WORLD METEOROLOGICAL ORGANIZATION

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

SIXTEENTH SESSION

Maputo, Mozambique

8 to 12 September 2003

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 Mozambique, the sixteenth session of the WMO Regional Association I (Africa) Tropical Cyclone Committee (RA I/TCC) for the South-West Indian Ocean was held at the Residential Kaya Kwanga, Maputo, Mozambique, from 8 to 12 September 2003. The session was attended by representatives from Botswana, Comoros, France (La Réunion), Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, South Africa, Seychelles, Swaziland, Tanzania and Zimbabwe. Australia participated as ex-officio member of the Committee. Also in attendance were observers from Kenya, the WMO Regional Association V Tropical Cyclone Committee (RA V/TCC) for the South Pacific and South-East Indian Ocean, International Civil Aviation Organization (ICAO), Drought Monitoring Centre-Harare (DMC-H), and Drought Monitoring Centre-Nairobi (DMC-N). The list of participants is given in Appendix I to this report.

1.1.2 On behalf of Professor G.O.P. Obasi, Secretary-General of WMO, Mrs Nanette Lomarda, the WMO Secretariat representative, welcomed the participants and expressed the appreciation of WMO to the Government of Mozambique for the kind invitation to host this biennial session of the Committee. Having acknowledged that tropical cyclones are among the most destructive of all natural hazards, causing considerable human suffering, loss of life and property damages in many countries, she asserted that technical means do exist or are being developed to reduce losses. The biennial sessions of the RA I Tropical Cyclone Committee for the South-West Indian Ocean have been providing excellent opportunities for Members to exchange information on these new technologies now available to upgrade tropical cyclone forecasting and warning services and improve public awareness of tropical cyclones. It is expected that it will continue to serve also as a forum to further enhance regional cooperation and capacity building, and develop new strategies for coordinated actions. In concluding, she assured the Committee that WMO will continue to support the RA I/TCC in achieving its objectives to the extent possible.

1.1.3 Mr S.N. Sok Appadu, Chairperson of the RA I/TCC, on behalf of the delegates from Member states of the Committee and on his own behalf, conveyed his deep appreciation to the Government of Mozambique and to its people for their warm welcome and hospitality. Gratitude was also expressed to Mr Filipe D.F. Lúcio, Permanent Representative of Mozambique with WMO, for the excellent facilities provided to the delegates to help them bring the work of the session to a successful conclusion. Mr Sok Appadu stated that the Tropical Cyclone Committee for the South-West Indian Ocean meets with the aim to provide National Meteorological and Hydrological Services (NMHSs) of countries exposed to tropical cyclones with the necessary knowledge of what should be done to protect life and property from destruction through such weather events and thus to contribute to sustainable socio-economic development.

1.1.4 In his opening address, Honourable Tomás Augusto Salomão, Minister of Transport and Communication, welcomed all participants to the country. He stated that the Mozambicans still have memories of tropical cyclones Domoína, Nádia, Eline, Japhet and the depression Delfina which caused loss of life and set back the socio-economic development of the country. The floods of 2000 which affected the central and southern parts of Mozambique, with a magnitude never seen before, are a testimony of the high levels of vulnerability that are always present, caused by meteorological phenomena. He also stated that due to human practices in the last hundred years or so, with impacts on the

environment, there are fears that global climate is changing. This change according to climate specialists, might mean an increase in the magnitude and frequency of occurrence of

extreme weather and climate events such as torrential rains, severe droughts and more intense tropical cyclones. It is in this framework of a future with possible increased vulnerability that Mozambique pay special interest to this sixteenth session of the RA I Tropical Cyclone Committee for the South-West Indian Ocean, due to the contribution that the Committee's operational plan will bring to the safety and well being of the people in the region.

1.1.5 The Minister thanked WMO for its contribution in the fields of training and creation of mechanisms which will allow countries to improve the quality of their meteorological services. He also extended his appreciation to the RMSC La Réunion, for the information provided which allows countries like Mozambique to be able to issue and disseminate early warnings during imminent tropical cyclone events. He also mentioned that as the data sparse South-West Indian Ocean remains the least studied ocean basin, it becomes necessary for this Committee's deliberations to focus on these aspects and also to take into account the various issues related to collaboration strategies that can allow sharing of knowledge, technology and information, particularly in crisis situations which always characterize natural disasters. He informed the Committee that with the help of their partners such as the European Union, Finland, Portugal and Spain, they have initiated a process with a view to transform the meteorological service in Mozambique. In closing, he wished the session success and good deliberations. The Minister declared the sixteenth 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 without change. 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 Filipe Domingos Freires Lúcio (Mozambique) 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 a working group, composed of a representative from each Member country, to make a detailed review of its Technical Plan. Mr Ian Tyrrell Hunter (South Africa) and Mr Paul Remois (France) were designated Co-chairpersons for the said working group.

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

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

2.2 The Chairperson expressed his appreciation to the Governments of France and Australia for co-sponsoring with WMO the 2nd RA I Training Course on Tropical Cyclones and Public Weather Services (PWS) (Saint-Denis, La Réunion, 29 October to 13 November 2001) and the Fifth Southern Hemisphere Training Course on Tropical Cyclones (Melbourne, Australia, 23 September to 4 October 2002) respectively.

2.3 The Chairperson was also grateful for the decision of the Permanent Representative of France with WMO, for RSMC La Réunion, in collaboration with WMO, to conduct the Third RA I Training Course on Tropical Cyclones and PWS, in Saint-Denis, La Réunion from

27 October to 8 November 2003. He urged the Members who have not yet sent in their nominations to do so before the 15 September 2003 deadline.

2.4 He urged the Members to take full advantage of the facilities of the Cyclone Research Cell at the RSMC La Réunion which had since its establishment addressed important research aspects of tropical cyclones, in particular to improve current forecasting techniques.

2.5 The Chairperson informed the meeting that he represented the Committee at the thirteenth session of RA I held in Mbabane, Swaziland from 20 to 28 November 2002.

2.6 On behalf of the Committee, the Chairperson welcomed Namibia who became the newest (14th) Member of the Committee during the above-mentioned session of RA I.

2.7 The Chairperson strongly urged the Members to give their full support to the Global Climate Observing System (GCOS) Regional Action Plan for Eastern and Southern Africa. This initiative involves the improvement of GCOS surface and upper-air networks in the region.

2.8 The Chairperson requested the Members to closely monitor activities related to the World Summit for Sustainable Development at the national level and use it as a means to strengthen the NMHSs in order to be able to provide inputs in sectors such as water, energy, health, agriculture and biodiversity.

2.9 The Chairperson urged Members to recommend to their national governments to support the establishment of a weather radar network and new communication facilities to monitor tropical cyclones and other extreme weather events in the South-West Indian Ocean in order to give maximum protection to life and property.

2.10 The representative from the DMC-H requested that the Cyclone Research Cell put emphasis on improving seasonal forecasts on tropical cyclone occurrence and frequency, which would be very helpful to government planners of most countries in the region.

2.11 The delegation from Namibia expressed its appreciation for being accepted as the 14th Member of the Tropical Cyclone Committee. He informed the Committee that cyclone “Eline” raged havoc in virtually all parts of Namibia during February 2000. This cyclone caused extensive damage to roads, railways, buildings, communication systems, crops and other infrastructures of the country. The severity of this cyclone emphasized the reality that Namibia is not immune to the catastrophic effects of tropical cyclones.

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 fifteenth session of the Committee (Moroni, Comoros, 4 to 10 September 2001).

3.2 Recognizing the importance of capacity building among the Members, the Committee was pleased to note the arrangements being made for the Third RA I Training Course on Tropical Cyclones and the PWS. It would be organized by Météo-France at the RSMC La Réunion for operational tropical cyclone forecasters in the region.

3.3 The Committee expressed its deep appreciation on the continued close cooperation and collaboration between the TCP and the PWS programme whereby, whenever possible, workshops on media issues are organized in conjunction with regular sessions of the tropical cyclone bodies or planned TCP training events for tropical cyclone forecasters.

3.4 The representative from ICAO noted with appreciation the close working relationship of WMO with a number of international and regional organizations, including the ICAO. He, however, noted with concern that there appears to be a lack of collaboration and coordination between the TCP and agencies in the region that are concerned with disaster preparedness, prevention and mitigation issues. In this regard, the representative of WMO informed the meeting that attempts to network with such agencies in the region have already been initiated.

3.5 Members were urged to actively participate in the following TCP sub-projects schedule for the period (2003-2007):

(a) TCP sub-project No. 23: Combined effects of storm surges/wind waves and river floods in low-lying areas;

(b) TCP sub-project No. 24: Establishment of a tropical cyclone forecaster Web site;

(c) TCP sub-project No. 25: Study on the economic and societal impacts of tropical cyclones;

(d) TCP sub-project No. 26: Evaluation of tropical cyclone warning systems (their effectiveness and deficiencies).

3.6 The delegate from Australia invited Members to incorporate into the technical plan of the Committee activities that could relate to the above-mentioned TCP sub-projects.

3.7 The Committee was informed that most of the TC RSMCs and TCWCs had already established links with the Severe Weather Information web site of WMO currently hosted by the Hong Kong Observatory. The delegate from France informed the Committee that the RSMC La Réunion had agreed to participate in this initiative aimed at enabling the public easier access to official tropical cyclone advisories.

3.8 The Committee requested WMO to look into the attachment of tropical cyclone forecasters from the region to the RSMC La Réunion during the cyclone season.

3.9 Recognizing the need to strengthen coordination between the Members, the Committee requested that a list of focal points among the Members be drawn up. The list is given in Appendix III.

4. REVIEW OF THE 2001/2002 AND 2002/2003 CYCLONE SEASONS (Agenda item 4)

Summary of the past two cyclone seasons

4.1 Reports of the 2001/2002 and 2002/2003 cyclone seasons were presented to the Committee by the representative of the RSMC La Réunion - Tropical Cyclone Centre.

2001/2002 cyclone season summary

4.2 During the 2001-2002 cyclone season, there were eleven named disturbances in the South-West Indian Ocean. With nine of the eleven reaching cyclone intensity, this season was considered the second most active season over the past 30 years. It is also worth noting that five of the nine developed into intense tropical cyclones. The most intense tropical cyclone of the season was Hary in March. Hary was a very compact cyclone and because only a very small portion of its circulation brushed across the eastern tip of Madagascar, the number of casualties and extent of property damage caused by the cyclone was kept to a minimum. The most destructive was Dina in January, which inflicted considerable property

damage in Mauritius and La Réunion. Kesiny, brought the cyclone season to a late closing on 11 May 2002.

2002/2003 cyclone season summary

4.3 This cyclone season was another long and active one in the South-West Indian Ocean. Although there were more named disturbances during the season (i.e. thirteen compared to the eleven in the 2001-2002 cyclone season), only eight reached tropical cyclone intensity, one less than the previous season. The season opened early with the formation of a tropical depression on the 5th of September. Although a weak system, it managed to cause catastrophic flooding and considerable property damage in the island of Praslin. Japhet in February-March, proved to be the only destructive cyclone among the three intense systems during the 2002-2003 season (i.e. Gerry, Japhet and Kalunde). It caused rainstorms and flooding in Mozambique where 19 people reportedly died. Another notable cyclone of this season, Delfina in late December, killed 50 people in Mozambique and rendered more than 300,000 homeless. The last cyclone of the season, Manou in May, swept across Madagascar where 70 people died and financial losses amounted to more than US$11 million.

4.4 The complete reports on the 2001/2002 and the 2002/2003 cyclone seasons submitted by the RSMC La Réunion and Member countries discussed at the session are given in Appendix IV.

4.5 The Committee noted that there is a need to include tropical cyclones in the development of seasonal forecasts in the region. In this regard, it recommended that the Committee should enhance and develop cooperation with subregional and regional institutions such as the DMCs in Harare and Nairobi and the African Centre for Meteorological Applications for Development (ACMAD) in order to enrich the seasonal forecasts and climate outlook prediction. It was emphasized that there is a need to develop appropriate public awareness programmes that would improve the information flow, such as early warnings to the populace.

4.6 The Committee took note of the abnormal events occurring during the cyclone seasons. Tropical systems reaching tropical cyclone intensity, were observed as late as May 2002 and 2003 and at latitudes far to the south of the equator. One system, originating from higher latitude patterns developed into a tropical cyclone towards the end of the season. In September 2002, Seychelles was hit by a midget storm with typical tropical cyclone characteristics.

4.7 Members expressed concern about these new challenges. Better coordination need to be developed among NMSs within the region and cooperation between existing institution such as the Cyclone Research Cell at RSMC La Réunion, DMCs Harare and Nairobi and Universities will have to be enhanced in order to tackle these problems.

4.8 The Committee noted the need for more studies that will determine the relationship between global warming/climate change and the occurrence, intensity and frequency of tropical cyclones.

4.9 The delegate from Australia informed the Committee that in their region they had found a strong statistical relationship between the Southern Oscillation Index (SOI) and tropical cyclone frequency whereby a negative SOI (El Niño) is correlated with a decrease in cyclone frequency and delayed onset of the cyclone season while a positive SOI (La Niña) is correlated with an increase in cyclone frequency and early onset of the cyclone season.

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

5.1 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 Réunion, which having the required facilities, has the responsibility of analysis, tracking and forecasting of tropical cyclones.

5.2 The Committee conducted an in-depth review of all the chapters of the Tropical Cyclone Operational Plan for the South-West Indian Ocean.

5.3 The Committee was informed by the delegate from France that RSMC La Réunion Tropical Cyclone Centre is extending its area of coverage for tropical disturbances from the equator to 40S, between 30E and 90E. This is in view of the increased frequency of tropical depression systems in the cyclonic basin of the South-West Indian Ocean, both near the equator and at high latitudes. The issue of analysis and cyclone forecast advisories for this new area will be operational from the 2003/2004 cyclone season. He further informed the Committee that with effect from the 2003/2004 cyclone season, the cyclone forecast advisory (WTIO30, WTIO31) destined, in particular, for the Meteorological Services of Members of the RA I Tropical Cyclone Committee, will be issued every 6 hours (instead of every 12 hours) in the event of cyclone activity in the area (at 00, 06, 12, 18 UTC). Furthermore, the issue of cyclone forecasts will be brought up to 72 hours at 12-hourly intervals. Track and intensity forecasts for up to 72 hours will be made available on the Météo-France La Réunion web site (http://www.meteo.re).

5.4 The Committee noted with appreciation that, as requested during the last session, RSMC La Réunion has since the 2001/2002 cyclone season been issuing regular bulletins even after the system had made landfall.

5.5 The representative from ICAO noted with appreciation that RSMC La Réunion had since 1 July 2003 complied with ICAO's format on the issuance of tropical cyclone advisories on aviation.

5.6 The delegate from Mauritius proposed the use of the mean of the Western North Pacific (WNP) and the North Atlantic (NA) minimum sea level pressure (MSLP) values for the South-West Indian Ocean (SWIO) cyclones, and to adjust to the NA MSLP for small cyclones and to the WNP MSLP for large cyclones. The Committee took this proposal into consideration and decided to undertake experiments during the intersessional cyclone seasons whereby a decision will be taken in the next session.

5.7 The Committee was informed that RTH Pretoria was in charge of relaying meteorological data to most of the Members of the Committee.

5.8 Recognizing the inability of some Members of the Committee to access data from the GTS, the delegate from France informed the Committee that, upon request, the RSMC La Réunion can send the tropical cyclone bulletins and advisories by e-mail.

5.9 The Committee after a thorough deliberation approved the list of tropical cyclone names given in Appendix V for the cyclone seasons 2004/2005 and 2005/2006.

5.10 In response to an inquiry from the delegate from Mauritius, concerning the adoption of Mauritius and Madagascar as sub-regional tropical cyclone advisory centres by RA I and by other WMO constituent bodies, the delegate was informed by the WMO representative that a formal request should be addressed to the Commission on Basic Systems (CBS).

5.11 Amendments to the text of the Operational Plan as given in Appendix VI were recommended to the President of RA I for approval on behalf of the Regional Association.

5.12 The Committee requested the Secretary-General of WMO to publish as soon as possible the 2003 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). It urged Members of the Committee to submit to the WMO Secretariat before 19 September 2003 any subsequent changes to the Plan for inclusion in the 2003 edition.

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

Under this agenda item, the Committee established a working group co-chaired by Messrs Ian Hunter (South Africa) and Paul Remois (France) which carried out the detailed review of the Plan, taking into account the development and progress made by Members and the RSMC La Réunion - Tropical Cyclone Centre, since the fifteenth session of the Committee. The Committee ultimately concurred with the updated Plan submitted by the group which is reproduced in Appendix VII.

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.

Observing Systems

6.1.2 The Committee was informed that countries of the region are contributing to the implementation of the Regional Basic Synoptic Network (RBSN) by operating 167 surface based stations and 33 upper-air stations as approved by the thirteenth session of RA I under Resolution 2 (XIII-RA I) in November 2002. Countries of the region are also contributing to the newly established Regional Basic Climate Network (RBCN) to enhance the availability of climate data on the regional scale. This network also serves as a target list for WWW monitoring and consists of 167 CLIMAT and 11 CLIMAT TEMP reporting stations as approved by the thirteenth session of RA I under Resolution 2 (XIII-RA I).

6.1.3 The Committee was further informed that the average availability of SYNOP and TEMP reports from the Members is 68 per cent and 29 per cent respectively. The availability of reports from the RBSN stations is therefore not generally satisfactory, in particular for TEMP reports. Nine of the 29 upper-air RBSN stations were silent and less than 25 per cent of the expected TEMP reports were received from ten other stations.

Regional Meteorological Telecommunication Network

6.1.4 The Committee was informed that significant improvement in the implementation of the Regional Meteorological Telecommunication Network (RMTN) has taken place in parts of RA I. Several Global Telecommunication System (GTS) circuits have been upgraded to medium/high speed via leased lines or public data networks. Several regional circuits were operating at high speeds via leased circuits with Regional Telecommunication Hub (RTH) Nairobi or via Public Data Network services with RTH Pretoria. There was significant progress in the introduction of the data communication TCP/IP protocol, in compliance with CBS recommendations. All the RTHs in the Region are automated and an increasing number of National Meteorological Centres (NMCs) have been automated, taking benefit from available, affordable and maintainable technologies based on PCs and the TCP/IP stack of data communication protocols. The rapid development in the field of Information and Communication Technologies is providing better opportunities for modernizing NMCs.

The automation of NMCs, besides improving the GTS/GDPS functions, also provides a good foundation for the further development of NMHSs. Complementary to the GTS dedicated circuits, a special telecommunication arrangement using the Internet was implemented in the South-West Indian Ocean to address current telecommunication gaps in that sub-region. In this regard, it should be noted that CBS-Ext(02) adopted, with a view to minimizing the inherent operational and security risks, recommended practices for collecting observational bulletins via e-mail, and a guidance document on the most appropriate practices and implementation options for Virtual Private Networks (VPNs) via the Internet.

6.1.5 The Committee noted that the Data Collection System (DCS), including the Data Collection Platform (DCP) Data Retransmission System (DRS) and the Meteorological Data Distribution (MDD) System, which are currently provided via METEOSAT-7, were integrated into the RMTN as a complementary means for the national collection of observational data, and for the distribution of observational data and processed information from RTH/RSMCs. Several products generated by African RSMCs, ACMAD and DMCs were included in the MDD programmes of transmission. In the framework of the EUMETSAT programme for Meteosat Second Generation (MSG), the current MDD and DRS services were planned to be integrated into the fully digital LRIT and HRIT transmissions. However, a power amplifier failure on board MSG-1 led to the non-activation of the LRIT and HRIT dissemination mission. As a result, EUMETSAT is implementing an alternative dissemination system via telecommunication satellite services, based on Digital Video Broadcast (DVB) techniques. In the framework of the World Area Forecast System (WAFS), Satellite Distribution System (SADIS) terminals are already installed in most countries of Region I.

6.1.6 The Committee was informed that the Réseau de Transmission d'Information Météorologique (RETIM)-Africa data-distribution service via satellite was put in operation in March 2003; France is funding the 128 kbit/s uplink and data-distribution service, including the required connection of RTH Toulouse. The telecommunication technology for RETIM Africa uses the satellite-based Digital Video Broadcast (DVB-S) technology, which was designed for digital TV broadcast, with low cost receiving stations. The RETIM-Africa is operating via the STELLAT satellite, and uses the C band radio frequency spectrum that is required for tropical/equatorial areas. Receiving stations need a 1.80 to 3.70 meter dish antenna, that are typical for satellite-based TV reception. The area of coverage of RETIM-Africa includes the whole of Africa including Madagascar and the South–West Indian Ocean. The data are fed to the satellite operator from a GTS Centre, which is RTH Toulouse in the initial phase; in a second phase, one or several African Centres can perform this function. The initial data rate of the data channel is 128 kbit/s, but the technology allows an increase of the data rate up to 6 Mbit/s. The information received through RETIM-Africa, which is in standard WMO formats, can be handled, visualised and processed on classical PC-based terminals or workstations, or sent, through a Local Area Network (LAN) or via a Message Switching System (MSS), to multiple users.

6.1.7 The Committee requested Mr Laurent Zerbib (France) to draw up a telecommunication network diagram for the South-West Indian Ocean region. The said diagram is given in Appendix VIII.

Meteorological Satellites

6.1.8 The Committee noted with appreciation the latest detailed information provided by the Secretariat on the status reports of the operational meteorological satellite systems that are presently providing data or have the potential to provide the data to Members in the South-West Indian Ocean.

6.1.9 The Committee was informed that one of the action items agreed upon at CGMS-XXX was for India, China and the Russian Federation to take into account the Committee´s request to consider the possibility of continuing and implementing, on a permanent basis, geostationary coverage of the Indian Ocean, in order to provide the necessary data in

support of the national mandates of the WMO Members in the region and to report to CGMS-XXXI.

6.1.10 The Committee thanked EUMETSAT for agreeing to maintain its coverage over the Indian Ocean at least until 2005. It however reiterated its concern about the absence of any permanent geostationary satellite coverage over the Indian Ocean and requested WMO to make representations with EUMETSAT to find a solution ensuring geostationary coverage of the Indian Ocean beyond 2005.

6.1.11 The Committee was informed that the Meteosat Second Generation Satellite (MSG) was successfully launched in August 2002. The African Meteorological Transition Project that will provide ground receiving equipment to all countries in Region I was progressing well and the first system will be installed in Nairobi before the end of 2003. Members were requested to provide the project officer, when requested, with the necessary information to facilitate the smooth implementation of the project.

Marine Observations

6.1.12 The Committee noted that buoy reports continue to increase, in particular those with pressure observations. This increase is due largely to the work of the Data Buoy Cooperation Panel (DBCP), and most especially its regional action groups, the International South Atlantic Buoy Programme (ISABP, many of whose buoys eventually drift into the Southern Indian Ocean), and the International Buoy Programme for the Indian Ocean (IBPIO). The IBPIO maintains a homepage at: http://www.shom.fr/meteo/ibpio/.

6.1.13 The Committee noted with appreciation that as a result of cooperative work within the programme, many of the previous simple oceanographic drifters in the region also now make meteorological measurements.

6.1.14 To assist in expanding the availability of marine data in the region, the Committee urged its Members to:

- participate in whatever way possible in the work of the IBPIO (e.g. through the provision of buoy deployment facilities);

- recruit more Voluntary Observing Ships (VOS) trading in the region.

6.1.15 The Committee was informed that a conference in Mauritius in November 2002 agreed to establish an Indian Ocean Component of the Global Ocean Observing System (IOGOOS), with support from over 20 institutions in 14 countries surrounding the Indian Ocean. An important pilot project of IOGOOS is the Western Indian Ocean Marine Applications Project (WIOMAP), which aims to enhance marine observing systems, data management and services in the western Indian Ocean through the cooperative involvement of eight countries in and bordering this region. It is hoped that the project document will be agreed and submitted to potential funding agencies by late 2003.

Aeronautical Meteorology

6.1.16 The Committee noted that nearly 150,000 Aircraft Meteorological Data Relay (AMDAR) observations per day are currently being exchanged globally on the GTS representing nearly a three-fold increase in volume compared to 1998 when the Panel was established. The Fourteenth World Meteorological Congress in May 2003 stressed that AMDAR had proved to be a very cost-effective data source that responded to the needs of WMO Programmes and brought benefits to end-users. Congress recognized the low cost of AMDAR observations compared to radiosonde soundings, the potential of such systems to improve data coverage in data-sparse areas, and the improvements to NWP attributed to the assimilation of such observations.

6.1.17 The Committee was informed that the Work Programme of the AMDAR Panel included four high priority items, namely the coordination of national and regional AMDAR programmes, improvement of AMDAR data exchange and quality control, and two pilot projects, including one on Southern Africa. The aim of the high-priority pilot project for Southern Africa is to enhance the quantity of automated reports over the Southern Africa region, including adjacent areas of the Indian Ocean, as a means to improve meteorological forecast accuracy. The South Africa Weather Service has kindly taken the lead in implementing this project. In addition to foreign international airlines flying over Africa and the Indian Ocean region, such as British Airways, KLM, SAUDIA, Lufthansa and Qantas two African airlines, namely, Air Mauritius and South African Airways continue to provide AMDAR data to the Region. The evaluation of the Southern Africa High Priority AMDAR Project has shown remarkable positive impacts of AMDAR data on weather forecasts over the Southern Africa region. The aim now is to establish a full-fledged AMDAR programme in Southern Africa in collaboration with national, regional and international airlines. All National Meteorological Services in the area have been encouraged to join in establishing a regional AMDAR Panel in which all the countries of the Sub-Region will be represented. In this regard, South Africa has already sent invitations to each country in the region to actively participate in establishing and implementing such an AMDAR programme.

Activities of Members

6.1.18 The delegate from Botswana informed the Committee of the establishment of two new manned surface stations (i.e. 68320-Werda and 68325-Goodhope) and that two new upper-air stations will be established soon at Kasane (68029) and Ghanzi (68024). She also informed the Committee that a Doppler Surveillance Radar (S-band) has been installed at Gabarone and discussions between Botswana and South Africa regarding networking are already ongoing.

6.1.19 The delegate from Comoros informed the Committee that an automatic weather station located in Foumbouni will be replaced in 2004 by a new synoptic station.

6.1.20 The delegate from Lesotho reported that the main synoptic station at the airport in Maseru has been upgraded by installing an automatic weather station. She informed the Committee that the Department furthermore plans to revive the synoptic stations at Mokhotlong (68542) and Qacha'snek (68456) by installing two new automatic weather stations.

6.1.21 The delegate from Malawi informed the Committee that there are still problems in the acquisition of consumables for their upper-air stations. He informed the session that one station (i.e. Mzuzu-67489) is not fully operational due to a shortage of staff. This will be remedied soon as a number of staff are currently undergoing training.

6.1.22 The delegate from Mozambique reported that the Instituto Nacional de Meteorologia (INAM) in coordination with the Disaster Management sector and with support from USAID/Famine Early Warning System Network (FEWS NET) Mozambique Integrated Information Network for Decision-Making (MIND) Project is in the process of dissemination and implementation of a new tropical cyclone warning system for Mozambique. A number of projects are ongoing with the sponsorship of the European Union, Spain, Finland and Portugal. He further informed the session that their future plans include: the installation of two weather radars in Xai-Xai and Beira, installation of computers with Internet in the capital cities of all provinces, upgrade of their message switching system, installation of automatic weather stations at major airports, establishment of automatic synoptic stations and training at various levels.

6.1.23 The delegate from Namibia reported that the NOAA receiver is currently not operational, but that the Meteosat receiver is in good working condition. He informed the Committee that a number of workshops were conducted by EUMETSAT to train staff on the MSG satellites. He mentioned future plans to revamp two upper-air stations and to install an

additional upper-air station in the north of Namibia. The Committee was informed that there are plans to establish a marine meteorological observing system and to put up two weather radars in the country.

6.1.24 The session noted that the availability of upper-air and synoptic observations had not improved significantly. This was attributed to expensive consumables for upper-air stations and inadequate budgetary allocations for the running of surface weather stations. The session was informed that the Global Climate Observing System (GCOS) programme was addressing this issue of rehabilitating the GCOS network. With regard to the upper-air observations, most Members reported that the cost of consumables remains prohibitive. The WMO representative informed the Committee that efforts were being made to review the procurement procedures and put in place a regional procurement framework.

6.1.25 The delegate from South Africa reported that they decided to implement a seasonal pattern of the operations of upper-air stations in order to combat the escalating costs of radiosondes and the resulting shrinking of the TEMP network. Summer coverage is aimed at providing more data over the northeastern parts of the country. He also informed the Committee that the South Africa Weather Service (SAWS) is continually expanding its Internet bandwidth and had in fact a three-fold increase to accommodate the increasing GTS traffic being diverted to e-mail. He urged other Members to seek ways and means of also increasing their respective Internet bandwidths. He informed the Committee that SAWS, through its Aviation Weather Centre in Johannesburg, continues to play a leading role in the AMDAR project, which has become increasingly important as the radiosonde network continues to shrink. South African Airways continues to increase its fleet of AMDAR-equipped aircraft.

6.1.26 The Committee requested that Members be informed on the decision/changes in the Implementation Program possibly through the World Weather Watch (WWW) News Bulletin.

6.1.27 The delegate from Seychelles informed the Committee of their plans to establish stations in small islands which are to be manned by volunteers. He mentioned that at times communication has been a recurring problem in some of the islands but that they had recently brought back to operational status the communication system in two of their island stations. He also reported that the equipment they recently acquired from the China Meteorological Administration (CMA) did not match their requirements. A formal letter has already been sent to CMA regarding this matter. He further reported that the installation of the RETIM system would be completed within the year.

6.1.28 The delegate from Swaziland reported that observations at three synoptic stations (i.e. Siteki, Nhiangano, Pigg's Peak) have been augmented by the installation of automatic weather stations (AWSs). He also informed the Committee that a new synoptic station in Mbabane will be operational by the end of 2004. Furthermore, AWSs are to be installed at Matsapha airport and at the soon to be constructed Sikhuphe airport.

6.1.29 The delegate from Tanzania reported that it had acquired the Horace diagnostic and display system from the United Kingdom toward the end of 2002, together with a Very Small Aperture Terminal (VSAT) system. The Horace system also contains facilities for integrating with NWP fields and access to NWP products from advanced centers. The system was of immense help in tracking cyclone Atang when it was approaching the Tanzania coast. He also informed the Committee that it is in the process of reviving the upper air stations at Dar-Es-Salaam and Mtwara.

6.1.30 The delegate from Zimbabwe reported that the Department of Meteorological Services provided early warnings to the populace during the occurrence of cyclone Japhet in March 2003. He also announced that during the intrasessional period Zimbabwe procured an Airborne Multi-Spectral Scanner (AMSS) (TRANSMET) and a weather display system (SYNERGIE), which have vastly improved their data transmission, weather forecasting and severe weather warning activities.

6.2 Hydrological Component (agenda item 6.2)

RA I Working Group on Hydrology

6.2.1 The Committee was informed that WMO, jointly with the European Commission for Africa (ECA), organized a Regional Seminar on African Water Resources Assessment. The seminar was held in Cairo on 22 July 2002. It reviewed, evaluated and developed proposals for water resources activities based on the African Water Resources Assessment Action Plan which was agreed upon at the Conference on Water Resources: Policy and Assessment held in Addis Ababa, Ethiopia, in March 1995. Discussed during the seminar were relevant actions in the field of water resources, which could be implemented with the framework of the New Partnership for Africa's Development (NEPAD).

6.2.2 The Committee noted that the eighth session of the Working Group on Hydrology of the WMO Regional Association I (Africa) was held in Cairo from 23 to 25 July 2002. The main purpose of the session was to discuss the various activities in hydrology and water resources in Africa as set out in the terms of reference of the Working Group and to review the implementation of the recommendations of the previous session. It identified specific areas with activities to be undertaken. The meeting considered also other water-related activities in the region in the context of NEPAD and agreed on a sub-regional and regional implementation and follow up action plan. The session was held in conjunction with a workshop for the English speaking countries of East and West Africa on Water Resources Assessment – Evaluation of National Capabilities (27-28 July 2002).

HOMS Regional Activities

6.2.3 The Committee was pleased to note that a course for the training of three instructors from RA I on Canadian Hydrological Operational Multipurpose System (HOMS) components was held in Ottawa, Canada, during September 2002. This was a first step towards the organization of a series of roving seminars to train African professionals on technologies of relevance to the work of their NHSs, utilizing local instructors. The national seminars are scheduled to take place during 2003.

Technical Cooperation Activities

6.2.4 The Committee was informed that during the seventh session of the RA I Working Group on Hydrology (RA I-WGH), the problem of rescuing the historical hydrological data in some African countries was raised. The WMO/VCP funds were used for the implementation of Hydrological Data Rescue pilot project. Nine African countries participated in the project. The English speaking countries were provided with Hydrological Database and Analysis System (HYDATA) software and the French speaking countries were provided with HYDROLOGIE de Montpellier (HYDROM) software. Each participating country was provided also with a PC, a software package for data processing and management, printer, and scanner. More than eighty nationals were trained in workshops for ten days on applying the suitable software for data management and they had been awarded certificates. The two consultants were from the region and presented reports on their missions to the countries. The project is successfully implemented and will contribute to the efforts to increase the security of hydrological data. It will also make an effective contribution to the implementation of RA I-WGH activities on water resources, the World Hydrological Cycle Observing System (WHYCOS) programme and research programmes by providing access to historical data and information. It will assist the participating countries in the establishment and strengthening of their national data banks and will help in the development of long term plans for sustainable development at national and regional levels.

WHYCOS Programme

6.2.5. The Committee was informed that eleven Southern African countries are participating in the Southern Africa Development Community-Hydrological Cycle Observing

System (SADC-HYCOS). The Regional Centre, which continues to maintain the database and operation of the projects' Internet server is hosted by the Department of Water Affairs and Forestry, Directorate of Hydrology, in Pretoria, South Africa. An Implementation Document for phase II has been prepared by the WMO Secretariat. The project's second phase, which would last four years, includes the consolidation/redesign of the regional observation network, which should be expanded to about a hundred hydrological stations. The proposal has been discussed and revised by the SADC Water Resources Technical Committee (WRTC) at its annual session held in Mauritius in May 2002. The Government of the Netherlands had expressed a strong interest in supporting a project which is currently estimated at US$ 4.2 million.

Exchange of Hydrological Data

6.2.6 The Committee was informed that recently, the member of the African Working Group (AWG) responsible for data exchange reviewed the replies received from European Commission (EC) members to a request for comments on the contents of the Technical Report No. 74 on the exchange of hydrological data. Based on his recommendation the AWG decided to proceed with a publication of the report with errata to correct the errors in some references in the report. He also advised that the other comment be taken into account in future editions of the report.

6.2.7 The Committee noted that in response to the request of Cg-XIII to the Executive Council in order to keep under review the implementation of Resolution 25 (Cg-XIII), a questionnaire on the exchange of hydrological data and products had been circulated to all WMO Members on 15 August 2002. As of mid-November 2002, 48 responses had been received, and they had been made available to the AWG for analysis.

6.2.8 The delegate from Namibia reiterated the need for Members to put emphasis on the exchange of hydrological data and therefore noted with appreciation WMO's initiatives on this issue. He requested that the result of the analysis to be made by the Commission for Hydrology on the responses received to the questionnaire on the exchange of hydrological data and products be distributed to all Committee Members.

African Water Initiatives - African Water Task Force (AWTF), UN Water-Africa

6.2.9 The Committee was informed that WMO participated in the activities of the United Nations System-wide Special Initiative for Africa (UNSIA), particularly in the implementation of the "Expanded Fresh Water Assessment" programme. WMO, together with the United Nations Environment Programme (UNEP) and the World Bank, was designated as a coordinating agency for the water cluster of UNSIA and contributed to the development of Water Cluster implementation strategy.

6.2.10 It noted that the African Ministerial Conference on Water (AMCOW) will convene the Pan-African Implementation and Partnership Conference on Water, in Addis Ababa from 9 to 14 December 2003. The Pan-African conference represents a political commitment at the highest level among African Governments to move forward in solving the continent's impending water crisis. The African Governments along with representatives of the international community, the scientific community, civil society and the private sector will meet in Addis Ababa to agree on how to turn commitments into action.

Third World Water Forum

6.2.11 The Committee was informed that WMO participated actively in the 3rd World Water Forum which met from 16-23 March 2003 in Kyoto, Osaka and Shiga, Japan, and was organized jointly by the World Water Council and the Government of Japan. WMO organized a session on Water and Climate during the Regional day for Africa.

Water Resources Assessment

6.2.12 The Committee noted that a series of roving workshops was organized by WMO to promote the use of the WMO/United Nations Educational, Scientific and Cultural Organization (UNESCO) Handbook for Evaluation of National Capabilities for Water Resources Assessment (WRA). This handbook contains a methodology, which could be used by NHSs to identify the strengths and weaknesses of their ability to assess their countries' water resources. A CD containing an electronic version of the Handbook, workshop materials, and an electronic/interactive set of the tables for undertaking the assessment of capability will be developed for use in both applying the manual and holding workshops. The CD would be included as a component in the HOMS Reference Manual. The Handbook could be further developed to serve as a quality management standard for NHSs. It is expected that the CD and the WRA Manual will be available by December 2003.

6.2.13 The representative from DMC Harare noted with concern that there appears to be a lack of activity or information pertaining to flood forecasting initiatives in the region.

6.2.14 The Committee noted that there was an information gap with regard to progress in the implementation of the hydrological component by Member states. The need to address this issue was noted.

6.3 Disaster Prevention and Preparedness Component (agenda item 6.3)

6.3.1 The Committee was informed that WMO continues to chair Working Group 1 on Climate and Disasters of International Strategy for Disaster Reduction (ISDR) Inter-Agency Task Force (IATF) wherein it had taken over the responsibilities of the United Nations Task Force on El Niño with an expanded mandate to consider all climate-related aspects of disasters.

6.3.2 The Committee noted that WMO participated in the preparation of ISDR's publication entitled "Living with risk", in the preparation of the Early Warning Conferences, as well as to the World Summit on Sustainable Development (WSSD). In turn, ISDR fully support a new WMO programme on natural disaster prevention and mitigation that would further enhance the collaboration between the two organizations.

6.3.3 The Committee was informed that WMO played an important role in WSSD where the issue of disaster management had been a key topic in its main outcomes. Natural disaster prevention and mitigation were included in WSSD's Plan of Implementation as essential elements for a safer world in the twenty-first century.

6.3.4 The Committee recommended to rename item 6.3 in future meetings, as follows: The Reduction of the Impacts of Natural Disasters and Preparedness Component (Agenda item 6.3).

WMO activities in the area of natural disaster prevention and mitigation

6.3.5 The Committee noted that WMO continues to play a significant role in international disaster reduction activities through the actions taken within its major scientific and technical programmes, namely WWW, Aeronautical Meteorology Programme (AMP), World Climate Programme (WCP), Hydrology and Water Resources Programme (HWRP) and Atmospheric Research and Environment Programme (AREP). Those programmes were particularly important in contributing to global capabilities in the detection, forecasting and early warning of hazards, and in providing effective means and procedures to minimize their adverse consequences through the application of science and technology.

Emergency and Disaster Response Group (EDRG)

6.3.6 The Committee was informed that Cg-XIV (Geneva, May 2003) noted that more involvement of Regional and Sub-regional Offices in the EDRG activities would be necessary and NMHSs were invited to provide information on the impact of natural disasters to meteorological infrastructures to enable the EDRG to take timely action.

Cross Commission Activities

6.3.7 The Committee noted that the co-president of the Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) had submitted an additional proposal to the project entitled Natural Disaster Reduction in Coastal Lowlands to the Meeting of the Presidents of Technical Commissions in February 2003. That proposal included the development of a generic system for mitigating the impacts of natural disasters, in particular tropical cyclones, in coastal lowlands, based on an assessment of those impacts on agricultural and other socio-economic sectors. The recommendation of the Meeting was to incorporate the proposed activities in the project already endorsed by the Council and agreed that the new initiative should be treated as a demonstration project implemented in one of the countries affected by tropical cyclones. Cg-XIV requested the Commissions involved, in consultation with the Secretary-General, to finalize the project proposal, to identify a location for implementation of the demonstration project and to find appropriate partners for project funding.

Natural Disaster Prevention and Mitigation Programme

6.3.8 The Committee was informed that the newly launched WMO Natural Disaster Prevention and Mitigation Programme's main focus is on disaster prevention and management of risk. The new programme is expected to be a major contributor to the development in developing countries in the future, especially Africa. Cg-XIV agreed to initiate a major programme on natural disaster prevention and mitigation, that would enhance international cooperation and collaboration in that field, as a major crosscutting programme, based on the activities carried out by a number of WMO Programmes. The programme would coordinate WMO actions to improve risk analyses at the national and regional levels, to improve mechanisms and communication for the delivery, use and evaluation of warnings, and the provision of prompt advice and assistance to Members.

6.3.9 The representative from DMC Harare noted with appreciation the change in the main focus of WMO's natural disaster activities which is shifting from protection and recovery to disaster prevention and management of risk. He also noted the need for the region to adopt a standardized early warning system.

6.3.10 The representative from DMC Nairobi noted with appreciation that the WSSD agreed that actions were required at all levels to improve surface-based monitoring and increase the use of satellite data to improve early warning systems and prediction of weather events and that WMO Members were urged by Cg-XIV to participate actively in the implementation of those actions.

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6.3.11 The delegates from Namibia and Swaziland noted the need to strengthen the collaboration and cooperation between the Committee and the regional agencies concerned with disaster prevention and preparedness.

6.4 Research (agenda item 6.4)

6.4.1 The Committee noted with satisfaction that the Fifth WMO International Workshop on Tropical Cyclones (IWTC-V) was successfully held in Cairns, Australia from 3 to 12 December 2002 with Professor R.L. Elsberry (USA) as the chairman of the International Committee (IC). The Committee was also pleased that it was well represented at the workshop.

6.4.2 The Committee was also informed that the final report of IWTC-V would soon be ready for distribution to the Members and that the report contains very important and useful recommendations separately addressed to WMO, the research community and the tropical cyclone operational scientists. The Committee urged its Members and all concerned to endeavour to implement the recommendations relevant to their activities. The Committee was particularly pleased that part of the recommendations of the workshop concerns proposals for the revision of the publication "Global Guide to Tropical Cyclone Forecasting". The Committee agreed with the recommendation of IWTC-V that the publication was a valuable forecast reference and strongly supported the recommendation that this guide should undergo an evolutionary revision and be reissued.

6.4.3 The Committee supported the establishment of a joint (WWRP/TMRP) *ad hoc* Science Working Group for the International Tropical Cyclone Landfall Programme (ITCLP) chaired by Dr G. Foley (Australia). The Committee urged participating countries and relevant scientific organizations to support the project which, if fully implemented, will no doubt reduce substantially the disastrous impact of tropical cyclones on coastal communities.

6.4.4 The delegate from Lesotho noted with concern that there are very few research studies/ materials from the Cyclone Research Cell that are in English text.

6.4.5 The delegate from France informed the Committee that activities of the Cyclone Research Cell will be available on the RSMC La Réunion future web site and that plans are underway for a bilingual web site. He also informed the Committee that research from RSMC La Réunion was available through the major journals (i.e. Monthly Weather Review, etc.) in English.

6.4.6 The delegate from Australia assured the Committee that the ITCLP which he chairs will be multi-lingual.

6.4.7 The Committee endorsed the consolidation of a list of research activities done or undertaken in the region.

6.4.8 The representative from DMC Harare noted the need for closer collaboration between the DMCs and RSMC La Réunion. He informed the session of their extensive climate database and urged Members to make full use of it.

6.4.9 The delegate from South Africa assured the other Members of the Committee of access to research results and their willingness to coordinate research activities with English speaking Members. He requested the assistance of WMO in the dissemination of these research results to the Members.

6.4.10 The delegate from DMC Nairobi reiterated the need to undertake studies on the indirect effects of tropical cyclones over equatorial regions, including East equatorial Africa.

6.4.11 The delegate from France proposed that a workshop be organized for Members to be able to discuss the research initiatives in the region. In said workshop, a working group could be established to look into the available databases in the region.

6.4.12 The delegate from Madagascar supported the need for Members to make full use of the available research facilities in the Region and informed the Committee that the Department of Meteorology of his country comprises a Research Service which initiated collaboration with the Cyclone Research Cell of RSMC La Réunion.

6.4.13 The Committee was informed that the planned forecasters' web site to be hosted by WMO would post research notes, operational studies and other tropical cyclone related materials.

6.4.14 The Committee noted with concern the lack of research studies done on wave forecasting/coastal damage from tropical cyclones and recommended that this be included in the prioritised research list for the region.

6.4.15 The Committee noted that a CD compilation of tropical cyclone related materials was distributed during IWTC-V and requested that copies of this CD be distributed to the Members and be available in the TCP Web site for easy access.

6.5 Training (agenda item 6.5)

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

6.5.2 The Committee expressed appreciation for the number of training events that were organized by WMO and Member countries since its last session, especially those events that were of direct relevance to tropical cyclones.

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

6.5.4 The Committee noted that WMO continued to assist Regional Meteorological Training Centres (RMTCs) to improve their training programmes by provision of financial support to purchase textbooks and to staff members for attending specialized training courses and scientific events abroad. The Committee urged its Members to make maximum use of the training programmes offered by these Centres. It also requested its Members to consider ways and means of assisting the RMTCs in organizing regular and specialized courses of interest to the Committee's activities.

6.5.5 The Committee noted the information on the activities of the Training Library and the use made of its services by the Members. It also appreciated the continuous updating of the Virtual Training Library (VTL) in an effort to provide the latest and most suitable available training material through Internet and recommended that those actions should be encouraged and continued. The VTL is available at: http://www.wmo.ch/web/etr/vtl.html.

6.5.6 The Committee noted the new scientific and technological developments in the application of meteorology and hydrology. The Committee therefore urged WMO and donor Members to continue arranging for relevant training at all levels to enable personnel from its Member countries to utilize more effectively the new technologies in these specialized fields.

6.5.7 The Committee noted the number of fellows from its Members, trained or still under training since its last session. It requested its Members to take full advantage of the WMO fellowship programme by selecting well-qualified candidates for training, bearing in mind the requirements for academic qualifications, relevant experience, language proficiency, age limit and other specific requirements, as stipulated by the host training institutions concerned.

6.5.8 The delegate from France informed the Committee that his country is actively involved in the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) African Satellite Meteorology, Education and Training (ASMET) programme with the objective to give Region I forecasters direct access to training modules on tropical cyclones, in French and in English on a web site as soon as 2004.

6.5.9 The Committee indicated priority subject areas for training listed below so that these may be taken into consideration:

a. Tropical Cyclone Public Awareness – training of forecasters on TV weather presentation;

b. Maintenance of Meteorological equipment;

c. Use of new satellite technologies;

d. Use of Numerical Weather Prediction Models and attachement to NWP centers;

e. Interpretation of weather radar products.

It requested the WMO Secretariat to continue its efforts to mobilize resources to assist Members with the implementation of such training activities.

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, several countries in the Region have received technical assistance under projects funded by various sources such as the United Nations Development Programme (UNDP), Trust Funds, the Word Bank (WB), the Global Environmental Facility (GEF) and the WMO's Voluntary Cooperation Programme (VCP). These projects were mainly aimed at strengthening the capabilities of NMHSs and Regional Centres to enable them provide reliable and accurate weather and 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, several major initiatives were being implemented. These included the DMCs in Nairobi, Kenya and the SADC DMC in Harare, Zimbabwe. Support for the Nairobi DMC and the Harare DMC was provided by the United States Agency for International Development (USAID), the Belgian government and the Southern Africa Transport and Communications Commission (SATCC)-SADC, respectively. With this support, the two DMCs continued to carry out their regular functions of providing weather and climate information, products and early warning advisories to the eastern and southern African countries. They also organized annually Climate Outlook Forums aimed at developing consensus seasonal forecasts for the coming rainy seasons.

7.3 The Committee noted that In addition to the above, the SADC-HYCOS project continued to be implemented satisfactorily with funding support from the EC. A similar project for the Intergovernmental Authority on Development (IGAD) countries is also being implemented with EC support.

7.4 The Committee noted that WMO has developed the "West Indian Ocean Marine Application Project (WIOMAP)" proposal whose overall development objective is to contribute to the conservation and sustainable use of marine resources in the West Indian Ocean region and to foster environmental protection and socio-economic development through improved application of marine data and products. Efforts are ongoing to secure funding for the project.

7.5 The Committee was informed that hardware and software which will considerably strengthen the reception, transmission and display capacities of Comoros, Madagascar, Mauritius and Seychelles, and will be installed in the very near future in the framework of the Indian Ocean Commission (IOC) project. A detailed presentation of the four components of the system to be implemented was made by the delegate from France. The TRANSMET system coupled with RETIM and INTERNET for the telecommunications will be associated with SYNERGIE for display and production of meteorological information. In order to streamline the training of forecasters and maintenance technicians and to facilitate the exchange of meteorological information all Members of the Committee strongly support the

extension of the system to all other Meteorological Services. The powerful display stations with a capacity to receive the considerable amount of MSG data should facilitate the efficient implementation of the Task Team on the Preparation for the use of MSG in Africa (PUMA) project in the near future.

7.6 The Committee noted that during the period under review, WMO continued to collaborate with the various economic sub-groupings in the region with a view to developing and implementing meteorology programmes and projects. These included the SADC, the IGAD and the IOC. In this regard, Memorandums of Understanding (MOUs) have been developed aimed at strengthening collaboration between WMO and the respective economic sub-groupings.

7.7 The Committee noted that WMO also continued to support the activities of the PUMA whose objective is to assist 47 African countries to acquire satellite ground receiving equipment for the reception of data and products from the MSG satellites. For this purpose, the EC has already approved funding for the PUMA project. For those countries such as the Republic of South Africa, which are not eligible to the EC funding mechanism, WMO and its cooperating partners have established a Trust Fund which will assist these countries to participate in the project. Assistance will also be provided under bilateral arrangements.

7.8 The Committee was informed that Météo-France (La Réunion) and Mauritius had requested the assistance of the European Union in the implementation of a project on the establishment of a Doppler meteorological radar network in the South-West Indian Ocean. The Committee agreed in principle that said radar network should be established and urged its Members to actively participate in the formulation of the project proposal and its subsequent implementation.

7.9 The Committee requested WMO to assist in the preparation of an inventory of existing weather radars in the region.

7.10 The Committee noted with interest that in order to overcome the persistent problems associated with the operation of WWW facilities in Africa, a Strategic Plan has been developed to improve the functioning of these facilities. In this respect, VCP funds were made available to support the development of project proposals for strengthening and rehabilitating WWW related infrastructure in the region.

7.11 The Committee noted with pleasure 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. Under a project supported by the United Kingdom, simplified PC-based media weather presentation systems were provided to some NMHSs in the Region. Training was also conducted in Nairobi, Kenya in the operation and maintenance of these systems.

8. SCIENTIFIC LECTURES AND DISCUSSIONS (Agenda item 8)

8.1 During the session, the Committee devoted part of its time to the presentation of the following scientific lectures and technical discussions:

- Status of communication at the Nairobi Regional Telecommunication Hub (RTH) and The Impact of Tropical Cyclones in the Southwestern Indian Ocean on weather in Kenya during 2001/2002 and 2002/2003 seasons (Mr Samuel Mwangi - Kenya);

- Management (Mr Göran Kari – Finland);

- INAM's Development Strategy (Mr Filipe Domingos Freires Lúcio – Mozambique);

- RA I Strategy on Implementation of WWW components in Africa (Mr Stephen Njoroge - WMO);

- 2001/2002 and 2002/2003 cyclone seasons in the South-West Indian Ocean and Using drifting buoys data to monitor Tropical Cyclones in the South-West Indian Ocean (Mr Philippe.Caroff - France);

- 2001/2001 and 2002/2003 Cyclone Season in Australia (Dr Gary Foley - Australia);

- A presentation on the method used to improve the transmission and visualization of meteorological information in the Mascarenes under the framework of the IOC project (Mr Laurent Zerbib - France);

- The Linux PC-based forecaster's Synergie workstation (Mr Laurent Zerbib - France);

- A radar network project for the Indian Ocean (Mr Dominique Landais - France);

- The Role of UN/ISDR in Disaster Reduction (Mr S. Njoroge for Mrs Rokotondrandria of UN/ISDR Africa);

- Issuance of Tropical Cyclone Advisories and SIGMETS for Aviation (Mr B.M. Sekwati - ICAO);

- Sizes of Tropical Cyclones in the South-West Indian Ocean (Mr S. Veerasamy - Mauritius);

- Influence of the Indian Ocean Tropical Cyclones on the Climate of the Greater Horn of Africa (GHA) (Mr W.N. Githungo- DMC-Nairobi).

8.2 The Committee recorded its appreciation to the lecturers for their interesting and informative presentations.

8.3 The Committee requested WMO for a CD compilation of the above presentations and its distribution with the final report of the session to all the Members. It further requested that the presentations be posted on the TCP web site.

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

9.1 The Committee expressed the need to continue its work in the light of Resolution 6 (XIII-RA I). It also expressed the desire that its seventeenth session be held before the 2005/2006 cyclone season, the precise dates to be determined later.

9.2 The delegate of Botswana informed the Committee that her country would propose to host the seventeenth session in 2005, subject to the approval of her Government. The Committee, in welcoming the information and accepting with pleasure this offer, expressed its warm appreciation to the Government of Botswana. It requested the Secretary-General of WMO to take appropriate action, in consultation with the President of RA I, its Chairman and the host country for the convening of the session in 2005.

10. CLOSURE OF THE SESSION (Agenda item 10)

10.1 The report of the sixteenth session of the Committee was adopted at its final meeting at 1400 hours on 12 September 2003.

APPENDIX I

LIST OF PARTICPANTS

MEMBERS

BOTSWANA	Gasewasepe Konopo NTHOBATSANG (Mrs)
COMOROS	Mahamoud Ali Bay POUNDJA
FRANCE (La Réunion)	Dominique LANDAIS Paul REMOIS Philippe CAROFF Laurent ZERBIB
LESOTHO	Mabafokeng Felesiah MAHAHABISA (Mrs)
MADAGASCAR	Alain Solo RAZAFIMAHAZO
MALAWI	Lucy MTILATILA (Mrs) Betinigo Willie GIDALA
MAURITIUS	S.N. SOK APPADU (Chairperson) Shyamnath VEERASAMY
MOZAMBIQUE	Filipe Domingos Freires LUCIO (vice-chairperson) Mussa MUSTAFA Moises Vicente BENESSENE Patricio Domingos MOSQUITO Daniel MACARINGUE Helder SUEIA
NAMIBIA	Franz UIRAB
SEYCHELLES	Wills AGRICOLE
SOUTH AFRICA	Ian Tyrrell HUNTER
SWAZILAND	Sandile GUMEDE
UNITED REPUBLIC OF TANZANIA	Philibert Felician TIBAIJUKA
ZIMBABWE	Joel CHABATA

EX-OFFICIO MEMBERS

Australia	Gary FOLEY

OBSERVERS

Drought Monitoring Centre-Nairobi	William NDEGWA GITHUNGO
Drought Monitoring Centre-Harare	Emmanuel Dumisani DLAMINI
RA V Tropical Cyclone Committee (RA V/TCC)	Gary FOLEY

Kenya	Samuel MWANGI
International Civil Aviation Organization (ICAO)	Boitshoko M. SEKWATI

LOCAL OBSERVERS

FINAM Project	Vasco Jose Gonçalvés JUNIOR
FEWS NET/MIND	Antonio Salomao MAVIE
INSTITUTO DA AVIAÇAO CIVIL DE MOÇAMBIQUE	Fortunato Henrique SARAIVA
LINHAS AEREAS DE MOÇAMBIQUE	Joao BANZE
INSTITUTO NACIONAL DE HYDROGRAFIA E NAVEGAÇAO	Manuel Antonio LISBOA Cândida Inês SETE (Mrs)
MINISTRY OF ENVIRONMENT	Angelo Artur Pedro CUIANA
MINISTRY OF AGRICULTURAL AND RURAL DEVELOPMENT	Mario UBISSE
ARA-SUL	Vasco MUNGUAMBE

WMO SECRETARIAT	Nanette LOMARDA(Mrs) Stephen NJOROGE
INTERPRETERS	Nelly CONFORTY-FERREUX (Mrs) Chantal MARIOTTE (Mrs) Emmanuel PETROS
TRANSLATOR	Michèle EL HINY (Mrs)

APPENDIX II

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 2001/2002 AND 2002/2003 CYCLONE 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 Meteorological component
   6.2 Hydrological component
   6.3 Disaster prevention and preparedness component
   6.4 Research
   6.5 Training

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

8. SCIENTIFIC LECTURES AND DISCUSSIONS

9. DATE AND PLACE OF THE SEVENTEENTH SESSION

10. CLOSURE OF THE SESSION

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APPENDIX III

LIST OF FOCAL POINTS FOR RA I/TCC

Member	Meteorological	Hydrological	DPP	Research	Training
Botswana	Mrs G.K. Nthobatsang E-mail : konopa@mail.com	Mrs G.K. Nthobatsang E-mail : konopa@mail.com	Mrs G.K. Nthobatsang E-mail : konopa@mail.com	Mrs G.K. Nthobatsang E-mail : konopa@mail.com	Mrs G.K. Nthobatsang E-mail : konopa@mail.com
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Mauritius	Mr K. Duaputh E-mail: meteo@intnet.mu	Mr R. Mungra E-mail: meteo@intnet.mu	Mr S. Veerasawy E-mail: meteo@intnet.mu	Mr B.M.R. Pathoack E-mail: meteo@intnet.mu	Mr S. Boodhoo E-mail: meteo@intnet.mu
Mozambique	Mr Filipe Domingos Freires Lúcio E-mail: flucio@inam.gov.mz	Mr Filipe Domingos Freires Lúcio E-mail: flucio@inam.gov.mz	Mr Filipe Domingos Freires Lúcio E-mail: flucio@inam.gov.mz	Mr Filipe Domingos Freires Lúcio E-mail: flucio@inam.gov.mz	Mr Filipe Domingos Freires Lúcio E-mail: flucio@inam.gov.mz
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APPENDIX IV

REPORTS OF THE 2001/2002 AND 2002/2003 CYCLONE SEASONS

(Submitted by RSMC La Réunion and Members)

REVIEW OF THE 2001/2002 AND 2002/2003 CYCLONE SEASONS

(Submitted by RSMC La Réunion)

THE 2001-2002 CYCLONE SEASON IN THE SOUTH-WEST INDIAN OCEAN

Following a year that could be described as relatively calm, the 2001-2002 cyclone season was very active – the second most active season over the past 30 years. The most remarkable and most characteristic feature of this season was the abnormally high average intensity attained by all the various disturbances, with an exceptionally high proportion of depression systems developing into tropical cyclones.

Fortunately, the majority of disturbances originated over the east of the South-West Indian Ocean Basin, and thus stayed well away from populated land. However, three of them did hit MADAGASCAR, although without causing too much damage, whilst intense tropical cyclone DINA hit the MASCARENES quite severely, making it the most memorable event of this cyclone season.

This season was a very active one, not because of a particularly high number of systems, but as a result of the high average intensity shown by the various events. Eleven depression systems reached the tropical storm stage (and were therefore named), a number which is in fact only slightly above normal (the average being nine), but of these eleven systems, nine developed into tropical cyclones, which is a far from normal proportion. To find comparable rates we have to go back 30 years to the beginning of the satellite era (a period when the quality of satellite imaging was far inferior and analysis of the intensity of tropical disturbances was to be treated with caution).

In the final analysis, this unusual frequency of cyclones – twice the normal rate - puts this season among the two or three most active since 1967 (start of the satellite era), virtually on a par with the most recent ‘big’ season, that of 1993-1994, which remains the point of reference for the height of cyclone activity in the South-West Indian Ocean Basin, both in terms of the number of depression systems and the number of cyclone days.

Compared with the previous 2000-2001 season, disturbance activity more than doubled, to a total of 73 days (as opposed to 36 during the previous season) on which there was significant depression system – i.e. intensity equating to at least a moderate tropical storm – compared to a mean of 54 and a median of 48. But the divergence from the norm is even more marked if we consider the number of cyclone days (days on which a tropical cyclone was present in the area): this figure reached 35, compared with a mean of 20 (reassessed figure to reflect the adjustment of the Dvorak scale at the end of 1999).

This intense cyclone activity was not the result of a particularly high incidence of cyclogenesis (advisories were issued regarding 15 depressions, which is not at all out of the ordinary), but resulted from the tremendous ease, throughout the season, with which depression systems that had formed were subsequently able to intensify. This dominant characteristic was the main specificity of the 2001-2002 season.

In addition to the fact that nine cyclones were able to come into being in this way, this strong potential for intensification allowed five of them to reach the stage of intense tropical cyclone, one of them even being classified as a very intense tropical cyclone (HARY thus superseding HUDA, the most recent cyclone to have known this rare privilege - in April 2000). The last time that such a large number of intense cyclones was recorded was during the ‘infamous’ 1993-1994 season – the season of reference that is followed closely by this season in the hierarchy of seasons with intense activity (26 days when a mature tropical cyclone was present in the area – with a Dvorak intensity of CI ≥5.0, as opposed to 27 in 1993-1994).

In terms of longevity, this season marks a split from those preceding it. The previous four seasons were in fact unusually late and fairly concentrated in terms of time, lasting more or less the three to four months of the whole hot season. This time the pattern was reversed, with a season that was both early and late, stretching out over six and a half months.

The first depression system, which originated in the South-East Indian Ocean, developed at the end of October, making this year one of the particularly early seasons. We note that as regards the median start date for the season is 17 November (50% of seasons starting before this date, 50% after). We have to go back in fact as far as 1992 to find the most recent system to have started earlier in the season, with the storm AVIONA.

The end of the season came very late, on 11 May 2002, which corresponds to the date of the last quintile, in terms of the end date for the season (season end dates being considerably less dispersed than start dates, with the median being 20 April). As the final fanfare to a season characterized by very intense systems, KESINY did not deviate from the pattern of previous events, becoming one of the few cyclones to be recorded over the basin in May and more importantly the first since the dawn of the satellite era to hit, at tropical cyclone intensity, populated land, namely the North of MADAGASCAR.

Cyclogenesis was spread at regular intervals throughout the cyclone season, although activity was more concentrated at the end of January, as is to be expected in the middle of the hot season. In addition to the fact that they were not especially numerous, but conversely were generally sustained and “effective”, we note that they generally formed over the east of the basin or outside it, that is to say over the South-East Indian Ocean, six systems forming east of 80°E, of which 4 were east of 90°E, in the Australian area of responsibility. It should be noted that only one depression system formed over the Mozambique Channel, and the area close to CHAGOS, normally a favoured zone for cyclogenesis, remained unproductive. Finally, we will make particular reference to cyclone GUILLAUME, due to its original cyclogenesis.

GUILLAUME also stands out as a result of its very unusual track. For the others the tracks were fairly varied, although there was, as during the previous season, a predominance of meridian or ‘pseudo-parabolic’ tracks. The largely zonal trajectories, fairly typical of those recorded at the beginning or end of a season, of ANDRE and KESINY were countered by the ‘pseudo-parabolic’ tracks of DINA and HARY, whilst almost all the tracks of those systems heavily concentrated over the east of the basin, as a result of a significant cyclogenesis rate in this sector, showed a strong meridian structure and associated with a cuspidal point or where there are fairly marked changes of track.

Most systems attained their full maturity between 15 and 20°S, as is often the case over the basin, but this was particularly spectacular this season, as the seven depression systems which moved in this range of latitudes all attained the cyclone stage there and this covered almost the entirety of this span of latitudes.

In seasons when meridian tracks largely dominate the cyclone risk is generally abated for the populated land concentrated in the west of the basin, and this tends to be all the more true when the majority of cyclones emerge far to the East, as was the case this season. This has proved only partially true, because whilst SOUTHERN AFRICA was indeed spared from any disturbance, the five depression systems that formed West of 80°E all came to bear with varying degrees of directness on MADAGASCAR and the MASCARENES.

MADAGASCAR was the worst hit, as is often the case because of its size. However, compared to some years at least, it did not in fact suffer too greatly from the various events that affected it. HARY, which was then almost at its maximum strength, was not only small but also, very fortunately, only ‘scraped’ the eastern point of the ‘big island’. It therefore did not have the disastrous impact that it could have done with a different track. The MASCARENES fared less well in the final analysis, intense cyclone DINA claiming some

victims in MAURICE and leaving behind considerable damage in MAURICE as well as at LA REUNION. They were, nonetheless, spared to a degree, in that they escaped a direct hit.

On the whole, we can nonetheless consider that this cyclone season did not have the disastrous consequences that it might have done, in view of the destructive potential of such a high number of cyclones and of particularly intense events. If we once again refer back to the 1993-1994 season, which was comparable in this respect, we remember still how terrible that year was for the populations of the east coast of MADAGASCAR, with cyclones GERALDA, LITANNE, DAISY, and NADIA. That year also saw a high rate of cyclogenesis over the east of the basin, but the trajectories were very much zonal.

More than the localization of cyclogenesis and their distance from populated land, the key element is the question of the tracks and their direction. In the event, the dominant meridian tendency of this 2001-2002 season did have a clear moderating effect in comparison to 1993-1994.

THE 2002-2003 CYCLONE SEASON IN THE SOUTH-WEST INDIAN OCEAN

Following a season of intense activity, the 2002-2003 cyclone season in many respects stuck to the pattern set by its predecessor. This was once again a long and active season in the South-West Indian Ocean Basin. The number of depression systems that developed even exceeded that of the previous season, which was itself very high. But although the disturbances were more numerous, they were nonetheless on the whole less intense than in the 2001-2002 season (which was exceptional in this respect), despite a higher than normal proportion of tropical cyclones.

With such strong disturbance activity, very little populated land was able to escape the impact, with varying degrees of directness, of one or more of these disturbances, which have taken a particularly heavy human and economic toll this season.

Thirteen disturbances were classified as having reached the stage of tropical storm (as opposed to 11 the previous season), which is a very high number for the basin, and very close to the maximum of 14 recorded since the beginning of the satellite era (1967-1968). Eight of them reached hurricane force (seven tropical cyclones, plus one subtropical system which reached this stage briefly). We note that normal activity in the basin is nine tropical storms, of which slightly less than half reach the cyclone stage.

Like the previous season, this strong disturbance activity did not stem from an unusually high incidence of cyclogenesis. Sixteen depression systems resulted in advisories being issued, which is only one more than during the previous year and the same number as during the 1997-1998 season of low activity for example (furthermore this cyclogenesis rate has been very stable during recent years, staying within the 14-16 range for five years, with the sole exception of the 2000-2001 season). But the rate of development into mature disturbances (13 tropical storms for 16 embryonic disturbances) was particularly high, generally indicating very favourable environmental conditions.

The number of disturbances that are given a name is however by itself not sufficient to quantify the degree of activity of a season. The number of days of cyclone activity, which is a more representative indicator of disturbance activity, is in fact considerably more telling and puts this seasons level of activity into perspective. With a total of 24 days when a tropical cyclone was present in the area (number of cyclone days), this season is only 20% above the norm (the mean is 20 days) and lags far behind the 35 days of 2001-2002. This difference is explained by the low intensity of this season’s disturbances and above all by their reduced longevity at the cyclone stage: just one disturbance managed to sustain more than three days at hurricane force (cyclone KALUNDE), as opposed to the four which did so the previous season. The effect of the high number – thirteen – of tropical storms or cyclones, did however tell on the number of days with a depression system of an intensity

equating to at least a moderate tropical storm. With a total of 68 days, this figure is considerably higher than normal (mean of 53, median of 48) and corresponds to a high level of disturbance activity, although it is nonetheless inferior to that of the previous season (when it reached 73 days), despite a higher number of disturbances.

Although this season's disturbances were not able to compete with their 2001-2002 predecessors in terms of longevity, the same cannot be said for the cyclone season itself, which did rather better, stretching out over more than eight months. 2002-2003 was one of the earliest and latest cyclone seasons. Since the beginning of the satellite era (1967-1968), only four seasons have started earlier and, curiously, four have finished later (taking the 1st of July as the start of the season).

The main difference with the previous season lies in the areas of cyclogenesis. Contrary to 2001-2002, no depression system originated in the south-east part of the Indian Ocean (east of 90ºE), all of them originating in our south-west part, the central area of the basin (south-west of CHAGOS) and the Mozambique Channel, which were largely unproductive last season but this time made a sizeable contribution. Moreover the systems formed, on average, more towards the South, the majority in the vicinity or south of 10ºS.

The typology of the tracks, for its part, did bear some similarities with the previous system. Whether the classical pseudo-parabolic (such as KALUNDE or CRYSTAL), atypical (such as those of GERRY or HAPE), meridian tracks or those with a dominant south-easterly direction were the most common, as a result of which the majority of systems favoured migration towards the Southern. One zonal track did however make an appearance, that of the first system of the season, which formed very close to the Equator and then moved to the heart of the SEYCHELLES.

This system, with this early start to the cyclone season at the beginning of September, immediately set the tone for the events to come: the season would not go unnoticed and would leave its mark.

This first disturbance of the season (unnamed) in fact followed a path that had never been seen before, due to its proximity to the Equator. The SEYCHELLES, whose main islands considered themselves, if not blessed by the gods, at least protected from the risk of cyclones, were transversed by a depression system the likes of which had not been seen in living memory. Despite the relatively weak intensity of this event, its passage was seriously felt on the small island of PRASLIN, which suffered considerable material damage.

Other more fatal consequences were, alas, to come. With such strong disturbance activity, not much populated land was able to escape the influence, with varying degrees of directness, of one or more disturbances. SOUTHERN AFRICA and especially the Mozambique coastline, spared completely the year before, this time felt the impact of tropical storm DELFINA, then tropical cyclone JAPHET. More than the wind, it was the associated rains and floods resulting from these two events that claimed dozens of victims in MOZAMBIQUE and MALAWI.

The MASCARENES, for their part, saw several disturbances move in their vicinity, and whilst MAURITIUS was only skimmed over and consequently only moderately affected by cyclone GERRY, the island of RODRIGUES was not so lucky, suffering the full force of cyclone KALUNDE. Even though this event, the strongest of the season, was then in an abatement phase, gusts of wind at more than 200 km/h and the temporarily torrential rain associated with the passage of the storm caused significant damage on the small Mauritian island.

The end of the season was tough. MADAGASCAR, which having only seen a very moderate influence of the tropical storm FARI in April had until then been relatively spared, once again paid a heavy toll when the last depression system of the season, tropical cyclone MANOU, struck, hitting the east coast of the 'big island' hard and claiming numerous victims.

With MANOU the season closed as it had started, with an exceptional phenomenon. The preceding year tropical cyclone KESINY had been a first, in that it was the first time since the beginning of the satellite era that a depression system in the tropical cyclone stage hit populated land in the basin in May. But MANOU took on an even more unusual character. More intense than KESINY, it was most importantly, of the six tropical cyclones recorded over the basin in May since 1967, the one to have reached this intensity at the highest latitude ever recorded during this period (south of 19ºS).

Moreover, the fact that a tropical cyclone was able to hit populated land in May two successive years, when it had never happened before, raises questions. Is this simply an extraordinary coincidence, or do we have to fear that this kind of phenomenon might now occur regularly?

We are familiar with the numerous questions being raised by the prospect of the forecasted global warming. One of the main questions for our area, and for the other cyclone basins around the globe, is of course whether we should expect an increase in cyclone activity (in terms of number or intensity). Current studies have not allowed us to answer this question, which remains unresolved. However we cannot help but think that, although there might not necessarily be any effect during the heart of the cyclone season, a modification in sea surface temperatures could have an effect on the margins, that is to say at the beginning or end of the cyclone season, in allowing earlier and later cyclogenesis. We can therefore reasonably ask whether the KESINY and MANOU episodes are not the first tangible signs of the start of such a prolongation of the cyclone season.

The fact is that sea temperatures were abnormally high this year (2003) and the cyclone season was indeed extremely long, stretching from September to May, which is more than eight months.

REVIEW OF THE 2001/2002 AND 2002/2003 CYCLONE SEASONS

REPORTS OF MEMBERS

(Submitted by Comoros, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Republic of South Africa, Seychelles, Swaziland, United Republic of Tanzania, Zimbabwe)

REPORT ON THE 2001/2002 AND 2002/2003 TROPICAL CYCLONE SEASONS

(Submitted by Comoros)

REPORT ON THE 2001/2002 AND 2002/2003 TROPICAL CYCLONE SEASONS

(Submitted by Lesotho)

(hard copy only)

(Lesotho – hard copy only)

REVIEW OF THE 2001/2002 AND 2002/2003 CYCLONE SEASONS

(Submitted by Madagascar)

2001-2002 CYCLONE SEASON:

Of the 14 cyclonic disturbances which developed over the South-West Indian Ocean basin, three affected the weather in Madagascar, namely:

1. **Severe Tropical Storm** CYPRIEN : *(from 1 to 3 January 2002)*

It originated in the Mozambique Channel and made landfall near the town of Morombe, after having started to move towards the south-east. This system therefore affected the south-west Madagascan regions.

Extreme meteorological parameters:

Station	Minimum pressure	Wind gusts	Max. rainfall in 24 h
MOROMBE	989.2 hPa	180 km/h	138.8 mm
TOLIARA	997. 8 hPa	219 km/h	139.6 mm
RANOHIRA	-	46 km/h	44.5 mm

Damage Statistics: (Source: Conseil National de Secours, CNS)

- In Morombe: 08 administrative buildings damaged, 150 homes destroyed, 900 people affected
- In Toliara: 1363 homeless, 180 houses damaged
- In Ranohira: 08 houses completely destroyed, 12 houses damaged.

2. **Very Intense Tropical Cyclone** HARY: *(from 06 to 13 March 2002)*

Coming from the Indian Ocean, this system reached the stage of very intense tropical cyclone just 90 km east of the town of Antalaha; fortunately it only brushed this part of the north-east Madagascan coastline and then moved away as it veered towards the south-east.

Extreme meteorological parameters:

Station	Minimum Pressure	Wind Gusts	Max. Rainfall in 24h
VOHEMAR	1004.0 hPa	32 km/h	26.I mm
ANTALAHA	1000.3 hPa	52 km/h	132.0 mm
SAINTE - MARIE	990.3 hPa	83 km/h	106.9 mm
TOAMASINA	996.9 hPa	56 km/h	243.4 mm

Damage Statistics: (Source: Conseil National de Secours, CNS)

- In Antalaha: 03 dead, 01 hospital destroyed, 80% of food crops damaged, 60 to 80% of wooden bridges damaged
- Floods in the central east coast regions

3. **Tropical Cyclone:** KESINY: *(from 05 to 11 May 2002)*

After beginning its life to the west of Diégo Garcia on 05/05/02, KESINY moved towards the south-west and then towards the west to make landfall in the town of Vohémar the morning of 09/05/02. It crossed the northern tip of Madagascar to the Mozambique Channel, and then after having made a loop, it turned towards the south to make landfall again in the sub-prefecture of Port-Bergé. Once over land, this system presented a south-eastern sheared structure which took hold in the region of Toamasina, causing particularly abundant rainfall. Severe floods were reported in the town of Toamasina.

Rainfall survey:

Station	Max. rainfall in 24h	Max. rainfall in 72h	10-day normals
TOAMASINA	484.0 mm	890.0 mm	74.4 mm
SAINTE-MARIE	120.2 mm	285.5 mm	119.2 mm
NOSY BE	93.9 mm	111.4 mm	23.4 mm
ANALALAVA	74.5 mm	130.8 mm	13.2 mm
MAHAJANGA	64.1 mm	64.9 mm	7.1 mm

Damage Statistics: (Source: CNS Conseil National de Secours)

- In Toamasina: severe floods, several landslips and landslides
- In Nosy Be: 02 dead.

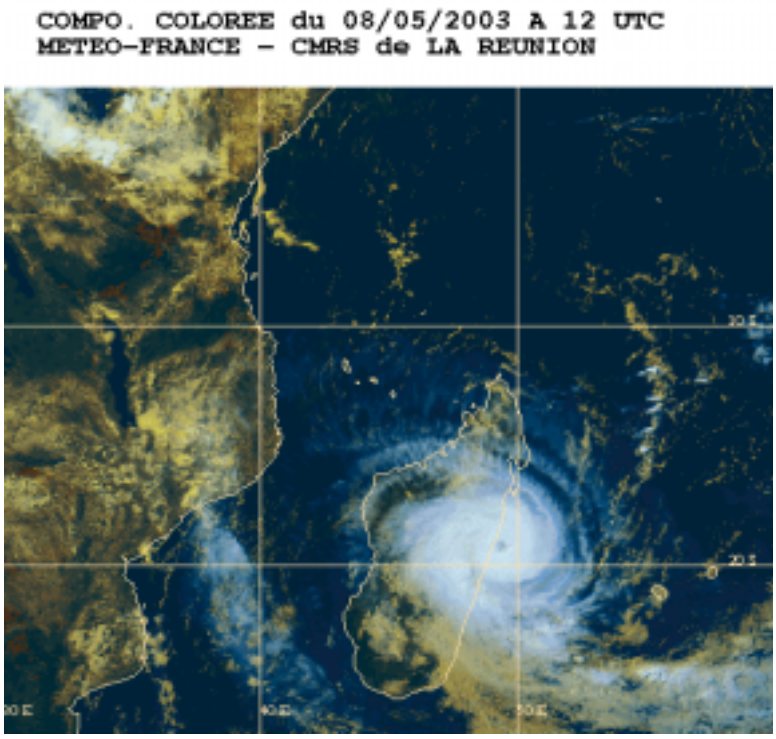


Photo of cyclone MANOU just east of VATOMANDRY
08/05/2003 at 12 UTC
(*Source*: METEO France – RSMC La Réunion)

2002-2003 CYCLONE SEASON:

Over the course of this cyclone season, 13 cyclonic disturbances developed in the South-East Indian Ocean basin; three of them affected the weather in Madagascar:

1. **Tropical Depression** ATANG: *(from 05 to 13 November 2002)*

It brushed the northern tip of Madagascar without causing significant damage.

Rainfall survey:

Station	Max. rainfall in 24 h
ANTSIRANANA	52.9 mm
VOHEMAR	41.7 mm
NOSY BE	12.6 mm

Damage statistics: (none)

2. **Severe Tropical Storm** FARI: *(from 25 to 31 January 2003)*

This storm, which originated in the Indian Ocean, made landfall in the rural commune of Masomeloka - Mahanoro 28/01/03 at midnight. It crossed the large island from east to west to go out to sea in the Mozambique Channel in line with Toliara.

Extreme meteorological parameters:

Station	Minimum pressure	Wind gusts	Max. rainfall in 24 h
MANANJARY	1005.5 Hpa	54 km/h	92.6 mm
RANOHIRA	-	59 km/h	19.6 mm
TOLIARA	1000.9 Hpa	72 km/h	16.1 mm
MORONDAVA	1002.9 Hpa	45 km/h	229.8 mm

Damage statistics: (none)

3. **Episode of heavy rain caused by the ITCZ**: *(from 11 to 20 January 2003)*

During the second 10 days of the month of January a branch of the ITCZ that had descended to 20°South in the Mozambique Channel, took hold on almost the northern two thirds of Madagascar. This monsoon regime caused torrential rainfall in this part of the island, in particular on the west coast and on the High Plateaux.

Rainfall survey:

Station	Rain collected from 11 to 20/01/03	10-day normals for January	Percentage
ANALALAVA	379.7 mm	131.2 mm	289%
MAHAJANGA	329.8 mm	117.7 mm	280%
MAEVATANANA	245.3 mm	109.4 mm	224%
ANTANANARIVO	424.5 mm	71.6 mm	593%
IVATO	323.8 mm	78.5 mm	412%
ANTSIRABE	178.8 mm	68.4 mm	261%
FIANARANTSOA	280.0 mm	60.6 mm	463%

Damage statistics:

- Floods in the north-western regions and in the High Plateaux regions at Antananarivo and Fianarantsoa.

4. **Tropical Cyclone** MANOU: *(from 03 to 11 May 2003)*

This last cyclonic disturbance of the season formed belatedly in the Indian Ocean. Having adopted a course towards the south-west since its emergence, MANOU hit the town of Vatomandry hard in the night of 08/05/03. It should be noted that this system remained almost stationary in this area for nine hours; it then turned towards the south-east, moving away from the Madagascan coasts.

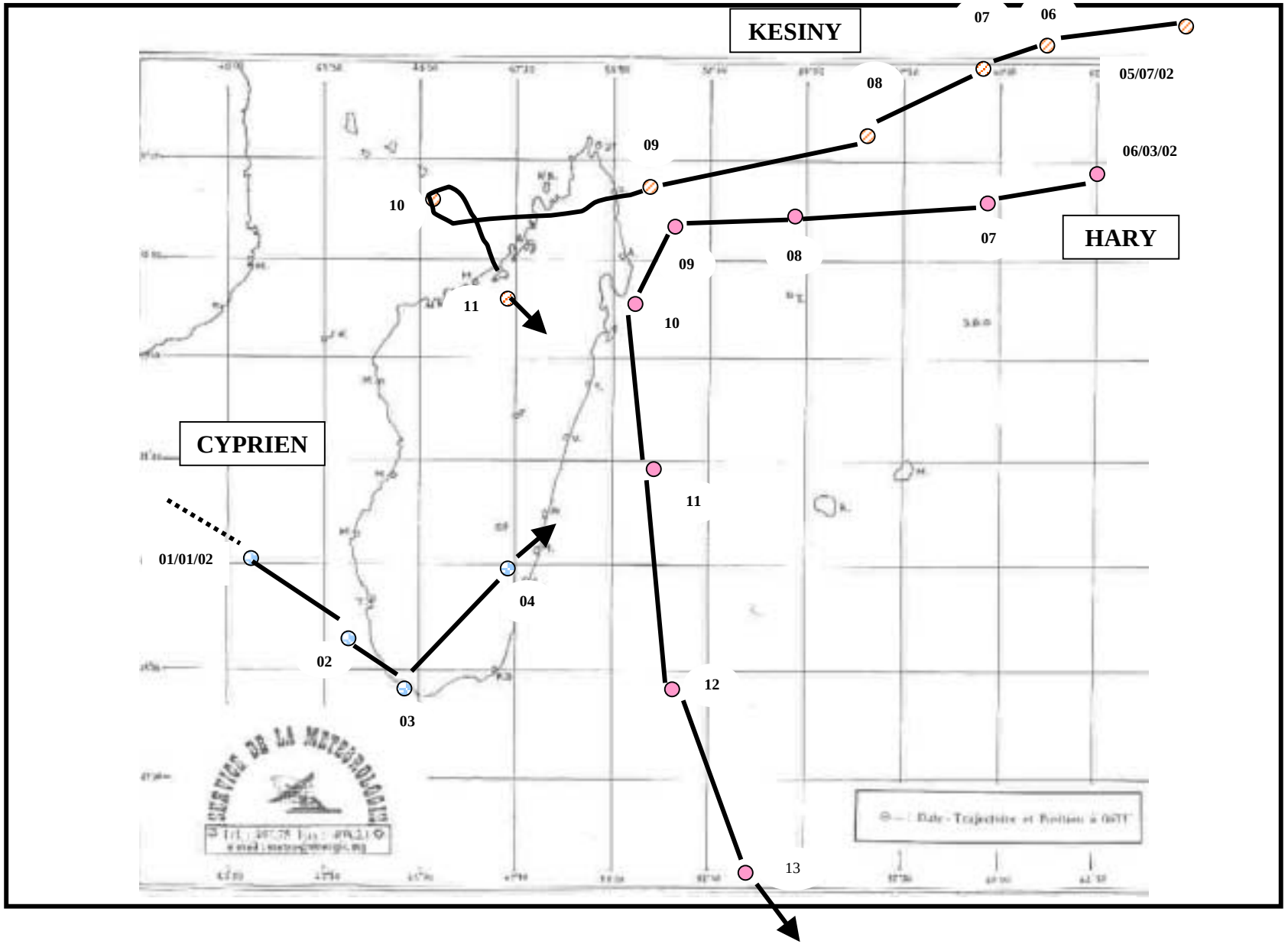
Extreme meteorological parameters:

Station	Minimum pressure	Wind gusts	Total rainfall from 07 to 10/05/03
SAINTE-MARIE	1005.8 hPa	45 km/h	0.3 mm
TOAMASINA	1002.6 hPa	50 km/h	20.0 mm
BRICKAVILLE	-	>100 km/h	150.0 mm
VATOMANDRY	-	200 km/h	270.0 mm
MAHANORO	998.9 hPa	120 km/h	260.0 mm
MANANJARY	1009.9 hPa	60 km/h	142.0 mm
FARAFANGANA	1001.0 hPa	45 km/h	176.0 mm

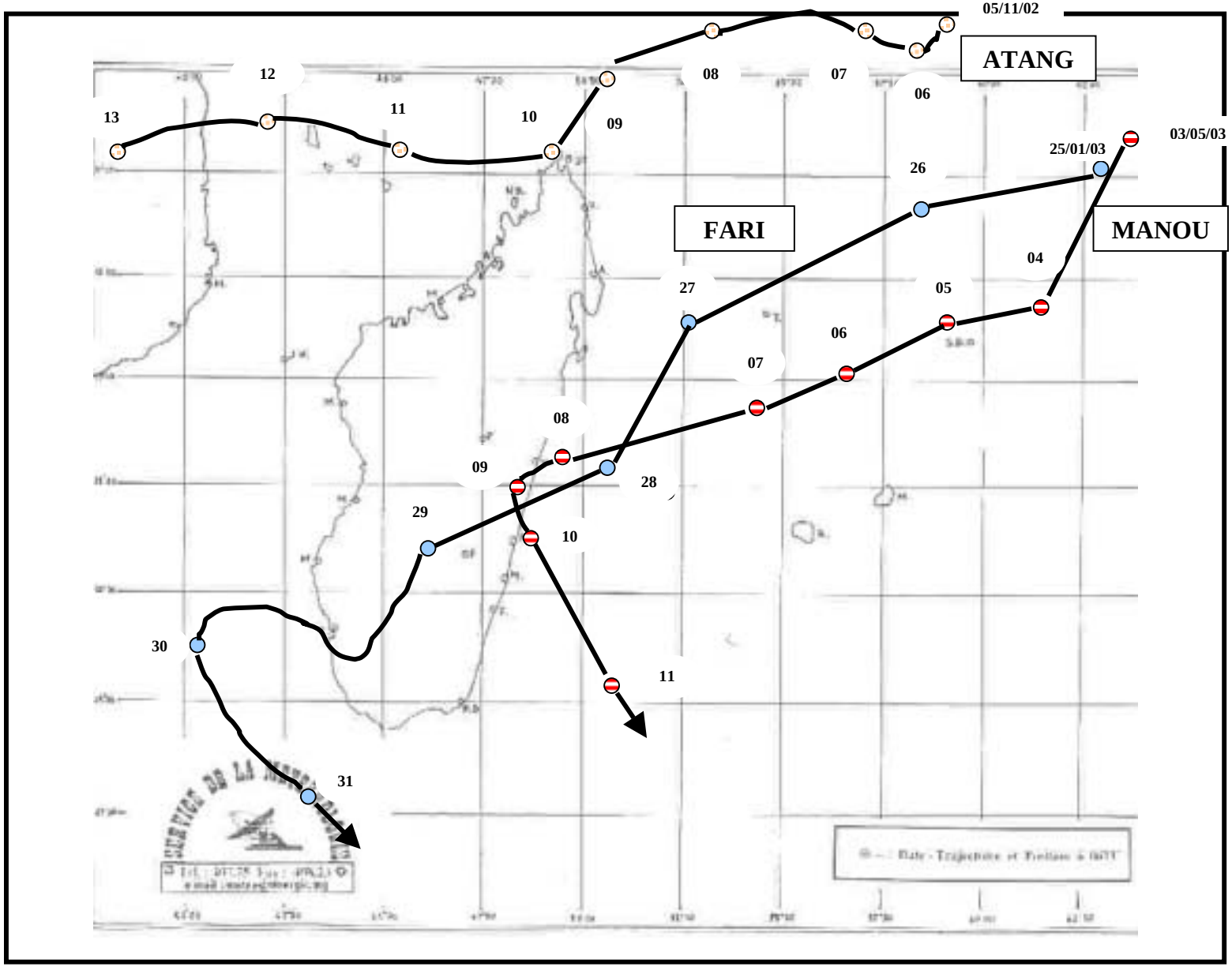
Damage statistics: (Source: Conseil National de Secours, CNS)

- Humanitarian toll: 70 dead, 19 missing, 86 injured, 115.000 homeless
- Material damage: 27134 private houses, 36 administrative buildings in Brickaville and 90% of administrative buildings in Vatomandry
- Material damage estimated at: US $11.310.000

TRACKS OF CYCLONIC DISTURBANCES THAT AFFECTED MADAGASCAR DURING THE 2001-2002 CYCLONE SEASON



TRACKS OF CYCLONIC DISTURBANCES THAT AFFECTED MADAGASCAR DURING THE 2002-2003 CYCLONE SEASON



REVIEW OF THE 2001/2002 AND 2002/2003 TROPICAL CYCLONE SEASONS

(Submitted by Malawi)

During 2001/2002, there was no cyclone that hit Malawi, but during the 2002/2003 season, cyclone Delfina progressed inland into Southern Malawi to about 16 degrees south and 36 degrees east and warnings were issued.

REVIEW OF THE 2001/2002 AND 2002/2003 TROPICAL CYCLONE SEASONS

(Submitted by Mauritius)

The cyclone warning systems in place for the Republic of Mauritius has functioned without any problems for all cyclones which were possible threats to it namely: Dina, Guillaume and Kessiny (2001-2002 season) and Crystal, Gerry, Hape, Kalunde and Manon (2002-2003 season).

Proposal: Minimum sea level pressure associated with tropical cyclones in the South-West Indian Ocean.

REVIEW OF THE 2001/2002 AND 2002/2003 TROPICAL CYCLONE SEASONS

(Submitted by Mozambique)

1. Mozambique's vulnerability to natural disasters, such as tropical cyclones, can be explained by its geographical location. Tropical cyclones can originate from the Mozambique Channel or reach it from the east, depending on the atmospheric conditions. In general, tropical cyclones of highest intensity are those originating outside the Mozambique Channel, which cause heavy rains in the coastal areas, associated with strong winds, floods and the consequent damages. In the Mozambique Channel, three to five cyclones are observed annually with the pick frequency around January to February. The most affected regions are the coastal areas of northern and central Mozambique. The provinces of Inhambane, Gaza and Maputo are occasionally affected by tropical cyclones which can penetrate inland reaching 400–500 km.

2. The National Institute of Meteorology (INAM) introduced during the 2002/2003 tropical cyclone season a new warning system of tropical cyclones. This system uses three colours (blue, yellow and red) to indicate the closeness of a tropical cyclone and the categorization of the cyclones to indicate their intensity and impacts.

3. During the last two tropical cyclone seasons, Mozambique was affected by the tropical depression "DELFINA" and tropical cyclone "JAPHET" which caused the death of 62 people and more than 307,550 people were displaced, and caused considerable damage to social and economic infrastructures.

TROPICAL CYCLONE SEASON 2001/2002

4. The tropical cyclone season 2001/ 2002 was of exceptionally low activity in Mozambique. No tropical cyclone occurred during this period in the Mozambique territory.

TROPICAL CYCLONE SEASON 2002/2003

5. At the end of November 2002, the northern extreme of the Mozambique Channel was affected by the tropical cyclone "ATANG" which did not cause any negative impact overland.

6. This season was marked by the formation of the tropical depression "DELFINA" and the tropical cyclone "JAPHET" in the Mozambique Channel waters. These caused several damages in infrastructures, crops and human lives.

7. "DELFINA" formed over the northern part of the Mozambique Channel and caused torrential rains in Nampula City, Angoche, Moma, Mongincual and Mogovolas. The winds reached 60 km/h. About 51 people lost their lives and more than 287,550 families were displaced. 17,400 hectars of crops were destroyed and considerable damage on infrastructures were recorded.

Tropical Cyclone " JAPHET" from 26 February to 05 March 2003

8. In the Mozambique Channel close to the coast of Inhambane a tropical cyclone which was baptized as "JAPHET" formed. This tropical cyclone reached the district of Vilanculos northern Inhambane in the afternoon of the 02nd of March 2003 with strong winds of about 104 km/h, having destroyed several infrastructures such as classrooms, petrol stations, crops, houses, etc. More than 18,000 families were affected and 19 people died and one was injured. This tropical cyclone affected not only the province of Inhambane but also Manica and Sofala. The system also caused rainfall that resulted in floods on the Save river basin. The cyclone dissipated over Zimbabwe on 05 March 2003.

REVIEW OF THE 2001/2002 AND 2002/2003 TROPICAL CYCLONE SEASONS

(Submitted by the Republic of South Africa)

TROPICAL CYCLONE SEASON 2001/2002

1. Whilst there were no landfalls on the east coast during this season, three tropical cyclones crossed into METAREA VII from the east, one developed just to the east of Madagascar within the METAREA VII boundary, and two developed in the Mozambique Channel.

2. In all six cases the Tropical Cyclone Warnings from RSMC La Réunion were included - in full - in the marine bulletins for the METAREA, i.e. FQZA31 and FQZA81.

3. Tropical cyclone Kesiny was a rather unique system which crossed the boundary on 8 May. Not only was it of an unusual intensity for this time of year, but it was also unusually far to the west for the month of May.

TROPICAL CYCLONE SEASON 2002/2003

4. The only significant east coast landfall was Tropical Cyclone Japhet which crossed the Mozambican coast just south of Vilanculos at approximately 14h00 UTC on 2 March 2003. Considerable coastal damage resulted from the extreme wind and wave conditions and this system was later associated with significant flooding well into the interior to the west of Vilanculos. A number of very useful Voluntary Observing Ship (VOS) reports were received in the vicinity of Japhet as it crossed the Mozambique Channel.

5. Short articles were posted on the SAWS web site describing aspects of three of the season's more intense systems, i.e. Gerry, Japhet and Kalunde. In the case of Kalunde, the trajectory passed very close to Météo-France's drifting buoy 14538 resulting in a rapid pressure fall down to 970 hPa.

Throughout both seasons the guidance provided by RSMC La Réunion was generally very accurate. The South African Weather Service would like to take this opportunity to thank Météo-France for their services in the region.

REVIEW OF THE 2001/2002 AND 2002/2003 TROPICAL CYCLONE SEASONS

(Submitted by the Seychelles)

TROPICAL CYCLONE SEASON (2001/2002)

The 2000/2001 Tropical Cyclone season got off to a normal start with eleven baptized disturbances and most attaining the tropical cyclone stage. Quite a few of them formed in the open sea quite far from most of the Southwest Indian Ocean Islands. They were tropical cyclones:

- Andre (27-31 October);
- Bako (28 Nov to 06 Dec);
- Eddy (22-28 Jan 2002);
- Francesca (30 Jan to 12 Feb.);
- Ikala (22-31 March); and
- Jerry (08-12 April).

Apart for the usual marine bulletin issued to mariners they were not a threat to most of the islands bordering the southwest Indian Ocean islands.

The following Tropical Cyclones had a major influence over the Seychelles:

- Intense TC Dina (17-26 Jan 2002) when one of its feeder band passed over Mahé and southern islands on the 18th January 2002 giving torrential rain and strong winds, then went on to impinge on Mauritius and La Réunion on 21st and 22nd January 2002, respectively;
- TC Guillaume (15-22 Feb 2002) passing close to Mauritius between 19th-20th February;
- TC Hary (05-15 Mar) which brushed the northeastern side of Madagascar on the 9th March;
- TC Kessiny (02-11 May) made landfall on the 9th May over northern tip of Madagascar where it weakened and decayed on the 11th. Some southern islands of the Seychelles were affected by the feeder bands of the above-mentioned tropical cyclones, giving torrential rain and strong winds.

It should be noted that tropical cyclones Hary and Kessiny followed similar track and affected the southernmost islands of Farquhar and Aldabra.

Warning System

The warning system was put into operational very soon after **Dina, Guillaume, Hary and Kessiny** were seen as a threat to the southern islands of Seychelles and careful watch was maintained throughout. Adequate warnings were relayed occasionally to the media and marine authority, the general public and the fishing community respectively. The Executive Secretary of Seychelles Islands Foundation (SIF) was informed of the situation and advised that these tropical cyclones would have a major bearing on these islands and to take the necessary steps to minimize the loss of property and other possible damages.

TROPICAL CYCLONE SEASON 2002/2003

The tropical cyclone activity for the 2002-2003 season is quite exceptional. There were thirteen disturbances formed and most of them formed close to the Seychelles territorial waters inflicting heavy damages to some of the southern islands. The quadrant 04-20S degrees latitude and 45-70E degrees longitude were quite conducive for the formation tropical disturbances associated with the Inter-Tropical Convergence Zone (ITCZ)

and further development into a more organized and intense tropical storm/cyclone. Therefore, vigorous convective activity developed giving severe weather, thunderstorm activity and strong winds over the Indian Ocean. But the highlight of this season was when a tropical depression formed within the Seychelles territorial waters and affected the northern islands of Mahé, Praslin and La Digue on 9th September 2002 causing significant loss of property and bringing the principal economic activities of these islands to a standstill. It must be noted that the depression was not named (see attached report). The warning system was put into operation and worked reasonably well which contributed to no casualty.

TROPICAL DEPRESSION , 5-8 September 2002

a. Forecast and Warning

The Tropical Depression developed about 500 km to the east north-east over of Mahé on 5th September and moved towards the mainland and inner islands. It reaches the eastern parts of Seychelles Exclusive Economic Zone (EEZ) (3.6 Deg South and 59.0 Deg. East) on 6th September at 1100 UTC, producing widespread moderate to heavy rainfall over Mahé and inner islands. A Tropical Depression warning was issued to inform the authority and the general public of the present of a Tropical Depression in the Seychelles EEZ. It was issued to all agencies concerned between 1100 and 1230 hours on Friday 06th September 2002. There was enough warning lead time when the first warning was issued which was more than 22 hours before the tropical depression force winds were reported over Praslin.

The warning (valid till 07/0600UTC) was read as follows:

A Tropical Depression centred at 3.5 Deg South and 59.0 Deg East at 1000 UTC, moving in a westerly direction at 20km/hr. It is situated 200Km. East North East of Mahe and Inner Islands. Strong Winds, Rough seas, Heavy Rain and Thunderstorm activities expected within 200Km of centre".

This warning was relayed twice on SBC radio at 1215 UTC in English and 1230 UTC in Creole. In the evening at 1635 UTC and it was presented in detail on SBC TV Meteo Bulletin.

On Saturday, 7th September, the following forecast and warnings (valid till Saturday, 1800 UTC) were updated and issued to the Coordinator of the Disaster Management Committee, general public, media and other authorities concerned. The forecast and Tropical Depression warning was written as follows:

"**Cloudy to overcast with widespread rain, at times heavy. Possibility of isolated thunderstorm activities".**

Winds: Variable tending South-easterly 45 to 55 Km/hr. Maximum between 90Km/hr to 100Km/hr. Sea Condition: Rough.

Latest position of Tropical Depression was centred at 4.2 Deg South and 57.3 Deg. East, moving WSW at 12 km/hr.

Forecasted position at 07/1200UTC: 4.4S 55.6E –Stationary intensity

Forecasted position at 08/0000UTC: 4.6S 54.0E –Weakening

b. Synoptic History

Satellite image and summary of meteorological observations (**Tables 1 and 2**) indicate that the Tropical Depression originated from a tropical wave within the equatorial trough that moved towards the east on the 5th September at 1600 hours produced a low-level cyclonic

circulation centred about 200 km to the east of Mahé The Tropical Depression tracked westward at about 20 km/hr across the eastern side of Seychelles EEZ, i.e. towards Mahé and inner islands. At 2.30 a.m on Saturday, Mahé experienced sustained gale force winds of between 90 km/hr to 100 km/hr primarily confined to a thunderstorm squall line in the eastern portion of the low pressure system. There was some associated the upper-level low acted to enhance the development of deep convection before moving close to Praslin on the 7th at 1400 hours and unleashed a maximum sustained wind of 120 km/hr for about two hours. At that time the centre of the system was 5 km south-east of Praslin and 30 km east-north-east of Mahé. The deep convection persisted during the day giving heavy rainfall and thunderstorm activities over Mahé, Praslin and La Digue. It then eventually continued to moved westward, weakened and became ill-defined It emerged on Sunday 8th as just a remnant of the Tropical Depression with low to mid-level south-easterly flow pushing it further away from the mainland, shortly after being sheared from the north-east before dissipating completely in the early hours of Monday, 9th September.

c. Meteorological Statistics - <u>What happened in Praslin?</u>

The fact that both Mahé and La Digue were unaffected by the strong winds (i.e. 120 km/hr wind) would suggest that whatever hit Praslin was something of only a few kilometers across which infact was a macro-burst which had developed locally within the Tropical Depression. A macro-burst is a large downdraft with its outburst winds extending in excess of 4 km in horizontal dimension and causing widespread, tornado-like damage that day on Praslin. These small entities are very difficult to predict. Even from satellite pictures, unless you have very high-resolution imagery, these systems can pass undetected. The best form of detection is from the use of Doppler weather radar. According to eyewitnesses on the island the weather situation on Praslin worsened suddenly around 1430hrs on Saturday 7th. A sudden surge of winds and rain engulfed the island. For the next one and a half to two hours Praslin was under siege from the storm. Winds were exceptional; nothing like this had been witnessed before. Reports from the airport at Amitié, where the roof of the control tower was ripped off and part of the roof of the terminal building blown off, maximum winds of 120 km/hr were recorded. But it should be noted that pressure read at 0800 UTC was 1010 hPa and no other reading could be taken because the barometer and the automatic weather station failed to function thereafter. Given the extent of damage and the way a number of trees felled, would suggest that winds could have been much stronger than that over other areas. Apart from the airport at Amitiés where gusts of 120 km/hr were recorded, other areas could have experienced 10-minute sustained winds of 80-90 km/hr with a one-minute gust of 130-140 km/hr. The general pattern of fallen trees would indicate that the prevailing winds were from the southeast, however over certain areas trees fell in a rather haphazard manner suggesting there could have been variations in direction. This seems to tally with certain accounts from eyewitnesses that they observed some swirling effects in the winds – hence a macro-burst. Another interesting feature to note is that the extent of damage was not uniform over Praslin. Certain areas particularly around Côte d'Or suffered severe damage whilst other areas suffered slight to moderate damage. This could be related to exposure to the prevailing winds or simply areas affected were in the direct path of the macro-burst within the storm.

Summary of Meteorological observations

Table 1: Wind Observations

Date	Seychelles International Airport Wind direction / mean speed (Knots)	Seychelles International Airport (Direction, speed, Maximum Gust (Knots) and frequency	Praslin Control Tower (Direction, speed and time of maximum gust)
6-Sep	130 – 160/**18.5**	140/44 (1)(0700UTC)	
7-Sep	080-290/**11.7**	130/46 (**1**) (0200UTC)	130/65 (10.20 UTC)
8-Sep	130-180/**11**	130/27(**1**) (1200UTC)	

Table 2: 24 hour rainfall (mm) over Mahé, Praslin and La Digue (from 6th to 8th September 2002)

Date	Seychelles International Airport Rainfall (mm)	Rochon	Praslin Airport	Fond Boffay Praslin	La Digue
6-Sep	45.5	25.1	39.0	94	107.8
7-Sep	89.9	261.8	93.5	125	128.5
8-Sep	39.5	20.3	0.5	0.0	Tr
Departure from respective Long term Average (%)	(111.9%)	(169.9%)	(89.1%)	(279%)	(151.7%)

d. Damage Statistics

The Tropical Depression's heavy rains and strong winds produced catastrophic flooding and structural damage over Praslin and on a minor scale to parts of Mahé and La Digue. The roof of Grand Anse Praslin Secondary School was blown off. More than 20 homes were completely destroyed or received major damage, and nearly an additional 100 houses had their roofs blown off. This occurred at Anse Kerlan, Baie St. Anne, Grand Anse and Côte d'Or. Part of the roof of the main airport terminal was damaged whilst that of the control tower was blown off. Domestic flight to and from Praslin was suspended as a result. Quite a number of trees were uprooted and many electrical poles were damaged leaving the island in total darkness on Saturday night. Fortunately there was no casualty.

The National Meteorological Services suffered severe damage to its meteorological equipment within the vicinity of the control tower. Both the automatic weather station and the manned station were severely damaged by the depression, which would take sometime before proper meteorological observations are carried out again.

In view of the fact that it was not possible to monitor the intensity of the storm when it struck Praslin, and also the inability to forecast the same due to lack of real–time meteorological observations on Praslin, it is imperative that an automatic weather station is installed in conjunction with a manned station.

ATANG (3 to 11 November 2002)

Satellite images and summary of meteorological observations indicates that the Tropical Depression "Atang" originated from the Inter-Tropical Convergence Zone in the afternoon of 3rd November 2002 at 07.0 Degrees South and 68.0 Degrees East and moved west southwest at 20 km/h towards the Seychelles Territorial Waters and came closer to Farquhar on the morning of the 9th November. The low-level cyclonic circulation was centred about 100 km to the North North-East of Farquhar and its associated convective clouds inflicted showery activities and gale force winds of between 70 km/hr to 90 km/hr between 6am and 6pm on the 9th primarily confined to a thunderstorm squall line in the eastern portion of the low pressure system.

It then eventually continued to move westward, weakened and became ill-defined. It emerged on the 10th as just a remnant of the Tropical Depression with low to mid-level south-easterly flow pushing it further away from the Farquhar towards the north-east coast of Madagascar, shortly after being sheared from the north east before dissipating completely in the early hours of 11th November 2002.

BOURRA and MANOU

Tropical cyclones Bourra (14-23 Nov 2002) and Manou (30th April to 9th May) also followed similar tracks to Atang, affecting the southern island of Seychelles giving heavy rain and strong winds.

CRYSTAL, DELFINA, KALUNDE and LUMA

These tropical systems did not influence the weather directly over the Seychelles archipelago.

EBULA

January saw the formation of the first cyclone of the year and the 5th named cyclone of the 2002/2003 season. A zone of disturbed weather (tropical perturbation) centered near 11°S and 70°E developed into a Tropical Depression on the night of the 8th January. After formation the system moved in a South-south-east direction and at 1000hrs local time on the 9th it was centered at 14.9° S. 71.0°E and was baptized **"Ebula".** At this stage, **"Ebula"** had attained the stage of Moderate Tropical Storm. **"Ebula"** continued on its South-South-eastern track for the next few days intensifying to Severe Tropical Storm on the 11th and degrading to Moderate Storm on the 12th before moving into extra-tropical latitudes. Throughout its evolution "Ebula" stayed on open waters and never threatened any land mass.

FARI

"Fari" originated as a Tropical perturbation near 14.7°S 74.9°E (south of the Chaos Archipelago) on the 23rd January. Very little development was observed in the system as it moved slowly westwards. The storm attained Tropical Depression stage on the 27th at position 18.5°S, 52.0°E. At this point, it was imminent that it would make landfall over Madagascar.

"Fari" crossed over Madagascar between the 28th and 31st January, thereafter recurving southwards over the Mozambique Channel.

February saw the evolution of four tropical storms over the Southwest Indian Ocean, namely "Gerry", "Hape", "Isha" and "Japhet". Another, "Fiona" remained over the Australia's zone of responsibility. Apart from "Gerry" which affected the island of Tromelin and also the Mascarene islands of La Réunion and Mauritius and "Japhet" which caused a fair amount of damage over Mozambique, all the other storms remained on open oceans.

GERRY

"Gerry" formed to the East Farqhuar on the 8th. After formation, it drifted southeastwards affecting the island of Tromelin. It continued to intensify as it moved southwards and attained maximum intensity of 'Intense Tropical Cyclone' on the 13th as it passed close to La Réunion and Mauritius. **"Gerry"** dissipated over extra-tropical waters to the southeast of the Mascarene on the 17th.

HAPE

"Hape" evolved around the same time as **"Gerry".** It formed near 14.5° South and 64.0° East. After formation, it moved initially southwards then northeastwards and finally southeastwards before dissipation on the 16th over open waters to the southeast of Rodrigues.

"Hape" attained maximum intensity of 'Tropical Cyclone' and as mentioned above, did not threaten any land mass.

ISHA and JAPHET

"Isha" formed just to the northeast of **"Hape"** on the 11th and lasted just a couple of days. It attained only Tropical Depression stage whereas **"Japhet"** formed towards the end of the month in the Mozambique Channel.

Conclusion

The 2001-2002 cyclone season was dominated mainly by the neutral phase of ENSO and most of the disturbances formed were between 15 and 20 degrees south and 80 to 90 degrees east and their tracks were mostly in the open sea and did not affect much of the Indian Ocean islands, apart for Intense TC Dina. During the season 2002–2003 most of the disturbances formed between the quadrant 04-20 degrees South and 45-70 degrees east, and it was during the El Niño event. The tracks were found to be further to the north. The sea surface temperatures over the South-West Indian Ocean, around these areas were quite conducive at this time of the year for the formation of tropical cyclones.

REVIEW OF THE 2001/2002 AND 2002/2003 TROPICAL CYCLONE SEASONS

(Submitted by Swaziland)

During these past seasons (2001/2002 and 2002/2003) there was no tropical cyclone that directly hit Swaziland. However, the Tropical Cyclones Cyprien (which occurred during the 2001/2002 season from 31/12/2001 to 04/01/2002) and Japhet (which occurred during the 2002/2003 season from 26/02/2003 to 03/03/2003) both formed in the Mozambique Channel and had indirect effects on the country. During these cyclones, there generally was a decrease of rainfall activity experienced over the country than was usual for those periods of the season. Whilst no quantitative study has yet been done, it has generally been observed that the presence of a deep low-level cyclonic circulation in the Mozambique Channel, especially to its south, often affects rainfall patterns in the country, more so when there are other weather influencing systems in the near vicinity.

REVIEW OF THE 2001/2002 AND 2002/2003 TROPICAL CYCLONE SEASONS

(Submitted by the United Republic of Tanzania)

The two tropical cyclone seasons were fairly active with eleven named storms during the 2001/2002 season and 13 named during the 2002/2003 season.

It was observed that most of the disturbances approaching our territorial waters tended to enhance rains in the country due to confluence of the air masses, associated with the feeder bands and the attraction of moist air from the Congo basin.

TROPICAL CYCLONE SEASON 2001/2002

No significant weather events were associated with the tropical cyclone activity.

TROPICAL CYCLONE SEASON 2002/2003

Significant rainfall was recorded as follows:-

"ATANG", which almost hit Mtwara region, on 12th November 2002 reached just 100 km away from the coast but had already weakened. Mtwara meteorological station recorded 90.7 mm of rainfall in 24 hours against monthly mean of 75.8 mm. This become the highest 24 hours rainfall amount ever recorded during the month of November.

"DELFINA", on 31st December was 500 km away from the southeastern boarder of Mtwara. Rainfall amount of 133.9 mm was recorded in 24 hours at Mtwara meteorological station against monthly mean of 151 mm.

The presence of "GERRY" to the northeast of Madagascar on 12th February 2003 about 15^{0} away from the coast of Tanzania induced confluence of air masses that were associated with its feeder band, enhancing rainfall in the western and southern areas of the country. Tabora, Iringa and Mtwara meteorological stations recorded 58.8 mm, 463 mm and 46.2 m in 24 hours against the monthly means of 113.2 mm, 93.0 mm and 111.5 mm respectively. During those episodes warning of increased rains and gusty winds were issued. However, apart from substantial rains accompanied with strong winds, there was no serious damage experienced.

REVIEW OF THE 2001/2002 AND 2002/2003 TROPICAL CYCLONE SEASONS

(Submitted by the Zimbabwe)

TROPICAL CYCLONE JAPHET AND ITS EFFECTS ON ZIMBABWE

Preamble

The tropical cyclone season in the South-West Indian Ocean Basin stretches from November to April, the onset varying across the geographical positions. In Zimbabwe, the season normally starts in December and ends in March (4 months). However, these cyclones have influenced the country outside the period above. Also, only tropical cyclones in the Mozambique Channel have a direct bearing on Zimbabwe, with either floods or in-season prolonged dry spells. Either way, the results have negative impacts on agriculture, the mainstay of the country's economy.

EVENTS OF THE 2002-2003 SEASON

The year 2003 was no exception. A low pressure area developed in the Mozambique Channel on the 21st of February and intensified into a tropical cyclone, Japhet, by 28 February. The cyclone then started moving SSW at 5 knots (9 km/hr) with winds of 65 to 70 knots (120 to 130 km/hr). The central surface pressure was about 965 hPa.

Figure 1. Track of Cyclone Japhet from the 26th of February to the 4th of March.

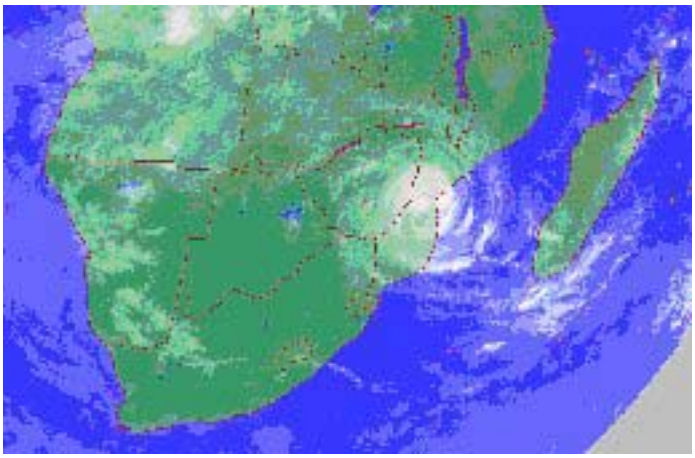


Figure2.
Infrared Image of TC Japhet centered over central Mozambique on the 3rd of March (06:30GMT).

Rainfall recorded

The depression nevertheless caused heavy falls in the south and eastern areas of Zimbabwe (**Figure 2**). An example is Masvingo, which recorded 204 mm of rain in the 24 hours from 6 to 7 March. Rupike, also in the southeast, recorded an amount almost seven times its March mean in the four days from 3 to 7 March. **Table 1** below summarises some of the heaviest falls experienced during the period.

Table 1: Comparisons of cumulative rain over 5 days and long term means for selected Stations.

STATION	TOTAL RAIN FROM 3 to 7 MARCH (mm)	LONG TERM MEAN FOR MARCH (mm)
Beitbridge	64	34
Buffalo Range	235	64
Chipinge	170	143
Masvingo	361	66
Rupike	437	65
West Nicholson	209	53
Zaka	199	75
Zvishavane	168	53

Figure 3.
Map of Zimbabwe showing the areas affected by the ex-Tropical Japhet Depression (shaded).

Steps taken with regard to Tropical Cyclone Japhet

The Department of Meteorological Services had been informing the public about the tropical cyclone since it was still a low-pressure area in the Mozambique Channel. When the low was upgraded to a tropical cyclone, the Department issued an alert on Monday the 3rd of March and provided updates until the 5th for Manicaland, Masvingo and Mashonaland East Provinces.

Statistics available from the Civil Protection Unit in the Ministry of Local Government, Public Works and National Housing indicates that three people lost their lives in Masvingo as a result of the floods caused by the depression. Still in Masvingo a number of houses were swept away, communication lines, some bridges and roads damaged and 170 hectares of maize and cotton washed away. In Mashonaland East, a whole village was submerged while in Mashonaland West the Airforce of Zimbabwe had to airlift 26 people to safety after they had been marooned. The World Food Programme, together with the Red Cross, assisted the Government in distributing food aid to displaced people.

Concluding remarks

The rains that fell as a result of the depression were a welcome relief in many parts of Zimbabwe. The impact was particularly welcomed in the agricultural and water resources sectors. Some crops which had been wilting due to moisture stress recovered, thus rekindling hopes of better harvesting than the previous two drought years. Winter wheat production was boosted as a result of increased surface water. Most dams also started spilling for the first time in the season. Regrettably, the cyclone also provided pools of stagnant water for the breeding of mosquitoes.

Although the damage caused by the depression cannot be compared to that caused by cyclone Eline in February 2000, it still left some unforgettable memories to the populace of the country more so to the affected ones.

As for the Department, the tropical cyclone's activity resulted in wrong seasonal forecasts issued in September and December 2002. Prior to incursion into Zimbabwe, the forecast was 80% accurate. This has caused the Department to intensify its research efforts into forecasting of tropical cyclones in the South-West Indian Ocean in general, and their linkages with extreme weather events in Zimbabwe in particular.

APPENDIX V

LIST OF TROPICAL CYCLONE NAMES FOR THE CYCLONE SEASONS 2004/2005 AND 2005/2006

Cyclone season: 2004-2005		**Cyclone season: 2005-2006**	
AROLA	(Lesotho)	ALVIN	(Seychelles)
BENTO	(Mozambique)	BOLOETSE	(Lesotho)
CHAMBO	(Malawi)	CARINA	(Mauritius)
DEVIKA	(Mauritius)	DIWA	(Malawi)
ERNEST	(Comoros)	ELIA	(Madagascar)
FELAPI	(Swaziland)	FARDA	(Comoros)
GERARD	(Seychelles)	GUDUZA	(Swaziland)
HENNIE	(Namibia)	HELIO	(Mozambique)
ISANG	(Botswana)	ISABELLA	(Namibia)
JULIET	(Zimbabwe)	JAONE	(Botswana)
KALO	(Madagascar)	KUNDAI	(Zimbabwe)
LILIAN	(Tanzania)	LINDSAY	(Mauritius)
MADI	(Botswana)	MARINDA	(Namibia)
NEDDY	(Seychelles)	NADETY	(Madagascar)
OULEDI	(Comoros)	OTILE	(Lesotho)
PATRICIA	(Mozambique)	PINDILE	(Swaziland)
QIQITA	(Lesotho)	QUINCY	(Seychelles)
RAMON	(Namibia)	RUGARE	(Zimbabwe)
SOPANI	(Malawi)	SEBINA	(Botswana)
TINA	(Mauritius)	TIMBA	(Malawi)
ULA	(Madagascar)	USTA	(Mozambique)
VERA	(Swaziland)	VELO	(Comoros)
WILLEM	(Namibia)	WILBY	(Seychelles)
XAOKA	(Botswana)	XANDA	(Madagascar)
YELDA	(Comoros)	YURI	(Mozambique)
ZUZE	(Malawi)	ZOELLE	(Mauritius)

APPENDIX VI

AMENDMENTS TO THE TEXT OF THE OPERATIONAL PLAN

(Submitted by Comoros)

Chapter V, Attachment V-A-1:

COUNTRY	MAIL ADDRESS	TELEX/FAX/E-MAIL	TELEPHONE NUMBER
COMOROS			
Poundja Mahammad Ali Bay Director of Meteorological Office	P.O. Box 78 Moroni	Telex: 241 PUBLIC KO Fax: (269) 730 447, 731 468 E-mail: dgacm@snpt.km jamnagarlibay@yahoo.fr	(269) 730 948 Home: (269) 731 339
Ibrahim Kassim Chief of Forecasting Services		Fax: (269) 730 447, 731 468 E-mail: aimpsi@snpt.km kassim@snpt.km	(269) 732 135, 731 593

AMENDMENTS TO THE TEXT OF THE OPERATIONAL PLAN

(Submitted by Lesotho)

1. METEOROLOGICAL COMPONENT

1.1.1 Surface-based sub-systems
Manned Surface System

i) Establishment of new stations

	Time Scale	Resource Obtained
Oxbow	2004-2005	Lesotho
Cheche	2005-2006	Lesotho

(ii) Maintaining Synoptic Observations

	Status
68542 (Mokhotlong)	Suspended
68456 (Qacha'snek)	Suspended
68454 (Maseru)	Reporting continuously (24 hrs)

1.1.2 Automatic Weather Stations

One automatic weather station has been installed at Moshoeshoe I Airport (Maseru).
Two more automatic weather stations will be installed at Mokhotlong and Qacha'snek by 2005. This is to upgrade the suspended synoptic stations. Local funding will be sourced to conduct this activity.

1.1.3 Equipment

Lesotho Meteorological Services received meteorological observing equipment for wind, rainfall and temperature measurements (Automatic recording rain gauges, Thermo Hydrographs and Anemometers) through WMO/VCP in August 2002. The Government of China donated this equipment worth USD 40,000.00 to Lesotho.

1.2 Telecommunications

1.2.1 Implementation of the National Data Collection Network

The Global Telecommunication Link between Lesotho and Pretoria has been upgraded from 24kbits to 64kbits.

1.2.2 Meteorological Satellite System

MDD/PDUS Meteorological Satellite receiving station is not functioning. WMO technical assistance is being awaited through the PUMA Project – Use of MSG in Africa.

AMENDMENTS TO THE TEXT OF THE OPERATIONAL PLAN

(Submitted by Madagascar)

Chapter II:

2.4 Special stations
2.4.1 Regional radar network (in table of list of stations)
- Antalaha)
- Morondavo) (remove – radars out of service)
- Antananarivo)

Chapter V:

5.1 Telecommunication systems

Insert : Madagascar – Mozambique (Internet)

Attachment V-A :

COUNTRY	MAIL ADDRESS	TELEX/FAX/E-MAIL	TELEPHONE NUMBER
MADAGASCAR			
Direction générale de la météorologie	P.O. Box 1254 Antananarivo 101		
Raelinera Nimbol Directeur Général		Fax: (261) 20.22.405.81 E-mail: meteo@simicro.mg	(261) 20.22.405.35
Razafimahazo Alain Solo Directeur des exploitations météorologique		Fax: (261) 20.22.408.23 E-mail: meteo@simicro.mg	(261) 20.22.407.75 (261) 32.02.680.07
Ratovoharison J.M. Victor Directeur des applications de la météorologie		Fax: (261) 20.22.405.81 E-mail: meteo@simicro.mg	(261) 20.22.402.41

AMENDMENTS TO THE TEXT OF THE OPERATIONAL PLAN

(Submitted by Malawi)

Chapter I, Attachment I-1 – Terms and Units Used for National Purposes:

Categories of warnings

Information Stage: Issued when the cyclone is within 45 and 55°East and 5 and 20°South. This is updated every 24 hours.

Alert Stage: This is issued when the cyclone is between 500 and 1,000 km from Malawi border, and is likely going to affect the country. It is updated every 6 hours.

Warning Stage: This is issued when the cyclone is within 500 km from Malawi border. It is updated every 3 hours.

Chapter V:

Telecommunication Systems

The links between Malawi and South Africa are by GTS and internet. There is no link between Zimbabwe and Malawi, instead replace with Malawi and La Réunion by e-mail.

Chapter V, Attachment V-A – List of Addresses and Telephone Numbers:

MALAWI
Director of Meteorological Services
Attention: Lucy Mtilatila
E-mail: metdept@metmalawi.com

AMENDMENTS TO THE TEXT OF THE OPERATIONAL PLAN

(Submitted by Mozambique)

Chapter II :

2.1 Networks of synoptic land stations

67273	ANGOCHE
67237	NAMPULA
67241	LUMBO
67285	PEBANE
67205	MICOMBOA DA PRAIA
67231	CUAMBA
67221	MARRUPA
67346	CHANGALANE
67335	XAI XAI

2.1.2 Other networks

67237	NAMPULA

Chapter III, page III-4, TABLE 3:

"RSMC Bulletins – Dissemination time" to read: 00, 06, 12, 18 UTC

TABLE 3

CYCLONE BULLETINS ISSUED BY RSMC/TROPICAL CYLONE CENTRE LA REUNION

Bulletins		Headings	Dissemination time
Marine Warnings	English	**WTIO20, 22, 24**	**GTS** 00, 06, 12, 18 UTC
	French	**WTIO21**	Same
RSMC Bulletins	English	**WTIO30**	**GTS** 00, 06, 12, 18 UTC
	French	**WTIO31**	Same
Satellite Bulletins	English	**TPIO20**	**GTS** as soon as possible after the satellite's passage
	French	**TPIO21**	same
ICAO Advisories	English	**-** **FKIO20**	**AFTN** 00, 06, 12, 18 UTC **GTS** 00, 06, 12, 18 UTC
"BUFR" Bulletins	-	**ATIO01**	**GTS** 00, 06, 12, 18 UTC
"Best-Track" Bulletins	-	**AXIO20**	**GTS** within one month after the cyclone's death
Cyclonic information Bulletin	English	**AWIO20**	**GTS** 12 UTC
	French	**AWIO21**	**GTS** 12 UTC

Chapter V, Attachment V-A-2:

Remove: Felix Tualufo
Add: Mussa Mustafa
E-mails: mussa.mustafa@inam.gov.mz
mozmet@inam.gov.mz

AMENDMENTS TO THE TEXT OF THE OPERATIONAL PLAN

(Submitted by Swaziland)

Chapter II:

2.5 Meteorological satellites (ground segment)

Swaziland	SDUS

Chapter V:

5.1 Telecommunication systems

Swaziland – South Africa	TCP/IP [64kbits/s] & Internet

Chapter V, Attachment V-A:

COUNTRY	MAIL ADDRESS	TELEX/FAX/E-MAIL	TELEPHONE NUMBER
SWAZILAND			
E.D. Dlamini Director of National Meteorological Service	P.O. Box 58 Mbabane	Telex: 2001 WD Fax: (268) 404 1530/2364 E-mail: ed_dlamini@dmc.co.zw Web: www.swazimet.gov.sz	(268) 404 6274/9468
Attn: S.P. Gumede		E-mail: sp_gumede@swazimet.gov.sz forecast@swazimet.gov.sz	

APPENDIX VII

(see separate file)

APPENDIX VIII

TELECOMMUNICATION NETWORK DIAGRAM FOR THE SOUTH-WEST INDIAN OCEAN