WORLD METEOROLOGICAL ORGANIZATION

RA I TROPICAL CYCLONE COMMITTEE FOR THE SOUTH-WEST INDIAN OCEAN

EIGHTEENTH SESSION

Lilongwe, Malawi

6 to 10 October 2008

FINAL REPORT

GENERAL SUMMARY OF THE WORK OF THE SESSION

1. ORGANIZATION OF THE SESSION (Agenda item 1)

1.1 Opening of the session (agenda item 1.1)

1.1.1 At the kind invitation of the Government of Malawi, the eighteenth session of the WMO Regional Association I (Africa) Tropical Cyclone Committee (RA I/TCC) for the South-West Indian Ocean was held at the Crossroads Hotel, Lilongwe, Malawi, from 6 to 10 October 2008. The session was attended by representatives from Botswana, Comoros, France (La Réunion), Kenya, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Seychelles, South Africa, Swaziland, Tanzania and Zimbabwe. Australia participated as ex-officio Member of the Committee. Also in attendance were RA I Working Group on Hydrology, International Civil Aviation Organization (ICAO), IFRC, UNOCHA/ISDR and representatives of the WMO Secretariat. The list of participants is given in **Appendix I** to this report.

1.1.2 On behalf of Mr Michel Jarraud, Secretary-General of WMO, Mr Koji Kuroiwa, Chief, Tropical Cyclone Programme (TCP) Division, welcomed the participants and expressed the appreciation of WMO to the Government of Malawi for the kind invitation to host this session. Reviewing the recent devastating damage by tropical cyclones such as Nargis and Sidr in the Bay of Bengal and Gustav and Ike in the Caribbean, Mr Kuroiwa stressed that storm surges are now emerging as critical issue that should be urgently addressed. In this connection, he informed the Committee that the Sixtieth session of WMO Executive Council (EC-LX) identified two high priority needs for tropical cyclone affected regions; technology transfer across basins for tropical cyclone forecasting and warnings, and incorporation of "Storm Surge Watch Schemes" in tropical cyclone advisory arrangements. He invited the Committee to review the EC-LX decisions with a view of turning these into concrete activities. He also informed the Committee about the WMO disaster risk reduction programme (DRR) which have resulted in a noticeable improvement in the warning systems in many parts of the world. However, there is still much to be done in this area and WMO gives a high priority to developing and promoting an integrated approach towards strengthening the disaster risk management capabilities. He stressed that the synergies between the DRR and the TCP activities are indispensable, which should be manifested through closely coordinated initiatives of the programmes related to TCP and DRR in concert with the WMO Regional Programme (RP). Finally, Mr Kuroiwa underlined the significance of the resource mobilization activities that could provide the assistance for effective implementation of the Committee's programmes, particularly those which cannot be funded nationally.

1.1.3 Mr Y. Boodhoo, Acting Chairperson of the RA I/TCC thanked the government of Malawi for inviting the Committee to convene its 18th Session in Lilongwe and welcomed all delegates for their presence at the meeting. He recalled that the 17th Session was held 3 years ago in Botswana and that the Committee could not convene last year as planned due to some unavoidable circumstances. The Acting Chairperson briefly presented a history of the Cyclone Committee and explained that while at the beginning the Members concerned were the South West Indian Ocean Islands, with time and as Members of coastal East and Southern Africa suffered from the impact of tropical cyclones, they adhered to the Committee. This has brought the size of the Committee to 16. He further expressed the opinion that the present Committee should expand its umbrella to consider other weather and climate related disasters and even tsunamis. Although tsunamis do not originate from weather-related events, the waves that propagate are within the purview of NMHSs. He briefly reviewed the past 3 seasons and opined that there may be the first signs of the impact of climate change on the rate of intensification of cyclones as more energy becomes available in the ocean. He encouraged research in this domain.

In conclusion, the Chairperson stressed the need for the above actions in order to strengthen the capability of Members to become more resilient to natural disasters. He reminded those present that one of the duties of NMHSs is to save life and protect property.

1.1.4 In his opening address, Mr Fletcher Zenegeya, Principal Secretary for Lands and Natural Resources, welcomed all the delegates to Malawi. He stated that the Malawi Government values its involvement in the RA I Tropical Cyclone Committee because it realizes the country's vulnerability to the impacts of weather and climate; its dependence on wether and climate for social and economic development and prosperity; and the threat that extreme events poses to the safety of lives and property. He also emphasized the fact that the majority of the natural disasters across the world are due to extreme weather and climate events among which tropical cyclone are the most important. Mr Zenegeya went on to list some examples of the recent damages that have been caused by tropical cyclones in the African region as well as other parts of the world. He highlighted the effects of the following* Tropical Cyclone Eline in March 2000 that caused flooding in Mozambique and part of Malawi; Hurricane Katrina in August 2005 that caused a lot of damage over New Orleans in USA; Tropical Cyclones Fame and Ivan in January and February 2008 that affected Madagascar; Tropical Cyclone Jokwe in March 2008 that affected northern Mozambique; and Hurricane Gustav that affected Louisiana. He then expressed the urgent need for a reliable early warning system for such events that would assist to minimize the losses due to these extreme events. In this regard, Mr Zenegeya urged the countries represented at the meeting to make use of the available tools for the monitoring of the tropical cyclones in order to minimize the loss of life and property due to such extreme events. He further called on the participants to come up with constructive conclusions and recommendations as they review the tropical cyclone operational plan and technical plan for the South West Indian Ocean in order to improve tropical cyclone monitoring, early warning and public response based on previous experience. He further urged participants to factor in disaster risk reduction strategies in to the deliberations during the side event on Disaster Risk Reduction. Finally, Mr Zenegeya thanked the World Meteorological Organization (WMO) for arranging and co-financing the hosting of the Tropical Cyclone Committee meeting in Malawi; RSMC La Reunion of Météo-France for timely provision of real- time advisory information and guidance on tropical cyclones that is vital for early warning and disaster preparedness at local, national and regional levels. He also thanked the local organizing committee of the meeting for their efforts in arranging for the meeting.

1.1.5 The Principal Secretary for Lands and Natural Resources declared the eighteenth session of the RA I Tropical Cyclone Committee for the South-West Indian Ocean officially open.

1.2 Adoption of the agenda (agenda item 1.2)

The Committee adopted the provisional agenda. The agenda for the session is given in **Appendix II** to this report.

1.3 Election of the vice-chairperson (agenda item 1.3)

The Committee unanimously elected Mr Donald Kamdonyo (Malawi) as Vice-chairperson of the session.

1.4 Working arrangements for the session (agenda item 1.4)

The Committee agreed on its working hours and work programme. It decided to establish designate chairs to lead discussions in various sessions. Mr Mohamed R. Matitu (Tanzania) and Mr Gérard Therry (France), respectively were designated to chair the sessions on the agenda items related to the Operational and Technical Plan respectively. Mr. Grey Munthali

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

2.1 The Committee noted with appreciation the report of Mr Y. Boodhoo, Acting Chairperson of the Committee, which reviewed briefly the activities that took place during the last intersessional period.

2.2 Mr Boodhoo recalled that the 17th Session was held three years ago in Botswana and that the Committee could not convene last year as planned due to some unavoidable circumstances.

2.3 He briefly presented a history of the Cyclone Committee and explained that, while at the beginning the Members concerned were the South West Indian Ocean Islands, with time and as Members of coastal East and Southern Africa suffered from the impact of tropical cyclones, they adhered to the Committee. This has brought the size of the Committee to 16.

2.4 He further expressed the opinion that the present Committee should expand its umbrella to consider other weather and climate related disasters and even tsunamis. Although tsunamis do not originate from weather-related events, the waves that propagate are within the purview of NMHSs.

2.5 He briefly reviewed the past 3 seasons and opined that there may be the first signs of the impact of climate change on the rate of intensification of cyclones as more energy becomes available in the ocean. He encouraged research in this domain.

2.6 The Chairperson informed the session of the following training events:

1) RSMC La Reunion hosted a training workshop on tropical cyclones in 2006.
2) A second similar event was hosted by Australia in 2007 and which was of significance to the RA I/TCC Members.
3) A regional research workshop on tropical cyclones was organized by Meteo-France at RSMC La Reunion in May 2008

After feedback from the RA I/TCC Members, the Chairperson stressed on the following:

1) The network of observing systems, upper-air and surface, needs to be strengthened so that regular data is available to enable reliable prediction.
2) The space-based observation facilities have room for improvement
3) The absence of weather radars is a matter of concern and needs to be addressed soon. Here he urged the Committee to seek assistance from potential donor organizations
4) The communication among and within the Members requires upgrading to allow quick exchange of hazard-related information
5) Monitoring of sea parameters need to be systematically organized so that data is available for input into numerical models
6) Members were urged to encourage research among their scientists. Some universities can be roped in into this initiative

In conclusion, the Chairperson stressed the need for the above actions in order to strengthen the capability of Members to become more resilient to natural disasters. He reminded those present that one of the duties of NMHS is to save life and protect property.

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

3.1 The Committee expressed appreciation for the detailed information provided by the WMO Secretariat on the implementation of the WMO Tropical Cyclone Programme (TCP). It noted with satisfaction the achievements and progress made in both the general component and the regional component of the TCP since the seventeenth session of the Committee.

3.2 The Committee was informed by the WMO Secretariat that the 15th WMO Congress (Geneva, May 2007) discussed the Tropical Cyclone Programme (TCP) from a broad perspective. Major decisions of the Congress in implementing the Programme are represented by the following key points:

1) To continue to give priority to capacity building, particularly in Small Island Developing States (SIDS) and Least Developed Countries (LDCs);
2) To promote cooperation with relevant WMO programmes such as DRR, PWS, MMOP, HWR and AREP;
3) To facilitate participation of hydrologists and DRR experts in the regular sessions of the five tropical cyclone regional bodies;
4) To pursue recommendations from the Sixth International Workshop on Tropical Cyclones (IWTC-VI).

TCP's activities have been implemented based on this guidance and contributed to various outcomes of WMO Strategic Plan, in particular Expected Result (ER) I (better forecasts and warnings) and ER VI (Multi-hazard early warning and DRR).

3.3 The Committee was also informed that the Executive Council, at its 60th session in June 2008, gave following guidance to the Tropical Cyclone Programme:

a) To give greater emphasis to the use of ensemble techniques and probabilistic forecasting in tropical cyclone warning operations in order to improve their utility.
b) To transfer research and development results between the tropical cyclone regional bodies with special emphasis on application of intensity forecast guidance.
c) To continue to support training events to allow forecasters of small NMHSs to achieve the skills and competencies required for effective operational capacity.
d) To develop and incorporate a storm surge watch scheme in the tropical cyclone advisory arrangements and in the regional operating plans and manuals for the risk management in the coastal regions.

3.4 The Committee was pleased to note that various training programmes were arranged by TCP to address the issue of sustainable development of NMHSs. In particular, RA I Training Course on Tropical Cyclones and Workshop on Public Weather Services (La Réunion, 23 Oct.- 4 Nov. 2006), RA IV Workshop on Hurricane Forecasting and Warning (Miami, USA, 16-28 April 2008 & 7 -19 April 2008) and Southern Hemisphere Training Course on Tropical Cyclones and Workshop on PWS (Melbourne, Australia,10-21 September 2007) were organized in cooperation with Public Weather Services Programme and highly valued for the practical training for operational forecasting as well as media skills. A similar event is planned jointly with PWS to be held in the Typhoon Committee region as a roving seminar in 2009. Attachment training was carried out by 5 RSMCs including RSMC Nadi, which hosted the training for the first time despite of its unfavorable operational situation. The Indian Institute of Technology Delhi hosted the attachment training for storm surge experts for the consecutive 7 years.

3.5 The Committee noted that TCP are making efforts also to promote application of research findings to operations in cooperation with AREP. International Training Workshop on Tropical Cyclone Disaster Reduction was held in Guangzhou, China in March 2007 and the RA I Regional Workshop on Tropical Cyclone Research was held in La Réunion in May 2008.

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

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

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

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

3.8 The Committee was informed that completion of the Study on the Wind Averaging Guideline has been delayed. A main report, which was submitted by the Systems Engineering Australia Pty Ltd (SEA) in January 2008, is currently under review by TCP Technical Coordination Meeting and a one-page summary for inclusion in operational manuals is being produced by SEA.

3.9 In relation with the activities of other TCP regional bodies, Mr Mike Bergin, the delegate of Australia and Chairman of the RA V Tropical Cyclone Committee (TCC), reported on the discussions at the recent meeting in Niue with respect to a possible Severe Weather Forecast Demonstration Project and a Disaster Risk Reduction Project in the region. RA V/TCC decided that a combined project should be implemented in RA V to include from the outset, severe weather forecasting and warning components as well as disaster risk reduction components. Such a project would be referred to as the Severe Weather Forecast and Disaster Risk Reduction Demonstration Project (SWFDDP).

4. REVIEW OF THE 2005/2006, 2006/2007 AND 2007/2008 CYCLONE SEASONS (Agenda item 4)

Summary of the past three cyclone seasons

4.1 Reports of the 2005/2006, 2006/2007 and 2007/2008 cyclone seasons were presented to the Committee by the Mr Philippe Caroff (RSMC La Réunion - Tropical Cyclone Centre, France).

2005/2006 cyclone season

4.2 The activity of the 2005/2006 cyclone season was low in the south-west Indian Ocean. The tendency to a regular and relatively fast decline of activity observed since the 2001/2002 season went on indeed, making this season the fifth least active one since the beginning of the satellite era (1967) in terms of the number of events (3 tropical storms and 3 cyclones) as well as the number of days of activity, with a deficit approaching 50% in number of days of aggregate activity as compared to the normal level.

4.3 The 2005/2006 cyclone season was similar in many aspects to the 1998/1999 season: low overall activity, slow start of the season (one had to wait until the fourth week of

February to have the third system of the season named, which is a record since 1960, the year tropical low pressure systems began to be named in our basin), dry anomaly in the basin, same number of named events (with a sixteenth tropical storm not being named during both years).

4.4 The season was rather mild for concerned populations. Only two events had a significant influence on inhabited regions, with a moderate impact. The African continent was spared again, just as during the two former seasons, and Madagascar was only slightly affected by a single event (*Boloetse*). Torrential rains associated with *Diwa* affected more strongly the Mascareignes and particularly La Reunion.

2006/2007 cyclone season

4.5 The 2006/2007 cyclone season was active in the south-west Indian Ocean. The number of events was only slightly above normal, but the number of cyclone days was very high, because of a remarkable occurrence of high-intensity systems: 6 intense tropical cyclones were registered. Such a number, never exceeded in over 30 years, was reached only once in the present era, during the “great” 1993/1994 season.

4.6 After five consecutive seasons of continuing decline in observed activity and following the low-level 2005/2006 season, the recovery was strong, with, in the end, an activity twice as intense as the previous season’s activity. This was not due to an excessive development of cyclones, but to a tendency for this development to turn into mature and high-intensity events at their peak, often occurring following a very efficient, and even explosive, intensification phase, as is shown by the exceptional intensification of *Jaya* and particularly *Bondo*. Another notable point to be underlined is the time distribution of this excess cyclone activity, which mainly concentrated in a limited timeframe. More than 50% of this activity occurred in February alone, with 5 mature systems, including 3 intense cyclones.

4.7 The second major characteristic of the 2006/2007 season was the marked spatialization of cyclone development and tracks, which was clearly concentrated in the western part of the basin. For most of their duration, almost all events developed west of 70° E, with a strong concentration of tracks from the Mascareignes to the northern part of Madagascar. With the activity being focused in the west central part of the basin, the cyclone risk was exacerbated for inhabited regions, practically all being hit more or less strongly, including some islands which had *a priori* practically no chance of being concerned by a mature phenomenon, among which are the Farquhar Islands in the Seychelles. But, as is generally the case with such a configuration, Madagascar was most exposed because of its size. Four events affected directly the “big island” this season, with countless damage and a heavy death toll. Nearly 450,000 people were affected by these events, mainly in the northern and north-eastern parts of the country, because of *Indlala*, the worst cyclone in the season, and, to a lesser extent, of *Jaya*, both landfalling in the same zone of the Antalaha area at an interval of less than 3 weeks.

4.8 After four relatively calm years, Mozambique was hit by cyclone *Favio*, whereas the Mascareignes Islands had to face very harsh meteorological conditions due to the influence of *Enok*, and particularly *Gamede*, the most impressive cyclone in the season, not because of its intensity but because of its size, affecting weather for several days in the sister islands of Mauritius and La Reunion, which broke several world rainfall records.

2007/2008 cyclone season

4.9 The activity of the 2007/2008 cyclone season in the south-west Indian Ocean was slightly above normal, with a large number of named storms, but whose excess influenced only the low- to moderate-intensity stages.

4.10 Twelve tropical storms were observed during this season, which is clearly one with a high number of events, ranking second in the last decade. Half of these storms developed

into cyclones, which is a normal proportion. The beginning of the season was rather slow, with a sequence of systems straining to intensify simply above the level of moderate tropical storms, but these 6 cyclones followed one another, often by pairs occurring at the same time over the basin between the end of January and the beginning of March, so that all of the cyclone days and nearly 75% of the significant activity were concentrated within less than 7 weeks.

4.11 The 2007/2008 season was characterized not only by a peak activity in a short time, but also by a duration shorter than usual, approximately 4 ½ months, the season ending suddenly at the end of March, which is very early, because over the last 25 years, it is the second time a cyclone season ends before the month of April.

4.12 The activity was distributed in a relatively balanced way over the width of the basin. The tracks of the phenomena were quite diverse and not particularly regular: there were a number of changes in direction and abrupt changes.

4.13 The 2007/2008 season was less active and more lenient on the populated areas than the last one. Of course, this type of judgment remains very relative and has only value if one thinks on a global scale. Indeed, inhabitants of St. Mary's Island, hardly hit by cyclone *Ivan*, or of the small town of Besalampy, severely affected by the landfall of cyclone *Fame* on the north-western Malagasy coast, will have quite a different opinion on this matter. Outside of Madagascar, which was hit by 3 cyclones (the two quoted above plus *Jokwe*), there was no major impact, except in Mozambique, where this same *Jokwe* went in a straight line over a whole coastline situated south of the historical town of Ilha de Moçambique.

4.14 The Mascareignes Islands were hit by quite a large number of storms, but most fortunately having a relatively low intensity. The wind was not a real risk factor, but the islands suffered from the rain occurring because of theses systems, the last of which, *Lola*, induced deadly floods in Mauritius.

4.15 The Committee expressed its gratitude to Météo-France for the detailed review of the past cyclone seasons and by the exemplary work of the Regional Specialized Meteorological Centre (RSMC) La Reunion in provision of tropical cyclone advisories to the Members and capacity building activities to enhance the tropical cyclone warning service in this region.

4.16 Following the presentation of RSMC La Réunion, each Member reviewed the 2005/2006, 2006/2007 and 2007/2008 cyclone seasons. The complete reports on the review submitted by the RSMC La Réunion for the session are given in Appendix III.

4.17 Reviewing the three cyclone seasons, Members expressed the views that in order to encourage research and enhance the capability of NMHSs to make forecasts, there is need for them to run numerical models, and more specifically limited area models. This requires skills, facilities and, most important of all, data. While the former two can be organized, for several members data availability is the issue to address. The Committee resolved that South-south capacity building be organized and that limited area models be encouraged among RA I/TCC Members.

4.18 The Committee noted that some Members of the RA I/TCC had participated in the phase one of the Severe Weather Forecast Demonstration Project (SWFDP), which was implemented under the leadership of South Africa Weather Service. The participating Members expressed satisfaction with the project outcomes which were very useful in issuing early warnings during Tropical Cyclones. It was recommended that Phase two of the project, which was under preparation should include all the Members of the RAI/TCC. In view of the great benefit to the Members, the Committee requested South Africa to make a detailed presentation of the SWFDP at the next Session of RA I TCC.

4.19 The Committee took note of the reports of the Members affected by tropical cyclones as given in **Appendix IV**.

5. REVIEW OF THE TROPICAL CYCLONE OPERATIONAL PLAN FOR THE SOUTH-WEST INDIAN OCEAN (Agenda item 5)

5.1 Mr Mohamed R. Matitu (Tanzania) served as Chair for this agenda item. Also, Mr Philippe Caroff (France) agreed to serve as rapporteur on the update of tropical cyclone names' list.

5.2 The committee recalled that the Operational Plan defines the sharing of responsibilities among Members for the various segments of the system and shows the high level of regional cooperation and coordination achieved. In particular, it provides the agreed arrangements including, amongst others, those for standardization of operational procedures, provision and efficient exchange of various data related to tropical cyclone advisories, and other products of the RMSC La Reunion, which having the required facilities, has the responsibility of analysis, tracking and forecasting of tropical cyclones.

5.3 The Committee conducted a careful review of all the chapters of the Tropical Cyclone Operational Plan for the South-West Indian Ocean.

5.4 The director of the RSMC wanted to come back to an item of the previous Committee meeting about consistency between the RSMC-Cyclone's intensity analysis and naming. The text on this item in the Operational Plan (page I-9) had been improved at the previous meeting and this had led to progress in the latest three seasons, but some difficulties that had been encountered remain however and it is therefore necessary to have a clearer wording. He proposed a new wording based on the technical definition of naming, which takes place at the moderate tropical storm stage (without the redundant reference to the Dvorak analysis), and recalling that naming is carried out by the sub-regional centre concerned in accordance with the RSMC's intensity analysis. He explained that he did not want to question the honorary responsibility for naming, but to ensure the indispensable consistency with the RSMC's intensity analysis, on which everyone agreed.

5.5 The general rule should be that the RSMC provide an analysis that is as consistent and objective as possible, whatever the position or intensity of the depression system (hence including when its intensity corresponds to the naming stage – i.e. the moderate tropical storm stage), whereas each country is responsible for warning on its territory.

5.6 In the debate that followed on this proposal of a modified wording in the Operational Plan, a full consensus could not be obtained: the representative of Madagascar found this amendment acceptable while the representative of Mauritius did not accept it. As this issue was not settled during the session, a solution would have to be found one way or another in the inter-sessional period.

5.7 The Committee deliberated on the need for changing the text of the document (1.5 – Identification of the tropical cyclones) on the page I-9. Considering that it requires more consultations within the Members and with other relevant institutions, the Committee decided to leave the matter to the next session and requested the WMO Secretariat to facilitate the consultations process.

5.8 Amendments to the text of the Operational Plan as given in **Appendix V** are recommended to the President of RA I for approval on behalf of the Regional Association.

5.9 The Committee considered a proposal that tropical cyclones forming from South-East Indian Ocean should not change their names when they move westwards and cross 90E as currently the common procedure in practice. After an in-depth discussion, the Committee was of the opinion that the matter be discussed in the next Committee Meeting when the necessary consultations would have been done.

5.10 The ICAO representative informed the Committee that the formats of tropical cyclone advisories and related SIGMETs have been changed. OUTLOOKS in SIGMETs are no longer a requirement after Amendment 74 to Annex 3 came into effect on 7 November 2007. With this update from ICAO, the Committee reviewed the paragraph 4.4 of the Plan to remove the requirement for OUTLOOKS.

5.11 The Committee requested the Secretary-General of WMO to publish as soon as possible the 2008 edition of the Tropical Cyclone Operational Plan in English and French as a WMO Technical Document (WMO/TD-No 577) in the TCP series (TCP Report No. TCP-12).

5.12 The Committee, in view of a more adequate and effective review of the Operational Plan, decided to appoint rapporteurs for continuous review and update of the Operational Plan. Mr Mohamed R. Matitu (Tanzania) agreed to serve as the rapporteur and Mr Philippe Caroff (France) offered to be the co-rapporteur. The rapporteurs will collect amendments and changes from the Members that would occur during the inter-sessional period prior to the next session and propose updates to the session for the Members' review. The rapporteurs will work closely with RSMC La Reunion in his work. Members will be urged to send the changes to the rapporteurs three months before the session for their revision. In this regard, the Committee requested the WMO Secretariat to take a necessary action to assist the rapporteurs for the update process.

6. REVIEW OF THE TECHNICAL PLAN AND ITS IMPLEMENTATION PROGRAM (Agenda item 6)

Under this agenda item chaired by Mr Gérard Therry (France), a detailed review of the Plan was carried out, taking into account the development and progress made by the Members and the RSMC La Réunion - Tropical Cyclone Centre, since the seventeenth session of the Committee.

Comments made during the meeting were noted on the update of the Plan regarding ground stations. Many corrections were noted. It was agreed to make a distinction between the evolution of the network in recent years and the important developments that remained to be achieved and that should be included in the updated Plan. The secretariat asked to be supplied before the end of November with all this information, and that on the other chapters of the Plan, to enable it to circulate a new consolidated version in time to the Committee members and then to the WMO authorities to which it had to be presented. Apart from simply compiling needs, the need was also highlighted for an argument based on an analysis in support of the dossiers to be prepared for seeking any external funding.

At the end of the discussion of the Plan, the chairman of the meeting pointed out that major work on the development of the structuring, monitoring and updating of the Plan was needed between sessions in order to prepare the work of the next plenary session. Unless a special rapporteur was appointed to coordinate this work, it would fall to the chairman of the Committee in association with the secretariat.

6.1 Meteorological Component (agenda item 6.1)

6.1.1 The Committee noted that the review of the meteorological component of the Plan focused on the status of implementation of the WWW, the needs for additional data, facilities and arrangements for the purpose of tropical cyclone detection, monitoring and forecasting, and on the modernization of the tropical cyclone warning system through regional coordination and cooperation.

Regional Basic Synoptic Networks (RBSN)

6.1.2 The Committee was informed that the countries of the region are contributing to the implementation of the Regional Basic Synoptic Network (RBSN) by operating a total of 838 stations (744 surface-synoptic and 94 upper-air) out of which 93 stations are AWSs as of August 2008.

6.1.3 The Committee was informed that the Annual Global Monitoring (AGM) of the operation of the WWW carried out in October during the years 2006 - 2007 found that the availability of the SYNOP reports from the respective RBSN stations in the area of the RA I Tropical Cyclone Committee had shown a positive increase from 63% to 67% during the period 2006 -2007. However, the number of TEMP reports received during the same period indicated a decrease from 34% to 27%. No TEMP reports were received from Madagascar, Malawi, Mozambique and Tanzania during the 2007 AGM exercise.

6.1.4 With respect to the unavailability of TEMP reports, the delegate from Botswana indicated that, since resumption of upper observations in 2007, it has been at times attributed to the hardware problem with the DIGICORA failure to automatically connect with the Message Switching System for transmission. This has resulted in manual reception from the upper-air stations by the headquarters leading to missing of cut-off time for GTS transmission. Tanzania is making all necessary efforts to put back into service the hydrogen generator which will restore the availability of data.

6.1.5 The Committee showed concern that there are a number of inaccuracies with the data presented and believed that it does not properly reflect the true level of observations being performed in the region nor of the issues affecting performance and communication of observations. While acknowledging that Members should keep WMO fully informed of the status of their observing networks, the Committee requested the WMO Secretariat to explore ways to improve the monitoring of SYNOP and TEMP reporting to better reflect the efforts of NMHSs at national level and to highlight the issues that need to be addressed to ensure a more effective observing network in the region.

6.1.6 The Committee noted the importance of radar observation to support forecasting of severe storms and tropical cyclones. It encouraged the Members that operate radars to establish a radar network to facilitate sharing of data. The Committee also recommended that funding be sought for the implementation of the radar network project for the SWIO. In this connection, the Committee was informed that Botswana is planning to procure 2 new weather radars at Maun (68032) during 2009-10 and Francis town (68054) during 2011-2012.

6.1.7 The representative of Kenya informed the Committee that it has 36 synoptic stations (either full time or part time) spread across the country and one upper air station making 1 ascent per day (i.e. 63741 – Dagoretti Corner). Kenya Meteorological Department has recently installed 12 Automatic Weather Stations to supplement surface observations. It plans to expand the upper air network to 4 stations in the near future. Kenya has also installed 3 tidal gauges along the coast and currently in the process of installing four radars to cover the entire country and part of the Indian Ocean. For maritime meteorology, Kenya launched 35 drifting buoys between 2005 and 2007, which are now part of the global drifting buoy network.

6.1.8 Satellite cover of the South-West Indian Ocean basin has remained at a fully satisfactory level since the previous meeting held in Gaborone in 2005. It could even be said to have improved. The successful launch of the Metop satellite, as the first European polar-orbiting satellite, during the inter-sessional period, has demonstrated in particular its extremely valuable contribution, on account of the new sensors and radiometers on board and of the amount of related new data produced (such as the data from the IASI sounder – and the assimilation of those observations has significantly contributed to improving the performance of the numerical models, or data from the ASCAT scatterometer radar, eminently useful for the analysis of tropical disturbances' windfields).

6.1.9 The Committee expressed its hearty thanks to Eumetsat for this, and for its invaluable support, that has permitted to maintain, for more than a decade now, a geostationary satellite operational over the Indian Ocean, including the fully successful transition from Météosat 5 to Météosat 7 that had taken place during the inter-sessional period. However, the Committee was very much aware that there is no long-term guarantee of keeping such a geostationary satellite, which is an absolutely crucial tool for monitoring hazardous meteorological phenomena such as tropical cyclones. Accordingly, the Committee requested the continued support of WMO to bring this concern to the attention of the decision-makers and operators of satellite programmes, in particular Eumetsat, and to point out this vital need for the weather watch in the southern Indian Ocean.

6.1.10 Moreover, the Committee has been informed by France of the planned launch (late 2009) of a new satellite named Megha-Tropiques. This satellite is a Franco-Indian cooperation venture and would carry a number of instruments, including a microwave imager known as Madras. This satellite's near-equatorial orbit would offer maximum cover of the area of cyclogenesis and development of depression systems, especially in our basin, with up to six orbits a day over the same geographical area. It would therefore prove a particularly useful tool for cyclone watch in our area. The Committee wished to encourage all current action aiming to ensure that the Megha-Tropiques data (especially those from its microwave imager) will be made available to all potential users, beginning with RSMC La Réunion, as soon as possible and in near real-time.

6.1.11 The Committee expressed its hearty thanks to Eumetsat for this, and for its invaluable support, that has permitted to maintain, for more than a decade now, a geostationary satellite operational over the Indian Ocean, including the fully successful transition from Météosat 5 to Météosat 7 that had taken place during the inter-sessional period. However, the Committee was very much aware that there is no long-term guarantee of keeping such a geostationary satellite, which is an absolutely crucial tool for monitoring hazardous meteorological phenomena such as tropical cyclones. Accordingly, the Committee requested the continued support of WMO to bring this concern to the attention of the decision-makers and operators of satellite programmes, in particular Eumetsat, and to point out this vital need for the weather watch in the southern Indian Ocean.

Aircraft Observations

6.1.12 The Committee noted that the global AMDAR Programme continued to expand into new areas. The volume of data disseminated on the GTS continues to increase and is now peaking at around 240,000 to 250,000 observations per day. Trials of the WVSS-II water vapour sensor in the USA and Europe are nearing completion with final reports on the performance of the sensing technology due to be released in early 2009. However, development of the WVSS-II water vapour sensor and AMDAR software proved unsuccessful in obtaining the necessary funds needed for this task. It has been identified that the future work programme of the WMO AMDAR Panel must include developing a strategy to implement a standard suite of AMDAR software and hardware solutions that could be made available to all NMHSs.

6.1.13 The South-West Indian Ocean region currently has only one AMDAR Programme operating with in the region, South Africa. South Africa is currently operating a fleet consisted of eleven A319 aircrafts being used on domestic and regional routes and 17 long-range aircrafts (six B747-400s and nine A340 300 and 600). The newly established South African AMDAR Regional Programme consists of South African Airline, Regional Airlines and International airlines operating into the region.

6.1.14 The Committee was informed that the potential of Southern Africa Regional Airlines to provide AMDAR data is being continually reviewed. Interest has been shown by several NMHSs in the region including Mauritius and Kenya. The Southern African Programme have identified a number aerodromes and regions that are not regularly or sufficiently serviced by SAA so a contract was entered into with EUCOS (E-AMDAR) that should they have AMDAR

equipped aircraft flying into identified regions they would enable those aircraft to transmit AMDAR data.

6.1.15 The Committee was also informed that the E-AMDAR Programme is working in partnership with ASECNA for the development of an AMDAR Software Solution for Air France's long haul fleet. This development will greatly assist with the provision of AMDAR observations into the ASECNA group of countries, including Madagascar.

6.1.16 The Committee recognized that the AMDAR Programme had contributed significantly to the availability of upper air data in the region. In view of the challenges experienced by the Members in the operation of upper air stations and that AMDAR data has become increasingly important for Members to fill the missing gaps, the Committee urged Members to continue the efforts to recruit their respective national airlines to join and participate in the AMDAR Programme.

Marine and Ocean Meteorological Observations

6.1.17 The Committee noted that, overall, the ocean in situ observing system is now 60% implemented, with the JCOMM plan driving to full implementation, in principle by 2012. All data are being made freely available to all Members in real-time. However, completion will require substantial additional yearly investment by the Member / Member States.

6.1.18 The global surface buoy network is now essentially complete and being sustained (1250 units). Efforts are being made to increase the number of surface drifters reporting sea level pressure (617 units in July 2008). The International Buoy Programme for the Indian Ocean, coordinated through the DBCP, has succeeded in substantially increasing the deployment of drifting buoys in the Indian Ocean, and hence the availability of data from these platforms on the GTS.

6.1.19 Progress continues towards the development of a 47-element Indian Ocean Observing System (IndOOS), a multi-national, multi- platform network designed to support climate forecasting and research. The array has been named the Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA). In 2007, the number of ATLAS moorings in RAMA is now 32% complete. The 2008 scheduled deployments will increase this to 43%. Progress has been made towards multinational sustained support for RAMA via Memoranda of Understanding and Implementing Arrangements between the US and India, between the US and Indonesia, and between the Peoples Republic of China and Indonesia.

6.1.20 The Committee noted that implementation of marine observing network in the Region has continued to expand. The Tropical Moored Buoy network is being extended across the Indian Ocean (15 of 47 sites have been deployed thus far) to complete coverage of the equatorial regions of the Atlantic, Pacific, and Indian Oceans - the heat engine of global climate and weather patterns.

6.1.21 The Committee noted that due to the existence of increasing risks of high waves, freak waves and storm surge impacts in the South West Indian Ocean basin, real-time/near real-time remote sensing data is increasingly required by the Members in the region. The available data sets from satellite altimetry would enhance protection of maritime navigation and coastal inundation in the RA I region. In this context, the Committee requested the WMO Secretariat to seek measures to allow the RA I/TCC Members to retrieve such data with adequate technology and facility.

Marine Meteorological and Oceanographic Services

6.1.22 The Committee was informed that, as a result of large swell waves which caused widespread flooding in the exposed islands of the Maldives in May 2007 and for the second time in June 2007, the ECMWF Council (Reading, UK, December 2007), in response to the

request by the WMO, agreed to make available ECMWF marine products on 2.5-degree latitude/longitude grids. These products are beneficial in particular for the developing countries and Least Developed Countries, including the Small Island Developing States, in their official duties dealing with sea state monitoring and forecasting. The enhanced set of ECMWF products is available on the ECMWF web site:
http://www.ecmwf.int/products/forecasts/d/charts/medium.
Access to the ECMWF Web site for WMO Members is password protected; therefore all requests for access should be made by the Permanent Representative with WMO to the Director of ECMWF (please see www.ecmwf.int) with a copy to WMO Secretariat.

6.1.23 The Committee noted, in reference to the paragraph 3.3.3 of this report, that EC-LX (June 2008) urged the regional associations concerned to incorporate a storm surge watch scheme in the tropical cyclone advisory arrangements and in the TCP Regional Operating Plans and Manuals. The Council requested the Secretary-General, based on the technical advice of JCOMM, to examine the capabilities and willingness of Tropical Cyclone RSMCs and other storm surge forecast producing centers to participate in regional storm surge watch schemes, and to develop proposals for consideration by the concerned regional Tropical Cyclone Programme bodies and regional associations.

6.1.24 The chairperson of RA V TCC informed the Committee, in regard to the storm surge watch scheme, that an extensive discussion was made by the RA V/TCC at its 12th session held in Niue in July 2008. He advised that the RA V TCC had decided to form an Action Team that would examine the issue of coastal flooding in the RA V region. The Team would review:

- the level of threat from storm surge and waves,
- the user defined requirements for warning information,
- gaps in the observation network and scientific knowledge of the threats
- the capability of specialist centres to provide adequate warning information and
- make recommendations to president of RA V as soon as possible.

He further advised that the Action Team would be relatively small to ensure a quick response to the EC-LX request, but would include a range of experts including disaster managers, forecasters and technical experts.

6.1.25 Noting the guidance provided by EC-LX and in consideration of the serious impact of the storm surge in this region and useful advice from RA V, the Committee decided to form an ad-hoc group to address the issue related to storm surge in the region. This issue should be considered in the broad sense, i.e. not only on surges resulting from tropical storms but also from mid-latitude storms. In this regard, the Committee noted that some Members have undertaken bathymetric studies of their coastal or near coastal areas. Gauging coastal stations are also being installed. However, the Committee had the view that there is a need for a global approach to storm surge monitoring and forecasting.

6.1.26 The Committee also agreed that the ad-hoc group will be composed of Chairperson of the Committee and the experts nominated by Mauritius, RSMC La Reunion, South Africa, Mozambique, Madagascar, Seychelles and Kenya. The experts will be from the fields of meteorology, marine meteorology and disaster management. The ad-hoc group will, inter-alia, consider the following:

- The vulnerability of Members
- The specific communities under risk
- Monitoring facilities and gaps
- Model outputs
- Response measures

6.1.27 The Committee had a view that capacity building is indispensable for a successful implementation of the storm surge watch scheme in this region. It requested the WMO Secretariat to provide the RA I/TCC Members with training opportunities for storm surge forecasting and warning.

6.2 Hydrological Component (agenda item 6.2)

6.2.1 The Committee was informed that following the proposal of the ninth session of RA I Working Group on Hydrology which met in Arusha, United Republic of Tanzania from 28 November to 1 December 2006, the XIV-RA I, through Resolution 16 (XIV-RA I) Working Group on Hydrology, established subregional groups for the five Subregions for Eastern, Western, Central, Northern and Southern Africa and designated five subregional coordinators plus a Liaison Officer to the Tropical Cyclone Committee (TCC) to facilitate organization of activities.

6.2.2 The Committee noted that the XIV-RA I, through Resolution 9 (XIV-RA I) Tropical Cyclone Committee for the South-West Indian Ocean, invited the chairperson of the RA I Working Group on Hydrology to designate a Member of the Committee to serve as Rapporteur on Hydrology. Accordingly, the Chairperson, Mr Dumsani Mndzebele (Swaziland) designated Mr Frankie Dupres (Seychelles) to serve as Rapporteur on Hydrology.

6.2.3 A Flash Flood Guidance System with Global Coverage will be implemented under the WMO's Flood Forecasting Initiative. As one of the first activities, a Regional Centre (RC) will be established in Southern Africa (along with those in Central America and the Mekong River Basin) for data archiving, analyses and communications with National Meteorological and Hydrological Services (NMHSs) in participating countries. The RC will process existing historical and near real-time data and information to produce estimates of flash flood guidance and flood threat – parameters which can be used to develop flash flood warnings and disseminate the information to NMHSs. A workshop for initiating the implementation of the Regional Flash Flood Guidance System in Southern Africa and to assess the region's needs was hosted by the South Africa Weather Service from 2 to 4 April 2008.

6.2.4 The Committee recognized that it is important to collaborate with the Regional Centre when established in order to access and exchange relevant data and information for mutual benefit of the two initiatives.

6.2.5 Members reported the relationship between the meteorological services and the hydrological services in their countries. The Committee noted that in a number of the countries there is no interaction between the two services while there exist good coordination of information and activities in some Member countries. In view of the significance of hydrological component in the TCC Technical Plan, the Committee recognized that more active interactions need to be established between the RA I/TCC and the RA I Working Group on Hydrology through the Liaison Officer to the Tropical Cyclone Committee (TCC).

6.3 Reduction of the Impacts of Natural Disasters and Preparedness Component (agenda item 6.3)

6.3.1 The Committee was pleased to note that WMO, through the crosscutting framework of its Disaster Risk Reduction (DRR) Programme, with the participation of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM), Tropical Cyclone Programme, the Commission for Atmospheric Science (CAS), the Commission of Hydrology (CHy), the Commission for Basic Systems (CBS) and partners is initiating a coordinated approach for development and implementation of integrated marine-related forecasting and warning systems for improved disaster risk management, in particular:

Enhanced tropical cyclone and other related hazards' risk Information

6.3.2 WMO through JCOMM, has initiated efforts for development of standard methodologies and tools for storm surges and waves. Guidelines for archiving and analysing historical information about storm surges are under development, and will be published as part of JCOMM's "Guide to Storm Surge Forecasting". Additionally, JCOMM is engaged in the development of a database of extreme wave events, which provides a useful reference of historical background to various studies and applications, including modeling, monitoring and predicting extreme events and their impacts. More information about the Extreme Wave Database is available at http://www.jcomm-services.org/JCOMM-Extreme-Wave-Data-Base.html).

6.3.3 Since 2003 and 2004, the WMO Tropical Cyclone Programme participated in the development of the global unique disaster identifier number (GLIDE: www.glidenumber.net), developed to facilitate quality management of databases, avoiding duplicates, enabling inter-operability and linking hazard events with the related disasters, inside and across national borders. In June 2007, the Global Risk Identification Program (GRIP: www.gri-p.net) was launched, with the goal to improve utilisation of information on disaster risks and losses into risk management decision-making. Specifically, GRIP is involved in the development and enhancement of national to international disaster losses databases, and is promoting utilisation of the GLIDE number for linking information about hazards and associated losses.

6.3.4 Through efforts of international agencies and programmes such as the World Bank and GRIP, projects are underway for disaster impact databases development and probabilistic risk modelling in different regions and countries. WMO is supporting the World Bank's "Central America Probabilistic Risk Assessment" (CAPRA: go.worldbank.org/YJ5KU1G5R0) project, launched in Managua on 22 February 2008, by facilitating NMHS' and regional specialized meteorological centres' participation for provision of hazard and forecast information for development of the hazard modules for these models. WMO, through its HWR Programme is also contributing to GRIP, with the goal to improve tools and methodologies for flood hazard and risk analysis. This effort could consider coastal flooding linked to tropical cyclones and marine-related hazards, such as storm surge and extreme waves.

Integration of maritime warnings and related information for improved coastal risk management

6.3.5 WMO has initiated an integrated effort by setting up or strengthening existing collaboration mechanisms among the regional Tropical Cyclone Programme coordination bodies, the Regional Associations and the technical commissions concerned, foremost JCOMM, CAS CHy and CBS, for developing and improving the service delivery in coastal risk management, with an emphasis on: (1) Developing guidelines for early warning systems related to detecting and forecasting marine-related hazards; and (2) Implementing, through pilot demonstration projects, improved operational forecast and warning systems for coastal inundation. These efforts will be built upon activities such as those through WMO WWRP's Working Group on Tropical Meteorology Research (WGTMR) which is working on high-impact weather events associated with tropical cyclones and monsoons that primarily affect the tropical and subtropical countries. Specifically, WGTMR is working on four projects namely: (1) an intercomparison of the recently developed advanced numerical modeling systems for the prediction of tropical cyclone structure/intensity changes; (2) a Forecast Demonstration Project to implement a state-of-the-art model for tropical cyclone precipitation in the Philippines (3) a tropical cyclone field experiment for the western North Pacific that would include targeted observations and advanced models to improve landfall forecasts; and (4) a project focused on the extra tropical transition of tropical cyclones.

6.3.6 In some countries, National Meteorological Services, together with other technical agencies (e.g. hydrological services, ocean services), have combined their information into information portals to facilitate access by the decision-makers and emergency operators.

This collaboration among agencies should ensure that authoritative information is available in a timely, understandable, and easily accessible fashion for emergency operators and decision makers

6.3.7 Following a request by the 58th Executive Council and further stressed by the15th Congress, WMO is initiating pilot projects on early warning systems with a multi-hazard approach to better understand institutional cooperation, and operational aspects of early warning systems, with the goal to develop guidelines on effective multi-hazard early warning systems with respect to governance, organizational coordination and operational aspects and the role of NMHS therein.

6.3.8 In the context of the humanitarian reform and under the framework of the Inter-Agency Standing Committee (IASC), the humanitarian community is working together to improve contingency planning and more coordinated response to potential disasters. This requires access to relevant official forecasts and other advanced information that can assist them in assessing potential disaster situations. Strengthening of operational linkages between national and regional offices of these agencies with NMHSs and RSMCs, and development of meteorological, oceanographic, hydrological and climate products and services that would address their needs and requirements could improve the coordination of humanitarian response and relief operations following a disaster.

6.3.9 Through collaboration of the space agencies, humanitarian agencies, NMHSs and RSMCs, value-added products combining meteorological, oceanographic, and hydrological information and forecasts with high-resolution satellite images provided by the Charter on Space and Major Disasters (www.disasterscharter.org), could be developed systematically to assist emergency responders in emergency planning, response, relief and post-disaster assessments.

WMO coordinated multi-hazard early warning systems pilot projects

6.3.10 In 2007 WMO initiated the development of early warning system pilot projects in RA IV, starting in Central America. In November 2007 a Regional Planning and Advisory Group (RPAG) was established under leadership of RA IV President, involving WMO network's experts in the region and other key partner agencies, including the World Bank and the Regional Office of the International Federation of Red Cross and Red Crescent Societies (IFRC).

6.3.11 Regional cooperation initiatives in southern and south-east Africa for development of technical capacities of NMHSs to use latest tools for forecasting has resulted in the development and implementation of (i) the severe weather forecasting demonstration project (SWFDP) in 5 countries of SADC (Botswana, Madagascar, Mozambique, Tanzania and Zimbabwe) and (ii) flash flood guidance system (FFGS) in 9 countries (Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe). The SWFDP is being rolled out to all SADC countries.

6.3.12 Efforts are underway to leverage these developments along with other capacities (regional specialized meteorological centres, tropical cyclone committee, etc.) for initiation of early warning system pilot projects with multi-hazard approach to optimize utilization of existing technical meteorological and hydrological tools and capacities for. (i) Optimal utilization of existing technical meteorological and hydrological tools and capacities for emergency preparedness and response operations (national to local), (ii) Provision of warnings, forecasts and other products and services to support improved community emergency preparedness and response, and (iii) Development of feedback mechanisms during and after events to improve NMHS contribution to the overall EWS system. The Secretariat has initiated the mapping of projects of WMO Programms, technical commissions, regional association, and other partners in support of disaster risk management in Africa, as an initial step for an integrated planning for DRR projects.

6.3.13. The meeting recommended that under the WMO DRR programme pilot demonstration projects in Early Warning Systems with a multi-hazard approach be implemented in the region.

6.4 Research Component (agenda item 6.4)

6.4.1 The Committee was informed that the Region I (Africa) Research Workshop on Tropical Cyclones was successfully held in La Réunion, France, from 26 to 30 May 2008. The workshop conclusions and other presentations from the workshop are now available online at:

http://swio2008.univ-reunion.fr/Workshop_Information_menu_1000.html

The workshop proposes an ambitious agenda including significant upgrades to the forecast system, improved use of new satellite data streams, training, and a focused observational campaign. The meeting was organized by the Laboratoire de l'Atmosphère et des Cyclones (LACy) of La Réunion in cooperation with WMO's Tropical Cyclone and World Weather Research Programmes. The workshop proceedings will soon be published as a WMO report.

6.4.2 The Tropical Cyclone Panel of the World Weather Research Programme's (WWRP) Working Group on Tropical Meteorology Research (WGTMR) organized an "Expert Meeting to Evaluate Skill of Tropical Cyclone Seasonal Forecasts". The meeting held in Boulder, Colorado, USA from 24 to 25 April 2008 reviewed the status of a number of statistical and dynamical techniques for seasonal forecasts. As recommended by the Sixth International Workshop on Tropical Cyclones (San Jose, November 2006) the meeting formally established a website for seasonal tropical cyclone forecasts on the WMO/WWRP/TMR website. Plans are to have the website on test mode during September 2008.

6.4.3 The Committee was informed that the Expert Team on Climate Change Impacts on Tropical Cyclones of the WGTMR's Tropical Cyclone Panel will organize next year the International Conference on Indian Ocean Tropical Cyclones and Climate Change in Muscat, Oman from 8 to 11 March. Plans are for the conference to be held in conjunction with the 36th session of the Panel on Tropical Cyclones.

6.4.4 The Committee noted that the first phase of THORPEX Pacific Asian Regional Campaign (T-PARC) is one of the largest field campaigns conducted to date that focuses on advancing the understanding and prediction of high impact weather over the Northwest Pacific Basin. T-PARC began on 1 August 2008 and will conclude in early October 2008. The tropical cyclone studies will be undertaken in conjunction with the Tropical Cyclone Structure (TCS08) field experiment. T-PARC is an international effort involving Australia, Canada, China, France, Germany, Japan, Korea, Malaysia, US, the UK and several international organizations.

6.4.5 The Tropical Cyclone Structure (TCS08) field experiment (August through September 2008) was sponsored by the US Office of Naval Research in conjunction with the Naval Research laboratory and the US Air Force and whose overall goal is to increase predictability associated with all aspects of tropical cyclones over the western North Pacific. Strong links occur between the international T-PARC and the US-led TCS-08 experiment. The three scientific foci of the field experiment are tropical cyclone formation, structure change including intensity changes, and the processes leading to recurvature.

6.5 Training Component (agenda item 6.5)

6.5.1 The Committee reviewed the involvement of its Members in various education and training activities supported under WMO Voluntary Co-operation Programme (VCP), regular budget (RB), UNDP and TCDC arrangements. It expressed appreciation for the training events that were organized by WMO and Member countries since its seventeenth session in 2005, especially those events that were of direct relevance to tropical cyclones, which were considered of great value in stimulating and assisting in further development of tropical cyclone committee activities.

6.5.2 The WMO Regional Training Centres (RTC) in Africa and RTCs in neighboring Regions continued to offer regular and specialized training courses in different fields of specialization and at various levels. Members of the Committee are encouraged to make maximum use of the training courses, which are relevant to their activities and available at these centres.

6.5.3 The Committee appreciated that WMO carried out the sixth survey, WMO/TD-No.1380 and ETR-No.19, on "Members Training Requirements, Opportunities and Capabilities in Meteorology and Hydrology" during 2006. The findings of the survey shows that "Numerical Weather Prediction", "Agrometeorology", "Marine Meteorology" and "Instrumentation" are the top priority topics for short and long term training in the Region.

6.5.4 Being informed that only 25 Members among 52 from Regional Association I responded to the sixth WMO Survey 2006, the Committee strongly encouraged its Members to actively respond to the next survey to be carried out in 2010 in order to better identify the training needs of the Region.

6.5.5 The delegate of Malawi stated that their staff sometimes fails to participate in the training session held in RSMC La Reunion due to visa problems. The delegate of Malawi requested the WMO Secretariat to take an appropriate action for a more smooth and timely visa arrangement for the participants from Malawi.

6.5.6 In regard to the RA I Training Course on Tropical Cyclone and PWS, RSMC La Reunion suggested that it would be an option to organize the next Training Course back to back the IWTC-VII to be held in 2010, if the Workshop is held in La Reunion. It could allow for sharing resource persons between the events and a maximum participation from the RA I/TCC Members under the limited funds.

6.6 Activities of Members

The Committee reviewed the activities of the Members carried out in during the inter-sessional period including important achievements, key issues and future directions by each Member under the five components, details of which are presented in **Appendix VI.**

6.7 Updated Technical Plan

6.7.1 The Committee noted that the current Technical Plan requires a detailed review for the update because three years has passed since the last session. In consideration of the important role of the Technical Plan to guide the Committee's activities for the next four years as well as the tight constraints of time during this session, the Committee decided that Members should continue to examine the Plan after the session and the update of the Plan should be carried out by correspondence. It agreed that TCC Chairperson should undertake the coordination for the update process. It requested the WMO Secretariat to assist the Chairperson in correspondence with the Members and preparation of the new Technical Plan. In this respect, the Committee urged the Members to send their comments to the WMO Secretariat by the end of November 2008.

6.7.2 Comments made during the meeting were noted on the update of the Plan regarding ground stations. Many corrections were noted. It was agreed to make a distinction between the evolution of the network in recent years and the important developments that remained to be achieved and that should be included in the updated Plan. The secretariat asked to be supplied before the end of November with all this information, and that on the other chapters of the Plan, to enable it to circulate a new consolidated version in time to the Committee members and then to the WMO authorities to which it had to be presented. Apart from simply compiling needs, the need was also highlighted for an argument based on an analysis in support of the dossiers to be prepared for seeking any external funding.

6.7.3 At the end of the discussion of the Plan, the chairman of the meeting pointed out that major work on the development of the structuring, monitoring and updating of the Plan was needed between sessions in order to prepare the work of the next plenary session. Unless a special rapporteur was appointed to coordinate this work, it would fall to the chairman of the Committee in association with the secretariat.

7. ASSISTANCE REQUIRED FOR THE IMPLEMENTATION OF THE TECHNICAL PLAN AND STRENGTHENING OF THE OPERATIONAL PLAN (Agenda item 7)

7.1 The Committee was informed that since the last meeting of the Tropical Cyclone Committee (Gaborone, Botswana 3-7 October 2005), several countries in the Region continued to receive technical assistance from various funding sources including Trust Funds, UNDP, the Word Bank (WB), the Global Environmental Facility (GEF), the WMO's Voluntary Cooperation Programme (VCP) and Regular Budget. The main objective of these projects was to strengthen the capabilities of National Meteorological and Hydrological Services (NMHSs) and Regional Centres to provide reliable and accurate weather/climate information and products in support of improved agricultural production, environmental protection, natural disaster preparedness and management, water and energy resources management, etc.

7. 2. The Committee noted that at the regional level, the IGAD Climate Prediction and Applications Centre (ICPAC) based in Nairobi, Kenya and the SADC Drought Monitoring Centre (DMC) in Gaborone, Botswana, continued providing weather and climate information, products and early warning advisories to the eastern and southern African countries. They also organized annually Regional Climate Outlook Fora to develop consensus seasonal climate outlooks for the coming rainy seasons. The operations of ICPAC and the SADC DMC were supported by funds provided by WMO and other cooperating partners especially the United States Agency for International Development (USAID). The Committee noted that SADC, DMC had relocated to Botswana from Harare and it required assistance for enhancing its operations.

7.3. The Committee noted that WMO in collaboration with the Intergovernmental Oceanographic Commission (IOC) of UNESCO continued to support the implementation of the "West Indian Ocean Marine Application Project (WIOMAP)" project whose overall objective is to contribute to the conservation and sustainable use of marine resources in the South-West Indian Ocean region through improved application of marine data and products. Efforts are ongoing to secure funding for the project.

7.4 The Committee was informed that WMO continued to collaborate with the various economic sub-groupings such as the East African Community (EAC), the Indian Ocean Commission (IOC), the Intergovernmental Authority on Development (IGAD) and the Southern Africa Development Community (SADC) with the aim of formulating and implementing meteorology development programmes and projects. The Committee was informed that the NMHSs in SADC countries have formed the Meteorological Association of Southern Africa (MASA) which will be the platform of development of Meteorology in the Region. The East African Community countries have developed a Meteorological Strategic Development.

7.5 The Committee was briefed on the activities of the WMO Programme for the Least Developed Countries (LDCs) which continued to organize assessment missions to several countries in the region. Project proposals have been developed for enhancing the operational activities of their NMHSs. Furthermore, workshops were organized in 2007 on strategic planning and resource mobilization. Currently, efforts are ongoing to implement the strategic action plan for the LDCs Programme that was developed at a meeting held in Geneva in April 2005.

7.6 The Committee was informed that the "African Monitoring of the Environment for Sustainable Development (AMESD)" project is under implementation through the financial

support of the European Union (EU) and implemented by the African Union (AU). In SADC, Botswana was designated the Regional Implementing Centre (RIC(and the the Indian Ocean Commission is the RIC for the IOC countries. The AMESD project will foster the use of Earth Observation data and environmental policies, and will also represent a major effort aimed at institution and capacity building and networking at regional and continental level. NMHss in the region were urged to use the opportunity offered by AMESD for further development of their operations. The Committee was further informed about the Climate for Development Project for Africa which is under the coordination of Africa Union and UNECA. WMO is a member of the AMESD Steering Committee and the CLIMDev.

7.7 The Committee noted the role played by WMO in collaboration with other UN agencies to develop a Tsunami Early Warning System. The components of the WMO GTS system have been upgraded in several countries through provision of new and additional technology and equipment. The WMO GTS continues to play a major role in the dissemination of the ensuing tropical Cyclones and Tsunami early warnings.

7.8. In order to enhance marine and oceanographic observations in the Southwest Indian Ocean area, Members were encouraged to continue their efforts to upgrade their observation systems for the provision of tropical cyclone forecasts. In this regard, it is to be noted that the Kenya Meteorological Department, with the support of NOAA deployed several drifting buoys along the Kenya coast in the Indian Ocean.

7.9. The Committee was pleased to be informed that under funding from the US Climate Change Research Initiative for the enhancement of global climate atmosphere observing systems, several countries in the region have received assistance within the framework of the VCP to upgrade their upper-air systems within the GUAN network. In this regard, upper air equipment has been installed in Namibia and Tanzania; while arrangements are under way to install similar equipment in Zimbabwe. Consumables such as radiosondes and balloons have been supplied to some of these countries. Similarly, hydrogen generators have been installed in Kenya, Mauritius, Namibia, United Republic of Tanzania and Zimbabwe under the project.

7.10 The Committee further noted that within the framework of the VCP, several Members in the Region received support in terms of equipment, spare parts and consumables, expert services, and training.

7.11 In order to attract increased national support, the Committee urged the Members to enhance the visibility of NMHSs in their respective countries and to actively contribute to socio economic development activities. In this respect the committee was informed of WMO plans to organize a conference of African Ministers responsible for Meteorology in 2009 with the aim of sentizing the senior policy levels of the importance of meteorological products and services to economic development activities. The Committee was further briefed on the ongoing preparations by WMO in organizing the Third World Climate Conference in 2009.

8. SCIENTIFIC LECTURES AND DISCUSSIONS (Agenda item 8)

During the session, the Committee devoted part of its time to the presentation of the following scientific lectures and technical discussions on the theme “Increase in frequency of unusual behaviors of cyclones in the Indian Ocean.”

(a) Mr Philippe Caroff (France)

(b) Mr Mike Bergin (Australia)

‘’TCWC Perth - Some Perspectives and Research Activities”

(c) Mr Mohamudally Beebeejaun (Mauritius)

''Climate Change & Multi-hazard System in the South West Indian Ocean"

9. OTHER MATTERS

9.1 The delegate of Mauritius informed the Committee of a study published in the AMS journal on the wind-pressure relationship for the Indian Ocean.

9.2 Regarding the use of the term "midget storm" in the operational forecast of tropical cyclones, Mauritius suggested that it be retained in order to avoid confusion.

9.3 The Chairperson informed the Members of the proposed holding in or before May 2009, of a RAI Conference of Ministers responsible for Meteorology. The findings and recommendations of this meeting will be input into the WCC-3 planned for end of August 2009. Members were urged to sensitize their respective governments

9.4 The ICAO representative stressed the importance of issuing SIGMET information for the safety of aircraft operations in particular those related to tropical cyclones. He requested the Committee Members to encourage their counterparts in meteorological watch offices (MWOs) to comply with the requirements of Annex 3 to the Convention on International Air Navigation and WMO Technical Regulations. The Committee was further informed that the ICAO Regional Offices will be conducting SIGMET tests in the coming weeks to assess the reliability of telecommunications systems for the exchange of information and compliance with the SIGMET format.

9.5 The RSMC La Réunion has presented a project of a field campaign in the South-West Indian Ocean called the South West Indian Cyclone Experiment (SWICE). This ambitious project, which was as yet only in the preliminary phase and not yet accepted, basically targets January-February 2011 for its achievement. It aims to involve many partners and scientific organizations, and would ideally consist of several components. If it eventually came to fruition, it would include both airborne measurements in the environment of tropical disturbances monitored during the campaign (thanks to the provision of a French instrumented research aircraft by the Institut National des Sciences de l'Univers – INSU), and ocean-atmosphere measurements (if SWICE were to be implemented, as intended, jointly with other measurement field campaigns also being planned for the same period, such as the follow-up campaign to the 2007 Vasco-Cirene experiment and the TRIO ocean measurement campaign). The campaign's main scientific objectives include :

- to test adaptive observation methods, in particular for assimilation in the numerical models
- to increase the use of and validate satellite data, especially those from new satellites due for launch soon (Megha-tropiques, ADM-Aeolus)
- to improve synthetic vortex analysis techniques (bogussing)
- to obtain data sets that will enable the testing of high-resolution numerical models
- to help improve coupled ocean-atmosphere models, notably by contributing data gathered by Aeroclippers
- to improve understanding of the physical processes (interactions with the large scale, with the various tropical waves, with the high-altitude environment)
- to improve understanding of the internal processes contributing to changes in structure and intensity of tropical depression systems.

9.6 The white paper for the project had been submitted to potential sources of funds responsible for scientific research in France. Preliminary contacts had been established at the research seminar held in La Réunion in late May 2008 with possible scientific partners for the project (BMRC in Australia, NOAA/HRD in the United States). Links have also been

forged with TMRP/WMO via Russ Elsberry, with a view to arranging WMO funding for holding a pre-campaign seminar in 2009 in order to carry out all the work, notably of a scientific nature, prior to organizing such a campaign.

9.7 The Committee was very interested to learn of the project's existence and expressed its support, hoping that it can be endeavoured successfully, as it is a major project for improving knowledge of depression systems in our particular basin, in order to improve tropical cyclone forecasting and reduce the adverse consequences of their impact on the countries in the area. Accordingly, the Committee recommended that WMO should also support it and – as far as its resources allowed – facilitate initiatives taken under this project. The member countries also declared their readiness to offer their support to the organization and implementation of the project regarding its regional implications, such as in particular carrying out more observations during the period of intensive measurements and observations.

9.8 The Committee requested ICAO and WMO to continue with the training activities for the preparation and issuance of SIGMET information to enhance compliance by MWOs. In this regard, the ICAO representative informed the Committee that the two organizations will conduct additional workshops during the next two years in the region on the issue.

9.9 The RSMC announced to the Committee that it intended by the next session to open a public website devoted to the RSMC La Réunion - Tropical Cyclone Centre, publishing both real-time information and archive data produced by the RSMC, and a variety of information on cyclones.

9.10 The RSMC La Réunion – Tropical Cyclone Centre had had ISO-9001 quality certification since 2005. It informed the Committee members that in this context it would organize a quality survey of all RSMC-Cyclone users, i.e. all national meteorological services represented on the Tropical Cyclones Committee. This will be a special opportunity for La Réunion RSMC to listen to the National Meteorological Services members of the Southwest Indian Ocean Tropical Cyclone Committee and to receive their opinions on the pertinence, the impact and the efficiency of the operational production of the RSMC and eventually to hear their needs. A questionnaire with an answer form will be sent during the inter-session to all directors of the NMHSs of the Committee.

10. DATE AND PLACE OF THE NINETEENTH SESSION (Agenda item 9)

10.1 The Committee expressed the need to continue its work in the light of Resolution 9 (XIV-RA I). It also expressed the desire that its nineteenth session be held before the 2010/2011 cyclone season, the dates to be determined later.

10.2 The delegates of Kenya, South Africa, and Lesotho informed the Committee that their countries would be privileged to host the nineteenth session of the RA I/TCC in 2010.

11. CLOSURE OF THE SESSION (Agenda item 10)

The report of the eighteenth session of the Committee was adopted at its final meeting at 12:45 hours on 10 October 2008.

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LIST OF APPENDICES

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AGENDA

1. ORGANIZATION OF THE SESSION

   1.1 Opening of the session
   1.2 Adoption of the agenda
   1.3 Election of the vice-chairperson
   1.4 Working arrangements for the session

2. REPORT OF THE CHAIRPERSON OF THE COMMITTEE

3. COORDINATION WITHIN THE WMO TROPICAL CYCLONE PROGRAMME

4. REVIEW OF THE 2005/2006, 2006/2007 AND 2007/2008 CYCLONE SEASONS

   4.1 Report of RSMC La Réunion
   4.2 Reports of Members on significant/notable cyclones of the seasons

5. REVIEW OF THE TROPICAL CYCLONE OPERATIONAL PLAN FOR THE SOUTH-WEST INDIAN OCEAN

6. REVIEW OF THE TECHNICAL PLAN AND ITS IMPLEMENTATION PROGRAMME

   6.1 Overall Programme
   6.2 Members' Activities
   6.3 Meteorological component
   6.4 Hydrological component
   6.5 Disaster risk reduction component
   6.6 Research
   6.7 Training

7. ASSISTANCE REQUIRED FOR THE IMPLEMENTATION OF THE TECHNICAL PLAN AND STRENGTHENING OF THE OPERATIONAL PLAN

8. SCIENTIFIC LECTURES

9. OTHER MATTERS

10. DATE AND PLACE OF THE NINETEENTH SESSION

11. CLOSURE OF THE SESSION

REVIEW OF THE 2005/2006, 2006/2007 AND 2007/2008 CYCLONE SEASONS

CYCLONE SEASON 2005/2006

The 2005-2006 cyclone season was scarcely active in the South-West Indian Ocean. Both in terms of number of phenomena (three tropical storms and three cyclones) and days of cyclone activity, it ranked fifth among the least active seasons since the beginning of the satellite era (in 1967) dropping behind the normal by nearly 50% for the cumulated number of days of activity. After the record 2005 cyclone season in the Atlantic, the Cassandra, who by too hasty and simplistic a generalisation, had announced a recrudescence of cyclone activity and a difficult season to come, had to bear the brunt of their misconceived prediction.

Thirteen depression systems elicited the issuance of advisories by RSMC La Reunion, less than during the preceding seasons. In fact, since the RSMC started operations (in the early 1990s), only one season saw fewer systems being monitored (in 2000-2001 with only 11 systems), another evidence which supports a season of reduced activity. Out of those thirteen systems, six were graded as tropical storms (including one unnamed), which is a rather weak rate of conversion into mature phenomena, this index of cyclogenesis efficiency being also a good criterion to evaluate the seasons' activity given that seasons which show a ratio under 50% are usually less active than the norm (which, as a reminder, amounts to 9 tropical storms in the basin). Looking more in detail, one can observe that the season was rather unbalanced in this way : after a rather disturbed start, with six monitored phenomena before 31st December (as many as in the previous season), but for a very poor yield though (only one mature storm developed against three in the previous season), the rest of the season was abnormally unproductive in cyclogeneses attempts (only seven other systems were monitored), but turned out to be much more efficient (five cyclogeneses converted successfully).

The amount of six tropical storms places this season at a very low level in terms of activity considering that since 1967 (beginning of the satellite era) only four seasons remained under this threshold. The same statement applies for the number of days of disturbed activity, which is a more representative parameter to the actual activity of the season, with a total of 30 cumulated days with the presence on the Southwest Indian Ocean of a depression system of an intensity equal to or greater than that of a moderate tropical storm (to compare with a mean of 53 days and the median of 48). Three of the observed tropical storms turned into tropical cyclones – a normal ratio –, including two intense cyclones. The number of cyclone days (cumulated number of days with the presence of a tropical cyclone on the zone) nevertheless remained far from the normal amount with only 10 days – instead of 20 in climatological average. The regular trend to a rather fast drop in disturbed activity observed in recent years (trend started after the peak season of 2001-2002) has thus been confirmed.

This cyclone season 2005-2006 exhibited much similitude with season 1998-1999. Season of low activity, laborious start, drought anomaly on the basin, all statements applying in 2005-2006 alike in 1998-1999 which had been an equally tardy season (while in 2005-2006 it was necessary to wait until the last decade of February to name the third system of the season, – a record since 1960 from which time tropical depression systems started being named in the basin –, in 1998-1999 the first storm of the season was only named on 16 January, the second most tardy date for a season to begin).

From a purely numerical point of view, these two cyclone seasons were nearly clones, either in terms of number of days of cyclone activity or number of systems, considering that those two seasons were not only credited the same number of named phenomena (five), but also had in common another additional feature, namely a sixth ephemeral tropical storm which deserved to be named but which was not. In 1998-1999 it concerned the faraway tropical storm HAMISH which came from the South-East Indian Ocean under the Australian

responsibility and which had not been renamed by the Mauritius Meteorological Services on the far edge of the basin after its crossing of longitude 90°East. This time could have borne out more consequences since the Number 09 system, a tiny midget-type storm was threatening Mauritius at the time of its peak of intensity. Last point in common between those two seasons: in both cases, the sister islands of Mauritius and La Reunion had to undergo – despite a low activity for the basin – the significant influence of a depression system each time in March, and of the 'Ds'-system (cyclone DAVINA in 1999, tropical storm DIWA in 2006), those meteors having had a major impact during their respective warm season either to mitigate or eliminate altogether the effects of a previous drought.

The cyclogeneses spread over two well-identified zones: after a first part of the season lasting until end of December when all monitored systems had appeared either over the eastern part of the basin or close to its eastern boundary, i.e. over the Southeast Indian Ocean, the formations then concentrated mainly north of the Mascarenes. No system formed nor developed between the Chagos Archipelago and the islands situated in the western part of the basin, which is an unusual situation. The Mozambique Channel was also rather calm and devoid of any cyclogenesis, considering that the rejuvenation of BOLOETSE cannot be qualified as a purely endogenous cyclogenesis.

The tracks were quite varied with however a dominant southwestward climatological orientation in the tropical domain. Unlike the previous season when extratropical transitions were legion, most systems this year dissipated within the tropical domain.

This cyclone season was rather clement to the populations, the African continent being spared once more and Madagascar having been only slightly influenced by the only phenomenon, BOLOETSE, which with its track similar to that of ERNEST's a year earlier, caused many less casualties on the southwestern coast of Madagascar. The heavy rainfall related to DIWA affected the Mascarenes and namely La Reunion, where its impact caused directly or indirectly the death of several people.

THE 2006-2007 CYCLONE SEASON

The 2006 – 2007 cyclone season was an active one in the SouthWest Indian Ocean. If the number of phenomena was just slightly above normal the number of cyclone days was very high due to the notable occurrence of systems of severe intensity: six intense tropical cyclones recorded, a number unsurpassed in more than 30 years and which was observed only once during this contemporaneous period (during the "great" 1993-1994 cyclone season).

Given that the disturbed activity moreover focused mainly above the central western part of the basin, it meant an exacerbated cyclone risk factor for the inhabited lands. Each gestating meteor represented a greater potential hazard than usual: e.g. a potential intense cyclone that might hit any given island in the area. As it is generally the case in such configuration, Madagascar was the most exposed because of its size and was directly affected by no less than four storms which left a trail of damage and disaster victims. But all surrounding lands (or islands), with no exception, were affected at various degrees including some islands for which the risk of being concerned by a mature tropical cyclone is deemed nearly nonexistent, such as was the case for the Seychelles Archipelago of Farquhar.

The continuous decrease in cyclone activity observed in five consecutive years since the 2001-2002 cyclone season could not last forever**,** obviously. But after the sluggishness of the preceding season of 2005-2006, the bounce was harsh yielding a season of rather severe activity which was not due to an excessive number of cyclogeneses but rather to a great facility to convert those cyclogeneses into phenomena which were not only mature but also peaked at strong intensity at their climax.

Fifteen depression systems elicited the issuance of advisories by RSMC La Reunion this season, e.g. a number which strictly conforms to the usual norm of the Centre's production in the last ten years. However among the fifteen monitored systems only four did not develop and aborted more or less rapidly. As for the rest, the attempts of cyclogenesis were not only successful but also frequently followed by efficient – or even explosive – intensification phases as testified by the out of norms intensification phases of JAYA and namely BONDO. As a result, seven tropical cyclones developed, among which six became intense, which represents a huge and unprecedented proportion making that season a very specific and prominent one since six intense cyclones represents the highest number to have been observed in the past decades during any cyclone season in the basin. It is interesting to note that in the meantime only five cyclones developed over the rest of the southern hemisphere which, unlike the Southwest Indian Ocean, went through a less disturbed activity than usual during this 2006-2007 cyclone season, with only about twelve tropical storms forming.

So, in detail, the Southwest Indian Ocean gave birth to ten tropical storms, a number close to the norm (being 9), plus one unnamed subtropical depression. The accruing number of days of disturbed activity – a parameter more representative of the real cyclone activity in the season – was double compared to the preceding season (when including the two days during which the subtropical depression n°15 generated gale force winds). Despite that, the total amount of 58 cumulated days with the presence over the Southwest Indian Ocean of a depression system of an intensity equal to or greater than that of a moderate tropical storm only ranks this season slightly above the norm (considering that the mean is set at about 53 days and the median at 48).

But in terms of cyclone days (cumulated number of days with the presence of a tropical cyclone in the area of responsibility), the statement is different since the 30 days observed represent a 50% excess compared to the climatological average norm (of 20) and drew up this season amid the leading group of most virulent seasons (only the seasons of 2001-2002 and 1993-1994 surpassing it in terms of severity in the last 30 years). The average intensity of the phenomena, with the six intense cyclones that developed, was undoubtedly the most remarkable feature of the season even if extreme intensity (maximum average winds of 100 knots or above) was limited in time and therefore did not enable the current season to rival with the two abovementioned seasons.

Another notable element to highlight was the temporal distribution of the cyclonic activity in excess: it mainly originated from a reduced period focusing on the month of February whose activity concentrated more than 50% of the disturbed activity (idem for the number of cyclone days). And with five mature storms including three intense cyclones raging in the same month, February had rarely been as worthy of the title of "month in the height of the cyclone season" (one has actually to go back to the early 1970s to find such overwhelming disturbed activity in a February month).

The cyclone season as a whole assumed a similar behavior, being rather focused time-wise as well. The season started off later and ended earlier than usual. Aside from the very peculiar case of the subtropical depression that developed south of the Mozambique Channel in April, one might even consider the 2006-2007 season as having ended prematurely with the last tropical phenomenon filling up early April, which nearly corresponds to the first quintile in terms of ending season date.

The second major feature of the 2006-2007 cyclone season was the marked spatialization of the cyclogeneses and of the tracks of the various meteors which clearly opted for the western part of the basin. Nearly all systems spent the main part of their life cycle west of longitude 70°East with a strong aggregation of tracks between the Mascarenes Islands and the northern Madagascar. And if we consider the cyclogenesis point as corresponding to the tropical depression stage, all cyclogeneses occurred west of the Chagos Archipelago's longitude except for one, HUMBA, the only system to have really concerned the eastern part of the basin.

The physical basis explaining the spatial variability of the cyclogeneses' areas (and of the localization of the induced cyclonic activity) remains unknown on the whole but still, one can propose some attempt of explanation. The onset of the season occurred in a moderate El Niño situation pervading in the South Pacific. While the austral oscillation has little influence over the quantitative activity of the cyclone season in the Southwest Indian Ocean (except for the most notable El Niño events), it is recognized that it seems to significantly influence the spatialization of the cyclone activity.

Climatological studies have thus shown that the cyclone activity tends to strengthen during the El Niño years in the central western area of the basin, typically between 55 and 73°East (i.e. between the longitudes of La Reunion and Diego-Garcia) and, on the other hand, to decline over the eastern part of the basin (and vice-versa during the La Niña periods). The 2006 El Niño episode ended in January 2007 with a return to a neutral situation in terms of austral oscillation. And the fact is that it was not until the February month that some balance was restored in the disturbed activity over the basin with the first disturbances of the season forming to the east of the Chagos while previously all the cyclone activity had focused over the western part of the Indian Ocean: a pattern conforming too much to the expected climatological modulations of the cyclone activity by the state of the austral oscillation for it to be seen just a mere coincidence…

But another key factor that might be suspected to have been playing a role, as much in terms of the intensity of the phenomena as of their spatialization, relates to the rather marked episode of the Indian Ocean Dipole which took place in the 2006 spring (at the beginning of the cyclone season hence) with the corresponding sea surface temperature (SST) pattern, i.e. a noticeable cooling of the SSTs on the eastern side of the basin (the strongest anomaly to be observed – near Sumatra – exceeding 2°C) and a significant warming on the western side of the basin, with more than 1°C of positive anomaly west of the Chagos, an area which indeed was a privileged cyclogenesis area during the subsequent cyclone season 2006-2007. However to infer a direct linkage may probably be over-simple and hazardous : during the 1990s for instance, two strong episodes of the Dipole occurred, in 1994-1995 and in 1997-1998, but both corresponding seasons presented characteristics very different from those of the 2006-2007 season. The 1997-1998 season in particular, which was also a season associated to an El Niño event (but quite a strong one), was extremely quiet. That says it all about the complexity of the matter and how far we still are from unraveling the mechanisms that rule (or may rule) the cyclonic activity in the Southwest Indian Ocean…

The tracks followed by the disturbances were varied but more regular than in the previous seasons with not as many cusps, U-turns or sharp changes of heading. Apart from the atypical track of ENOK, the trajectories conformed to climatology on the whole, i.e. with rather zonal westward to west-southwestward tracks prevailing during the early life-cycles at low latitudes and then assuming more meridian-like trajectories leading them towards the southern latitudes even if less than half the disturbances were eventually ejected towards the subtropical domain.

It is a frequent feature for disturbances to reach their maximum of intensity between 15 and 20°South in the basin. But during this season this was far from being a general feature and there were even a few notable exceptions among which FAVIO which turned to be the most emblematical one. This storm, the only one to have touched Africa, became the most intense cyclone observed south of latitude 25°South over the Mozambique Channel since the beginning of the satellite era. Besides, it was the first cyclone to have affected the African coast (Mozambique namely) after skirting around Madagascar via the south. As for BONDO, it turned to be the first tropical cyclone since decades to have concerned the seas north of latitude 10°South and so far westwardly of the basin thus shaking the immemorial peacefulness of the islets of the Farquhar Archipelago and wreaking havoc on the northernmost ones.

Unfortunately, those Seychelles outer islands were not the only target for the cyclone activity to come on the long list of affected territories. Indeed, the focus of the cyclogeneses and

subsequent storms' tracks over the western part of the basin had a great impact in terms of cyclone hazard for the populations of the Indian Ocean zone. The inhabited lands, concentrated on the western side of the basin, were subject to increased cyclonic risk and none of them managed to escape the more or less marked influence of one to several meteors which caused the death or disappearance of more than 200 people in total.
As it is often the case, Madagascar was the first in line and underwent the "thunder" of four systems (BONDO, CLOVIS, INDLALA and JAYA), a fifth one (FAVIO) brushing the southern coast. One has to go seven years back (1999-2000 season) to find such a tantamount profusion of phenomena having hit the Great Island in which nearly 450 000 inhabitants were affected by the aforementioned storms. The North and Northeast of the country were the most hard-stricken as a result of the impact of INDLALA which was the most devastating cyclone of the season and to a lesser degree by JAYA, the two cyclones landing – at three weeks' interval – in the same area of Antalaha.

After four years exempt of any threat, Mozambique faced cyclone FAVIO which coincidently struck at the same spot as the last cyclone (JAPHET) to have touched the country (in early March 2003). As previously mentioned, numerous meteors roamed north of the Mascarenes Islands and while the latter did not undergo major impact, they nonetheless had to face the rough meteorological conditions generated by ENOK and namely GAMEDE, the mightiest cyclone of the season – if not in terms of intensity at least of size – which affected the weather for several days over the sister islands of Mauritius and La Reunion, with Reunion beating some world records of rainfalls on that occasion.

REPORTS OF THE MEMBERS AFFECTED BY TROPICAL CYCLONES

Botswana

1. Tropical Cyclone Season 2005/2006

Botswana, being located in the interior of the Southern African subcontinent is very rarely directly affected by tropical cyclones. In a few incidences, the country may experience increased rainfall due to easterly disturbance caused by tropical cyclones which make landfall over the east coast or otherwise dry conditions are experienced when tropical cyclones are in the Mozambique Channel thereby depriving the interior of the moist air for the Indian Ocean.

The 2005/006 tropical cyclone season had six cyclones of which only 'BOLOETSE' moved into the Mozambique Channel. Tropical cyclone 'BOLOETSE' was in the Mozambique Channel from the 30th January 2006 to the 4th February 2006. An easterly disturbance in the upper atmosphere associated with the tropical cyclone resulted in increased rainfall over the Chobe District in the north of the Botswana during this period. Heavy falls were reported at places on the 31st January. Kazungula recorded 70mm whilst Kasane recorded 52mm.

2. Tropical Cyclone Season 2006/2007

During this season up to 14 Tropical cyclones were reported in the South West Indian Ocean Region. Of interest to Botswana was tropical cyclone 'FAVIO" which made land fall in Mozambique between Beira and Inhambane on the 22nd of February 2007. Its effects were felt over the north and north-eastern areas of the Botswana where some heavy rains were recorded with flooding at places. On the 23rd February 2007 Letlhakane (68040) recorded 80mm, Taupye 79mm, Serule 66mm and Masunga 60mm.

3. Tropical Cyclone Season 2007/2008

Like the previous season, the 2007/2008 Tropical Cyclone Season also recorded 14 cyclones in the region. Tropical Cyclone 'IVAN' was of interest to Botswana as it remained in the Mozambique Channel for a week (20th – 27th February 2008). Its spillover caused widespread rainfall over eastern Botswana with heavy falls at places. 80mm of rain in 24hrs was recorded at Mogapi on the 27th.

Tropical Cyclone "JOKWE' (02-16 March 2008) had a similar effect. Its spillover caused widespread rains with heavy falls at places over eastern Botswana. On the 13th March 2008, 110mm was recorded at Pilikwe, 106mm at Semikwe, whilst some other places in the area recorded more than 50mm each. Localized flooding was recorded at places.

Lesotho

1. During the past tropical cyclone seasons (2005/2006, 2006/2007 and 2007/2008) Lesotho was indirectly affected by tropical cyclones activity. The increased activities of tropical cyclones or tropical depressions over the Mozambique Channel and in the vicinity suppress moisture availability over Lesotho. There were observed prolonged and recurring dry spells especially with increased tropical cyclones or tropical depressions activities in the South-West Indian Ocean. For example during the 2006/2007 season after a good start of rains in October and November, 2006 a dry spell which began in December 2007 persisted through to February, 2007 and turned into a severe drought in February 2007. It was during the 2006/2007 season that a positive El-Nino phase was forecast. It was during the dry spell and the drought when it was observed that the tropical depressions and tropical storms activities in the Mozambique Channel and in the vicinity resulted in decreased rainfall activities over Lesotho.

2. The following Tropical cyclones (TC) and disturbances had a negative influence over rainfall activity over Lesotho:

- Intense tropical cyclone Bondo (15-28 Dec 2006) re-strengthened near the northern tip of Madagascar on Dec 23.
- Tropical disturbance 04R (22-28 Dec 2006) headed towards Madagascar on Dec 26.
- Tropical disturbance 06R (05-08 Jan 2007) was spotted near the western coast of Madagascar on Jan 05
- Intense tropical cyclone Favio (11-23 Feb 2007) made landfall on February 22 in Inhambane province as an intense tropical cyclone.
- Intense tropical cyclone Indlala (9-19 Mar 2007) made landfall early on March 15 near Antalaha, Madagascar.
- Intense tropical cyclone Jaya (26 Mar – 08 Apr 2007) Made landfall near Sambava, near Madagascar and re-emerged over the water in the Mozambique Channel.

3. Conclusion

Information on the forecasts of intensities and movements of tropical cyclones are made available by RSMC-Reunion and RSMC-Pretoria and has proved to be useful in the monitoring of the tropical cyclones.

Madagascar

SAISON CYCLONIQUE 2005-2006

Cette saison est assez calme pour Madagascar car une perturbation cyclonique « BOLOETSE » a touché la Grande Ile. Au stade de Perturbation Tropicale, ce système a atterri sur la côte Centre Est par le District de NOSY VARIKA. Il a traversé l'île pour sortir dans le Canal de Mozambique et s'y est intensifié ;ainsi, au stade Cyclone tropical il a de nouveau atterri sur le Sud-Ouest dans le District d'Ampanihy.

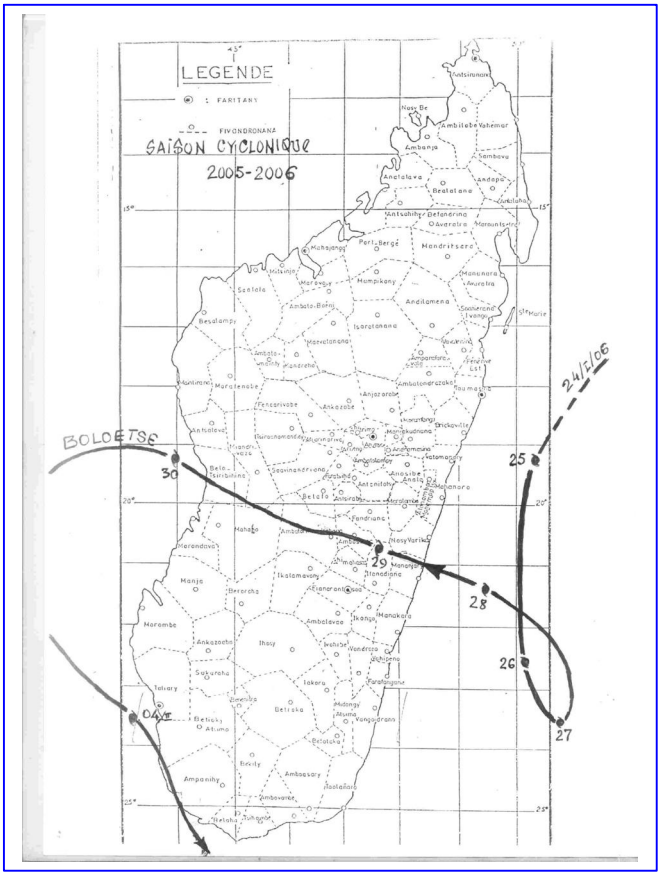
Les caractéristiques

Lieu	Quantité de Pluies (en 24h)		Vitesse maximal du vent	
	en mm	date	en Km/h	date
Mahanoro	131.2	28/01/06		
Morondava	117.9	03/02/06	85	03/02/06
Morombe	130.6	03/02/06	83	04/02/06
Toliara			144	04/02/06

Les dégâts :(Source Bureau National pour la Gestion des Risques aux Catastrophes)

Sans-abris : 528
Sinistrés : 6537

Trajectoire :



SAISON CYCLONIQUE 2006-2007

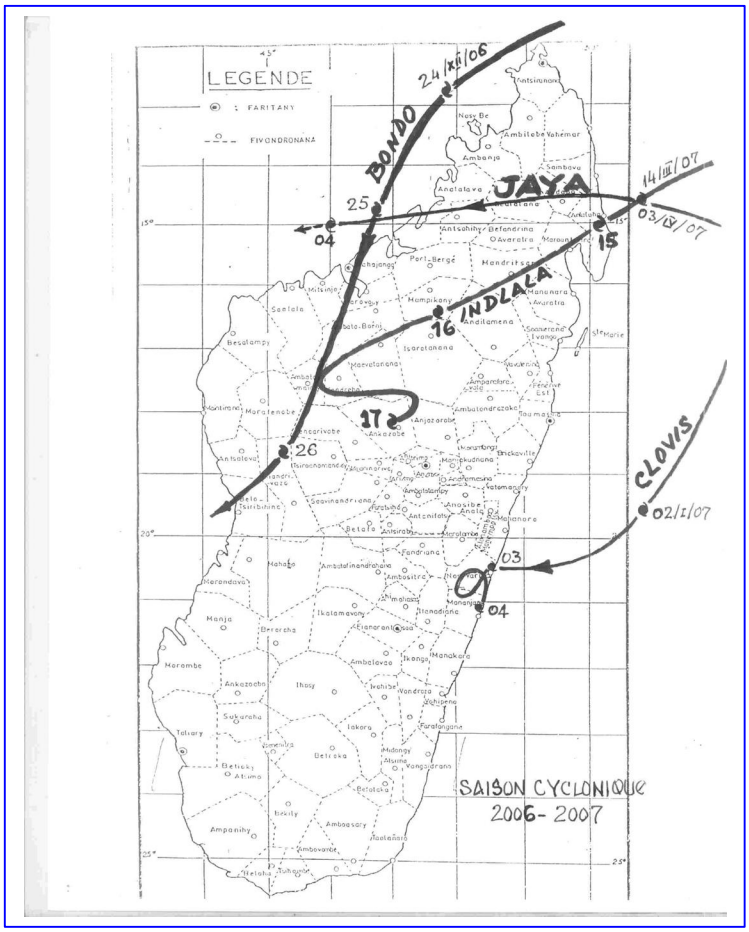
Une saison d'activité intense, puisque 04 perturbations cycloniques ont touché la Grande Ile.

- « BONDO », un système de petite taille, (diamètre : 300Km) atterrissait sur le Nord-Ouest à 35Km au Nord de la ville de Mahajanga au stade de Forte Tempête Tropicale. Dans son déplacement par le Sud-Ouest, il provoquait des pluies diluviennes sur le Nord de l'île avant de sortir dans le Canal de Mozambique où il se dissipait.
- « CLOVIS » a atterri sur le Sud-Est de l'île au stade de Forte Tempête Tropicale dans le District de NOSY VARIKA et se comblait le jour suivant dans le District de MANANJARY après avoir fait une boucle sur terre.
- « INDLALA », vaste système de 600Km de diamètre, est entré par la Ville d'ANTALAHA au stade Cyclone Tropical Intense. Il s'est comblé au bout de 2 jours au centre de l'Ile dans le District d'ANKAZOBE.Lors de la traversée de l'île, le système a provoqué des pluies abondantes sur le Nord de l'île
- « JAYA », système de petite taille (diamètre <200Km) a atterri sur le Nord-Est de l'Ile dans le District d'ANTALAHA au stade de Forte Tempête Tropicale. Ce système provoquait des pluies abondantes sur la côte Est .JAYA est sorti en mer dans le Canal de Mozambique et s'y est dissipé.

Les caractéristiques

Perturbations cycloniques	**Lieu**	**Quantité de Pluies (en 24h)**		**Vitesse maximal du vent**	
		en mm	date	en Km/h	date
BONDO	Antsiranana	131.9	23/12/06	80	23/12/06
	Antalaha	142.1	24/12/06		
	Mahajanga	179.0	25/12/06	155	25/12/06
CLOVIS	Mananjary	92.2	03/01/07		
		121.7	04/01/07		
INDLALA	Antalaha	355.2	14/03/07	245	15/03/07
	Antsohihy	344.7	15/03/07		
		240.7	16/03/07		
	Sainte Marie	107.9	15/03/07		
	Mahajanga	221.2	16/03/07		
JAYA	Sambava	141.3	03/04/07	125	03/04/07
	Antalaha	144.0	03/04/07	125	03/04/07
	Toamasina	216.1	03/04/07		

Traiectoire :



Les dégâts :
(Source Bureau National pour la Gestion des Risques aux Catastrophes)

Perturbations Cycloniques	Décidés	Blessés	Sans abri
BONDO	11	1	20.001
CLOVIS	4	2	13.465
INDLALA	150	126	188.331
JAYA	1	2	8.015

SAISON CYCLONIQUE 2007-2008 :

Une saison active pour la Grande Ile car 3 systèmes ont atterri sur le territoire malagasy.

- « FAME » A 13TU, le 27 janvier 2008, la huitième perturbation cyclonique de la saison , se renforce comme prévu, cette Forte Tempête tropicale génère des vents soufflant entre 120 à 160km/h avec une pression au centre estimée à 972hpa et un nombre de DVORAK T=4.0+. Elle se dirige vers la ville de BESALAMPY avec une vitesse de déplacement de 16km/h. Le 28 janvier 2008 à 06TU, FAME est accompagnée de pluies diluviennes.
- « IVAN » au stade de Cyclone Tropical Intense a atterri sur la côte Est de Madagascar entre SAINTE-MARIE et FENERIVE-EST avec des rafales de vent dépassant les 250km/h à SAINTE-MARIE accompagnés de pluies abondantes provoquant des inondations dans la ville de TOAMASINA, IVANA a traversé la Grande Ile d'Est en Ouest tout en s'affaiblissant . Il est sorti en mer avec des vents moyens inférieurs à 70km/h.
- Dans l'Océan Indien, la Tempête Tropicale Modérée « JOKWE » s'approchait à vive allure des côtes Nord-Est de Madagascar, (V=28km/h). Avec son élan, il a atterri à quelques kilomètres de la ville d'ANTSIRANANA pour sortir en mer dans le Canal de Mozambique, où il s'est trouvé au-dessus d'une surface de la mer dont la température est favorable à son intensification. En effet, JOKWE s'est évoluée en Cyclone Tropical Intense le 11 mars 2008 après avoir fr^lé la côte Nord-Est de Mozambique le 08 mars 2008.

La particularité de cette saison cyclonique est l'importance des précipitations provoquées par les 2 systèmes « FAME » et « IVAN » qui se sont succédés, engendrant des inondations sur les parties Nord et Centre de l'Ile.

Les caractéristiques

Perturbations cycloniques	Lieu	Quantité de Pluies (en 24h)		Vitesse maximal du vent	
		en mm	date	en Km/h	date

FAME	Besalampy	146.7	28/01/08	120	27/01/08
	Mahajanga	76.5	28/01/08		
IVAN	Sainte-Marie			> 250	17/02/08
	Toamasina	261	17/02/08		
JOKWE	Antsiranana			> 100	05/03/08
	Nosy Be			75	05/03/08
	Toamasina	130	17/02/08		

Trajectoire

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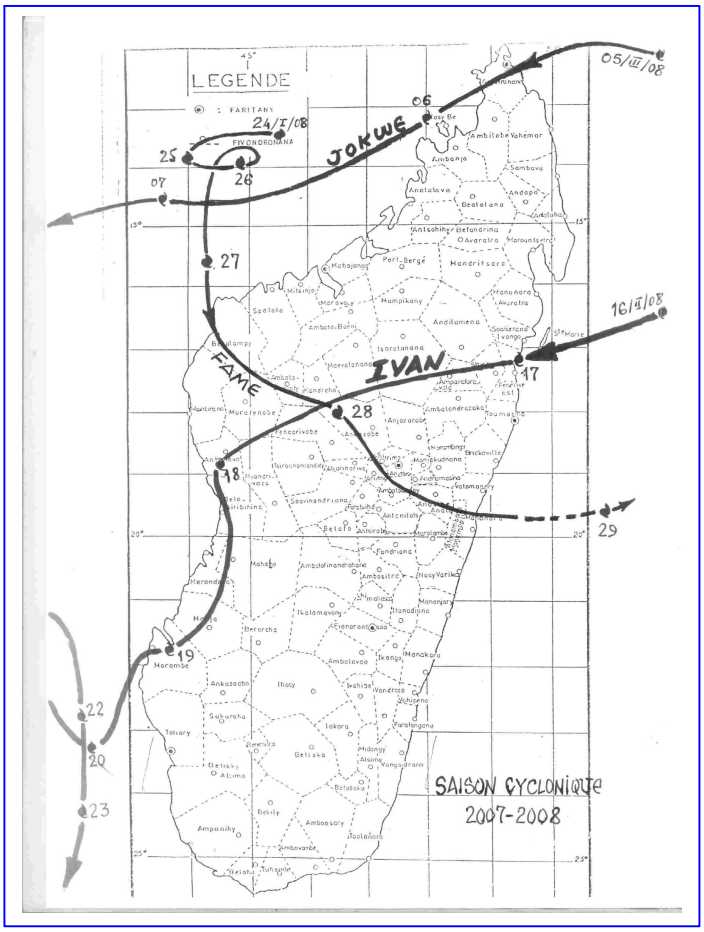
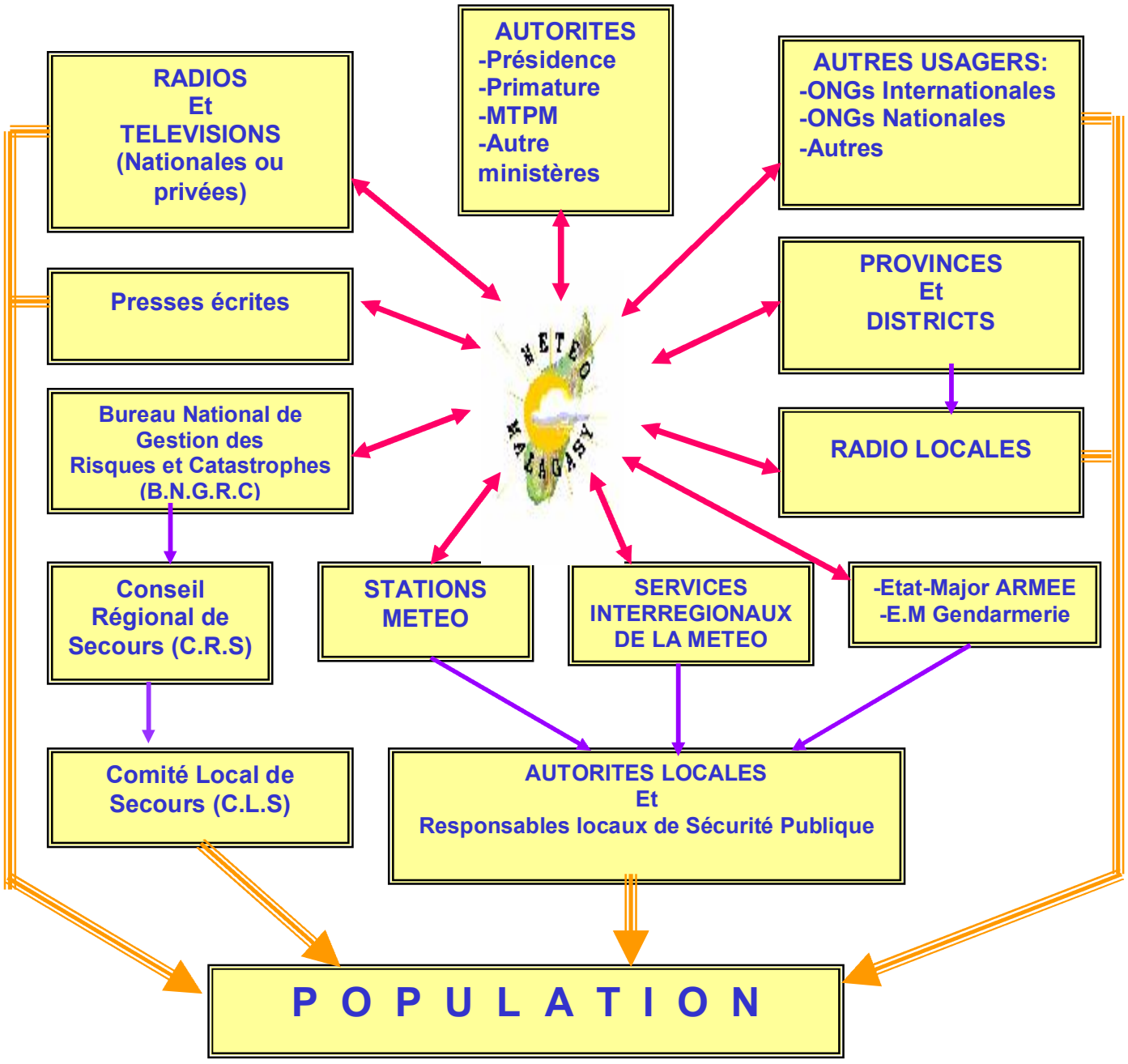


Les dégâts :(Source Bureau National pour la Gestion des Risques aux Catastrophes)

Perturbations Cycloniques	Décidés	Blessés	Disparus	Sans abri
FAME	11	1		20.001
IVAN	93	639	176	332.391
JOKWE				400

SYSTEME D'AVIS D'ALERTES CYCLONIQUES A MADAGASCAR



LE SYSTEME D'ALERTE NATIONAL

Points forts	Points faibles
Plusieurs intervenants éparpillés dans l'Ile	Les zones enclavés ne sont pas saisies

Les informations arrivent aux zones concernées par plusieurs moyens	En cas de système d'intensité importante (CTI, CCTI), les zones d'impact se trouvent coupées de tout contact (coupure d'électricité, téléphone, ...)

Malawi

1. INTRODUCTION

Malawi spans within latitudes 9 and 18 degrees south; and longitudes 32 and 35 degrees east located within the tropics is not spared from the wrath of tropical cyclones that move into the Mozambique Channel and occasionally make a landfall on the African coast and move inland into Mozambique towards Malawi during the southern hemispheric summer October to March spilling into April. The impact is either direct or indirect depending on the position of the tropical cyclone in the Mozambique Channel; causing substantial rainfall when located north of 20 degrees latitude and close to the African coast or dry spells when located at 20 degrees latitude and further away from the coast. The establishment of an effective early warning system through a coordinated approach with other stakeholders, continued coverage of the South West Indian Ocean by Meteosat Indian Ocean Data Coverage service (IODC) and also the issuance of tropical cyclone warnings by the Regional Specialised Tropical Cyclone Centre La Reunion immensely contributed to mitigating loss of life and property.

2. TROPICAL DISTURBANCES THAT AFFECTED MALAWI 2005 TO 2008

2.1 Tropical Cyclone Season 2005- 2006- Boloetse

Out of the five named tropical disturbances only one cyclone drifted into the Mozambique Channel on 29 January and looped in the Channel up to early February 2006. The tropical cyclone Baloetse indirectly affected Malawi by anchoring the Inter Tropical Convergence Zone (ITCZ) over the southern parts and caused an influx of Congo air into central and northern parts of the country during the first decade of February. Consequently caused appreciable rains on 2nd and 3rd February 2006 and improved water content in many areas of the south.

The rains received in this first decade of February resulted into normal to above normal rains over many places in the south and improved the rainfall situation during the 2005 to 2006 Tropical Cyclone Season .

The National Meteorological Centre issued an alert on 1st February 2006. The alert was then cancelled on 4 February when the storm moved southwestwards towards Madagascar.

Table 1 shows rainfall figures for some selected stations collected on 2nd and 3rd February 2006 while table shows the overall performance of rainfall from October 2005 to first decade of February 2006 over some selected stations in the south.

STATION	*RAINFALL (mm) ON 2 FEB*	*STATION*	*RAINFALL (mm) ON 3 FEB*
Chancellor College	30.3	Mimosa	35.1
Chitipa	23.6	Lunyangwa	31.1
Chileka	21.9	Chitedze	20.2
Stella Maris Sec.Sch.	17.4	Makoka	13.1

STATION	*RAINFALL (mm) ON 2 FEB*	*STATION*	*RAINFALL (mm) ON 3 FEB*
Bolero	14.1	Mimosa	13.1

Table 1: rainfall figures collected on 2 and 3 February 2006

Table 2 overall performance of rainfall from October 2005 to first decade of February 2006 over some selected stations in the south

STATION NAME	DECADAL TOTAL RAINFALL	DECADAL NORMAL	DECADAL TOTAL AS A %	TOTAL TO DATE	NORMAL TO DATE	TOTAL TO DATE AS A %	RAINY DAYS
SOUTHERN REGION	mm	mm	NORMAL	Mm	mm	NORMAL	≥ 0.3 mm
Bvumbwe Met.	79.0	80.0	**99**	850.6	669.8	**127**	5
Chancellor College	148.3	113.8	**130**	767.3	855.8	**90**	3
Chichiri Met.	56.1	82.3	**68**	699.4	679.5	**103**	6
Chileka Airport	80.1	70.9	**113**	649.9	570.6	**114**	3
Chingale Agric	2.0	80.4	**2**	454.5	616.2	**74**	1
Chiradzulu Agric	55.9	79.8	**70**	720.7	678.7	**106**	3
Kasinthula Res. Stn.	95.6	54.2	**176**	770.8	441.5	**175**	4
Liwonde Township	22.5	72.8	**31**	492.7	531.2	**93**	3
Makoka Met	37.5	82.3	**46**	765.3	630.4	**121**	4
Mangochi Met.	38.0	86.8	**44**	349.6	531.9	**66**	3
Mulanje Boma	108.8	96.8	**112**	1386.8	925.4	**150**	7
Namiasi Agric	20.9	115.9	**18**	366.8	552.0	**66**	2
Naminjiwa Agric	38.2	83.3	**46**	690.2	640.7	**108**	3
Nchalo Sucoma	88.5	69.4	**128**	613.4	435.6	**141**	4
Ngabu Met.	37.8	69.6	**54**	548.2	489.8	**112**	3
Nsanje Boma	42.1	66.1	**64**	474.6	552.5	**86**	4
Ntaja Met.	25.1	62.6	**40**	452.5	563.8	**80**	4
Satemwa Tea Est. No.1	77.2	105.7	**73**	709.3	778.1	**91**	6
Toleza Farm	29.0	75.8	**38**	637.2	548.6	**116**	2
Thyolo Boma	43.1	96.3	**45**	894.5	702.6	**127**	3
Thyolo Met	91.9	92.2	**100**	797.2	702.3	**114**	5
Zomba RTC	157.0	101.1	**155**	1005.1	780.4	**129**	6

TABLE 2: DECADAL RAINFALL FOR SELECTED STATIONS FOR DECADE 1 OF FEBRUARY 2006: PERIOD 01 – 10 February 2006

3. TROPICAL CYCLONE SEASON 2006- 2007

A total of 15 tropical disturbances developed in the South West Indian Ocean and two affected Malawi. These are as follows:

3.1 Tropical Storm Anita

The storm developed in the Mozambique Channel and lingered in the channel from 30th November up to 1st December 2006. The storm negatively affected Malawi during its 3 day stay in the Channel; it caused dry south-westerly airflow into the country which resulted into dry conditions.

3.2 Tropical Cyclone Favio

Favio entered into the Mozambique Channel on 20th February 2007 through the southern tip of Madagascar and unusually took the north-westerly path and made a land fall along the southern Mozambique coast close to Beira on 22 February 2007 about 220 km south west of Nsanje a town in Malawi. The National Meteorological Centre issued both the alert and warning to all the stakeholders.

The tropical cyclone maintained moist Congo air and the ITCZ over Malawi. As a result most areas received normal to above normal decadal rainfall amounts, with good spatial and temporal distribution during the last decade of February 2007. Some stations

particularly over the south and centre recorded more than twice the expected decadal rainfall amounts. The widespread rains led to flooding in flood prone areas.

TABLE 3: DEKADAL RAINFALL FOR SELECTED STATIONS FOR DEKAD 3 OF FEBRUARY 2007: PERIOD 21 – 28

STATION NAME	**DECADAL**	**DECADAL**	**DECADAL**	**TOTAL**	**NORMAL**	**TOTAL**	**RAIN**
	TOTAL	NORMAL	TOTAL	TO	TO	TO DATE	DAY
	RAINFALL		As %	DATE	DATE	As %	
SOUTHERN REGION	mm	mm	NORMAL	mm	mm	NORMAL	0.3 mm
Balaka Township	78.0	43.4	180	886.8	657.6	135	3
Bvumbwe Met.	103.5	52.0	199	910.1	800.9	114	6
Chancellor College	51.3	79.3	65	1086.6	1017.1	107	6
Chichiri.	130.9	50.7	258	968.1	810.3	119	7
Chileka Airport	36.6	44.7	82	813.8	683.1	119	5
Chiradzulu Agric	103.0	51.1	202	772.4	805.4	96	6
Kasinthula Res. Stn.	26.8	41.4	65	1103.6	529.2	209	6
Liwonde Township	28.5	54.8	52	679.7	646.2	105	2
Lujeri Tea Estate	69.7	110.3	63	1407.0	1451.5	97	7
Makoka Met.	107.0	67.4	159	877.2	767.8	114	7
Mangochi Met.	32.8	45.5	72	1015.6	645.7	157	3
Mimosa Met.	121.7	60.3	202	1126.8	998.8	113	7
Mulanje Boma	81.3	85.8	95	1276.0	1114.9	114	5
Naminjiwa Agric	47.8	49.7	96	781.8	765.6	102	4
Nchalo Illovo	42.4	39.4	108	922.1	531.6	173	5
Ngabu Met.	90.8	44.7	203	889.9	592.9	150	7
Nsanje Boma	75.6	35.9	211	799.6	655.2	122	5
Satemwa Tea Estate No 1.	66.8	55.8	120	1242.7	909.8	137	6
Toleza Farm	110.5	42.0	263	800.6	655.6	122	4
Thyolo Met.	64.3	42.8	150	1055.7	828.1	127	6

Zomba RTC	115.9	70.6	1648	1305.6	919.8	142	6
CENTRAL REGION							
Bunda College	43.6	67.0	65	773.4	682.8	113	3
Chileka Namitete	135.5	60.4	224	775.9	737.7	105	6
Dowa Agric	130.8	58.9	222	861.5	679.3	127	7
Dwangwa Illovo Sugar	61.0	68.9	89	945.4	800.3	118	5
K.IA. Met	41.6	49.6	84	661.6	655.0	101	6
Kasungu Met.	157.5	58.9	267	1128.6	706.7	160	7
Mlangeni Njolomole	41.4	47.6	87	701.5	768.7	91	3
Mwimba Research	176.8	79.4	223	953.6	723.1	132	5
Nathenje Agric	67.7	56.7	119	845.8	679.7	124	4
Ntchisi Boma	83.2	62.8	132	1536.5	679.7	226	5
Salima Met.	67.5	80.0	84.	1168.4	911.7	128	7
Dedza RTC	17.1	42.3	40	989.1	764.7	129	4
NORTHERN REGION							
Bolero Met.	50.1	30.6	164	642.2	571.5	112	4
Chitipa Met.	52.0	50.6	103	883.2	731.2	121	5
Chintheche Agric	57.5	76.6	75	730.6	950.6	77	4
Mzimba Met.	38.0	51.8	73	832.5	746.9	119	6
Mzuzu Met.	38.0	51.8	73	832.5	746.911	111	6
NkhataBay Met.	31.2	24.6	127	909.6	954.0	95	4

4. TROPICAL CYCLONE SEASON 2007- 2008

A total of four storms moved into the Mozambique Channel and affected Malawi weather causing floods in January and a dry spell over southern Malawi during the second and third decade of February 2008 resulting in wilting of crops in some parts of southern Malawi. The national Meteorological Centre issued alerts and warnings in accordance with the National Cyclone Warning stipulated procedures.

4.1 Moderate Tropical Storm Elnus and Severe Tropical Storm Fame

The presence of Elnus from 29th December 2007 to 5th January 2008 and also Fame from 23rd January to 1st February 2008 in the Mozambique Channel respectively maintained

an influx of Congo air and the ITCZ over the country particularly over the southern and central parts of the country culminating into widespread rains associated with flooding over low lying areas in January 2008.

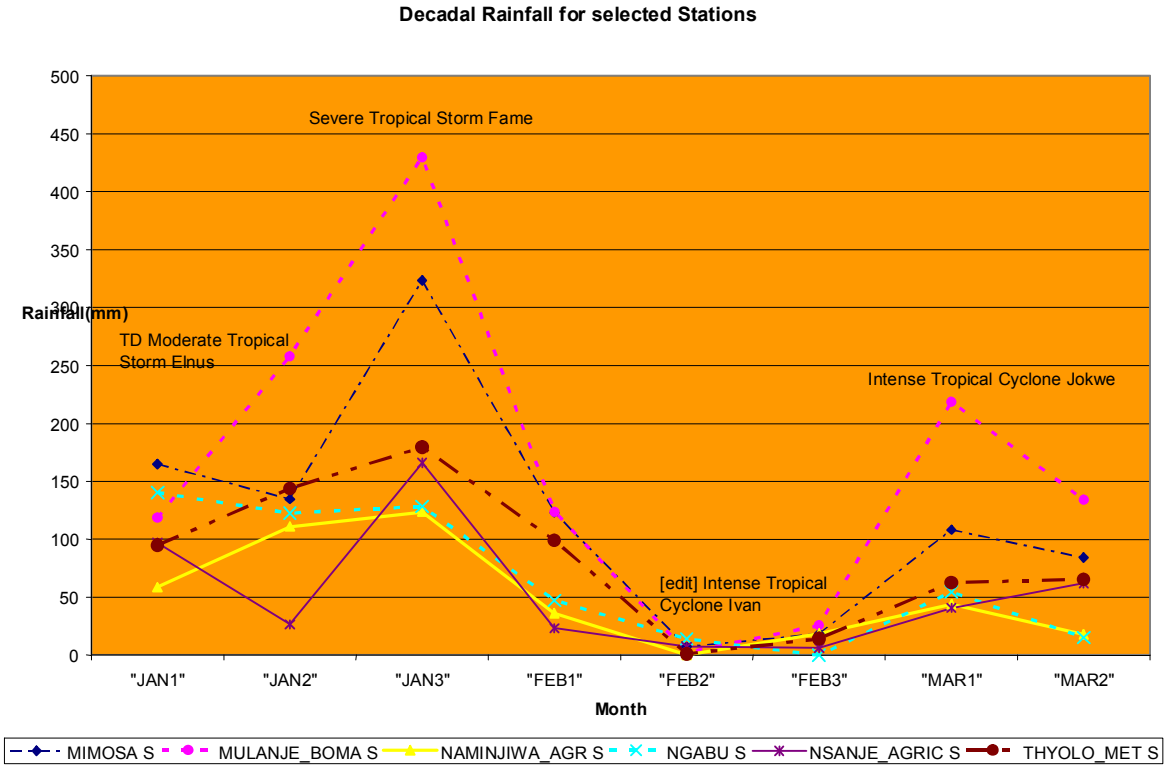
4.2 Intense Tropical Cyclone Ivan 5th February to 22 February

Ivan maintained the rain bearing air masses over Malawi during the first decade of February but later caused an influx of south westerly airflow particularly into the better part of the southern half of the country during the second and third decade causing dry spell over the south.

4.3 Intense Tropical Cyclone Jokwe 2nd March to 16th March

On 5th March Jokwe cut through the northern tip of Madagascar and on 8th March made a landfall north of Angoche and then tracked back into the Mozambique Channel on 9th March establishing the rain bearing air masses over southern Malawi.
Jokwe brought relief to the wilting crops as it brought back the much wanted rains into southern Malawi.

Table below shows decadal totals for selected stations in the southern region of the country.



Tanzania

1 INTRODUCTION

Tropical cyclones form annually over warm tropical oceans. Initially they start as tropical disturbances then develop and attain intensity with surface wind speed increasing to about 200 km/h. In the Southwest Indian Ocean they are called Tropical Cyclones. In other regions of the global Oceans they are called Typhoons or Hurricanes. In the West Indian Ocean the period during which most of the Tropical disturbances and cyclones occur is between November and mid May, this is known as the Cyclone Season (WMO report no. TCP-46).

Tropical cyclones are among the most devastating of all natural hazards. They have potential to change wind flow and weather patterns over our region causing violent winds, torrential rainfall and floods; moreover they can also cause poor seasonal rainfall depending on their strength and position from our country. Every year several tropical disturbances and tropical cyclones cause disasters of varying scales, with loss of life, human suffering, destruction of property, severe disruption of normal agricultural activities and adversely effects to social and economic progress.

Regional Storm Monitoring Center La Réunion (RSMC) carry out monitoring and forecasting of tropical cyclones, provide advisory information and guidance to National Meteorological Services. The provision of tropical cyclone warnings over our national territory and coastal waters is the responsibility of Tanzania Meteorological Agency (TMA). The official warnings are contained in advisories and warnings issued by the Tanzania Meteorological Agency from time to time. The positions and strengths of tropical storms and tropical cyclones over the south-western Indian Ocean are important factors to the occurrences of particular weather in Tanzania. In most cases tropical cyclones that pass through the Mozambique Channel tend to enhance precipitation over the country particularly coastal areas, north-eastern highlands and southern regions. Good forecasts on the tracks of these tropical cyclones are therefore crucial and important contributions to early warning system in the country whose outputs are the issuance of warnings and advisories.

2. 2005-2006 TROPICAL CYCLONE SEASON

The 2005-2006 Tropical Cyclone Seasons recorded very few Tropical storms and the season stated as early as September 2005 and ended in the first week of March 2006. During the Cyclone Season about 4 Tropical Storms and Tropical Cyclones occurred over the South West Indian Ocean for which bulletins were obtained from the RSMC La Réunion.

This particular season was characterised by very low frequency of tropical Cyclone occurrences over the Southwest Indian Ocean. These include Tropical cyclone Alvin, Boloetse, Carina and Diwa.

Tropical Cyclone Diwa was devastating is some parts of the country. The Tanzania Meteorological Agency through its Central Forecasting Office responsible for issuing warnings and advisories in the country was able to get early responses from RSMC La Reunion. The forecasts showed that the track of the tropical cyclone would bring heavy rains over our area particularly the coastal areas and North-eastern highlands. Some parts of these areas had serious floods. Most of the cyclones were generally weak and moved south wards east of Madagascar Island, only 2 cyclones moved in the Mozambique Channel.

3. 2006-2007 TROPICAL CYCLONE SEASON

Tropical Cyclone Season 2006-2007 started late in the third week of November 2007. The first tropical depression that occurred developed to a Tropical Storm Anita. The

season ended in the second week of March 2007. During the Cyclone Season about 9 Tropical Storms and Tropical Cyclones occurred over the South West Indian Ocean for which bulletins were obtained from the RSMC La Réunion. 7 tropical storms were identified as having significant influence to our weather during the Cyclone Season 2006-2007. According to the bulletins obtained from RSMC La Réunion 2 of the storms reached a category of Intense Tropical Cyclone and 5 were categorized as Severe Tropical Storm.

During this tropical cyclone season rainfall was enhanced significantly by tropical cyclones Anita, Bondo, Clovis and Dora. Tropical Storm Anita showed much influence over the North-eastern (between 60-152mm of rainfall was recorded in 24 hours), western and southern parts of the country. Towards the end of January 2007 and early February 2007 tropical cyclone Dora contributed to enhanced rainfall over Lake Victoria basin, Western, and South-western parts of the country. The Tanzania Meteorological Agency was able to make good forecasts during the period and warnings and advisories were issued accordingly.

4. 2007-2008 TROPICAL CYCLONE SEASON

The onset of 2006-2007 Tropical Cyclone season was in the second week of October 2007 when the first tropical depression occurred over the South West Indian Ocean. The season ended late towards the fourth week of March 2008 compared to the normal ending period of mid March. During the Cyclone Season 2007-2008 there were about 12 Tropical Storms and Tropical Cyclones over the Southwest Indian Ocean for which bulletins were obtained from the RSMC La Réunion. About 8 tropical storms were identified as having significant influence to our weather during the Cyclone Season 2007-2008. According to the bulletins obtained from RSMC La Réunion 4Tropical storms reached a category of Tropical Cyclone, whereby 3 of them were categorized as Severe Tropical Cyclone 1 reached intense tropical Cyclone stage.

Most of these tropical cyclones reached position and intensity significant to influence our weather. However, very few of these systems came close to our country as most of them tracked south westwards along the eastern coast of Madagascar rather than passing through the Mozambique Channel.

The influence of Tropical cyclones to our weather was more significant during the month of February and March 2008 where tropical cyclones Ivan and Jokwe contributed to enhanced rainfall over different parts of the country.

The Tropical Cyclone Jokwe reached the strength and position that enabled it to align the weather patterns over our country for increased rainfall. The Northern, south-western and southern sectors of our country were mostly influenced. The cyclone contributed to the floods and heavy rains that were experienced over the North-eastern and the southern parts of Tanzania. The monthly total rainfall reported over the North-eastern Highlands of Tanzania around Mount Kilimanjaro was the highest ever since rainfall measurements started at the stations more than 50 years ago

Strong winds and floods destroying buildings, infrastructures and crops were reported over the North-eastern and South-western highlands.

5. SUMMARY

The Tropical Cyclone Season 2005-2008 contributed towards enhanced wet conditions, floods and the destructive strong winds over some parts of the country. However the 2005-2006 tropical cyclone seasons had very little influence to the weather that prevailed over most areas of the country.

The tropical storm information and forecast guidance from the Regional Storm Monitoring Centre La Réunion (RSMC) was very useful input in developing and issuing cyclone warnings over the country. Timely and accurate early warnings of impending

disasters caused by destructive nature of tropical cyclone are very important in safeguarding the life of people and property for sustainable development.

Tanzania has also benefited from the Severe Weather Project which ended in November 2007. Under this pilot project, Tanzania was able to access products from several Global Centres such as UK Met Office, NCEP, ECMWF, and RSMC among others. Feedback mechanism also helped to improve NMS's early warning system. Under the Tsunami Early Warning System (TEWS) of the Indian Ocean, Tanzania received some forecasting equipment (SYNERGIE), RETIM and an Automatic Message Switching System (AMSS). This equipment has helped in strengthening the early warning system since the approach now is having a Multidisciplinary Early Warning System. Early warnings and advisories on tropical cyclones issued by Tanzania Meteorological Agency have been appreciated and continued to assist the public and vessels plying along the coastal areas including local fishermen who use primitive types of vessels.

UPDATED OPERATIONAL PLAN

(Please refer to a separate document referred to as TCP-12, Edition 2008)

ACTIVITIES OF THE MEMBERS CARRIED OUT DURING THE INTERSESSIONAL PERIOD

Kenya

1. Meteorological component

Kenya has 36 synoptic stations spread across the country that report and transmit hourly data daily. Some observe and transmit data round the clock while others observe for standard working hours (8.00 Am to 5.00 Pm.). Kenya operates one upper air observing station located at Nairobi Dagoretti 63741 that makes one (1) radisonde ascent per day. A total of 24 Automatic Weather Stations (AWS) are already installed at locations coinciding with synoptic stations. This is for purposes of validation.

Equipment

Kenya Meteorological Services has installed 2 MSG satellite receiving stations (**PUMA**) at Nairobi and Mombasa. Twin SYNERGIE forecaster systems have been installed at Nairobi and Mombasa respectively. Software for the Utilization for Meteorological Outlook (SUMO) has been acquired and installed from mid 2008.New TRANSMET systems were installed and commissioned in 2007.

Telecommunications

Kenya is linked to RTHs Offenbach, Pretoria and Cairo, and to several NMC Dares salaam, Kagali, Bujumbura, Entebbe, Addis Ababa.

2. Meteorological Satellites

The MSG satellite receiving station (**PUMA**) installed Nairobi and Mombasa are both operational. There has however been a problem of viruses interrupting the operations of the stations.

3. Hydrological component

Kenya Meteorological Department works in close collaboration with the water sector (Department of Water Affairs) and provide advisories related to weather, water and climate. A Hydrological Division within the Department that deals with monitoring and forecasting of floods in the country.

4. Disaster risk reduction component

Kenya Meteorological Department is a member of the National Disaster Management Committee under the office of the President. The Department has continued to execute its role of issuing warnings and advisories in time.