TB-DM/518a

PRELIMINARY REPORT ON TROPICAL CYCLONE 'BOLA'
(26 February - 4 March 1988)

(All times local)

Introduction

'BOLA' was named as a tropical cyclone at 1700 hours on Friday 26 February 1988 having formerly been a tropical depression centred over the Fiji group for some time.

Its initial path - southwestwards - seemed to indicate the islands of Maewo and Pentecost were in some danger. However as 'BOLA' proceeded further southwards it entered a region where the upper wind pattern was light and variable. It is these upper winds which usually provide the 'steering force' which determines the speed and direction of movement of tropical cyclones. In addition an area of high pressure centred in the Tasman Sea provided a 'block' to 'BOLA's' movement. As a result its path from the early hours of the morning of Sunday 27 February became slow and very difficult to predict. The path of 'BOLA' as given in Appendix A is the best estimate from meteorological reports from our official observing stations, satellite fixes from the Tropical Cyclone Warning Centre (TCWC), Nadi, aircraft reports and consideration of the areas seeming most affected. The times on the path are a 'best guess' in tne absence of exact information but are not liable to be in error by much. This serves to emphasis the fact that without the most sophisticated (and expensive) equipment - such as a high resolution satellite system, weather radar - or indeed more local observing stations (either manned or automatic), it is very difficult to pinpoint the exact location of a tropical cyclone at any particulat moment in time. Thus development potential and future speed and direction of movement are extremly difficult to forecast.

Winds

As can be seen from the track, tropical cyclone 'BOLA' appeared to make two 'clockwise loops' - one between the Shepherd Isles and Efate, the second between Efate and Erromango. Such movements are not unknown in cyclone behaviour, but they are the most difficult to predict and forecast. The intensity of 'BOLA' seemed to be steady until about midnight on Sunday 28 February - with wind speeds of between 40 and 50 knots being estimated close to the centre. There seemed to be rapid intensification from then reaching a maximum around midnight on Tuesday 1 March whe. TCWC, Nadi estimated some 90 knots at the centre. However it d. appear that all of Nadi's estimated wind speeds are slightly on the high side - although 'BOLA' came wit. about 50 nautical miles of Port Vila on two separat. occasions the actual observed winds appeared some i. 25 per cent less than the forecast winds. It should be ad. d however that without a much larger number of w. d measuring instruments (anemometers) sited throughout the p. public it will always be impossible to state with any certainty exact w.nd speeds and maximum gusts (see below for observations from the official stations). Unofficial estimates of wind in Port Vila harbour give gusts of up to 75 knots - compared w.th 60 knots at the Nambatu office. From about m.dday on Tuesday 1 March 'BOLA' began both to slowly diminish in intensity and move

away from Vanuatu - gale strength winds only really ceasing from about midnight on Wednesday 2 March 1988.

Pressure

The minimum pressure recorded at an official station was 977.3 hPa at 0336 hours on Wednesday 2 March at Nambatu, Port Vila. From the attached track it would appear that 'BOLA' was about 60 nautical miles away at this time - thus the central pressure was in the range 956-970 hPa (between Moderate and Severe in the Saffir-Simpson Scale - see Appendix B). The value of 950 hPa given by the New Caledonian Meteorological Service seems to be an over-estimate.

Rain

As with nearly all tropical cyclones 'BOLA' was accompanied by large amounts of rain. Figures for rainfall over the period are given below. No reports of actual sea levels are available at this time, but given a minimum central pressure of 965 hPa a storm surge between 2.5 and 3 metres could have been expected.

Warnings

The Tropical Cyclone Warning Centre, Nadi issued 41 'Special Tropical Advisory' messages for Vanuatu between 1630 hours on Friday 26 February and 1300 hours on Thursday 3 March 1988 as well as 15 more general 'Tropical Disturbance Advisory' messages.

The Vanuatu Meteorological Service issued 20 'Special Tropical Cyclone Bulletins' (the first at 1420 hours on Friday 26 February, the last at 0800 hours on Thursday 3 March 1988) - mainly for broadcast by Radio Vanuatu; and 14 'Tropical Cyclone Warnings' (between 0530 hours on Saturday 27 February and 0805 hours on Thursday 3 March 1988). In addition two live broadcasts were made over Radio Vanuatu (the evenings of Tuesday 1 and Wednesday 2 March).

The Warning Lights both at the Nambatu Office and on the Government Building were switched on/off as follows:-

RED	(Gale Warning)	- On at 1800 hours Sunday 28 February
DOUBLE RED	(Storm Warning)	- On at 0400 hours Monday 29 February
		- Off at 2045 hours Monday 29 February
		- On at 0320 hours Tuesday 1 March
		- Off at 1115 hours Wednesday 2 March
RED	(Gale Warning)	- Off at 0815 hours Thursday 3 March

Conclusions

From a meteorological point of view tropical cyclone 'BOLA' was a difficult one with which to deal. Unlike previous cyclones of recent memory ('UMA' and 'ANNE') which both passed through Vanuatu at reasonable speed and relatively straightforward tracks 'BOLA' both meandered and appeared to move in a very erratic manner - sometimes slow, sometimes stopping and sometimes performing loops. The eye only became (poorly) visible on satellite imagery at 0600 hours on Tuesday 1 March - after it had

almost completed its second loop. The irregular path created great difficulties for TCWC, Nadi to accurately predict its future position - this in turn made the task of the Vanuatu Meteorological Service in issuing local forecasts somewhat frustrating in that warnings for one set of islands (ie Maewo and Pentecost) had to be quickly amended for a different region (such as the Shepherds and central districts). Later on the warnings for the southern islands (Tanna and Aneityum) had to be quickly revised to cover Erromango and Efate.

From a practical viewpoint the Meteorological Department's Warning Plan worked well. There were a couple of communications problems during the 5 or 6 days that 'BOLA' threatened Vanuatu - one (on the Nadi receive line) was quickly repaired by Vanitel, another with a terminal at the Bauerfield Office (Nadi transmit line) was eventually repaired by the Senior Technical Officer. As a 'back-up' arrangement observations from the outstations were collected (by HF radio) from the Nambatu Office and sent to Nadi via telex. In addition the New Zealand High Commission, Port Vila made arrangements for the New Zealand Meteorological Service to provide any information through telex/telefax. Fortunately this was not needed - but the offer was greatly appreciated at the time.

Because 'BOLA' was a slow-moving cyclone it spent more time threatening the Republic than has been the case in recent years. The Meteorological Service was working at a very high level for most of the 5 to 6 days it was in the area. Extra reports were made, long extra shifts were worked in order to maintain the flow of information about the cyclone's progress - it became impossible to log the number of phone calls or the number of personal enquiries because there were so many.

Acknowledgements

Many thanks must go to a great number of people who helped the Vanuatu Meteoorological Service cope with this particular tropical cyclone. As ever the Director and staff of the Fiji Meteorological Service for a seeming never-ending stream of advisory messages (they seemed to go from 'Number Seven' to 'Number Thirtysix' in the space of a few hours !); the New Zealand High Commission for providing the means for 'back-up' information at a time of need; the various kind friends who provided hot coffee, pizzas, donughts, biscuits and other 'refreshments' for our hard working staff (some of this yet has to be consumed !). Also thanks must go to the Director of Media Services and the staff of Radio Vanuatu for coping with the various bulletins we issued, translating them into Bislama and French, and broadcasting them so promptly and efficiently. There were many others who helped us get through the days and nights by kind words or deeds. Finally my thanks must go to the staff of the Vanuatu Meteorological Service - both in Efate and all the outstations - who worked unceasingly and uncomplainingly throughout the whole period.

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Appendix B

Intensity Scale of Tropical Cyclones

Magnitude	Saffir-Simpson Scale	Central Pressure (hPa)	Maximum Wind Gust (knots)	Maximum Storm Surge (metres)
Mild	1	>990	40-60	0 - 1
Moderate	2	970-985	70-90	1.5 - 2.5
Severe	3	950-965	100-120	3 - 4
Very Severe	4	930-945	130-150	4.5 - 5.5
Catastrophic	5	<925	160-180	6 - 7

The above table illustrates a classification system of tropical cyclones based on the Saffir-Simpson intensity scale. It should be emphasised that the relationship between central pressure, maximum wind speed and maximum storm surge height are only approximate and that many cyclones do not fit this pattern.

Note: 1 knot = 1.15 miles per hour = 1.85 kilometres per hour

Appendix C

Details of Wind Speeds, Maximum Gusts and Lowest Pressures measured at official Vanuatu Meteorological Offices

Note: All times local

Station	Lowest Pressure (hPa)	Time of Lowest Pressure	Maximum Mean Wind (kt)	Time of Max Mean	Maximum Gust (kt)	Time of Max
Sola	.....	.....	240/18	various 29 Feb	240/36	various 29 Feb
Santo	.....	.....	260/20	30/0500	210/35	30/0700
Lamap	979.5	30/0300	260/50	30/0300	260/60	30/0300
Bauer-field	977.8	03/0300	210/29	03/0300	230/48	02/0000
Port Vila	977.3	03/0356	200/39	02/2008	210/60	1822/1949/2124 2 Mar
Tanna	986.0	03/0200	070/28	30/1100	130/39	03/0800
Aneityum	991.0	03/1700	130/20	03/1400	140/40	02/2100

Note: Wind speeds at Bauerfield, Port Vila and Tanna are measured by anemometers, all other values are estimates.

Details of Rainfall

Rainfall during period 09-09

Station	Fri 26 Feb	Sat 27 Feb	Sun 28 Feb	Mon 29 Feb	Tue 1 Mar	Wed 2 Mar	Thu 3 Mar
(a) Official Meteorological Office stations:							
Sola	3.9	116.5	159.7	54.4	9.4	0.2	0.9
Santo	nil	66.2	104.9	266.4	60.1	14.2	0.8
Lamap	1.4	51.0	326.7	217.7	243.5	7.3	nil
Bauerfield	2.7	17.1	91.0	33.6	118.5	20.0	0.1
Port Vila	1.0	16.5	105.1	24.2	121.8	40.9	1.0
Tanna	2.5	17.1	12.7	33.0	150.8	3.2	1.4
Aneityum	1.5	0.8	16.5	36.4	64.6	20.2	nil
(b) Auxiliary Stations:							
Norsup (Malekula)	1.3	51.0	68.0	-	-	-	-
Ulei (Ambrym)	23.0	76.0	84.0	-	-	-	-
Chez Lee (Port Vila)	1.0	12.0	99.1	28.2	107.4	54.1	-

(- : not yet available)