THE USE OF REMOTE SENSING IN REDUCING LOSS OF LIFE AND PROPERTY: THE ZAMBIAN CASE.

Mudenda, O S
Zambia Meteorological Department, P.O. Box 30200, Lusaka 10101 Zambia, Central Africa.
Fax: 260-1-271312 Tel.260-1-271100 Email:omudenda@yahoo.co.uk

ABSTRACT

This case study is representation of the application of remote sensed data in monitoring and tracking the typical cycle of a tropical cyclone in order to reduce loss of life and property. Until after the September eleven terrorist attack, the most costly insurance cover ever in USA was due to a hurricane. Because of its geographical position, Zambia (Lat 08-18 degree south and Long 22-34 degrees East) is not very vulnerable to Tropical cyclones. In 1996 tropical cyclone 'Bonita' was monitored and tracked from the warm waters of Mozambique channel in the Indian Ocean until it dissipated over the cool water of the Atlantic Ocean in Angola. Both the visible and the infrared images were used in the study. Reducing loss of life and property from the cyclone was achieved through the daily weather forecasts, alerts, warnings and disaster preparedness. This episode provides an interesting laboratory of how geoinformation technologies through remote sensing can be used to monitor and track the development, movement and dissipation of cyclones, and therefore prevent an imminent disaster.

Keywords: Reducing loss of life and property

1. INTRODUCTION

Global coastal populations and coastal property values have been increasing at a significantly greater rate. Until after the September eleven terrorist attack, the most costly insurance cover ever in the USA was due to a hurricane. Hence it is inevitable that the relative impact of tropical cyclones on mankind will grow with time. Monitoring and tracking the typical cycle of a tropical cyclone could achieve significant reduction in the loss of life and property. Tropical cyclone 'Bonita' of January 1996 was the first documented storm to have traversed the entire breadth of the southern African subcontinent, from the Indian Ocean to the southern African Atlantic coast. A good number of them are known to weaken fast after crossing the African coast due to friction and insufficient moisture over land, Mumba and Mudenda (1996). The significant reduction in the loss of life and property was achieved by the delivery of public weather services. In partnership with the local Zambian television operators and broadcasters, these services were in the form of weather forecasts (short, medium and long range), warnings, alerts and advisories.

2. SYNOPTIC DEVELOPMENTS AND SEQUENCES

Tropical cyclone "Bonita" started as an area of disturbance over the Indian Ocean on Saturday 6th January 1996. This disturbance was in the form of a weak tropical low. After developing into a strong vortex just east of Madagascar on 9th January, "Bonita" moved north westwards to northern and then central Madagascar on 10th and 11th January respectively. By Friday 12th January, the storm was a full-fledged tropical cyclone over the warm waters of the Mozambique Channel, battering coastal areas of the central Mozambique province of Zambesia, including the provincial Capital - Quelimane. Press reports indicated winds of up 110km per hour, and 213 millimetres of rainfall was reported to have been recorded in the space of twelve hours in Quelimane. Houses were reported to have been flooded, and in some cases, roofs blown off, though there were no reports of any deaths up to this point in time. Figures 1a and 1b show the Meteosat visible and infra red images for 1200 UTC on 12th January, with the surface isobaric and 700 hpa streamline patterns superimposed, respectively. Both images clearly show the inverted comma-shaped overcast associated with Bonita in the channel, and the ITCZ cloud band from northwest of the storm to the African interior. By 13th (not shown), Bonita showed a well-defined eye very close to the African coast, and the ITCZ had moved well to the north over central parts of the subcontinent. On 14th, (figure 2a, 2b) Bonita was positioned over the lower Zambezi valley, well inside the African continent, but with no visible eye. The IR image shows extensive cirrus debris to the north and east of the storm. Further to the west and south, favourable conditions for the continued westward movement of the weakened storm persisted. By Monday 15th January, the Tropical Cyclone was over Eastern Zimbabwe. At the surface, both the 0600 and 1200 UTC charts were showing a westward trough extension from the centre of the storm, linking with an Eastward extension of the seasonal Angola low. The linking formed a well-defined ITCZ trough along the Zambezi valley, a more southerly position than that of 13th and 14th January. Both 0600 and 1200 UTC charts were showing widespread reports of rain over both Zimbabwe and Zambia with cloudy to overcast conditions. Sustained unseasonably strong winds, though nowhere near tropical cyclone strength (15-20 knots compared to less than 2 knots which is the normal for this time of year) were experienced throughout the 16th over most stations in the

southern, central and western parts of Zambia. Such wind speeds at this time of the year can be damaging to the standing maize crop. The heaviest falls of rain occurred on this day at many Zambian stations: Choma 134mm, Senanga 104mm, Magoye 66mm, Mongu 63mm, Kafue 54mm and Lusaka 34mm. Zambia normally receives about 5 per cent of the total seasonal rainfall during the 7-day period 12-18 January (based on the 1961-90 normal period). Over the same period of the 1995/96 seasons, the contribution to seasonal rainfall was substantial (18-20 per cent) in parts of central, southern and western provinces, but marginally above or below the normal contribution over the rest of Zambia.

On Wednesday 17th January, "Bonita" had weakened further. Both 0600 and 1200 UTC charts showed a broad trough extending from western Zambia through central Zimbabwe to Mozambique. Over Zambia, the whole day was cloudy initially with short sunny intervals up to mid-day, but cloudy with fairly widespread rain in the afternoon. A few heavy falls were recorded (30mm or more) over the southern and western parts. By Thursday 18th January 'Bonita' was still evident as a very active 'tropical low' over Angola on the Atlantic coast. The ITCZ spanned the breadth of the subcontinent from this low, to the channel, along 20S. Settled weather characterised most of the subcontinent, with an extensive cirrus deck donning the eastern seaboard. Over Zambia a significant change in weather was observed with sunny weather from morning up to about mid-day, and scattered afternoon showers.

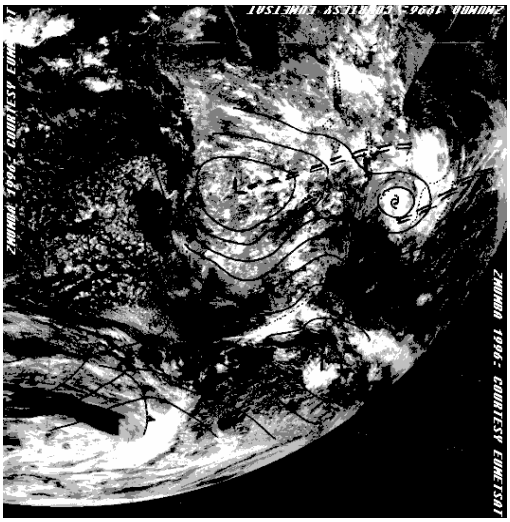

Figure 1a Meteosat VIS Image at 1200 UTC on 12th Jan 1996

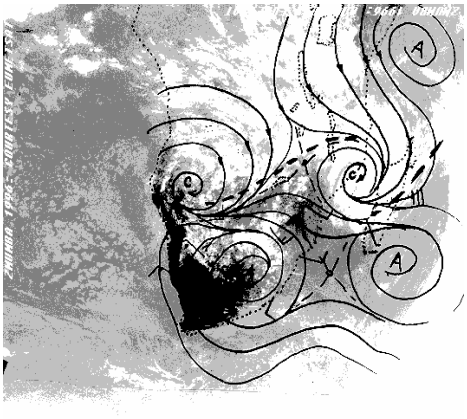

Figure 1b Meteosat IR Image at 1200 UTC on 12th Jan. 1996

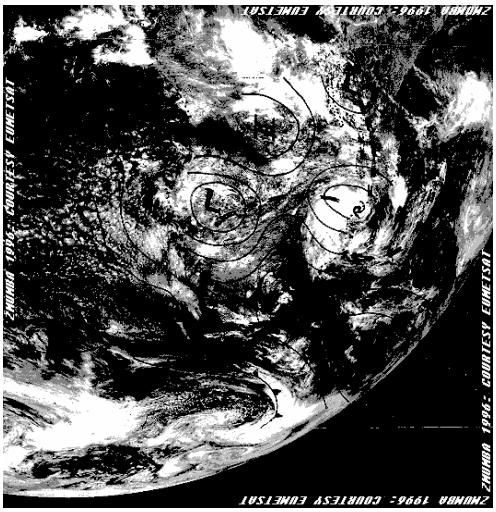

Figure 2a Meteosat VIS Image at 1200 UTC on 14th Jan 1996

Figure 2b Meteosat IR Image at 1200 UTC on 14th Jan 1996

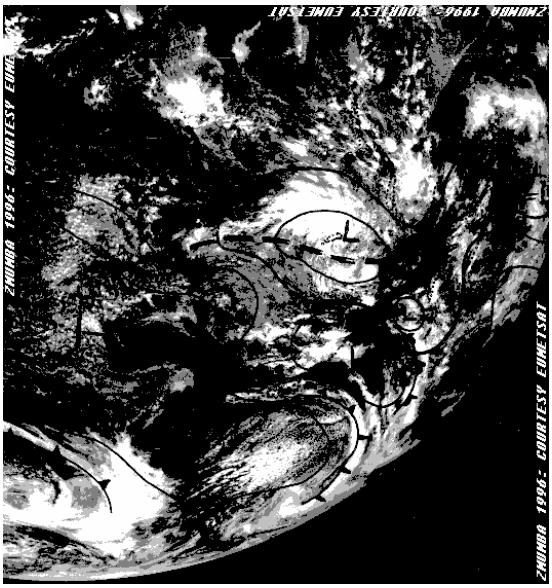

Figure 3a Meteosat VIS Image at 1200 UTC on 16th Jan 1996

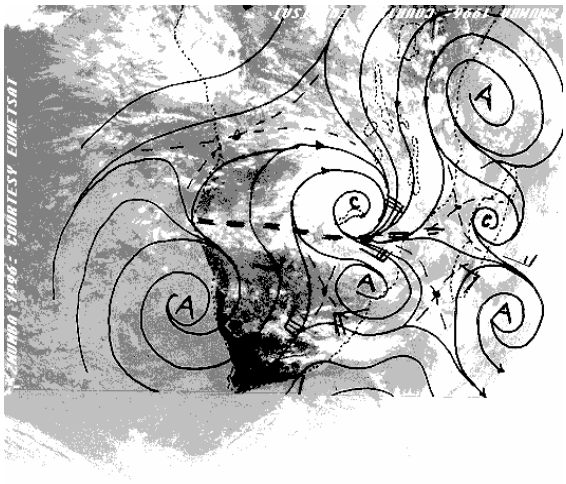

Figure 3b Meteosat IR Image at 1200 UTC on 16th Jan 1996

3. RESULTS AND DISCUSSION

Figure 4 below shows the difference between the percentage of seasonal rainfall normally received during 12-18 January and that received during the same period in 1996.

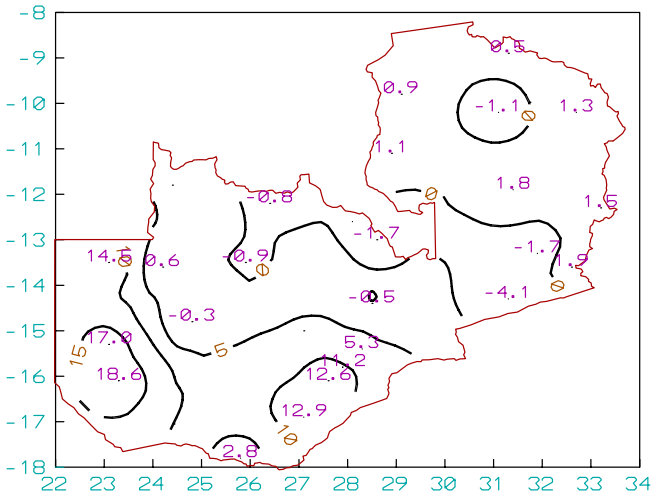

Figure 4. Contribution of Tropical Cyclone Bonita, 12th-18th January, 1996, to seasonal rainfall over Zambia

3.1 The short, medium and long-range forecasts.

The short-range forecasts were the most accurate. They contained the most detail and generally included predictions of cloud cover, temperature, precipitation type, wind speed and direction associated with the cyclone. Special forecasts predicting the position/location, intensity, expected movement, developments and dissipation were also available, and thus enabling civic defence agencies and relief organisations to take urgent action regarding evacuation, cleaning up, recovery etc. Using computer and communication techniques, the Meteorologist was able to view the latest satellite data analyses and prognoses in a graphical form careless of distance. This data was interpreted for public consumption in a non-technical format.

3.2 Weather warnings

These were designed to alert the public of the hazardous severe weather likely to occur before, during and after the passage of the cyclone. These warning programmes told the people of severe weather which might endanger lives and property , thus reducing comparative losses. Adequate lead-time with as accurate warning as possible was provided so that the public and authorities may take appropriate precautions. The various criteria for issuing a weather warning will vary with climatic and geographic conditions. For example Zambia is a landlocked country. Because of its geographic position, Zambia (Lat. 08-18Deg. South and Long.22-34 Deg. East) is not very vulnerable to tropical cyclones. On the other hand, the same geographic position makes the country vulnerable to severe thunderstorms with regular heavy rainfall during summer. The criteria for weather warnings and lead times requirements were established in consultation with the users and are well publicised.

3.3 Weather advisory, alert or watch

For the safety of people and property, our radio and television network regularly issued advisories, alerts and watches. Weather advisory issued for actual or expected weather conditions that may cause concern or general inconvenience, but did not pose a serious enough threat to warrant a weather warning. Weather alerts were for early warning and weather watches for conditions favourable for the development of severe hazardous weather. To make the information more useful, effective and unlimited in practice, it was issued when most of the population was awake. Alerting the public in time to take action and make remedial preparations helped cut the safety risk. For user institutions mandated to monitor water levels in rivers/lakes and the Aid groups, printed maps were found to be a handy working document.

4. CONCLUSION

The tropical cyclone is frequently described as the most devastating of all natural phenomena. In its combination of violence, duration and size of area affected, a tropical cyclone appears to be without equal for the sum total of the destruction it can cause. This case study therefore provides an interesting laboratory demonstration of how remote sensing can be used to monitor and track the development, movement and dissipation of cyclones, and therefore prevent an imminent disaster. Remote-sensing satellites have been an indispensable aid in locating and tracking these storms. In most cases satellites have provided a good estimate of cyclone intensity. Predicting monitoring and tracking cyclone ‘Bonita’ prevented an imminent disaster in terms of life and property. Early warnings were used to combat the adverse effects of the cyclone and therefore minimise loss of human life and property.

5. ACKNOWLEDGEMENTS

Sincere thanks to EUMETSAT, for making available very promptly the satellite pictures used in this case study; the Meteorological Department for the logistics and Mr. Z.L.S.Mumba and Mr E. Nkonde for the technical advice and formatting of the paper respectively during the first draft of the same paper.

6. REFERENCES

M.M.Baghare 1978: Tropical Cyclones over Southern Africa with Special Reference to Weather over Zambia. Meteorological Notes, Series A No. 15. Zambia Meteorological Dept, 29pp. .

Mumba, Z.L.S., and Chipeta, G.B., 1984: Synoptic Aspects of Rainfall in Zambia, with Special Reference to the Migratory Westerly Systems of the Southern Middle Latitudes. Meteorological Notes, Series A No. 20. Zambia Meteorological Dept., 20pp.

Mudenda O.S. and Mumba Z.L.S: The Unusual tropical storm of January 1996.Meteorological Notes, Series B No.9

Royal Observatory, Hong Kong 1992: Tropical cyclones in 1991.