# TROPICAL CYCLONE EXPERIENCES IN VANUATU

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**Abstract**

Tropical cyclones are one of nature's most disastrous natural events. With the assistance of the World Meteorological Organization, the nations of the South West Pacific have formed a Tropical Cyclone Committee (TCC) whose aim is to minimise the loss of life, human suffering and damage caused by tropical cyclones. How the region is organized to cope with the annual threat and how one particular nation - Vanuatu- has been affected in recent years is discussed by a former member of the TCC, and Director of the Vanuatu Meteorological Service.

## 1. Introduction

Tropical cyclones occur in many places in the world (Fig. 1). In the SW Pacific Tropical Cyclone is a generic term to describe a non-frontal cyclone of synoptic scale developing over tropical waters and having definite organised wind circulation with a average wind speed at its centre of 34-47kt. 63-87 kph or more. Thus you can have a Tropical cyclone with gale force winds (34-47 kt, 63-87 kph) ..a Tropical cyclone with storm force winds (48-63 kt, 88-117 kph). and a Tropical cyclone with hurricane force winds (64 kt (118 kph) or greater). I will discuss in some detail only the areas south of the Equator and east of Australia - the South West Pacific For this area is I will describe:-

- The Tropical Cyclone Warning System;
- How it is organised;
- How it works in practice;
- Some recent experiences in Vanuatu;
- What of the future?

Vanuatu is a Y-shaped chain of 14 largish islands plus another 60 smaller ones islands, extending over some 1200 km Its nearest neighbours are the Solomon Islands (170 km to the north), New Caledonia (230 km to the south-west) and Fiji (800 km to the east). Vanuatu's population in 1990 was some 155,000 - the vast majority (94%) being indigenous Melanesians (termed ni-Vanuatu) Other races - Polynesian, Chinese and Vietnamese and a number of expatriates - live there either as long-term residents or short-term contract workers. The economy is essentially one of subsistence agriculture (mainly copra), but in recent years has branched out into tourism, off-shore banking and meat production There is a small National Meteorological Service (37 staff) of which 2 are expatriate and operates six manned observing stations, one upper-air station and one automatic weather station It provides public weather forecasts for the local radio station, marine bulletins for local shipping and aviation forecasts for local and international airlines flying in the republic. More importantly it provides a tropical cyclone warning service. There is an annual Tropical Cyclone Season between November and April - but as I always used to say *"cyclones can, and do, occur outside these months"*. It has been a member of the World Meteorological Organization since 1982.

I went to Vanuatu in 1985-1992 to take up the position as Director of the Vanuatu Meteorological Service. One of the things that I did was to write a Meteorology Act. This was eventually approved by the Vanuatu Parliament. One of the functions of the Meteorological Service was *"the exclusive responsibility for the issue of warnings of gales, storms and other weather conditions likely to endanger life or property, including conditions likely to give rise to floods or storm surges"*.

It should be obvious that to be an effective 'National Meteorological Service' and also 'a provider of Warnings of severe weather' ' information and assistance is needed from outside the boundaries of each island state. In 1985 WMO set up a 'South Pacific Tropical Cyclone Committee' Briefly its aims were to *"promote and co-ordinate the planning and implementation of measures for the improvement of cyclone warning systems and related meteorological services and facilitate the efforts to minimise loss of life, human suffering and damage caused by tropical cyclones"*

Similar WMO-sponsored committees operate in four other tropical cyclone basins. The SW Pacific Tropical Cyclone Committee also obtained some money through a joint WMO/UNDP Project to improve conditions in the region - meteorology, hydrology and disaster preparedness This project ran from 1986-1990.

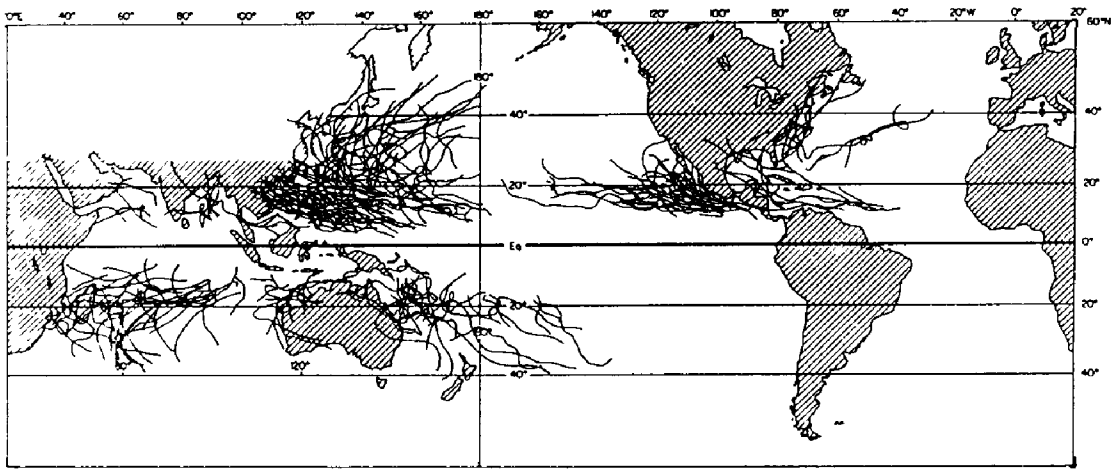

*Figure 1. Worlwide tracks of tropical cyclones for a 3 year period.*

What it did essentially was to bring together the nations of the S Pacific (WMO members and non-members) and help them organise a *regional tropical cyclone system* so that the adverse effects of cyclones would be reduced. Thus although each Meteorological Service has it's own national role - it is also part of a 'regional system' organized for self benefit. An Operational Plan was written - laying down the responsibilities of each Pacific island nation - observational procedures, communications facilities (listing current satellite links, telephone, telex and facsimile numbers, points of contact); back-up telecommunication arrangements; names of future tropical cyclones, procedures for the Issue of Warnings/Advisories, terminology, end-of-season procedures.

A Work Plan for training, equipment procurement and communications upgrades was drawn up and completed by the end of the period. At an end-of-project wash-up (Wellington 1990) all 13 nations involved agreed that the Warning System in the region was much improved on 4 years before, better organized, more efficient and capable of providing timely warning of impact of tropical cyclones. Plans for a second Project were drawn up which would build on the first. Unfortunately, funds for this follow-up Project have not been secured. Early this year the Commission of the European Communities expressed some interest in providing funds for this purpose. An exploratory mission should be taking place at about this time.

## 2. Tropical Cyclone Warning System

This is not just the matter of a meteorologist writing a Warning and saying *"that's my job done, I can go home now!"*. The Warning itself is only part of the System - and in many respects only a minor part! Figure 2 shows how (an ideal) tropical cyclone Warning System works. It actually applies to almost any sort of 'natural disaster' you can think of. Vanuatu, for instance, as well as being subject to an annual tropical cyclone season also has to contend with earthquakes, volcanoes, tsunami, droughts, tropical downpours (landslides).

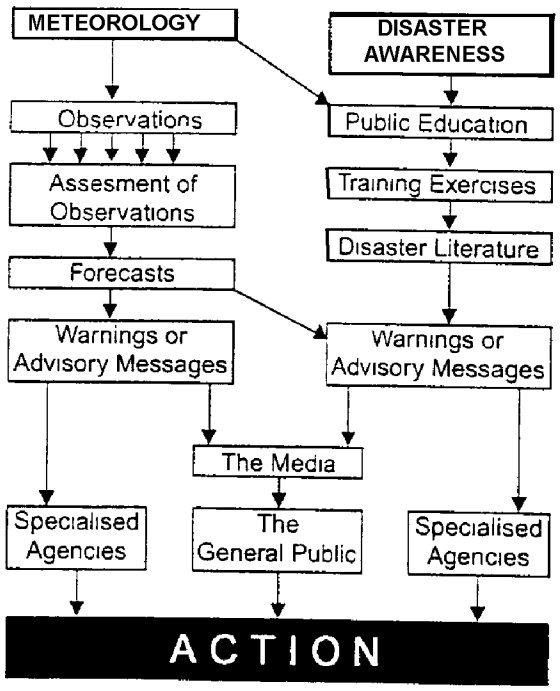


*Figure 2. Ideal tropical cyclone warning system.*

The first part of the System (on the Meteorology side) is Observations:

- **surface reports** - there is a small network manned observing stations on the various island states. These are being supplemented by an even smaller number of automatic weather stations. These are usually interrogated via satellite (the Japanese GMS or American NOAA).

- **ship reports** - some are available but not too many.

- **aircraft reports** - similar to ships. There is a slight increase in the number of aircraft reports.

- The one giant leap for mankind (well at least those threatened by tropical cyclones) was the introduction in the mid-1960's of *weather satellites*. Before that the documentation of tropical cyclones in remote areas of the globe was very fragmented and depended mainly on chance encounters with ships or with populated areas. Satellite technology changed all that. It would be virtually impossible nowadays for any tropical cyclone to develop without being noticed. Two type of satellites in use - geostationary orbiting (Japanese geostationary meteorological satellite GMS), and polar-orbiting (American NOAA series). The information if free (albeit now encoded) - all that is needed is the necessary ground equipment. The costs are such that now even the smallest of national meteorological services can have some form of satellite-receiving equipment.

- **Satellites** provide routine visual and IR pictures of cloud development plus land- and sea-surface temperature details, usually every 3 or 6 hours.

- **Weather radars** do also provide detail of rainfall rates but are really confined to the more affluent nations of the region - Australia in particular has a very comprehensive coast radar network. The justification of the considerable expense is in providing a severe weather service to the very large percentage of the population who live near the coasts. The cost of installing such radars on SW Pacific island states, and of maintaining them in operational state is prohibitive.

Basically therefore the SW Pacific is a *data-sparse area*. The same could be said of most of the tropical cyclone development areas. This is the first problem. Observations are needed from the whole Pacific basin - so that development of weather systems can be monitored, and where they are going to go to tomorrow can be forecast

There is an increasing use being made of automatic weather stations and floating buoys - but these do need funding by outside Aid Donors. I managed to get one AWS established - in the Banks Islands - funded by the USA (it took 4 years of negotiations before it produced its first report). These AWSs are usually sited on remote islands - interrogated by satellite - the information being fed into the GTS (Global Telecommunications System) the world-wide comprehensive meteorological telecommunications network. But here we come across the second of the problems in the operation of the Tropical Cyclone Warning System. Information from all the above observational system needs to get to 'the Forecaster'. In the SW Pacific not all of the individual national meteorological services have forecasting staff, or the necessary expertise, to be able to provide their own 'warning services'. As a result a number of the large services have been deemed 'TCWCs' - Tropical Cyclone Warning Centres - and have the responsibility from proving *Tropical Cyclone Warning* or *Advisory Messages*. The Centres so designated are usually situated in more developed countries, have better-than-average facilities (equipment) and better trained professional staff.

Essentially TCWCs provide Warnings for those island nations who have no forecasting capabilities of their own - i.e. Tonga, Tuvalu, Western Samoa, the Cook Islands, Kiribati; and Advisories for those who do - Solomon Islands, Vanuatu. It is intended that Warnings could be issued directly to the media services for onward transmission to the general public; whilst Advisories form the basis for the island nations themselves (with forecast staff) to compile their own Warnings (in local terms).

As I alluded to earlier there are communication problems in getting basic meteorological reports, say from outer islands, to the forecaster at a TCWC Communications links do exist but they are frequently low-speed (shared 50 baud lines are not unusual) and are prone to breaking down - particular (especially?) when the weather gets worse. Forecast staff however are used to these problems and it is a credit to their professionalism that they still mange to produce timely Warnings/Advisories.

Writing such messages is not too difficult - TCWC staff are faced with this task season after season. But we do again come across the communications problems. The Warning/Advisory message has to get to the threatened island community. About three years ago Western Samoa was threatened by a tropical cyclone - the Nadi TCWC issued something like 28 Warning messages - of which less than ten actually got through to Apia. The main problems are not in producing the written Warning - that is relatively easy - getting it to the public is much more difficult.

A number of years ago it was considered - by meteorologists - that it was just their job to write a

warning and once that was done they could go home, their job done The role of the meteorological has now changed - his job is now to issue a warning, to see that it gets to its intended audience, to see that it is understood by the audience .. and that they take some ACTION Unless this last point happens, then all that has gone before has been a waste of time. A 'perfect' warning which no-one takes any notice of is worse that a 'mediocre' one which generates a response.

As you can see there is another side to the Warning System - that of Disaster Management. In an ideal world each country will have its own 'national met service' and its own 'national disaster office' - each managed by professional staff and with sufficient funding for each organisation to fulfil its own role. In the developing world - such as the SW Pacific - such arrangements are not common. Usually the Met Service is underfunded, understaffed and undervalued - and if there is a Disaster Office then it is likely run as a sideline in some minor government ministry. More than likely the staff are untrained and do not really know what to do and frequently take the easy way out, by doing very little or nothing, except when a disaster has struck. Then they have a very busy time.

### 3. Cyclones in Vanuatu

The Vanuatu Meteorological Service has access to synoptic data (through the Global Telecommunications System of the World Meteorological Organization) which provides meteorological data from anywhere in the world - the SW Pacific area in particular We could therefore plot and analyse our own charts. In addition we had radio-facsimile receivers to obtain plotted/analysis charts from both Australia and New Zealand. Very useful - but some hours out of date. And finally our weather satellite receiving equipment - 3 hourly pictures from the Japanese Geostationary Meteorological Satellite (GMS) and approx 6-hourly pictures from the polar-orbiting American NOAA satellites The former are more useful in that they are automatically gridded, the latter had to be gridded manually. (*Note· anmajor upgrade for the satellite ground station has been introduced since I left - it can now store the data automatically, add appropriate grid lines to NOAA pictures and manipulate the images on a PC).* The VMS was reasonably self-sufficient - but needing the advisory messages from Fiji (and Brisbane).

As well as development of the Met Service I also became very involved in work of the National Disaster Co-ordinating Committee (NDCC) and the National Disaster Office (NDO). Originally the NDCC only met after a disaster (usually a cyclone) had struck and then involved itself in assessing the damage, requesting foreign aid and distributing it. There were *no pre-disaster preparations, no public education programmes.*

In my early days in Vanuatu the Met. Service prepared Warnings (based on Advisories from Nadi) - issued it to the radio station (no television), phoned up a few people (mainly government departments and the police) and then went to bed. Gradually all this changed. First we procured a telex machine - this enabled us to deliver the warning much quicker than by telephone, it also ensured that the recipient got a hard-copy version of the warning (not what he thought he heard over the telephone). We then increased our warning recipient list to about 35 (major hotels - Vanuatu is a tourist destination; local High Commissioners, shipping companies, insurance agents etc). A further improvement was to get computerised telex equipment which enabled eight warnings to be sent out automatically at the same time. This greatly reduced the manual effort in disseminating the messages, and also the time taken to do so. Further improvement was the procurement of a fax machine (courtesy of the New Zealand High Commission) which enabled a (words + map) type of warning to be issued. Only problem with this was that with that type of fax machine (and Vanuatu telephone exchange) only one message at a time could be sent. Technology to send the same message to multiple addressees was not available.

A slight diversion - the cost to VMS of sending 'warning messages'. As we became more and more organised - and well-thought of - more people wished to be put on our 'Warning List'. All the hotels, shipping and airline companies, more insurance companies, high commissions, say about 35/40 customers. In a busy season, with say four or five cyclones or developing depressions, we could issue something like 50/60 warnings or advisories. This (naturally) had an adverse effect on the VMS 'telecommunications' budget. I introduced a policy of *'free tropical cyclone warnings to everyone, but charge for delivery'*. Anyone could come and collect a warning - we operated an 'open door policy', or they could pay the telephone/telex/fax charges. There were no complaints whatsoever. Our budget was saved! Following season added a '10% handling charge' - again no complaint.

We now come to the events of February 1987 and the (infamous) tropical cyclone UMA. This cyclone of 4-11 February 1987 - was the most serious to affect the Republic of Vanuatu for some 30 years. It affected the capital Port Vila and was of *hurricane force - mean winds of 90 kt, gusts to 130 kt.*

Before we get into details some background however is needed. In November 1986 the French Government announced it was withdrawing a number of 'aid funded posts' in response to a move by Vanuatu (and other SW Pacific nations) to get New Caledonia put onto the UN list of *'non-self-governing countries'*. The French Government were not pleased when this was raised in the United Nations. Two posts were lost from the VMS - one forecaster, one climatologist The French High Commission was informed that the country was just commencing its annual cyclone season and really did need the 'forecaster' post until the following March. They were unconcerned.

In December (13-17) one small tropical cyclone (PATSY) affected the extreme north-west of Vanuatu. It caused little or no damage, but did have the effect (unrealised at the time) of sharpening up the VMS procedures for dissemination of tropical cyclone warnings.

In February a depression developed north of Vanuatu. Timely Advisories were received from Nadi TCWC, and issued to the general public. When it became a tropical cyclone Warnings were issued to Vanuatu. On the evening of Saturday 7 February tropical cyclone UMA hit Port Vila with :

Mean wind of 90 kt (gust to 130kt) - estimated
Torrential rain (Tanna - 256.4 mm in 3 hours, 446.6 mm in 24 hours)
Lowest recorded pressure (Port Vila) 956.6 hPa

On Sunday morning devastation lay all around. Houses and property destroyed, crops ruined, no electricity (it was to be off for 3 weeks), and worst of all, 30 people dead - mainly (as is the norm with tropical cyclones) water related. Two local boats, with full crews, and apparently trying to save their cargoes put to sea directly into the path of the cyclone. From a personal point of view - the Met Office lost half it's roof, my house (which was next door) also lost half it's roof ( a number of personal items were lost) but at the end of the day we were all alive. Many trees were uprooted and blown down, most of the greenery had gone - either blown off or burnt by the sea spray.

NDCC meetings were set up, Aid Donors contacted and immediate assistance provided (Australia, New Zealand, UK, France were the major donors). Later other projects were set up to repair the longer term damage. But at the end of the day - the economy of Vanuatu was seriously effected (tourist trade reduced to zero, copra crop damage, local agriculture diminished). Aid funds did not pay for all the damage done to Government installations so Government reserves (given to the fledgling independent country in 1980) had to be utilised and were almost completely used up. From a 'development' point of view it was a major disaster. From a personal point of view thirty lives were lost.

There was an investigation, funded by UNDRO (United Nations Disaster Relief Organization) into the events - the Met Office were highly praised for their timely issued of warnings and for their general preparedness measures, the fact that warnings were ignored in many cases was highlighted as a deficiency. The NDCC machinery was too unwieldy to be able to deal with such a disaster. The ship's captains (who both conveniently died in the storm) were blamed for the deaths of their crew.

There were a number of important recommendations made - reorganisation of the NDCC, more attention being given to improving the National Disaster Management Office, having the previous draft Disaster Act approved by Parliament. Unfortunately all improvements required funding - and at that time such moneys were not available, so not much happened. The (very capable) Chairman of the NDCC was removed - because of political affiliations - and replaced by a largely ineffectual political appointee.

The VMS however did seek to improve matters on its own. I obtained a place on a course run by the Asian Disaster Preparedness Centre (ADPC) at Asian Institute of Technology, Bangkok for myself (as a Met. man) and someone from the NDMO (as a Disaster man). This was to be a watershed in my tropical cyclone disaster education. The main thrust of the seminar was to bring together Met and Disaster personnel so that they were more aware of each others work and problems. It also introduced the view of *"getting the message to the audience"*.

On return to Vanuatu we began to ask ourselves some questions. *"Who were our audience?"*. Now the population of Vanuatu was about 150,000, with some 30,000 living in the two major townships of Port Vila and Luganville. These represented only some 20% of the population. Thus the majority of the population, 80%, was the ni-Vanuatu living in the bush They were our real audience.

Next we asked *"Do they get our messages?"* We were assured by Radio Vanuatu that *"yes they did - everyone listened to our news broadcasts"*. That seemed acceptable for the time being. Next *"Do they understand our messages?"*. *"Don't know"* was the answer. Two things followed. First we arranged the issue of public education material. There were funding problems (no government funds were available) but eventually we got a local service club (the Kiwanis) and an Insurance Company to funded

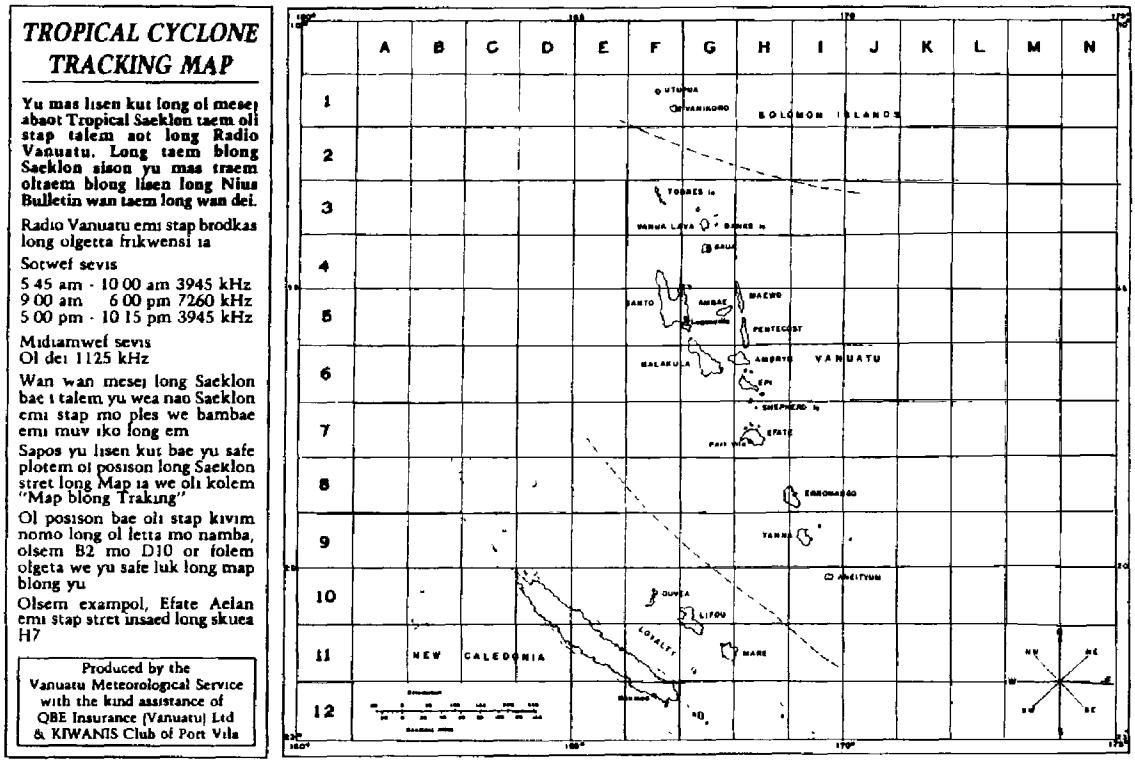


*Figure 3. Tropical cyclone tracking map for Vanuatu.*

the 'English' version. Later New Zealand aid money funded the 'Bislama' version and eventually another insurance company funded the 'French' version. So far so good. We organised (as part of IDNDR) an exhibition on disaster preparedness (collected a wide variety of disaster literature from over the world) and a poster competition for schoolchildren with prizes from the British High Commissioner. The exhibition was fairly successful - but did only reach people living in Port Vila. Lack of funds prevented us from involving a wider audience.

Next step in 'understanding' was to ask for half a day at the next 'Local Government Secretaries Annual Meeting' LGSs are the next stage of government down on the outer islands - and ex officio chairmen of the local government disaster offices. VMS plus NMDO gave lectures about what warnings were, what they meant, and what people should do - as illustrated by our disaster literature. We also did a 'plotting exercise'. Met. men had traditionally used terms like "northwest, southeast", but were these terms understood by 'the general public'. In thinking about the matter we had the suspicion that they didn't. We provided the Local Government Secretaries with a standard map of Vanuatu, read them a (previously issued) warning (twice, slowly and in Bislama) - and asked then to 'plot where tropical cyclone is now' and 'where will it be in 12 hours time' The exercise was very useful in that it was very obvious that the concept of a 'tropical cyclone northwest of Santo - moving southeast' was too difficult for the Local Secretaries (they are reasonably well-educated in local terms, but usually appointed because they are the local 'political party' workers). The exercise was repeated with a revised version of the map (termed our 'bingo sheets'). Phrases like "*Cyclone now in square C3 moving to square G6 by midnight*". The repeat exercise brought forward smiles - we'd made a major breakthrough. We then got the 'Plotting Maps' printed (again external funding) - words in Bislama, and including Radio Vanuatu frequencies, and widely distributed via schools, churches, non-governmental officers, telephone books, insert in local newspaper (Fig. 3). The new method had the advantage of being very easily understood by all - thus people became more aware that it was their island that was under threat - or conversely *was not under threat.*

We asked if all could receive Radio Vanuatu (the main method by which Warnings were disseminated). Answer *"yes"* - this supported views expressed by Director of Media Services - but when the question *"do you always listen to the midday news?"* a different answer was received - "*not always - the (short-wave) reception is frequently bad - much better in the evening*". This came as a bit of a shock - we had always concentrated on the 1200 Local Time News Broadcast as being the one to get any Warnings/Advisories on - assuming this as being the

news which most people would listen to, giving some 6 hours of daylight in which to make any preparations. Our supposition had been wrong. We tried to get a survey done of radio reception throughout the islands - but lack of funds stopped us. Radio Vanuatu themselves repeated that radio reception was OK throughout the republic. A future aid project (Australia-funded) was going to replace the radio transmitters with more modern equipment ,so it was assumed for the time being that matters would improve (not done before I left)

Just before I left Vanuatu I became (by default) Chairman of the NDCC. It was an ideal opportunity for me to introduce a few measures which had been lacking under the previous leadership The main point really - at the end of the season - was to look back and say *"well that's another cyclone season over, how did we deal with it, could we have done better and what should we do different next year?"* This is an essential part of any Disaster Mitigation System. I called a meeting of all the government departments on the NDCC to discuss such matter However only four people turned up - two from the Met Office, one from the NDMO and one man from the Ministry of Foreign Affairs. The Meeting was cancelled and a new plan of action set in motion. I set up an NDCC Steering Group (essentially the above four people plus someone from the Planning Office). We wrote a Project Document for an external expert to come to Vanuatu and assess how well the 'Disaster Organization' of the Republic worked, and could it be improved, and got it accepted by Government.

The Project found funding from AIDAB (the Australian International Development Assistance Bureau), who also provided a disaster expert, (Joe Barr), who did a 3 month consultancy (Sep.-Nov. 1989). His Report was a fine piece of work and showed the way forward Most of my own ideas found their way into this document. The main recommendations were to:-

- Bring in an outside Technical Adviser for one to two years to implement the recommendations of the Report.
  Replace the NDCC with a much slimmer National Disaster Advisory Committee (NDAC);
- Appoint a National Disaster and Emergency Co-ordinator (NDEC) to manage all disaster preparedness and response matters;
- The NDEC to oversee and direct the work of the National Disaster Management Office (NDMO).

**4. Future Prospects**

A good Tropical Cyclone Warning system should have the following character:

- must be close co-operation between the Met and Disaster organizations - they need to work hand-in hand. If they are telling the same story then the public will gain in confidence.
- training of disaster officials - it is important that they are professional (funds are available for training, they just need to be used),
- public education (very important, needs to constantly reinforced) - different approach for those nations who get regular (annual) cyclones and those only affected once every ten years or so.
- improvement of facilities to disseminate Warnings/Advisories, i.e. must reach as large an audience as possible.

Fiji, Papua New Guinea, New Caledonia, French Polynesia and Vanuatu seem reasonably well organised; their Meteorological Services and Disaster Offices are quite professional. Others, mainly the smaller SW Pacific island states, are not quite so organized. More funding is required in order to improve their facilities and thus better prepare their populations against 'tropical cyclones'. Incidentally an effective tropical cyclone warning system will also be applicable to warnings of earthquakes and volcanic eruptions.

What of the future for Meteorology?

- The basic observing network needs to be maintained, if not actually increased. However in these days of financial stringency this is not likely to happen. Some existing manned stations (particularly upper-air stations) have closed down, it is unlikely that they will be reopened. The situation does not look too promising. Some automatic weather stations are being installed, but not enough.

- The weather satellite programme needs to be maintained and the information freely available to all. This does not seem to be a problem. Future data may well be encrypted but this should not make it inaccessible to national met. services As prices comes down even the smallest met. service should be able to procure satellite ground-receiving equipment.

- There does need to be a major improvement in telecommunications within the SW Pacific region - both within a country and throughout the region. The technology is here, through satellite communication links, but these do cost considerable amounts of money.

- Training of meteorological and disaster management staff . This not seen as a problem, Aid Donors do provide funding for such training events

- Improvement of the Tropical Cyclone warning Centres in the areas - particularly at Nadi, Fiji. Again does depend on external aid funding.

All of the above depend on external funding - some of the tasks have been done from Phase I of the TCC Project. It was hoped to build on these with a Phase II, but UNDP did not provide the necessary funds. It is not known if it was because the Project Submission was not good enough or because of 'politics' . It is my personal view that the areas where available funds were directed appeared to be targeted by UNDP rather than the participating countries

One little ray of hope. In January 1994 the Commission of the European Communities expressed interest in providing some funds to 'Improve tropical cyclone Warning Systems in the SW Pacific'. I was asked to participate in an initial study tour, but could not be released from my present job. An Australian (in fact the former Director of the Fiji Meteorological Service) will shortly be visiting the region, together with a UK Disaster Expert to assess their needs. It looks promising and there is a possibility that something will be built on the work of Phase I.

**Discussion**

Dr. Williams (NRI) raised the issue of warnings coming from one country concerning hazards in another. Mr. Longworth cited the case of cyclone warnings picked up on shortwave radio from elsewhere in the Pacific and acted upon in Vanuatu. The message was in his case - become the sole authority to issue warnings and make people aware of it.