60	996	
Patricia	TS	October 11-14	60	996	
Rick	MH	October 15-21	180	906	2

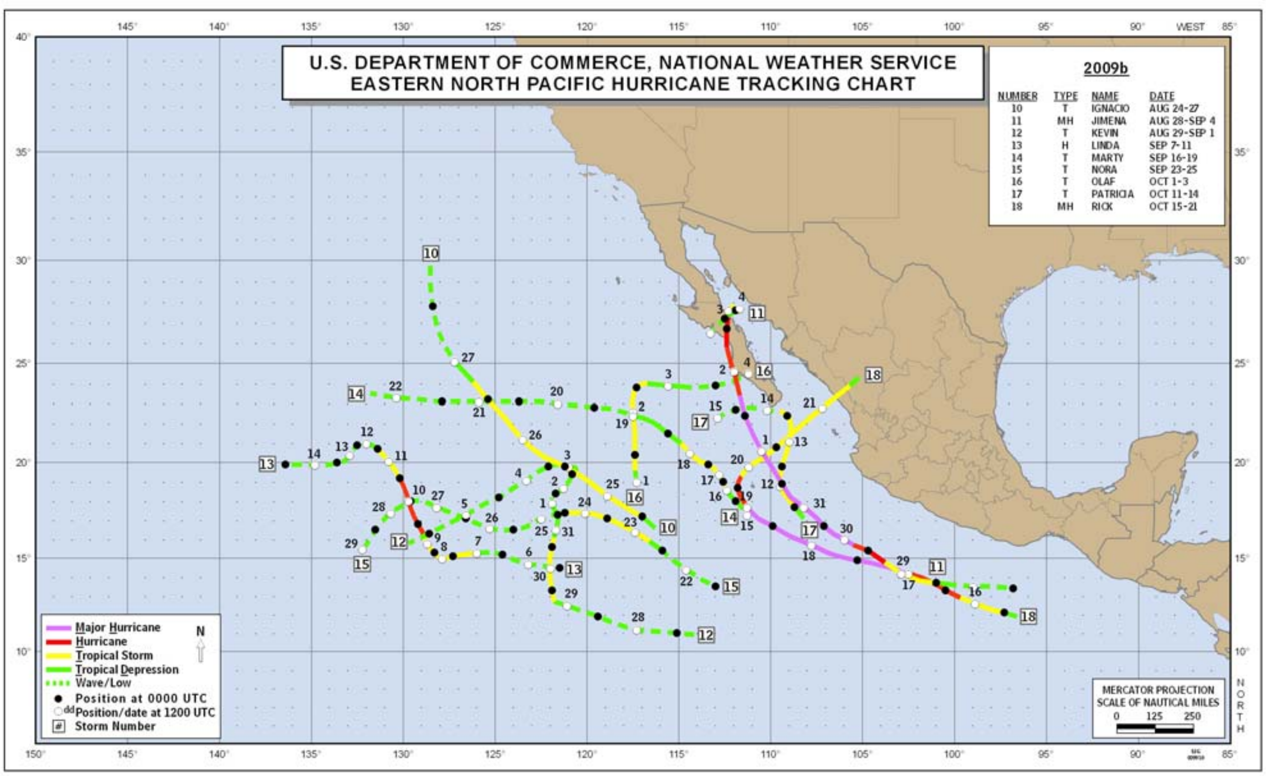
[a] TS - tropical storm, maximum sustained winds 39-73 mph; H - hurricane, maximum sustained winds 74 mph or higher; MH – major hurricane, maximum winds 111 mph or greater.

[b] Dates begin at 0000 UTC and include tropical/subtropical depression stage, but exclude extratropical stage and remnant low stages

APPENDIX III

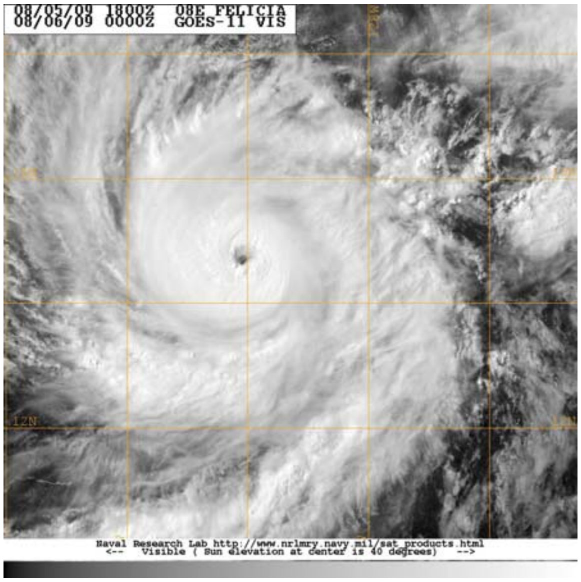


Tracks of eastern North Pacific tropical storms and hurricanes of 2009: Andres through Hilda.



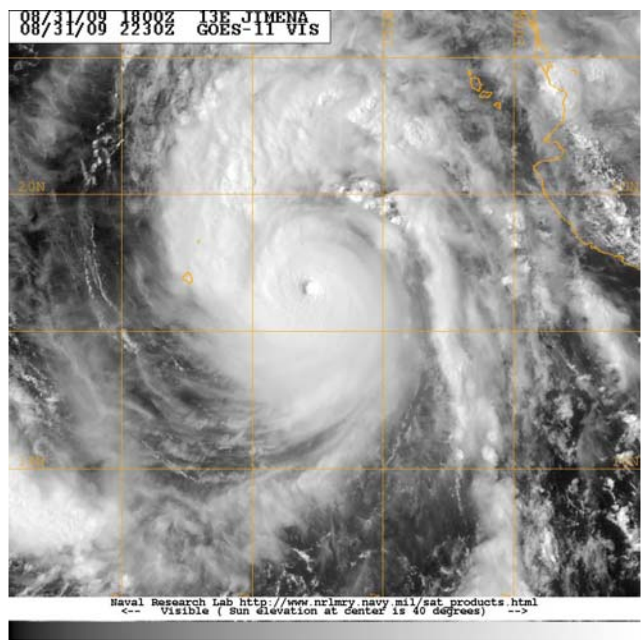
Tracks of eastern North Pacific tropical storms and hurricanes of 2009: Ignacio through Rick.

APPENDIX III

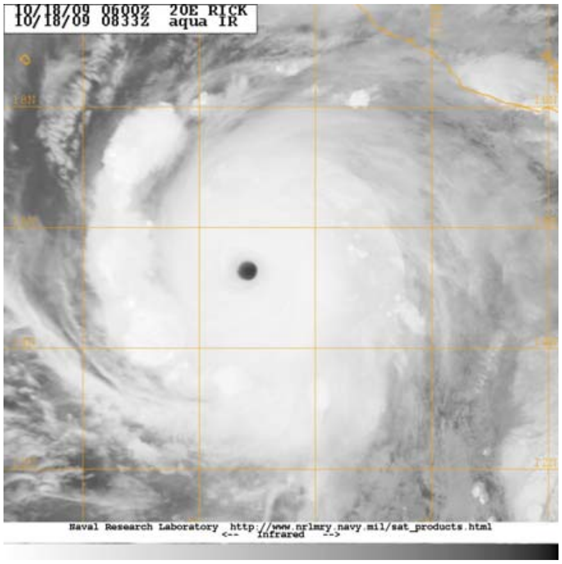


GOES-11 visible satellite image of Hurricane Felicia near its estimated 145-mph peak intensity at 0000 UTC 6 August 2009. Image provided by the Naval Research Laboratory's Marine Meteorology Division in Monterey, CA.

GOES-11 visible satellite image of Hurricane Jimena near its estimated 155-mph peak intensity at 2230 UTC 31 August 2009. Image provided by the Naval Research Laboratory's Marine Meteorology Division in Monterey, CA.



APPENDIX III



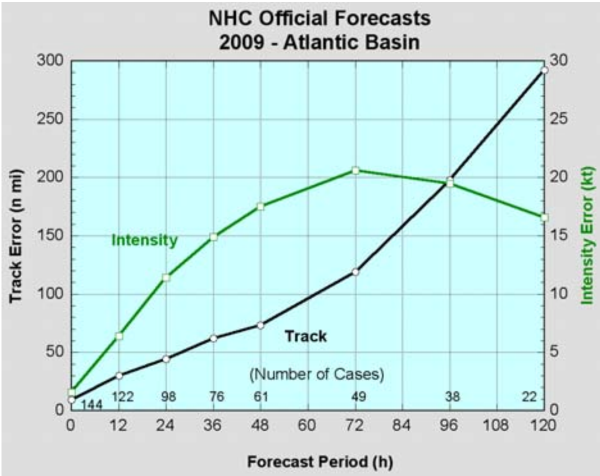
GOES-11 infrared satellite image showing the well-defined eye of Hurricane Rick at 0833 UTC 18 October 2009. Image provided by the Naval Research Laboratory's Marine Meteorology Division in Monterey, CA.

Acknowledgements:

The cyclone summaries are based on the Tropical Cyclone Reports prepared the Hurricane Specialists at the National Hurricane Center. These reports are available at http://www.nhc.noaa.gov/2009atlan.shtml.

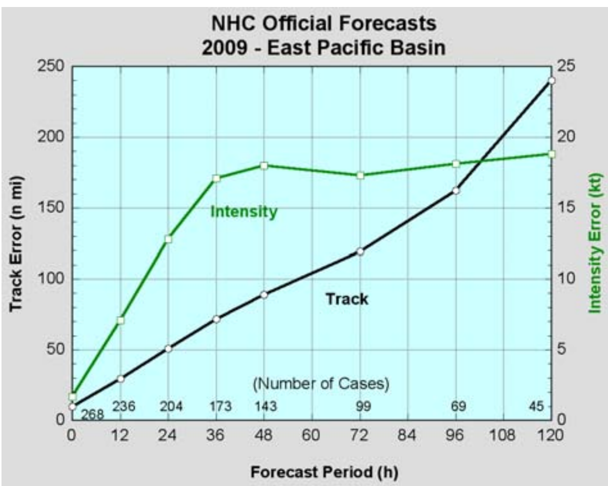
APPENDIX III

Atlantic verification



VT (h)	NT	TRACK (n mi)	INT (kt)
000	144	9.6	1.6
012	120	30.1	6.4
024	96	44.5	11.4
036	75	61.8	14.9
048	61	73.2	17.5
072	49	119.2	20.6
096	38	197.9	19.5
120	22	292.3	16.6

Eastern North Pacific verification



VT (h)	NT	TRACK (n mi)	INT (kt)
000	268	9.7	1.7
012	236	29.5	7.1
024	204	50.9	12.8
036	173	71.9	17.1
048	143	89.0	18.0
072	99	119.2	17.3
096	69	162.5	18.1
120	45	240.4	18.8

Values in green tied or exceeded all-time lows.

APPENDIX IV

REVIEW OF THE PAST HURRICANE SEASON

Reports of hurricanes, tropical storms, tropical disturbances and related flooding during 2009

(Submitted by Members of the RA IV Hurricane Committee)

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

APPENDIX IV

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

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
1.1 DEVELOPMENT OF METEOROLOGICAL SERVICES									
1.1.1	Development and provision of adequate staff and equipment to enable the national Meteorological Services in the area to meet their responsibilities in the provision of hurricane warning services						Members	National and external assistance	
1.1.2	Full implementation of the observing, telecommunication and data-processing systems of the World Weather Watch in the hurricane area						Members	National and external assistance	With advice of WMO, where needed
1.2 METEOROLOGICAL OBSERVING SYSTEM									
1.2.1	Manned surface stations								
1.2.1.1	Assignment of the highest priority to the removal of deficiencies in the synoptic observation programmes at 0000 and 0600 UTC at stations of the RA IV regional basic synoptic network lying in the area between latitudes 5°N and 35°N, and between longitudes 50°W and 140°W*						Members	National	

*During 2010-2011 items with an asterisk to be given priority attention

APPENDIX IV

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
1.2.1.2	Investigation of the possibilities of establishing simple stations which may be operated by volunteers and would supply hourly observations of direction and measured wind speed and atmospheric pressure only during periods (hours) that a hurricane is within about 200 km of the stations						Members with large land masses	National	Such stations could suitably be placed where stations of the WWW network are more than 200 km apart.
1.2.1.3	Introduction of the practice of requesting stations along the shore to provide observations additional to those in the regular programme during hurricane periods, in particular when required by the RA IV Hurricane Operational Plan*						Members	National	
1.2.1.4	Expand the synoptic observation network of the RAIV in the area between latitudes 5ºN and 35º and longitude 50ºW and 140ºW.						Members	National	

*During 2010-2011 items with an asterisk to be given priority attention

APPENDIX IV

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
1.2.2	Upper-air stations								
1.2.2.1	Establishment of the following upper-air stations: • Guatemala • 80400 Isla de Aves - radiosonde						Guatemala Venezuela	) National and) external) assistance	
1.2.2.2	Implementation of two rawinsonde observations per day at all rawinsonde stations throughout the hurricane season*						Members concerned	National and external assistance	
1.2.2.3	Maintaining two rawinsonde observations per day whenever a named hurricane is within 1,000 km of the station, until the requirements of paragraph 1.2.2.2 above can be accomplished*						Members	National	

*During 2010-2011 items with an asterisk to be given priority attention

APPENDIX IV

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
1.2.2.4	Implementation of the upper-air observations required at 0000 GMT under the World Weather Watch plan to enable a sufficient coverage during night hours						Members concerned	National and external assistance	
1.2.3	Ships' weather reports								
1.2.3.1**	Continuation of efforts to recruit ships for participation in the WMO Voluntary Observing Ship Scheme, in particular by : • Recruiting selected and supplementary ships plying the tropics* • Designating Port Meteorological Officers*						Members Members	National National	
1.2.3.2	Improvement of liaison between Meteorological Services and Coastal Radio Stations and arrangements for specific requests for ships' reports from any area of current hurricane activity even if such reports have to be transmitted in plain language*						Members operating coastal radio stations	National	

*During 2010-2011 items with an asterisk to be given priority attention ** concern expressed regarding disclosure of ship position due to security reasons

APPENDIX IV

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
1.2.4	Automatic weather stations								
1.2.4.1	Exploration of the possibility of installing automatic reporting devices at stations with insufficient staff for operation throughout the 24 hours; such stations might then be operated during daylight hours as manned stations and during night-time as unattended automatic stations, possibly with a reduced observing programme	———	———	———	———	———	Members concerned	National and external assistance	
1.2.4.2	Exploration of the possibility of installing automatic weather stations at locations which may be considered critical for the hurricane warning system for operation at least during the hurricane season	———	———	———	———	———	Members concerned	National and external assistance	

APPENDIX IV

I. **METEOROLOGICAL COMPONENT**

TASKS		TIMESCALE 2010	2011	2012	2013	2014	BY WHOM	RESOURCES	COMMENTS
1.2.4.3	Establishment of automatic weather stations at the following locations:								The USA requested that countries planning to install automatic weather stations which use the GOES satellite for collection consult early with NOAA concerning details of the station configuration and transmission code formats which should be in WMO formats if possible
	Dominican Republic (19)						Dom. Rep.	National & USA	
	Panama (6)						Panama	National and external assistance	
	Guatemala (31)						Guatemala		
	Cuba (30)						Cuba		
	Trinidad (3)						Trinidad		
	Jamaica (15)						Jamaica		
	Belize(1)						Belize		
	Mexico (30)						Mexico		

APPENDIX IV

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
1.2.5	Radar stations								
1.2.5.1	Promotion of the establishment and operation of a sub-regional network of 10 cm/5.6 cm wavelength radar stations, including replacement of unserviceable radars*								Being implemented
	• Installation of radar in Cayman Islands						BCT (Cayman Islands)	National & European Union	
1.2.5.2	Establishment and operation of 10 cm/5.6 cm wavelength radar stations at the following locations or nearby:								
	• Honduras (1)						Honduras	) National and external assistance	
	• Guatemala (1)						Guatemala	)	
	• Venezuela (3 more)						Venezuela	)	

*During 2010-2011 items with an asterisk to be given priority attention

APPENDIX IV

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
1.2.5.3	Speedy availability of 10 cm/5.6 cm radar images including the position of the centre to all the other countries in the region, and particularly eye-fixes, to all other countries in the hurricane area in accordance with the Hurricane Operational Plan for Region IV*						Members operating 10 cm/5.6 cm radar stations	National	
1.2.5.4	Development of pictorial radar information sharing programme including composites among all RA IV countries in the hurricane area in accordance with the Hurricane Operational Plan*						France	USA and France	France produces composites based on 5 radars**; USA provide the telecommunication facilities.
1.2.5.5									
.6	Air reconnaissance flights								
1.2.6.1	Continue provision of aircraft reconnaissance when required in accordance with the Hurricane Operational Plan for Region IV and dissemination of the information obtained to all concerned*, whenever this activity is not in violation of the sovereignty of the countries concerned.						USA	USA	

*During 2010-2011 items with an asterisk to be given priority attention

** French Guyana,Trinidad,Barbados,Martinique and Guadeloupe; the others radar from the project (Guyana, Jamaica, Belize) will be added as soon as they are available; Studies will be conducted to integrate radars from Cuba, Porto-Rico and St-Maarten.

APPENDIX IV

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
1.2.7	Meteorological satellite systems								
1.2.7.1	Maintaining and operating the LRIT stations for the reception of cloud pictures from GOES and near-polar-orbiting satellites, including any modified or new equipment necessary for the reception of information from the POES series of satellites*						Members	National	
1.2.7.2	Installation and operation of direct read-out satellite reception facilities, in view of their great utility in hurricane tracking and forecasting*						Members able to do so	National and external assistance	
1.2.8	Storm surges **								
1.2.8.1	Establishment of a network of tide-gauge stations in coastal areas where storm surges are likely to occur						Members able to do so	National	Data should be provided in near real-time

*During 2010-2011 items with an asterisk to be given priority attention

** The Membership is directed take note of Agenda Item 4.1 of the ICG/CARIBE EWS-III Working Documents: Report of Working Group I on Monitoring and Detection Systems, Warning Guidance. The report presents a catalogue of tide gauges and sea level stations maintained by countries in the region and the status of their operation.

APPENDIX IV

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
1.2.9	Lightning detection systems								
1.2.9.1	Installation of a high resolution lightning network for the Lesser Antilles						France, CMO	To be identified	1st phase explore networks available to find one best suited for the region to be upgraded or installed.

APPENDIX IV

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
1.3 METEOROLOGICAL TELECOMMUNICATION SYSTEMS									
1.3.1	National telecommunication networks								
1.3.1.1	Provision of suitable telecommunication facilities for the collection at NMCs of all observational data from stations in the regional basic synoptic network in accordance with the requirements of the WWW (i.e. 95% of reports to reach the collecting centre within 15 minutes of the observing station's filing time)*						Members	National and external assistance	Take urgent action
1.3.2	Special hurricane telecommunication arrangements								
1.3.2.1	Implementation, where necessary, of communication links to enable direct contact between warning centres to permit direct communication between forecasters						Members	National	Use of systems such as VSAT is recommended
1.3.2.2	Implementation, where necessary, of national and international communication links for distribution of warnings and advisories						Members	National and external assistance	

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
1.3.3	Regional telecommunication network								
1.3.3.1	Continue to improve and upgrade telecommunication systems in accordance with the RA IV Regional Meteorological Telecommunication Plan,*						Members		
1.3.3.2	Promote installation of EMWIN systems						USA Members	External Assistance & National budget	

*During 2010-2011 items with an asterisk to be given priority attention

APPENDIX IV

I. METEOROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
1.4 HURRICANE AND STORM SURGE SIMULATION, FORECASTING AND WARNING									
1.4.1	Storm surge project activities								
1.4.1.1	Develop storm surge maps and undertake hazard assessment activities*						Members	National and external assistance including TCDC	With advice of WMO; IOC
1.4.1.2	Undertake bathymetric and topographic data collection for vulnerable areas*						Members		
1.4.1.3	Enhance storm surge map coverage by using SLOSH						Bahamas		Digitized format ; Resolution 0.1 to 1.0 nautical mile
1.4.1.4	Include the tsunami and other coastal hazards early warning system community in storm surge modelling and hazard assessment activities						Members		
							CIMH		

APPENDIX IV

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
1.4.1.5	CIMH in collaboration with UWI and the World Bank will develop a series of storm surge hazard maps for the Caribbean Region								
	Provide bathymetric data towards the development of a local circulation model and inundation risk maps, which will facilitate assessment and real time forecasting of impacts from storm surge, tsunami and other coastal hazards.								

*During 2010-2011 items with an asterisk to be given priority attention;;

APPENDIX IV

II. HYDROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
2.1 SUPPORT TO HYDROLOGICAL SERVICES AND FACILITIES									
2.1.1	Strengthening the national Hydrological Services and, in particular, improvement of the hydrological observing networks and data transmission and processing facilities**						Members concerned	National and external assistance	**This would include promoting the use of quantitative precipitation information from precipitation forecasts, surface radar networks and satellites, as considered in the meteorological component of the Technical Plan
2.1.2	Establishment and development of national and/or sub-regional hydrological workshops to repair and maintain hydrological instruments, and promotion of the establishment of sub-regional facilities for the calibration of these instruments						Members concerned	National and external assistance	

APPENDIX IV

II. HYDROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
2.2 HYDROLOGICAL FORECASTING									
2.2.1	Establishment, improvement and/or expansion of hydrological forecasting (including flash floods) and warning systems in flood-prone areas, and in particular: (a) The countries indicated to be invited to consider the establishment/ expansion of systems in the:							National	
	• YAQUE DEL SUR river basin • YAQUE DEL NORTE river basin						Dominican Republic		
	• RIO LEMPA						El Salvador and Honduras Guatemala		
	• International river, RIO GRANDE (RIO BRAVO) river basin						Mexico & USA		Additional data required
	• VIEJO,COCO and TUMA river basins						Nicaragua		
	• RIO PARRITA and RIO SARAPIQUI						Costa Rica		

APPENDIX IV

II. HYDROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
2.2.1 (cont'd)	Establishment, improvement and/or expansion of hydrological forecasting (including flash floods) and warning systems in flood-prone areas, and in particular:								
	(b) Establishment of flash flood warning systems in flood-prone areas;						Members concerned	National	
	(c) Promote the use of hydrological models to forecast the behaviour of rainfall and run-off characteristics, paying special attention to the use of radar and satellite information.						Members concerned	National	
2.3 BASIC SUPPORTING STUDIES AND MAPS									
2.3.1	Determination of flood-prone areas; compilation of an inventory of existing hydrological observing, transmission and processing facilities in these areas; and determination of requirements for related meteorological services						Members concerned	National and external assistance	For these studies, use should be made insofar as possible, of previous experience of Member countries of the Committee
2.3.2	Implementation of hydrometeorological and rainfall-runoff studies (including depth-area duration-frequency analyses of rainfall) for use in planning and design						Members concerned	National and external assistance	

APPENDIX IV

II. HYDROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
2.3.3	Carry out surveys as soon as possible, immediately following flood events for the purpose of delineating the limits of flooding. The survey should include if possible aerial and satellite imagery						Members concerned	National	
2.3.4	Preparation of flood risk maps in flood-prone areas for their use in: (a) Planning and undertaking preventive measures and preparations for flood mitigation; (b) Long-term planning covering land use						Members concerned	National	Members sharing basins encouraged to standardize the scales of these maps
2.3.5	Assessment of quantitative precipitation information from precipitation forecast, satellite, radar and raingauge networks for flood forecasting						Members concerned	National and external assistance including TCDC	

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
2.3.6	Initiation of research studies and operational data collection for analysis and forecasting of combined effects of storm surge and river flooding phenomena** ** WMO Operation Hydrology Report No. 30 "Hydrological Aspects of Combined Effects of Storm Surges and Heavy Rainfall on River Flow"						Members	National and external assistance	For these studies, use should be made, insofar as possible, of previous experience of Member countries of the Committee

II. HYDROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
2.3.7	Basic studies on the vulnerability of the monitoring networks to damage caused by tropical storms, taking into account also the problems which might be generated when stations become inoperative, both with regard to the interruption of the available historical series and to the provision of observations and data of subsequent events						Interested Members	National and TCDC	
2.3.8	Basic studies on the intensity and spatial variability of rainfall produced by all tropical storms during the tropical cyclone season, as well as on the optimal density of the recording rainfall network required						Interested Members	National and TCDC	
2.3.9	Preparation of flood-risk maps of zones susceptible to flooding caused by tropical storms, separating floods resulting from local rains from those resulting from rainfall in the headwaters of the basins						Interested Members		
2.3.10	Basic studies on the problems of operation of reservoirs when their basins are affected by rainfall produced by tropical storms and decisions to be made with respect to the water impounded						Interested Members	National and TCDC	
2.3.11	Initiation of a GIS-based database to be used by all countries of the region						Interested Members	National and TCDC	

II. HYDROLOGICAL COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
2.3.12	Establishment of a regional project to generalize the hydrological impact knowledge of tropical storms and hurricanes**						Interested Members	National and TCDC	
2.4 TRANSFER OF HYDROLOGICAL TECHNOLOGY									
2.4.1	Attention to the availability through HOMS of components and sequences containing hydrological technology suitable for the hydrological component of the technical plan*						Members	National and TCDC	With advice of WMO
2.4.2	Undertaking a promotional effort among Member countries, so that they may develop HOMS components reflecting in particular experiences in regions affected by tropical storms; the Committee to encourage the inclusion of the components in the HOMS Reference Manual						Hurricane Committee in cooperation with its Members	National and TCDC	

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

** The meeting expressed a desire for the hydrology and meteorology group to be compatible and for the Working Group on Hydrology (RA IV) to consider technical plan for RA IV.

APPENDIX IV

III. DISASTER REDUCTION AND PREPAREDNESS

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
3.1 DISASTER REDUCTION									
3.1.1	Drawing the attention of national authorities of the principal role of meteorological and hydrological factors in carrying out vulnerability analyses in the fields of physical and urban planning, land-use zoning, public works and building codes						Members	National, regional and international	
3.1.2	Promote public awareness of the hurricane risk and the associated risks prior to each hurricane season						Members	National, regional and international	Members are encouraged to collaborate with ISDR
3.1.3	Participate actively in appropriate conferences and activities related to natural hazard mitigation and multi-hazard warning systems. The Hurricane Committee will nominate a representative to attend meetings of the Sessions of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG)						Members	National, regional and international	
3.1.4	Participate actively in the preparation and on-going review of the national disaster prevention and preparedness plans						Members	National	

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
3.1.5	Cooperate with all national and regional agencies in their annual pre-hurricane season exercises. Where these do not exist meteorological services should promote their implementation						Members	National and regional	

III. DISASTER REDUCTION AND PREPAREDNESS

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
3.1.6	Promote good relationship with the media and make full use of their services to disseminate information prior to and during the hurricane season						Members	National, regional and international	
3.1.7	Arranging for the early transmission of forecasts of hurricanes and flooding to the central coordinating agency responsible for the organization of protective and relief measures, and to similar coordinating agencies at regional level, to allow the timely dissemination of warning by such agencies						Members	National and regional	
3.1.8	Participate in ensuring that official advisory statements concerning forecasts, warnings, precautionary actions or relief measures are only to be made by authorised persons and to be disseminated without alteration						Members	National, regional and international	
3.1.9	Advising on and contributing to training programmes to support preparedness programmes to include disaster administrators, disaster control executives and rescue/relief groups and workers in all counter-disaster authorities and agencies						Members	National, regional and international	

III. DISASTER REDUCTION AND PREPAREDNESS

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
3.2 REVIEWS AND TEST EXERCISES									
3.2.1	Participating in periodic reviews of both disaster prevention and disaster preparedness plans to ensure that they are active and up to date						Members	National and external assistance	With advice of OCHA/IFRC/ CDERA
3.2.2	Conducting of periodic staff checks and test exercises to test the adequacy of NMHSs disaster preparedness plans, preferably on a progressive annual basis prior to the expected seasonal onset of natural disaster threats but also, in respect of plans to meet sudden impact disasters, on an occasional no-warning basis						Members	National	

APPENDIX IV

IV. TRAINING COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
4.1 TRAINING OF METEOROLOGICAL PERSONNEL									
4.1.1	Assessment of current and expected future needs for the training of specialized staff to man their warning systems at all levels under the following headings:								
	(a) Those capable of being met through training facilities already available in Member countries*						Members	National	
	(b) Those for which assistance from external sources is needed*						Members	National	With advice of WMO
	Take appropriate steps to organize such training programmes*						Members	National and external assistance	
4.1.2	Support as appropriate and make full use of the training facilities offered at the WMO Regional Training Centres at the CIMH, Barbados, and the University of Costa Rica, San José, as well as at the Tropical Desk in Washington.						Members	National and external assistance	

* During 2010-2011 items with an asterisk to be given priority attention

APPENDIX IV

IV. TRAINING COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
4.1.3	Arrangements for short courses of approximately 2 to 3 weeks duration on topics related to storm rainfall estimation and to hurricane forecasting to be organized at the RSMC Miami Hurricane Center and the Regional Training Centres at the CIMH and the University of Costa Rica*						Regional centres	Regional, national and external assistance	These events should be conducted in English and Spanish
4.1.4	Arrangements for periodic seminars or workshops on specific topics of particular interest for hurricane prediction and warning purposes, priority being given in the first instance to operational techniques for the interpretation and use of NWP products, satellite and radar data and to storm surge prediction**						Members, Hurricane Committee	National and external assistance	
4.1.5	Arrangements for exchange working visits of Staff between operational and training centres						Members, training centres	National and external assistance, regional projects, TCDC	
4.1.6	Specific training for forecasters from Haiti						France	To be determined	

*During 2010-2011 items with an asterisk to be given priority attention
** Workshop proposed to be held in the Dominican Republic during November or December 2010

IV. TRAINING COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
4.2 TRAINING OF HYDROLOGICAL PERSONNEL									
4.2.1	Assessment of current staff availability and capabilities and future needs for training hydrologists in specific subjects concerning hydrological forecasting and warning and of hydrological technicians, to promote and take appropriate steps to organize and disseminate information on training courses, workshops and seminars, and in particular to support the following:						Members concerned	National and external assistance	
	(a) The establishment of a sub-regional centre in the Central American Isthmus for hydrological technicians' training;								
	(b) The training of operational hydrological personnel at the sub-regional (training) centre in the Caribbean;								
	(c) The organization of a course for training in tropical cyclone hydrology and flood forecasting.						USA or other Members concerned	National and external assistance	
	Courses and workshops on hydrological forecasting techniques or data acquisition, processing and analysis								

APPENDIX IV

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
4.2.2	Arrangements for exchange working visits of staff between national hydrology and flood forecasting centres and regional hydrological training centres						Members, training centres	National and external assistance, regional projects, TCDC	

APPENDIX V

V. RESEARCH COMPONENT

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
5.1 RESEARCH									
5.1.1	Making readily available information on research activities and results carried out in Member countries to other Members of the Committee with a view for transfer to operational application as appropriate *						Members	National	*WMO, when requested, to facilitate the exchange of information on these activities as well as on sources of data available for research
5.1.2	Formulation of proposals for consideration by the Committee for joint research activities to avoid duplication of effort and to make the best use of available resources and skills						Members	National	

*During 2010-2011 items with an asterisk to be given priority attention

APPENDIX V

TASKS		TIMESCALE					BY WHOM	RESOURCES	COMMENTS
		2010	2011	2012	2013	2014			
5.1.3	Arrangements for exchange visits of staff between national research centres						Members	National and external assistance, regional projects, TCDC	

APPENDIX VI

GUIDE ON THE HYDROLOGICAL INFORMATION CONTAINED IN THE ANNUAL NATIONAL REPORTS ON HURRICANES, TROPICAL STORMS, AND PERTURBATIONS WITH ASSOCIATED FLOODING

Introduction

The objective of this Guide is to ensure that the hydrological information contained in the reports on hurricanes, tropical storms and perturbations with associated flooding that are prepared every year for the Hurricane Committee session has common elements in order to be able to make a regional evaluation of the hydrological impact of these events.

Content of the Guide

1. Hydrological characterization of the season:

It should only include information on meteorological events which are accompanied by severe hydrological events. It should present all available information, even if it is not possible to complete the following table.

Number	Objective	
1	METEOROLOGICAL EVENTS	
2	RAINFALL	
2.1	Total number of days with rainfall associated with the meteorological event	
2.2	Maximum rainfall in 24 hours	
2.3	Maximum rainfall in 48 hours	
2.4	Maximum rainfall in 72 hours	
2.5	Total rainfall	
2.6	Maximum rainfall intensity in 1 hour	
2.7	Maximum rainfall intensity for another interval of importance for this event (include duration)	
3	MOST AFFECTED HYDROLOGICAL BASIN	
3.1	Geographical location (latitudes and longitudes including the basin)	
3.2	Maximum rainfall in 24 hours	
3.3	Maximum rainfall in 48 hours	
3.4	Maximum rainfall in 72 hours	
3.5	Total rainfall	
3.6	Maximum rainfall intensity in 1 hour	
3.7	Maximum rainfall intensity for another interval of importance for this event (include duration)	
3.8	Maximum water level	
3.9	Maximum discharge	

2. Brief evaluation of the season:

Consisting of an analysis comparing this season with previous seasons as regards the behaviour of the hydrological phenomena, aiming to classify the season with respect to historical maximum values on the basis of the available data.

3. Brief evaluation of the forecasts:

By comparing the forecasted with the observed values.

4. Brief evaluation of damage by flooding or direct impact of rainfall:

Based on the magnitude of flooding, economic damage and loss of human lives caused by water-related disasters (flooding and landslides).

____

Report of the first meeting of the "RA IV Haiti task team" (HTT) on planning of urgent assistance for re-establishing the "CNM Haïti" (Haitian Meteorological Service)

Introduction

At the call of the President of RA IV, this "ad hoc" task team (HTT) was created during the Side Meeting "Assistance for Haïti", which took place on 9 March 2010 during the RA IV Hurricane Committee 32nd Meeting, to examine the urgent needs of re-establishing the CNM Haïti following the disastrous earthquake of 12 January 2010.

The HTT members included Bruce Angle (BA, Canada), Tyrone Sutherland (TS, CMO), Jean-Noël Degrace (JND, Météofrance), Ronald Semelfort (RS, Haïti), Fred Branski (FB, USA), supported by Peter Chen (PC, WMO Secretariat, HQ), and Hugo Hidlalgo (HH, WMO Secretariat, RA IV). JND acted as the chairperson.

The HTT agreed to focus these discussions on immediate actions required to re-establish a minimum level of operational functionality of CNM Haïti in the short period of a few months before the commencement of the 2010 Hurricane season. At the same time the HTT recognized that while the immediate actions should be essential, it understood that medium- and long-range planning must be undertaken to steadily build the capacity and capabilities of the CNM Haïti in the remainder of 2010, and over several years to come. It is anticipated that offers of assistance will continue to be received from Members, and the UN Flash Appeal, which has already been launched, could result in cash or in-kind support to the re-construction efforts.

The present focuses on urgent actions, which fell under five aspects:

1) Monitoring network and secure facilities,
2) Forecast guidance dedicated Extranet,
3) Human resources,
4) Final product dissemination,
5) Public visibility of CNM Haïti.

1- Monitoring network and secure facilities

1.1 Setting up the Centre is the highest priority

The HTT consider that "setting up the centre" is the first obligatory task to assist in setting up EMWIN, ISCS systems, Internet access, observation networks and to facilitate other forms of assistance.

The actual Civil Aviation facility building is safe and secure and equipments can be installed on their premises. There should be no problem with installing antennas on the roof of the CAA which may allow them to receive the Internet independent of the CAA. But there is a need to identify a technical expert in Haiti, within the Met service or the CAA to work with RS to investigate more closely and to verify, before the end of March

- the adequacy of electrical supply, physical infrastructures, and site security for the installation of equipment at the four monitoring sites, and for the 2 EMWIN units, including lightning protection.

- the Internet access at the airport locations and the possibility of acquiring Internet access via satellite-based ISP, as primary or back-up facility.
- a possible practical mechanism for real-time data collection and exchange (e.g. Internet-based).
- the possibility of a safe and secure storage for new equipment and housing for installation crew for monitoring equipment

1.2 Basic local observation network
The office has actually no trustworthy transmission system. There is no recovery of data There are manned stations at Port au Prince & Cap Haitian (cabled but not in working order). Data from Port au Prince autostation at end of runway are transmitted by phone only. Les Cayes (there has been flooding) and Jeremie have observers reporting without instrumentation .
It is important to establish the full functioning of the two Synoptic monitoring sites at the airports at Port-au-Prince (ID 78439) and at Port Haitian (ID 78409), and two additional Synoptic monitoring sites at Jérémie (ID 78435) and Les Cayes (ID 78447).

1.3 EMWIN
USA plan to install two EMWIN units, one per airport site, as soon as possible (see bullet 1.1 for technical roadblocks and 3. 2 for human and housing requirements)

2- <u>Forecasting guidance dedicated Extranet</u>

The goal is to develop rapidly and provide a dedicated Extranet site in french as a single-window on meteorological information, data, and prediction products to assist Haitian forecasters in their production of daily forecasts, and warnings.
The main categories of products are: Regional monitoring, Regional guidance products, NWP products. For RSMC/NHC Miami products, the HTT consider that, as observers and forecasters in Haiti are used to the NOAA WEB site, there is no need to include tropical storms products in the Extranet
Possible products to be made available via the Extranet in each of these categories are listed in annex A, as examples.

The HTT advised that NWP products should be kept to a minimum number at the initial implementation, and will gradually increase as

- the data flow from the different partners increase (radar from USA/Cuba/Jamaica, NWP from Canada, etc.)
- the capacity of forecasters increase.

The HTT also advised that deployment of such products should come with a short (2 days) but practical "in situ" training in order forecasters and observers could take the maximum advantage of all the products.

The following actions are to be urgently completed:

- Canada & France to each provide their respective lists of suggested products for inclusion on the Extranet, by 17 March 2010
- JND and PC will work on the Extranet specifications based on the list in annex A after consultation with R.S. by 31 March

- JND to provide the contact of the focal person at Meteofrance to work on the exchange of data needed for the Extranet by 17 March 2010
- Meteofrance to complete the first stage of the Haitian Extranet by end of april 2010.

The HTT also consider important to determine why Corobor unit at CNM is not in working order, and initiate repair or replacement as soon as possible.

3- <u>Human Resources</u>

3.1 Synoptic Tropical Desk (STD) in the FWI (Centre de Previsions Synoptiques)
Meteofrance is prepared to provide

- routine bulletins for synoptical guidance focused on Haiti and specific advisories when needed, specially for non tropical cyclone (to be included in the Extranet + fax + email).
- a 24x7 Hotline (e-mail and telephone) service for Haitian forecasters, to coordinate watches and warnings. The Hotline would also support use of Extranet products.

3.2 "In situ" forecast support
Presently there are two operational forecasters in CNM Haïti., while others are basically observers. Forecasting staff in Météo-France Martinique is also limited. In addition, Martinique will take on additional responsibilities (Extranet, Hotline). Therefore it is desirable to seek and deploy qualified French speaking "visiting" forecasters from another NMHS (e.g. Canada, France, UK) to assist in the forecasting for Haïti, and also support training of Haitian forecasters.
However, while health and safety, and lodging issues in Haïti need to be satisfactorily resolved, any visiting forecasters identified could as a first stage be deployed to STD in Martinique, and at a later stage considered for rotational deployment into Haïti.

The following actions are agreed:

- Implementing the Hotline service, by 30 April 2010
- Identify interested "visiting" forecasters by 31 March 2010
- Develop a deployment plan and rotation timetable by 30 April according to Haiti housing facilities, with projected first deployment to Martinique on 15 May 2010.

4- <u>Final Product Dissemination</u>

It is recognized that the earthquake disaster caused the collapse of the forecast and warning broadcasting facilities in Haïti, therefore there is an urgent need to utilize any communication methods which have been steadily restored, such as cellular networks. The following possible dissemination systems for broadcasting to the public should be investigated: cellular phones, wind-up radios, and Weatheradio. In addition the status of radio and TV broadcasts should be clarified with the idea of finding ways improve their reach.

As part of this aspect, routine forecasts and warning criteria should be clearly defined, e.g., lead-times, parameters, warning thresholds, etc. These “standards” would help to identify which products (and schedule) would be made available on the Extranet.

These actions should be initiated immediately, and a plan of action should be completed by 15 April 2010. The responsibility for these actions rests with CNM Haïti and its national EMO partners. The HTT will advise on possible equipment and systems that could be made available. This topic is to be more discussed during the meeting in Costa Rica (26th march 2010) following the WMO EWS Workshop.

5- Public visibility of CNM Haïti

The HTT agreed that the earliest and broad recognition of the re-establishment of the Haitian Meteorological Service is of strategic importance. It therefore offered to assist CNM to take measures to create the public visibility. A suggestion is to create a public Web page with a clear “brandmark” for the CNM, where weather information and daily forecasts are made available. BA suggested Canada might be able to assist with the design however the HTT we will need to understand the capacity and products to deliver. The Web page could be developed and initially hosted off-site, and later migrated to a CNM Haïti platform. The World Weather Information Website should include a link to the CNM Haïti public Web site. The HTT agreed that when the re-establishment of CNM Haïti is well underway, that this achievement should be made widely known.

6- Coordination with the “WMO Assessment Team”

The HTT noted that WMO will soon deploy a technical assessment team to determine more clearly the status of the CNM Haïti, and to develop a medium- to long-term plan for the development of meteorological and hydrological services in Haïti for the prevention and mitigation of natural disasters. The HTT wishes to use this opportunity to clarify a number of immediate questions in order to better match offers of assistance to requirements. The HTT will provide a list of questions to the Secretariat by 31 March 2010.

7- Other matters

7.1 The President of the RA IV will send a request to the PRs of USA, Jamaica and Cuba to get their agreement for displaying real time radar imagery from their respective countries on the Extranet.

7.2 The HTT agreed to explore the possible involvement of MFI, because of their ability to develop and implement end to end system (airport observations, AWS network, forecast workstation, production and dissemination systems, …)

7.3 The HTT strongly request to the RAIV/Hurricane Committee that the next workshop at NHC in Mars 2011 could be also conducted in French in order that Haitian forecasters are able to attend.

APPENDIX VII

Forecast Guidance Extranet : 1st stage , to be ready before end of april

1- Domains of display
   Large domain (LD): 5N-35N / 35W-90W
   Small domain (SD): 10N-27N / 60W-80W
   Zoom domain (ZD): 15N-22N / 65W-75W

2- Regional observations
   a. Geostationnary Satellite imagery (GOES-E & METEOSAT)
      i. IR+lightning, IR coloured, Vis & WV on LD
      ii. Vis 1km , IR coloured on ZD
   b. Radar imagery (USA-Guantanamo,Cuba, Jamaïca, St-Domingo,)
   c. Plotted charts (Synop, ships, buoys, …) on SD

3- Regional expertised products
   a. 3D analysis (meteorological features from surface to tropopause) and forecast (Day+1,2 and 3) on LD
   b. Routine synoptic guidance bulletins and special advisories on potential risk

4- NWP products
   a. From ECMWF
      i. Deterministic charts on GD
         1. From 00 to 168 hours by 12 hours step
            a. MSLP + 12hours rain acc (threshold 2-3mm)
            b. Humidity 700hpa + Windbarbs 700hpa
            c. Vorticity 850hpa (filtered) + Windbarbs 250hpa
      ii. Deterministic charts on SD
         1. From 00 to 84 hours by 6 hours step
            a. MSLP + Windbarbs1000hpa + 6hours rain acc
            b. Humidity 850hpa + Windbarbs 850hpa
            c. Marine : Total wave height + swell barbs + windwave barbs
      iii. Forecast Radiosounding for Port au Prince
      iv. EPS probabilistic charts on SD
         1. From 00 to 168 hours by 12 hours step
            a. Rainfall probabilities threshold 5mm
            b. Rainfall probabilities threshold 20mm
      v. EPSgrams for at least 4 points in Haiti (stations with observations)

   b. From Canada
      i. EPSgrams for the 4 stations with observations + 2 others points

   Other NWP products from the REPS are to be defined between April and June 2010 for being added in a progressive upgrade of the extranet